



**numa·logic**

**HPPC-1500/1700 APL  
Programming Manual**

## CONTROL KEYS

Name	Function
Enter	Signals the Loader that the information just entered through the Keyboard is complete and ready to be used. For example, during programming, the Enter key is pressed just after the element and its address are keyed in.
Backspace	Moves the cursor left one space and deletes the character located there when in the Program mode.
Control	The Ctrl key is pressed and held while a second key is pressed. It performs software-dependent commands or functions. Some examples of the use of the Control key with the Advanced Program Loader software follow: ①
Control, C	Clears the ladder diagram area of the display screen.
Control, E	Returns the screen to the Executive mode's main menu display.
Control, F	Saves the current screen on diskette for later retrieval.
Control, G	Accesses a screen formerly filed on a diskette.
Control, K	Displays labels and comments associated with the documentation feature.
Control, L	Allows entering of labels and comments associated with the documentation feature.
Control, N	Renumbers the networks contained in the ladder diagram.
Control, P	Displays the status of the programmable controller.
Control, Q	Initiates the display of all keys which can currently be used.
Control, S	Initiates the search operation.
Control, T	Toggles between the Program and Monitor modes while displaying the same network.
Control, W	Allows a documentation-type label to be entered for a coil or contact.
Control, X	Initiates a global search-and-replace operation.
Control, Z	Continues a search for predesignated element in the ladder diagram during search operations.
Escape	Used in the Program mode to move an element. To move an element or elements, place the cursor on the element to be repositioned, press the Escape key and a cursor control key (→, ↓).
Number Lock	When pressed once during the Program mode, this key causes the upper-case characters of each key to be continuously entered. The use of the Number Lock key is <b>not</b> recommended.
Control, Alternate, Delete	Sequentially pressing and briefly holding these 3 keys in the order listed causes the DOS software to be accessed from the DOS diskette. This is a hardware function of the computer not related to any software contained in the personal computer's memory.
<p>① Note: Proper key pressing requires that the first key (Ctrl) be pressed and held, and only then should the second key be pressed. Both are then released to initiate the function.</p>	

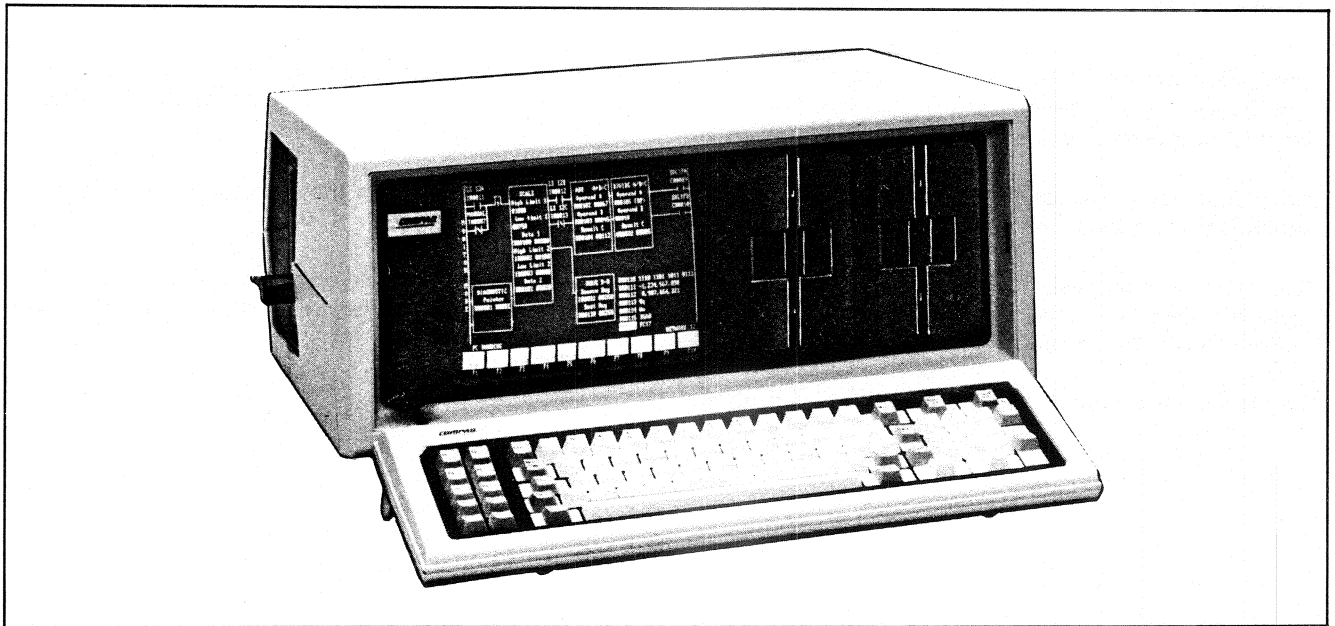


# numa·logic

*CAP- 50-1133W*  
*BASIC MODULE*  
*Ref* [5662] *Keypile*  
[5602] *PID*

## HPPC-1500/1700 *Ref* Programmable Controller

## APL Programming Manual



*1-800-245-6326*

**Westinghouse Electric Corporation**  
Industry Electronics Division  
1521 Avis Drive  
Madison Heights, MI 48071

August, 1985

## WARNING

**THIS EQUIPMENT HAS NOT BEEN TESTED TO SHOW COMPLIANCE WITH NEW FCC RULES (47 CFR, PART 15) DESIGNED TO LIMIT INTERFERENCE TO RADIO AND TV RECEPTION. OPERATION OF THIS EQUIPMENT IN A RESIDENTIAL AREA IS LIKELY TO CAUSE UNACCEPTABLE INTERFERENCE TO RADIO COMMUNICATION, REQUIRING THE OPERATOR TO TAKE WHATEVER STEPS ARE NECESSARY TO CORRECT THE INTERFERENCE.**

Since the equipment explained in this manual has a variety of uses, the user and those responsible for applying this equipment must satisfy themselves as to the acceptability of each application and use of the equipment. Under no circumstances will Westinghouse Electric Corporation be responsible or liable for any damage, including indirect or consequential losses resulting from the use, misuse, or application of this equipment.

The text, illustrations, charts, and examples included in this manual are intended solely to explain the use and application of the **Numa-Logic** PC-1500/-1700 Programmable Controllers. Due to the many variables associated with specific uses or applications, Westinghouse Electric Corporation cannot assume responsibility or liability for actual use based upon the data provided in this manual.

No patent liability is assumed by Westinghouse Electric Corporation with respect to the use of circuits, information, equipment, or software described in this manual.

No part of this manual may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, including electronic, mechanical, photocopying or otherwise, without the prior express written permission of Westinghouse Electric Corporation.

This manual is printed in the U.S.A. and is subject to change without notice.

## COPYRIGHT

1985

WESTINGHOUSE ELECTRIC CORPORATION

ALL RIGHTS RESERVED

## THUMB TAB INDEX

**Section 1 Introduction**

**Section 2 General Description**

**Section 3 Computer Modifications**

**Section 4 Operational Features**

**Section 5 Advanced Program Loader Startup**

**Section 6 Keyboard Operations**

**Section 7 Executive Function Mode**

**Section 8 Program Mode**

**Section 9 Monitor Mode**

**Section 10 Registers, Groups, and Constants**

**Section 11 Search Function**

**Section 12 Ladder Diagram Documentation**

**Section 13 Print Mode**

**Section 14 Disk Mode**

**Section 15 User Diagnostics Mode**

**Appendix A Error Messages**

**Appendix B Printer Interfacing**

**Appendix C Glossary**

**Appendix D COMPAQ Computer Modifications**

**Appendix E Grounding Practices**

## Table of Contents

Section/ Par.	Title	Page
<b>1</b>	<b>INTRODUCTION</b>	<b>1-1</b>
1-1	Advanced Program Loader (APL) Explained . . . . .	1-1
1-2	Purpose of the Manual . . . . .	1-2
1-3	Related Documentation . . . . .	1-2
1-4	Important General Considerations . . . . .	1-2
1-5	Scope of the Manual . . . . .	1-3
1-6	Organization of Topics . . . . .	1-3
<b>2</b>	<b>GENERAL DESCRIPTION</b>	<b>2-1</b>
2-1	Introduction . . . . .	2-1
2-2	Description . . . . .	2-1
2-3	Specifications . . . . .	2-1
2-4	Software . . . . .	2-1
2-4-1	DOS 2.0 . . . . .	2-2
2-4-2	Software Programming Packages . . . . .	2-2
2-5	Color Graphics . . . . .	2-3
2-6	Loading Software into the Loader . . . . .	2-3
<b>3</b>	<b>COMPUTER MODIFICATIONS</b>	<b>3-1</b>
3-1	Introduction . . . . .	3-1
3-2	Memory . . . . .	3-1
3-3	Communications . . . . .	3-1
3-3-1	Communication Board . . . . .	3-3
3-3-2	Communications Cable . . . . .	3-3
3-3-3	Communications Adapter Plug . . . . .	3-3
3-4	Serial Printer . . . . .	3-4
3-5	Diskettes . . . . .	3-4
3-6	Communication Board Setup . . . . .	3-5
3-7	Communication Board Installation . . . . .	3-5
3-8	Cable, Plug Installation . . . . .	3-7
3-9	Printer Connection . . . . .	3-7
<b>4</b>	<b>OPERATIONAL FEATURES</b>	<b>4-1</b>
4-1	General . . . . .	4-1
4-2	Modes of Operation . . . . .	4-1
4-2-1	Program Mode . . . . .	4-2
4-2-2	Monitor Mode . . . . .	4-3
4-2-3	Disk Mode . . . . .	4-4
4-2-4	Print Mode . . . . .	4-4
4-2-5	Executive Function Mode . . . . .	4-5
4-2-6	User Diagnostics . . . . .	4-5
4-3	Control Functions . . . . .	4-5
4-3-1	Search Function . . . . .	4-5
4-3-2	Label (Documentation) Function . . . . .	4-5
4-3-3	Register Function . . . . .	4-6
4-3-4	Store/Recall Screen Function . . . . .	4-6
4-3-5	Program-to-Monitor Change Function . . . . .	4-6
4-3-6	Enter Executive Mode Function . . . . .	4-6
4-3-7	Help Function . . . . .	4-6
<b>5</b>	<b>ADVANCED PROGRAM LOADER STARTUP</b>	<b>5-1</b>
5-1	Introduction . . . . .	5-1
5-2	Environmental Considerations . . . . .	5-1
5-3	Advanced Program Loader Cabling . . . . .	5-3
5-4	Diskettes . . . . .	5-3
5-4-1	Care . . . . .	5-4
5-4-2	Insertion Procedures . . . . .	5-5
5-5	Producing Backup Diskettes . . . . .	5-5
5-6	Verifying a Copy Operation . . . . .	5-8
5-7	Write-Protect Notch . . . . .	5-9

Section/ Par.	Title	Page
5-8	Merging Westinghouse and DOS Software . . . . .	5-9
5-9	Loader Startup With Merged DOS and Master Diskette . . . . .	5-10
5-10	Default Configuration . . . . .	5-11
5-11	Master Diskette as a Backup . . . . .	5-12
5-11-1	Reloading a Master . . . . .	5-12
5-11-2	Master Diskette Use Guidelines . . . . .	5-12
5-12	Formatting a Diskette . . . . .	5-12
5-12-1	General Information . . . . .	5-12
5-12-2	Command Entry . . . . .	5-12
<b>6</b>	<b>KEYBOARD OPERATIONS</b>	<b>6-1</b>
6-1	Introduction . . . . .	6-1
6-2	Keyboard Layout . . . . .	6-1
6-2-1	Alphanumeric Keys . . . . .	6-1
6-2-2	Control Keys . . . . .	6-2
6-2-3	Cursor/Number Pad Keys . . . . .	6-3
6-2-4	Function Keys . . . . .	6-4
<b>7</b>	<b>EXECUTIVE FUNCTION MODE</b>	<b>7-1</b>
7-1	Introduction . . . . .	7-1
7-2	Network Renumber (F1) . . . . .	7-2
7-3	Clear Memory (F2) . . . . .	7-2
7-4	PC Status (F3) . . . . .	7-3
7-5	Fault Table (F4) . . . . .	7-4
7-6	Repack (F5) . . . . .	7-6
7-7	Set Parameters (F6) . . . . .	7-6
7-7-1	Set Parameters Entry . . . . .	7-6
7-7-2	Scan Considerations . . . . .	7-6
7-8	System Configuration (F7) . . . . .	7-7
7-8-1	Transitional Elements (F1), UDSF Subroutines (F2) . . . . .	7-13
7-8-2	Memory Block Configuration (F3) . . . . .	7-13
7-8-3	Total I/O Configuration . . . . .	7-16
7-8-4	SIM Configuration . . . . .	7-16
7-9	Highway Configuration . . . . .	7-17
7-10	Port Configuration . . . . .	7-18
<b>8</b>	<b>PROGRAM MODE</b>	<b>8-1</b>
8-1	Introduction . . . . .	8-1
8-2	Program Mode Screen Format . . . . .	8-1
8-3	Ladder Diagram Construction Guidelines . . . . .	8-5
8-4	Ladder Diagram Entry Examples . . . . .	8-6
8-5	User Defined Special Function Entry . . . . .	8-12
8-5-1	User-Defined Subroutine Entry . . . . .	8-12
8-5-2	UDSF Block Entry . . . . .	8-12
8-5-3	UDSF Entry Considerations . . . . .	8-12
8-6	Editing Guidelines . . . . .	8-12
8-6-1	Editing Elements . . . . .	8-13
8-6-1-1	Removing Elements . . . . .	8-14
8-6-1-2	Changing Elements . . . . .	8-14
8-6-1-3	Inserting Elements . . . . .	8-14
8-6-1-4	Inserting a Horizontal Space . . . . .	8-14
8-6-1-5	Inserting a Vertical Space . . . . .	8-16
8-6-2	Inserting, Deleting Networks . . . . .	8-16
8-6-2-1	Deleting a Network . . . . .	8-17
8-6-2-2	Inserting a Network . . . . .	8-17
8-6-3	Global Search and Replace . . . . .	8-17
8-7	Network Reconstruction . . . . .	8-18
<b>9</b>	<b>MONITOR MODE</b>	<b>9-1</b>
9-1	Introduction . . . . .	9-1
9-2	Monitor Mode Searches . . . . .	9-2
9-3	Monitor Mode Screen . . . . .	9-2
9-3-1	Free Contact Monitoring . . . . .	9-2
9-3-2	Trace/Retrace . . . . .	9-2
9-3-3	Force . . . . .	9-3

Section/ Par.	Title	Page
9-3-4	Double-Precision Operation . . . . .	9-6
9-3-5	Register Operations . . . . .	9-7
9-3-5-1	Register or Group Monitoring . . . . .	9-7
9-3-5-2	Loading Register or Group Values . . . . .	9-8
<b>10</b>	<b>REGISTERS, GROUPS, AND CONSTANTS</b>	<b>10-1</b>
10-1	Introduction . . . . .	10-1
10-2	Constants . . . . .	10-1
10-3	Holding Registers . . . . .	10-1
10-4	Input, Output Registers . . . . .	10-2
10-5	Input, Output Groups . . . . .	10-2
<b>11</b>	<b>SEARCH FUNCTION</b>	<b>11-1</b>
11-1	Introduction . . . . .	11-1
11-2	Searching for Contacts . . . . .	11-1
11-3	Searching for Registers . . . . .	11-4
11-4	Searching for Coils . . . . .	11-4
11-5	Searching for Programmable Functions . . . . .	11-5
11-6	Searching for Networks . . . . .	11-6
11-7	Searching for UDSF . . . . .	11-6
11-8	Listing Unused I/O . . . . .	11-7
<b>12</b>	<b>LADDER DIAGRAM DOCUMENTATION</b>	<b>12-1</b>
12-1	Introduction . . . . .	12-1
12-2	Displaying Labels, Comments . . . . .	12-1
12-3	Single Label Entry . . . . .	12-2
12-4	Label Function . . . . .	12-2
12-4-1	Label Entry . . . . .	12-2
12-4-2	Comment Entry . . . . .	12-3
<b>13</b>	<b>PRINT MODE</b>	<b>13-1</b>
13-1	Introduction . . . . .	13-1
13-2	Print Mode's Primary Screen . . . . .	13-1
13-3	Port Configuration . . . . .	13-1
13-4	Print Category Selections . . . . .	13-4
13-4-1	Ladder Diagram . . . . .	13-4
13-4-2	I/O Documentation Labels . . . . .	13-5
13-4-3	I/O Network Reference Numbers . . . . .	13-6
13-4-4	Registers . . . . .	13-6
13-4-5	Register Timing . . . . .	13-6
13-4-6	Contact Timing Diagram . . . . .	13-8
13-4-7	Control Character . . . . .	13-9
13-5	Print Screen . . . . .	13-9
<b>14</b>	<b>DISK MODE</b>	<b>14-1</b>
14-1	Introduction . . . . .	14-1
14-2	File Names . . . . .	14-2
14-3	Active Drive Selection . . . . .	14-3
14-4	Save Operation . . . . .	14-3
14-5	Load Operation . . . . .	14-5
14-5-1	Loading Ladders, Registers, Documentation . . . . .	14-5
14-5-2	Loading Configuration Data . . . . .	14-7
14-5-3	Loading Configuration Size Considerations . . . . .	14-8
14-6	Verify Operation . . . . .	14-8
14-7	Delete Operation . . . . .	14-8
14-8	Directory Operations . . . . .	14-9
14-8-1	Disk Directory . . . . .	14-10
14-8-2	Change Directory . . . . .	14-10
14-8-3	Make Directory . . . . .	14-11
14-8-4	Delete Directory . . . . .	14-11
<b>15</b>	<b>USER DIAGNOSTICS MODE</b>	<b>15-1</b>
15-1	Introduction . . . . .	15-1
15-2	SIM Status . . . . .	15-1
15-3	Module Faults . . . . .	15-1
15-4	Communication Hardware Test . . . . .	15-1



Section/ Par.	Title	Page
<b>Appendix A</b>	<b>ERROR MESSAGES</b>	<b>A-1</b>
A-1	Introduction . . . . .	A-1
<b>Appendix B</b>	<b>PRINTER INTERFACING</b>	<b>B-1</b>
B-1	Introduction . . . . .	B-1
<b>Appendix C</b>	<b>GLOSSARY</b>	<b>C-1</b>
C-1	Introduction	C-1
<b>Appendix D</b>	<b>COMPAQ COMPUTER MODIFICATIONS</b>	<b>D-1</b>
D-1	Introduction . . . . .	D-1
D-2	Installation . . . . .	D-1
<b>Appendix E</b>	<b>GROUNDING PRACTICES</b>	<b>E-1</b>
E-1	Introduction . . . . .	E-1

## List of Figures

Figure	Title	Page
1-1	Advanced Program Loader (Typical) . . . . .	1-1
2-1	IBM Portable Computer . . . . .	2-1
2-2	IBM Personal Computer . . . . .	2-2
3-1	WAVE™ Memory Expansion Board . . . . .	3-2
3-2	Advanced Communication Board . . . . .	3-3
3-3	Communications Cable (NLC-4PL) . . . . .	3-4
3-4	Connection Arrangement . . . . .	3-4
3-5	Centronics 150 Series Printer . . . . .	3-5
3-6	Advanced Communication Board Setup . . . . .	3-6
3-7	Communications Cable Connections . . . . .	3-7
4-1	Modes of Operation . . . . .	4-1
4-2	Program Mode Screen . . . . .	4-2
4-3	List of Files (Typical) . . . . .	4-3
4-4	I/O Cross Reference Numbers . . . . .	4-4
4-5	Network With Labels . . . . .	4-6
5-1	Loader-to-SIM Connections . . . . .	5-2
5-2	Simple Loader-to-Processor Connection . . . . .	5-3
5-3	Common Diskette Features . . . . .	5-4
5-4	Opening Drive Doors (Typical Unit) . . . . .	5-5
5-5	Proper Installation Method . . . . .	5-6
5-6	Startup Key Locations . . . . .	5-7
5-7	Executive Mode's Main Menu . . . . .	5-11
6-1	Alphanumeric Keys (Unshaded Area) . . . . .	6-1
6-2	Control Keys (Unshaded Area) . . . . .	6-2
6-3	Cursor/Number Pad Keys (Unshaded Area) . . . . .	6-3
6-4	Function Keys . . . . .	6-4
6-5	Program Mode Primary Screen . . . . .	6-5
7-1	Executive Function Mode Primary Screen . . . . .	7-1
7-2	Clear Memory Screen . . . . .	7-2
7-3	PC Status Display . . . . .	7-4
7-4	Primary Fault Table Screen . . . . .	7-5
7-5	Set Parameters Primary Screen . . . . .	7-7
7-6	System Configuration Entry Patterns . . . . .	7-12
7-7	System Configuration Type Selection . . . . .	7-11
7-8	Edit Configuration Screen . . . . .	7-11
7-9	PC Configuration Screen . . . . .	7-14

Figure	Title	Page
7-10	Memory Allocation	7-15
7-11	Total I/O Configuration	7-16
7-12	SIM Configuration, IOP 1	7-17
7-13	Communication Port Configuration	7-19
8-1	Program Mode's Primary Screen	8-2
8-2	Secondary Function Key Selections	8-3
8-3	SF Selections; First Screen	8-4
8-4	SF Selections; Second Screen	8-5
8-5	Timer Entry Example	8-6
8-6	Counter Entry Example	8-7
8-7	Math Entry Example	8-7
8-8	Shift Register Entry Example	8-8
8-9	Conversion Entry Example	8-8
8-10	Move Function Entry Example	8-9
8-11	Logic Functions Entry Example	8-9
8-12	Table Operation Entry Example	8-10
8-13	Stack Operations Entry Example	8-10
8-14	Comparison Entry Example	8-11
8-15	I/O Function Entry Example	8-11
8-16	UDSF Block	8-13
8-17	Inserting a Horizontal Space	8-15
8-18	Inserting a Vertical Space	8-16
8-19	Element or Register Selection	8-18
8-20	Reconstruction Example	8-19
9-1	Monitor Mode's Primary Screen	9-1
9-2	Secondary Contact Screen	9-3
9-3	Force Function Key Selections	9-5
9-4	Double Precision Display	9-6
9-5	Secondary Register Screen	9-7
9-6	Single/Table Register Screen	9-7
9-7	Register/Group Select Screen	9-8
10-1	Constant Example	10-2
10-2	I/O Group Related to Discrete Addresses	10-3
11-1	Search Function's Primary Screen	11-1
11-2	Contact Type Selection	11-3
11-3	Ladder Diagram Portion Selection	11-3
11-4	Register or IG/OR Group Selection	11-4
11-5	Coil Type Selection	11-5
11-6	Network Search Screen	11-6
11-7	Unused I/O Selections	11-7
12-1	Distinguishing the Word "Label"	12-1
12-2	Label Function Screen	12-2
13-1	Print Mode's Primary Screen	13-2
13-2	Port Configuration Screen	13-2
13-3	Print Category Key Selections	13-4
13-4	Ladder Diagram Selection	13-5
13-5	I/O Network Cross References	13-6
13-6	Register Selection Options	13-7
13-7	Register Timing Exception Example	13-8
14-1	Disk Mode is Primary Screen (Typical)	14-2
14-2	File Name Example (Typical)	14-3
14-3	Save Function Keys	14-5
14-4	Load Function Keys	14-5
14-5	Configuration Selection	14-7
14-6	Directory Tree Example	14-9
14-7	Directory Operation Function Keys	14-10
15-1	User Diagnostics Mode Primary Screen	15-1
15-2	SIM Status Screen	15-2
B-1	Communications Cable Wiring Diagram	B-2
D-1	COMPAQ Portable Computer (Typical)	D-1
D-2	COMPAQ Lid Removal	D-2
D-3	Input/Output Compartment Cover	D-3
D-4	Input/Output Compartment	D-4

## List of Tables

Table	Title	Page
2-1	IBM Portable Computer Specifications . . . . .	2-3
2-2	IBM Personal Computer Specifications . . . . .	2-3
3-1	Summary of Required Items . . . . .	3-2
3-2	Switch Positions . . . . .	3-5
6-1	Control Keys . . . . .	6-2
6-2	Cursor/Number Pad Keys . . . . .	6-4
7-1	SIM Timing Requirements . . . . .	7-7
7-2	System Configuration Data Sheet . . . . .	7-9
7-3	Communication Ports . . . . .	7-18
9-1	Function Key Description . . . . .	9-3
9-2	Forced Element Results . . . . .	9-4
11-1	Search Selections . . . . .	11-2
11-2	Search Related Commands . . . . .	11-2
12-1	Search Function Summary . . . . .	12-2
13-1	Printout Selections . . . . .	13-3
14-1	Save Operations . . . . .	14-4
14-2	Load Operations . . . . .	14-6
14-3	Directory Operations . . . . .	14-10
A-1	Error Message Descriptions . . . . .	A-1
B-1	Interface Connector Pin Assignments . . . . .	B-3

# Section 1

## Introduction

### 1-1. ADVANCED PROGRAM LOADER (APL) EXPLAINED

The programming device for the HPPC-1500/-1700 programmable controller is a portable/personal computer for which Westinghouse supplies specialized software. Users may purchase the computers from retail outlets, or they may choose to purchase specific models directly from Westinghouse. The following is a list of computers available from Westinghouse:

- NLPL-1581 IBM Portable Computer
- NLPL-1582 IBM 5531 PC XT (hardened)
- NLPL-1583 IBM 7531 PC AT (hardened)
- NLPL-1584 IBM 7532 PC AT (hardened)
- NLPL-1580 COMPAQ Portable Computer

In general, it can be assumed that all IBM personal desktop computers and many COMPAQ portable computers are acceptable. However, to be used, the unit **must** meet these requirements:

- Be compatible with IBM's DOS, Version 2.0, or later

- Contain expansion slots capable of accepting IBM or IBM-type boards
- Support a keyboard like the one used by IBM

Additionally, for proper operation with the HPPC-1500/-1700, the computer must have loaded in and active the Westinghouse Software Programming Package (NLSW-1581 or -1581H).

Once loaded correctly with the proper programming package, the computer becomes an Advanced Program Loader (APL). (See Figure 1-1.)

More specific information about required standard and optional equipment, and about ordering, is given in Section 2. Note that regardless of the computer used, 512Kb of memory must be installed.

**Note**

This manual is written with the assumption that the user will have an IBM Portable Computer. However, since the COMPAQ and other types of computers are "look-alike" units, and since the IBM Personal Computer is

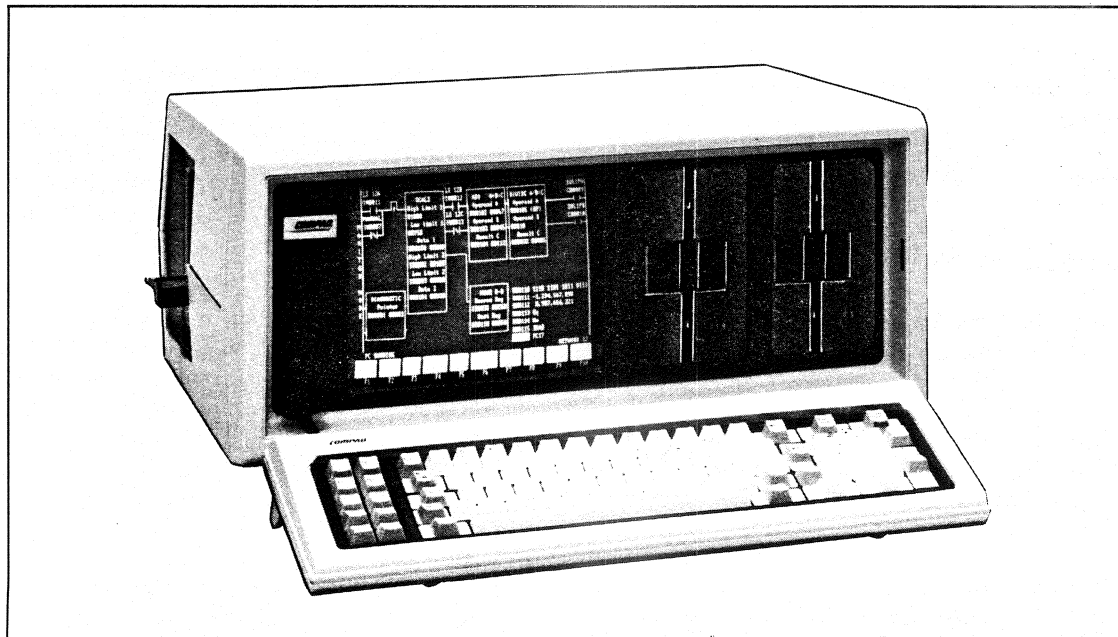


Figure 1-1. Advanced Program Loader (Typical)



almost identical in operation, there will be few, if any, difficulties when operating the other units.

The IBM units differ only in small hardware design aspects. The COMPAQ has somewhat larger hardware differences. However, the NLSW-1581 and -1581H Software Programming Packages can be loaded into all of the acceptable computers, and the displays and operations are identical, as are the programmable function entries.

## 1-2. PURPOSE OF THE MANUAL

This manual is designed to be used to:

- Select proper equipment
- Start up the Loader
- Operate the Loader

The majority of discussions contained here are devoted to the actual use of the unit. Emphasis is placed on **how** to perform the basic tasks. (Refer to the Systems Manual Supplement for explanations of the programmable functions.)

In general, the tasks the Loader performs are:

- Entering the main ladder diagram program in the programmable controller in an on-line operation
- Entering the ladder diagram program in the Loader's memory in an off-line operation
- Monitoring a ladder program already contained in the programmable controller
- Storing a ladder program on, and recalling it from, a diskette
- Producing a hardcopy printout of the ladder program

## 1-3. RELATED DOCUMENTATION

In addition to the information presented here, there are other related documents which should be consulted. These are:

- HPPC-1500/-1700 Systems Manual (Catalog No. NLAM-B821). This is available from Westinghouse and is shipped as standard with each programmable controller.
- HPPC-1500/-1700 Systems Manual Supplement (Catalog No. NLAM-B807). This is available from Westinghouse and is shipped as standard with each programmable controller.

- IBM Guide to Operations or COMPAQ Operations Guide. It is supplied with each computer but may be obtained separately.
- DOS Reference Guide. This may or may not be supplied with each computer, depending on the manufacturer.
- CC-232E User's Manual (Pub. 000175-001A). This is supplied with each AST Research, Inc. Advanced Communication Board, Version E.
- Installation Manual/User's Guide (No. 20065-Rev. 1.0). This is supplied with each TECMAR, Inc. Memory Expansion Board. (Note: If a different manufacturer is chosen, use the provided manual.)

## 1-4. IMPORTANT GENERAL CONSIDERATIONS

Selection, interconnection, and use of devices such as printers or monitors, other than those recommended by Westinghouse, are the sole responsibility of the customer.

### WARNING

**THE AC SUPPLY LINE HI/LO (L1/L2) WIRING ARRANGEMENT FOR THE HPPC-1500/-1700 CONTROLLERS MUST BE IDENTICAL WITH THE ADVANCED PROGRAM LOADER AND ANY OTHER PERIPHERALS CONNECTED TO THE CONTROLLER. ALSO, A THIRD-WIRE GROUND MUST BE USED. SEVERE INJURY OR EQUIPMENT DAMAGE COULD RESULT DUE TO NON-IDENTICAL ARRANGEMENTS. REFER TO APPENDIX E OF THIS MANUAL BEFORE INSTALLATION.**

Only the computers noted in Paragraph 1-1 are known to be completely compatible with the HPPC-1500/-1700 programmable controller and the NLSW-1581 and -1581H Software Programming Packages. Other IBM "look-alikes" or alleged "IBM compatibles" have not been verified by Westinghouse. There is no guarantee that the Software Programming Packages will operate properly.

Westinghouse does assure specific support for computers purchased through Numa-Logic. Units purchased through other sources must be serviced and supported elsewhere.



## 1-5. SCOPE OF THE MANUAL

This manual contains the following Sections:

### 1. Introduction.

2. **General Description**, which describes hardware and software features of the Advanced Program Loader.

3. **Computer Modifications**, which lists hardware modifications necessary to allow the IBM Portable Computer or the IBM Personal Computer to function as an Advanced Program Loader.

4. **Operational Features**, which describes the modes and functions of the Advanced Program Loader.

5. **Advanced Program Loader Startup**, which provides a step-by-step approach to the initial startup of the Loader and the copying of diskettes.

6. **Keyboard Operations**, which describes the keyboard layout and operation of the Advanced Program Loader.

7. **Executive Function Mode**, which provides information needed to configure the Advanced Program Loader for any specific ladder program and perform other miscellaneous executive functions.

8. **Program Mode**, which describes how to enter and edit a ladder diagram program.

9. **Monitor Mode**, which lists the operations associated with monitoring a ladder program.

10. **Registers, Groups, and Constants**, which provides a centralized description of registers, input and output groups, and constant values.

11. **Search Function**, which lists the various aspects of the search function.

12. **Ladder Diagram Documentation**, which explains the

assigning and monitoring of ladder diagram documentation.

13. **Print Mode**, which describes the connection and operation with a printer.

14. **Disk Mode**, which lists step-by-step procedures associated with the storage and retrieval of ladder programs.

15. **User Diagnostics Mode**, which describes the operation of the User Diagnostics mode.

A. **Error Messages**, which lists the error messages and gives a brief description of each.

B. **Printer Interfacing**, which lists the signals brought out on the Communications Cable.

C. **Glossary**, which defines some of the more technical terms used with communication systems.

D. **COMPAQ Computer Modifications**, which lists the hardware modifications necessary to allow the COMPAQ Portable Computer to function as an Advanced Program Loader.

E. **Grounding Practices**, which summarizes the grounding considerations which apply to the user of the Loader and associated peripherals used with the HPPC-1500/-1700 system.

## 1-6. ORGANIZATION OF TOPICS

Since many portable/personal computers are discussed here together, there is the natural problem of individual differences. For the most part only general explanations are included in this manual, although most of the Sections tend to emphasize the IBM units. Users of the COMPAQ Portable Computers are directed to Appendix D where some of the more significant differences are detailed.

## Section 2

# General Description

### 2-1. INTRODUCTION

Both the IBM and the COMPAQ Guide to Operations manuals contain extensive hardware descriptions for the units. Refer to them for information concerning AC line connections and the power-on switch location. This Section is intended only as a very brief description of the major components of the Loader.

In addition to certain optional equipment noted in Section 3, the minimum required personal computer hardware includes dual floppy disk drives and 512Kb of memory. It is, however, acceptable to go beyond this minimum level and use a larger memory capacity along with one floppy and one hard disk drive, if desired. Computers lacking the minimum hardware level will not perform the Advanced Program Loader's function properly.

While the required optional equipment is installed in the Loader, the unit can still function as a personal computer, assuming the correct software is loaded into memory.

The following description lists hardware features for the IBM Portable Computer and the IBM Personal

Computer. Refer to Appendix D for similar information about the COMPAQ unit.

### 2-2. DESCRIPTION

The major hardware features for an IBM Portable Computer are shown in Figure 2-1. Note that the display is an integral part of the system unit. The Personal Computer's display is separate. (See Figure 2-2.)

In all cases the Loader's keyboard, although detachable, remains connected to the system unit by means of a fixed cable.

### 2-3. SPECIFICATIONS

A summary of the more important specifications for the IBM Portable Computer are listed in Table 2-1. Refer to Table 2-2 for the Personal Computer.

### 2-4. SOFTWARE

There are 2 different software requirements that must be available and loaded into the computer before it can be used as an Advanced Program Loader. These are:

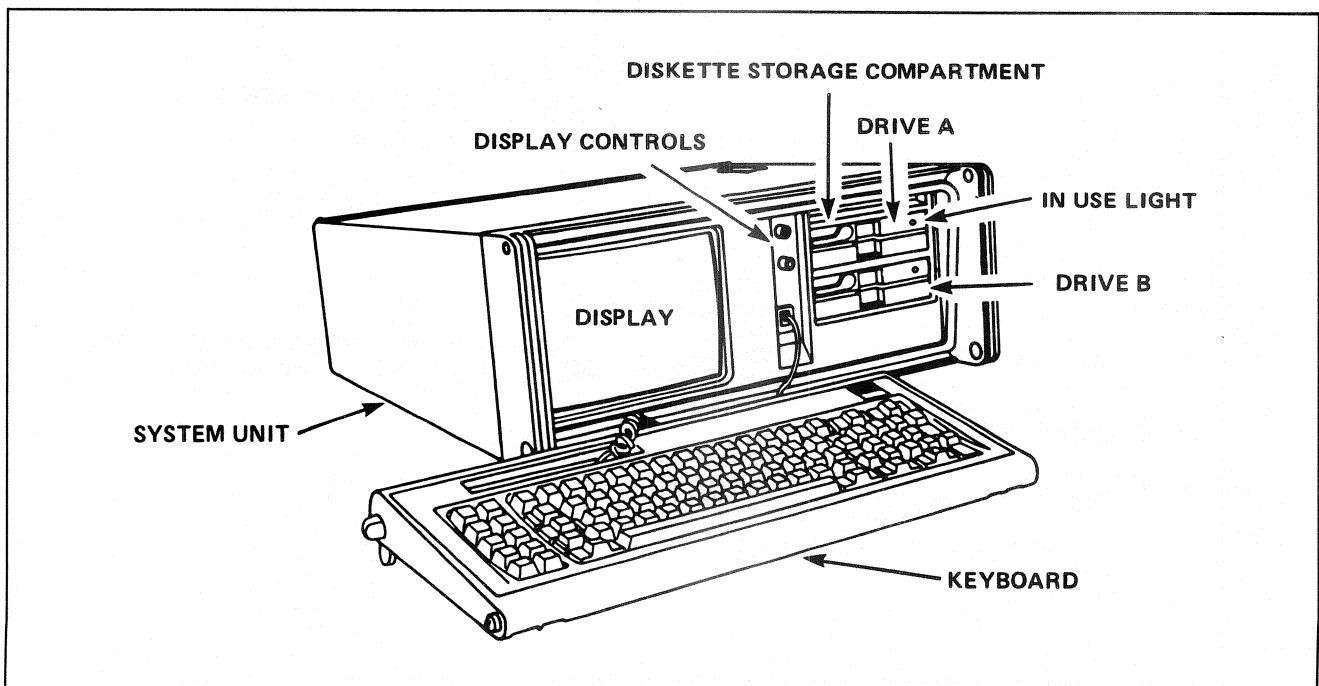


Figure 2-1. IBM Portable Computer



- Disk Operating System (DOS), Version 2.0, or later. This must be an IBM DOS or an IBM-compatible DOS.
- Westinghouse Software Programming Package (Catalog No. NLSW-1581 or -1581H)

#### 2-4-1. DOS 2.0

The Disk Operating System can be obtained from IBM or Microsoft, Inc. It consists of a grouping of programs that are used to perform the following functions:

- Formatting a diskette
- Producing a copy of a diskette
- Storing information on a diskette
- Retrieving information from a diskette
- Loading information directly into the computer from a Westinghouse Software Programming Package diskette

It is necessary to use a Version 2.0, or later DOS.

In addition, it is suggested that the DOS diskette be merged with the Westinghouse Master diskette to minimize the time required to load the software when initializing or starting up the Loader. (See Paragraph 5-8 for merging procedures.)

#### 2-4-2. SOFTWARE PROGRAMMING PACKAGES

Westinghouse optionally makes available 2 different Software Programming Packages for use with the HPPC-1500/-1700. These are:

- Catalog No. NLSW-1581, which is used with a personal computer containing only floppy disk drives.
- Catalog No. NLSW-1581H, which is used with a personal computer linked with one floppy and one hard disk drive.

These Packages are not interchangeable. Each may be used only with **either** an exclusively floppy disk computer or with a hard disk-computer combination.

The Packages consist of the following items:

- 1 On-Line Ladder Executive diskette
- 1 Off-Line Ladder Executive diskette
- 1 Master diskette, which contains the software programs necessary to load the On-Line or Off-Line diskettes into the computer
- 1 APL Programming Manual (Catalog No. NLAM-B806)

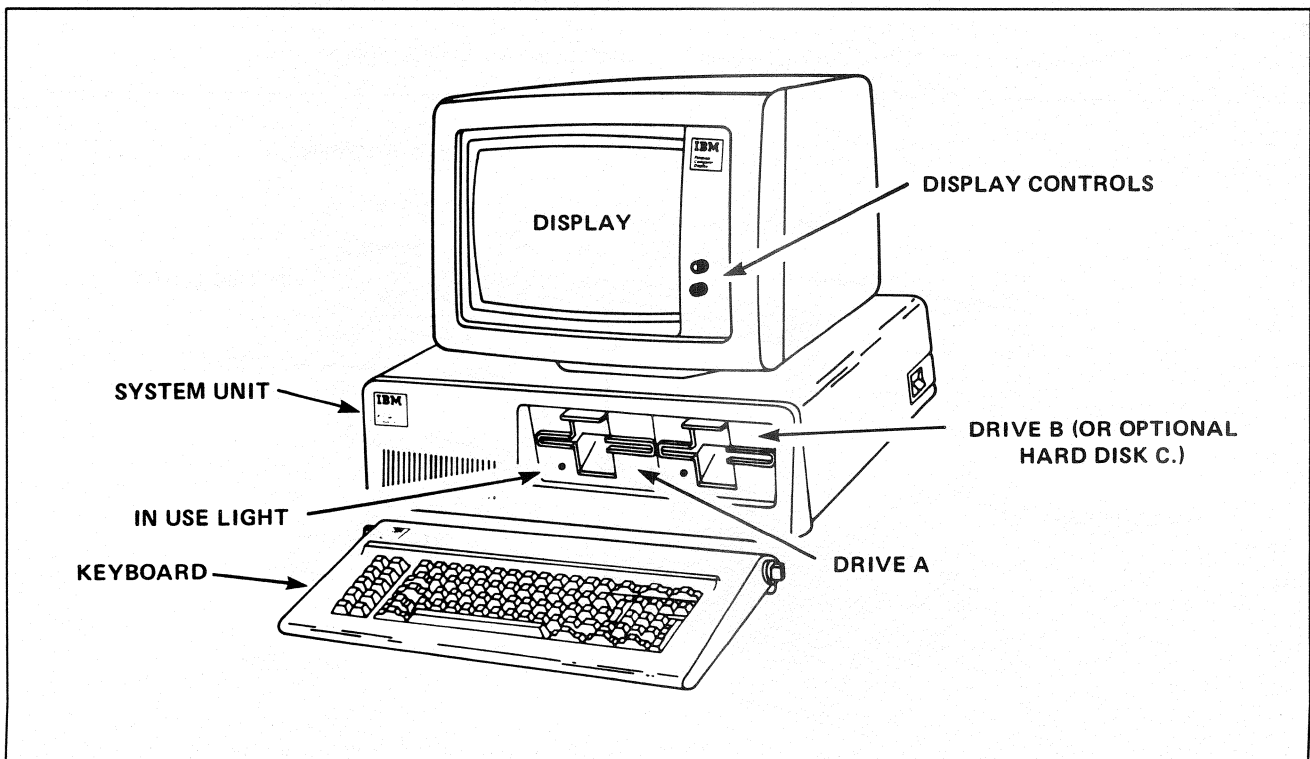


Figure 2-2. IBM Personal Computer





**TABLE 2-1. IBM PORTABLE COMPUTER SPECIFICATIONS**

<b>System Unit</b>
<b>Dimensions (W D H)</b> 20 x 17 x 8 in. (50.8 x 43 x 20.3 cm)
<b>Weight</b> 30 lbs (13.6 kg)
<b>Supply Voltage</b> 115/230 VAC, switchable 50/60 Hz, switchable
<b>Power Consumption</b> 114 watts
<b>User Memory</b> Size - 512Kb Access time - 200 nanosec. Cycle time - 345 nanosec.
<b>Keyboard</b>
<b>Dimensions (W D H)</b> 18 x 7.5 x 1.5 in. (45.7 x 19 x 3.8 cm)
<b>Weight</b> 4 lbs (1.8 kg)

**TABLE 2-2. IBM PERSONAL COMPUTER SPECIFICATIONS**

<b>System Unit</b>
<b>Dimensions (W D H)</b> 20 x 16 x 5.5 in. (50.8 x 40.6 x 14 cm)
<b>Weight</b> 28 lbs (12.7 kg)
<b>Supply Voltage</b> 120 VAC 60 Hz
<b>Power Consumption</b> 200 watts
<b>User Memory</b> Size - 512Kb Access time - 250 nanosec. Cycle time - 410 nanosec.
<b>Keyboard</b>
<b>Dimensions (W D H)</b> 20 x 8 x 2 in. (50.8 x 20.3 x 5 cm)
<b>Weight</b> 6 lbs (2.7 kg)
<b>Monochrome Display</b>
<b>Dimensions (W D H)</b> 22.8 x 13.9 x 10 in. (60 x 35.3 x 25.4 cm)
<b>Weight</b> 17.3 lbs (7.9 kg)
<b>Display</b> 25 lines x 80 characters

**2-5. COLOR GRAPHICS**

Color graphics are optionally available for the IBM Portable/Personal and the COMPAQ computers. When used with the optional Westinghouse WESTCAMP Software System, the Advanced Program Loader is capable of producing data-logging, alarm-logging, and spreadsheet data analysis information related to the programmable controller. These features are especially valuable for process control applications.

Complete information about this option is contained in separate literature.

Additional modules are required in the computer, as is special user-written programming. Also, it is necessary to use a computer with a hard disk.

**2-6. LOADING SOFTWARE INTO THE LOADER**

Section 5 of this manual contains detailed procedures for loading software into the Advanced Program Loader. If the Loader has never been used with the Westinghouse Software Package, follow Paragraphs 5-5 thru 5-9. If the DOS and Master diskettes have been merged, follow Paragraph 5-9.



## Section 3

# Computer Modifications

### 3-1. INTRODUCTION

None of the types of recommended portable/personal computers noted in Section 1 can be immediately plugged in and operated as an Advanced Program Loader. It is first necessary to install certain optional pieces of hardware and software.

Users may choose to assemble all of the hardware and install it themselves. Alternately, certain models of the IBM personal or COMPAQ portable computers can be ordered from Westinghouse with many of the required items installed. Use these Catalog Numbers:

- NLPL-1581 IBM Portable Computer
- NLPL-1582 IBM 5531 PC XT (hardened)
- NLPL-1583 IBM 7531 PC AT (hardened)
- NLPL-1584 IBM 7532 PC AT (hardened)
- NLPL-1580 COMPAQ Portable Computer

Refer to the most recent Westinghouse Numa-Logic Programmable Controller price list to determine exactly what is included with these catalog numbers. In general, it can be assumed that the following items will be included:

- 1 DOS Operating System diskette (Version 2.0, or later)
- 1 AST Advanced Communication Board

Whether or not the computer is purchased from Westinghouse, it is also necessary to purchase the software required for proper operation with the HPPC-1500/-1700 system. Order the optional Westinghouse Software Programming Package (Catalog No. NLSW-1581 or -1581H). These are detailed in Paragraph 2-4-2.

The purpose of this Section is to assist the customer who obtains the computer from a retail outlet and must, therefore, assemble and install all of the required options. (See Table 3-1 where all of the items are summarized.)

This Section also gives general installation instructions and outlines cabling methods. If a COMPAQ Portable Computer is being used, refer also to Appendix D.

### CAUTION

Equipment damage can result when certain cables are connected or disconnected while AC line power is applied to the personal/portable computers. Be sure to disconnect the computers at the AC socket before connecting any cables.

### 3-2. MEMORY

The Advanced Program Loader must minimally contain a total memory capacity of 512Kb in order to function with the HPPC-1500/-1700. This capacity can be requested at the time of order. It may also be separately purchased and installed by the user at a later time. Since the "basic" computer memory capacities, along with available memory increments, vary so much, no generalizations are made here. All that can be said is that 512Kb are required.

In many instances a 256Kb basic Memory System, together with a 256Kb "memory expansion board," can be installed, thereby meeting the total requirement.

There are a number of manufacturers making memory expansion boards. The following board is known to function with the personal computers recommended.

WAVE™ Memory Expansion Board  
Tecmar, Inc.  
6225 Cochran Rd.  
Solon, OH 44139

(See Figure 3-1, which shows the Board.)

### 3-3. COMMUNICATIONS

A number of hardware items provide communications between the Advanced Program Loader and the HPPC-1500/-1700, or with a printer, if used. These are:

- Communication Board (3-3-1)
- Communications Cable (3-3-2)
- Communications Adapter Plug (3-3-3)



TABLE 3-1. SUMMARY OF REQUIRED ITEMS

Item	Description
Memory Expansion Board ①	256Kb
CC-232 Programmable Advanced Communications Board, Revision E, or later ①	AST Research Inc. only
Communications Cable (NLC-4PL) ②	Order from Westinghouse ④
Communications Adapter Plug ② (NLC-4CA)	Order from Westinghouse
Printer ③	Serial printer with asynchronous type transmission to connect with Port A on Communications Adapter Plug
Disk Operating System Software ① (DOS, Version 2.0)	IBM or COMPAQ (Version 2.0, or later), or any DOS compatible with IBM's
Software Programming Package (NLSW-1581 or -1581H) ③	Order from Westinghouse
Diskettes ③	Double-sided, double-density, 5-1/4 in. (Order quantity 10.)

① These items are included as standard if the computer is ordered through Westinghouse. They may also be ordered directly from their respective manufacturers.

② These items are included as standard if the computer is ordered through Westinghouse. They may also be ordered separately from Westinghouse.

③ These items are optional and must be ordered separately whether or not the computer is purchased from Westinghouse.

④ This cable is to be used with a Centronics 150 Series printer only. All other printers require a user-fabricated cable.

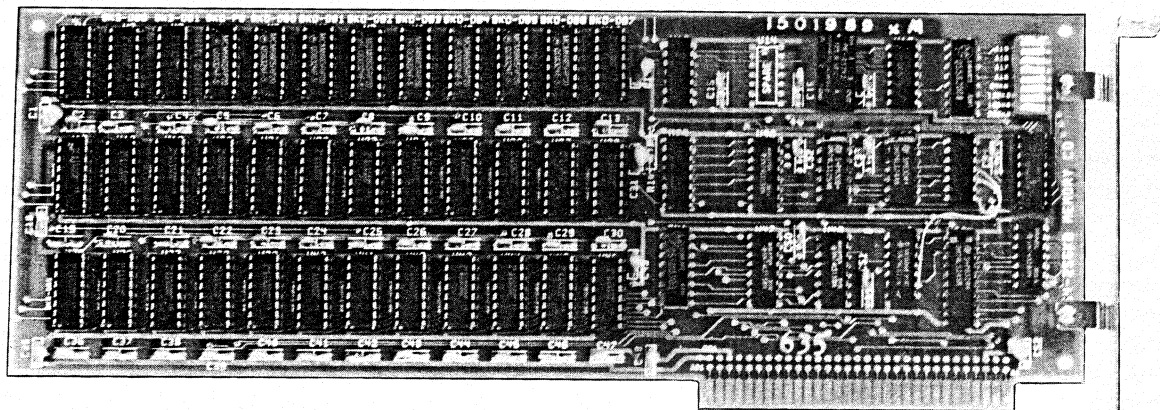


Figure 3-1. WAVE™ Memory Expansion Board



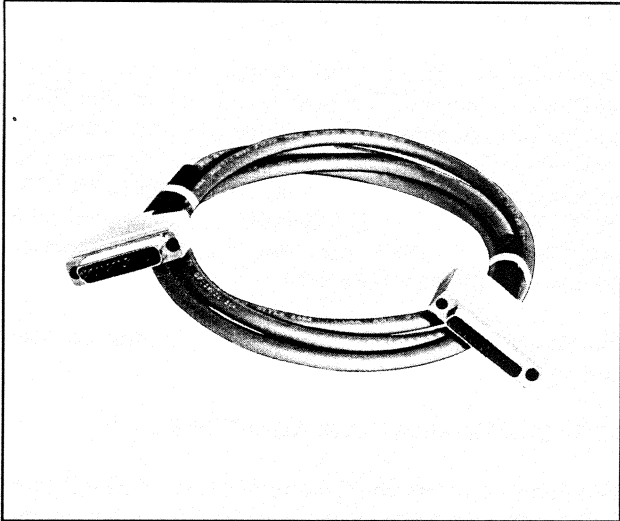


Figure 3-3. Communications Cable (NLC-4PL)

### 3-4. SERIAL PRINTER

Many printers that follow the RS-232-C standard can be used with the Advanced Program Loader. The printer allows a hardcopy of the ladder diagram or any other screen of the Loader to be produced.

The preferred printer is a Centronics 150 Series, which Westinghouse optionally makes available. It is an

asynchronous, high-speed, bi-directional, 9x7 dot matrix, 96-character ASCII, one-line buffer, RS-232-C interface, with 40/80/132 column format. Its use allows a hardcopy of the ladder program to be produced through the Advanced Program Loader. (See Figure 3-5.)

The manufacturer's address is:

Centronics Data Computer Corp.  
Hudson, NH 03051

The Westinghouse Communications Cable (NLC-4PL) is used only with the Centronics 150 Series printer, as explained in Paragraph 3-9. Other types of printers require a user-fabricated cable. See Appendix B.

Although Westinghouse optionally offers this printer, a wide variety of other printers are compatible.

### 3-5. DISKETTES

Users will want to have a number of diskettes available to use during the development of a ladder program or for storage. Always choose a high-quality type since data retention and durability are critical. An initial quantity of 10 is sufficient.

Order double-sided, double-density, soft-sectored, 5-1/4 in. diskettes.

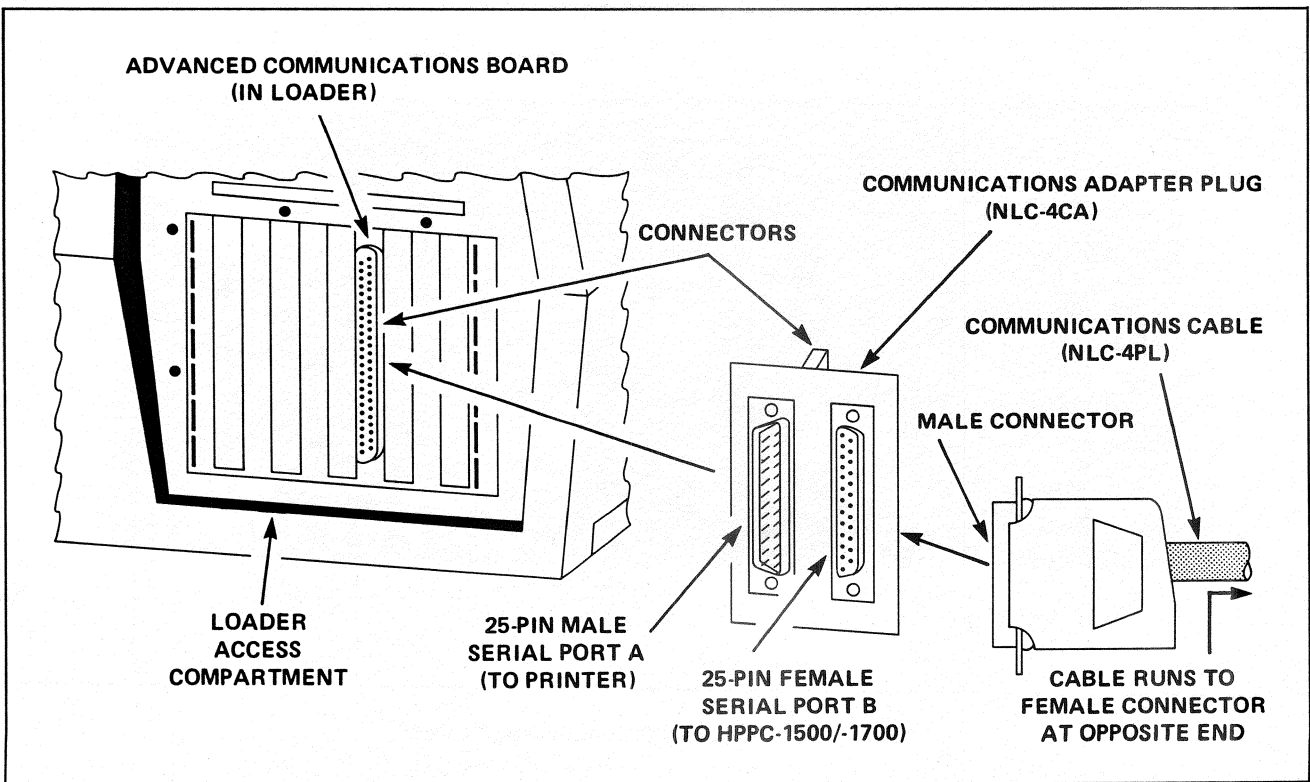


Figure 3-4. Connection Arrangement



### 3-6. COMMUNICATION BOARD SETUP

The recommended Advanced Communication Board is "programmable." Therefore, it must be set up before actual installation, assuming it is purchased separately, and not supplied by Westinghouse in a computer. Refer to Figure 3-6 and locate SW1 thru SW3. Then follow these procedures:

**Step 1** — Set rocker switches SW1 thru SW3, as noted in Table 3-2. (Use the top of a ballpoint pen.)

**Step 2** — Install the provided shorting plugs in the following 4 positions:

- Between positions S and T
- Between positions N and P
- Between positions D and E
- Between positions L and M

**Step 3** — Verify there is not a shorting plug between positions J and K. (See Figure 3-6.)

#### Note

The positions of shorting plugs on pins W, V, and X do not matter.

**Step 4** — Verify that DIP shunts are plugged into

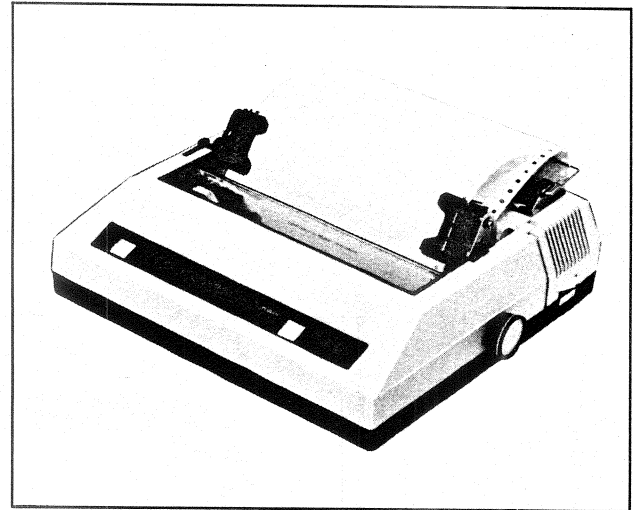


Figure 3-5. Centronics 150 Series Printer

locations J3 and J5. (They are not to be plugged into J4 and J6.)

### 3-7. COMMUNICATION BOARD INSTALLATION

The Advanced Communication Board can be plugged into any of the expansion slots located inside the personal/portable computers. (Look in the "Options" section in the appropriate IBM or COMPAQ Plus Guide to Operations manual for illustrations. If a COMPAQ unit is being used, see Appendix D of this manual.)

TABLE 3-2. SWITCH POSITIONS

Switch SW1								
Position	1	2	3	4	5	6	7	8
Setting	On	On	On	On	On	On	Off	Off
Switch SW2								
Position	1	2	3	4	5	6	7	8
Setting	On	Off	Off	Off	Off	Off	On	Off
Switch SW3								
Position	1	2	3	4	5	6	7	8
Setting	Off	Off	On	Off	Off	Off	Off	Off

Basic drawing courtesy of AST Research, Inc.

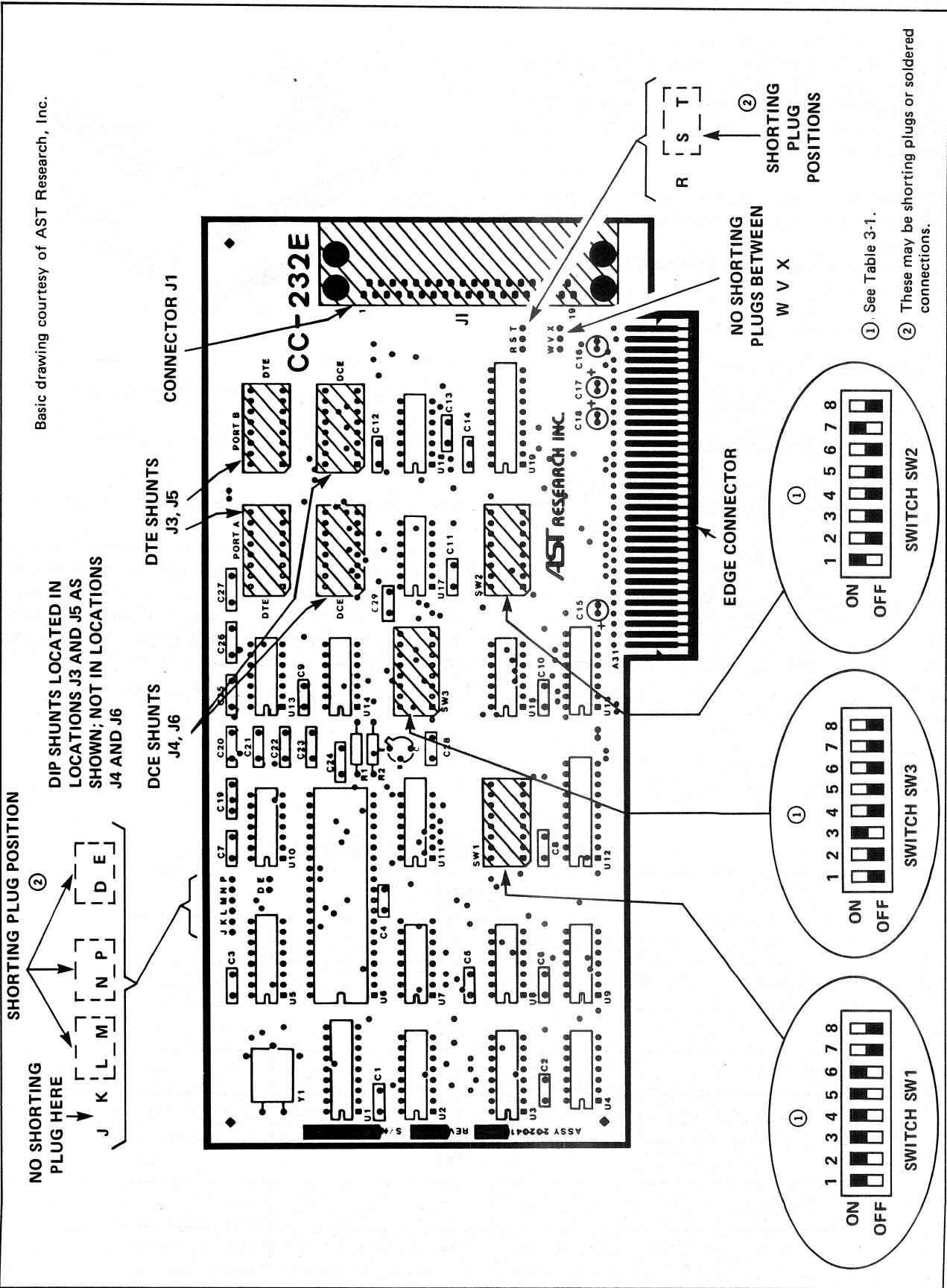


Figure 3-6. Advanced Communication Board Setup



### 3-8. CABLE, PLUG INSTALLATION

Once the Communication Board is properly installed, its socket will be accessible from the outside of the computer. Place the Communications Adapter Plug (NLC-4CA) over this socket and seat it firmly. (See Figure 3-4.) Orient it so that the type can be read.

Next, place the Communications Cable (NLC-4PL) onto the plug's 25-pin connector marked Serial Port B. Connect the other end with the HPPC-1500/-1700. (See Figure 3-7.)

#### Note

When performing off-line programming, there is no absolute need to

connect the Communications Cable with the HPPC-1500/-1700.

### 3-9. PRINTER CONNECTION

Run the Westinghouse Communications Cable (NLC-4PL) to the Communications Adapter Plug socket marked Serial Port A. (See Figures 3-7 and 3-4.) Connect the other end with the Centronics 150 Series printer only.

#### CAUTION

For printers other than the Centronics 150 Series, refer to Appendix B. A user-fabricated cable may be necessary to assure correct operation and prevent damage.

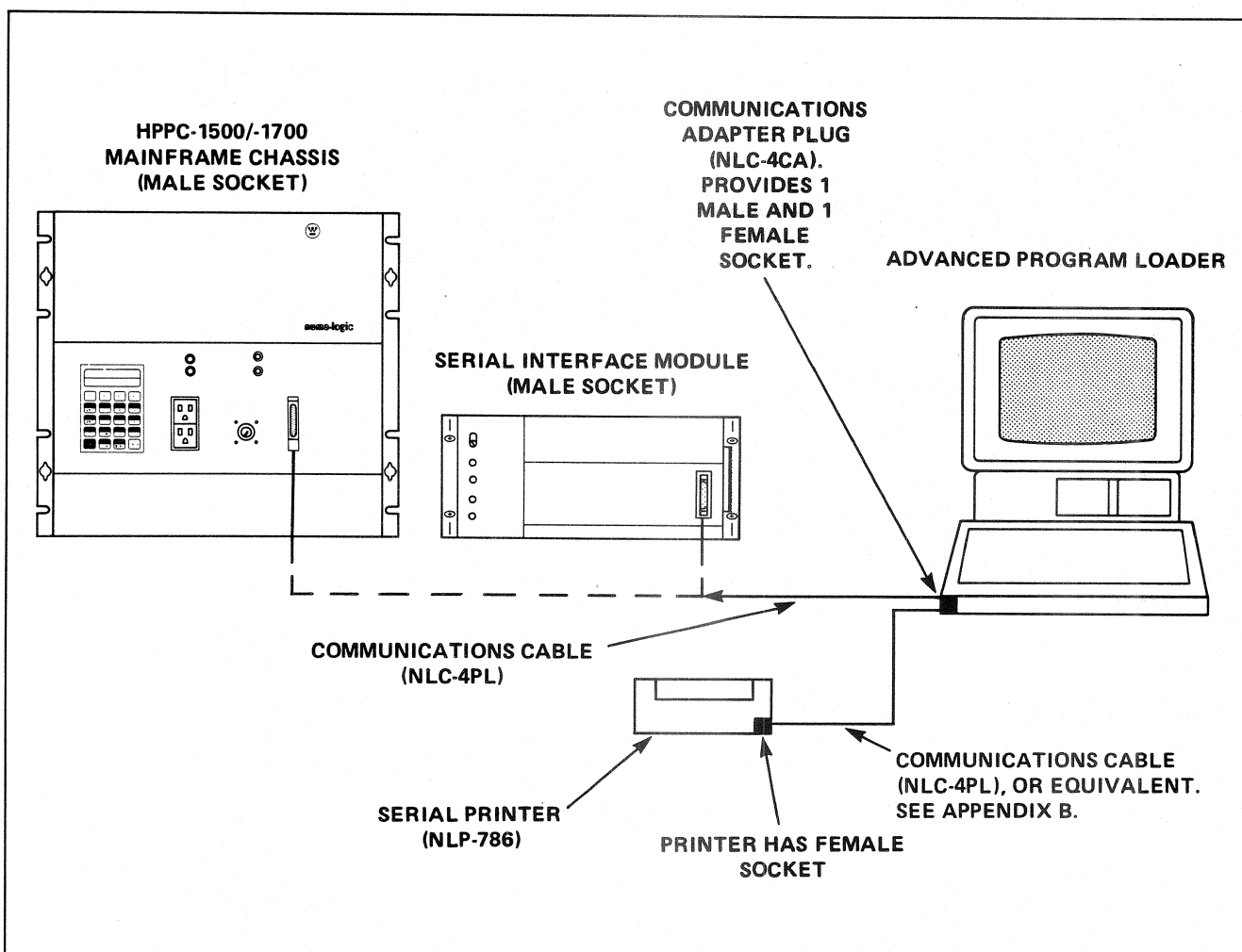


Figure 3-7. Communications Cable Connections





## Section 4

# Operational Features

### 4-1. GENERAL

An Advanced Program Loader consists of a combination of personal/portable computer hardware and Westinghouse software. The Loader has 2 general operating features:

- **Modes of Operation.** The modes of operation are divided into the 7 logical divisions of tasks. (See Figure 4-1.) The Loader is always in one of these modes when the Westinghouse software is being executed. Each of these modes is described in more detail in Paragraph 4-2 of this Section.
- **Control Functions.** The control functions can be considered as secondary functions. They can be entered from one or more of the modes of operation. They perform functions such as searching the ladder diagram for a specific contact, or assigning labels to inputs and outputs. These functions are described in Paragraph 4-3.

It is the function of this Section to present a very brief overview of these topics. The Section acts as a consolidated summary of information that is detailed in

subsequent Sections. Only a few graphic illustrations are used here since the majority are included in the detailed discussions.

### 4-2. MODES OF OPERATION

When the Westinghouse software is loaded into the personal computer, the following modes are available:

- Executive mode
- Program mode (4-2-1)
- Monitor mode (4-2-2)
- Disk mode (4-2-3)
- Print mode (4-2-4)
- Executive Function mode (4-2-5)
- User Diagnostics mode (4-2-6)

The Executive mode is the main menu mode used to access all the other modes of the Loader. (The Executive mode should not be confused with the Executive Function mode discussed later.)

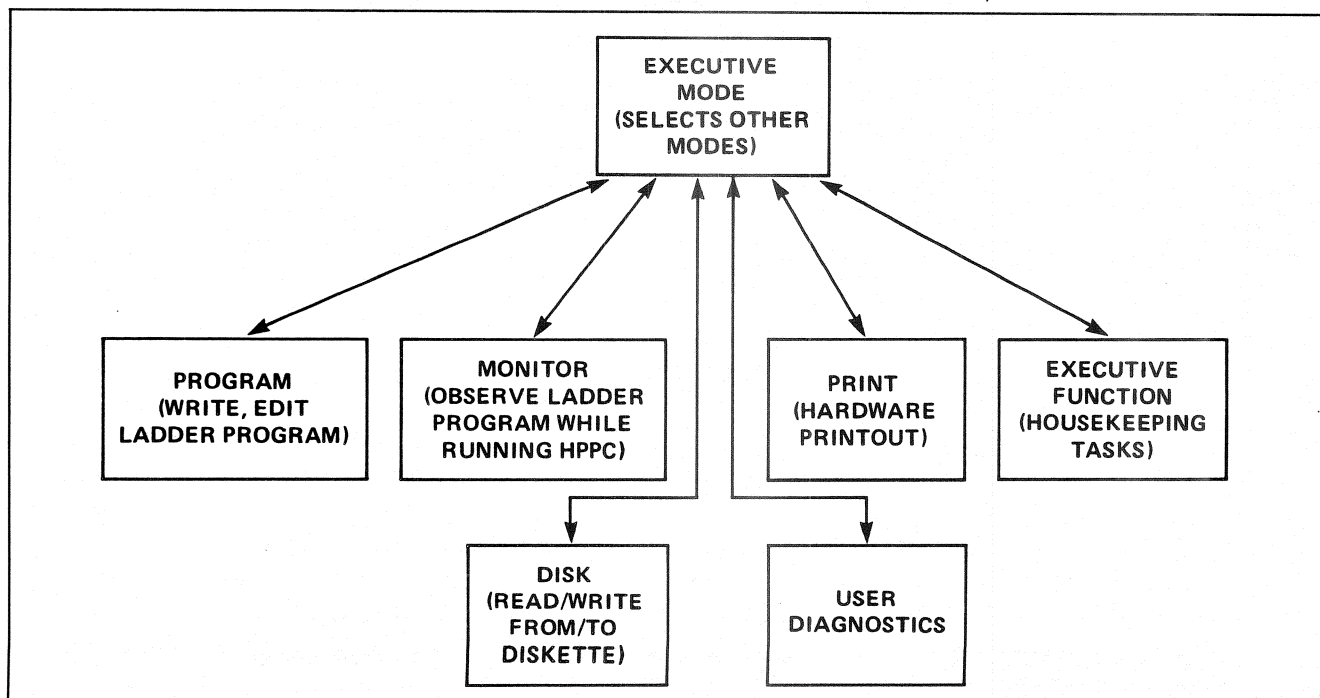


Figure 4-1. Modes of Operation



**Note**

The Executive mode can be accessed at any time by pressing and holding the Ctrl key, and then pressing the E key.

**4-2-1. PROGRAM MODE**

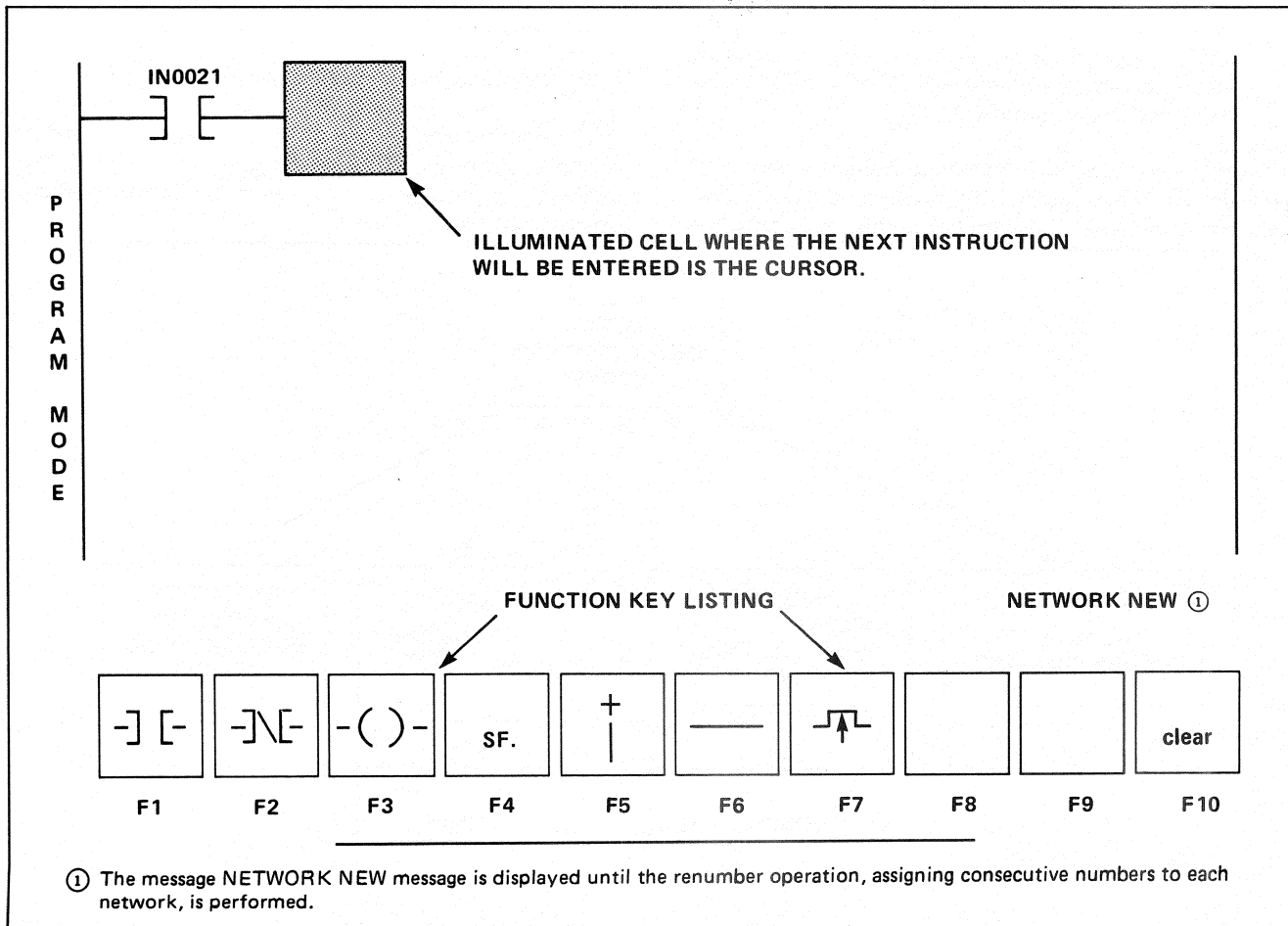
The Program mode is used to write or edit the ladder logic program, which is called the ladder diagram in this manual. The Program mode functions in 2 distinct ways:

- On-line programming, during which the rungs of the ladder diagram are "inserted," or loaded, directly into the memory of the programmable controller.
- Off-line programming, during which the rungs of the ladder diagram are inserted or stored in the memory of the personal computer.

During both on-line and off-line programming, the instructions for the various rungs are entered by means of

the "softkeys." These are the keys labeled F1 thru F10 on the left side of the keyboard. Figure 4-2 shows the screen displayed when the Program mode is first entered. Observe the Figure and note the following:

1. The top portion of the screen is used to display the ladder diagram network currently being entered.
2. A contact is shown here in the upper left corner of the screen as an example. To the immediate right of this contact is an illuminated area referred to as a "cell." This is the area where the next instruction is to be entered. Most of the screen is divided into an 11x7 "matrix of cells." The matrix has 11 horizontal and 7 vertical cell locations. Each cell can contain a "ladder element" such as a contact or coil. Many of the special functions require more than one cell.
3. A single cell is always illuminated when the Program mode is active. This is the cursor used to tell the programmer in which location the next ladder element will be entered.
4. The Advanced Program Loader automatically assigns



**Figure 4-2. Program Mode's Primary Screen**



the NETWORK NEW designation to each ladder diagram segment which appears on the screen and has been entered into the processor's memory. (This statement assumes on-line operation.) A network number is assigned, as described in Paragraph 7-2 of the Executive Function mode. Both the NETWORK NEW message and the assigned network number appear in the lower right-hand corner of the display.

As the programming of each network is completed, it is entered into the memory of the personal computer during off-line programming. It is entered directly into the memory of the HPPC-1500/-1700 during on-line programming.

5. The function of each of the Keyboard keys F1 thru F10 is shown near the bottom of the screen. For example, if a contact is to be entered, the F1 key is pressed, and the contact element appears in the cursor cell.

The Program Loader allows the positioning of the cursor on any cell within the network. This ability is referred to as "free-format programming." The 4 cursor control keys of the Keyboard, described in more detail in Section 6, allow the cursor to be moved in 4 directions to any cell location for the entry of the next element.

When the entering or editing of the ladder diagram is completed, the entire program can be stored on a diskette for subsequent retrieval and use.

**Note**

Selected function key uses of the Program mode have been discussed here

to allow the first-time user to gain an insight into the Loader operation. Function keys are used in a similar manner in the other modes and in many of the control functions described next. However, specific function key uses are not listed in the following descriptions, since they are covered in detail in subsequent Sections.

**4-2-2. MONITOR MODE**

The Monitor mode allows the user to monitor the state or condition of inputs, outputs, internal coils, or registers when operating on-line. Several different functions may be performed through the use of the Monitor mode, such as:

- Monitoring complete rungs of a ladder network
- Monitoring individual contacts not associated with the displayed network
- Monitoring registers, or changing data in registers
- Forcing discrete inputs or coils

When operating in the Monitor mode, the user has the advantage of a visible display of circuit continuity, or power flow. Contacts are intensified when conducting, but not intensified when not conducting; coils are intensified when energized, but not intensified when de-energized.

Section 9, Monitor mode, contains specific information

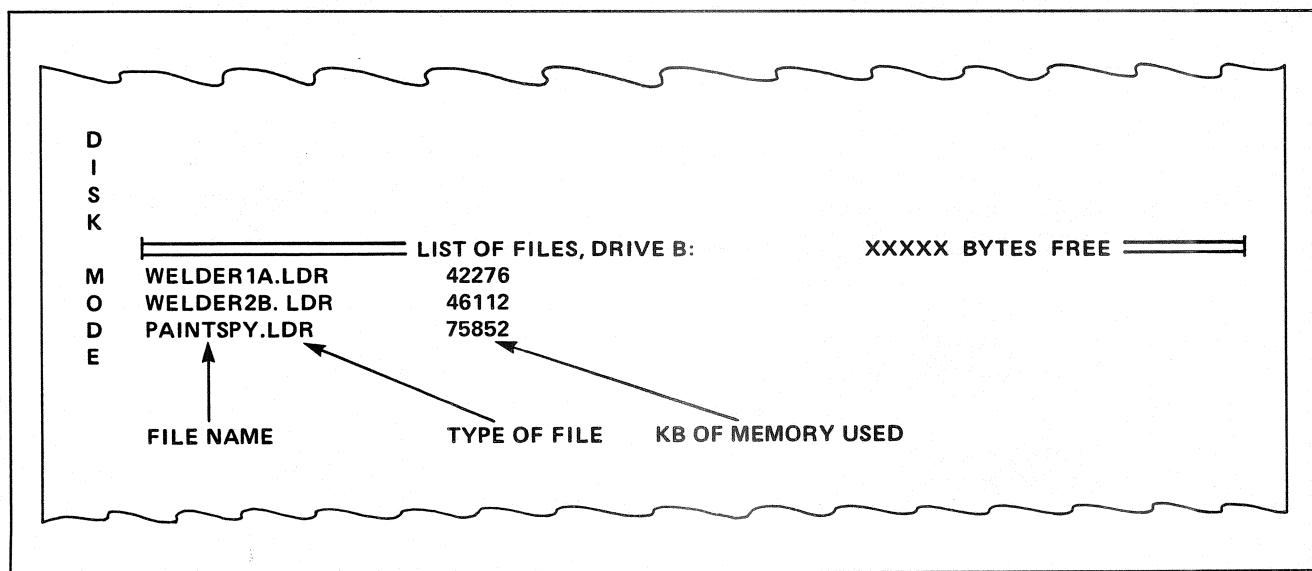


Figure 4-3. List of Files (Typical)



such as key sequences and the various screens associated with the Monitor mode.

#### 4-2-3. DISK MODE

The Disk mode provides for the storage and retrieval of the ladder diagram program on or from a diskette. The specific functions of the Disk mode are:

- To store a ladder diagram together with the associated parameter table on a diskette
- To load a ladder diagram from a diskette into the programmable controller or into the memory of the Advanced Program Loader
- To verify that information stored on a diskette or loaded into memory has been transferred correctly

A listing of the programs, called "files" and stored on a diskette, can also be displayed on the screen. (See Figure 4-3.)

#### 4-2-4. PRINT MODE

The Print mode is used to obtain a hardcopy printout of the ladder diagram program. The following 4 choices or types of ladder diagram printouts can be selected:

1. Ladder diagram only.
2. Ladder diagram with I/O cross referencing, where the networks numbers containing the coil are printed directly below each network. (See Figure 4-4.)
3. Ladder diagram with labels, where "labels" optionally assigned by the user to IN contacts or CR coils are printed directly above the reference number of the

contact or coil. (Here "labels" refer to ladder diagram documentation. See Paragraph 4-3-2.)

4. Ladder diagram with both I/O cross referencing and "labels."

The user is given the selections from any of the following ladder types:

- UDSF ladder only
- Main ladder only
- Both UDSF and main ladder

When printing the ladder diagram, it is **not** necessary to print all the networks. Any starting and ending network numbers can be selected.

In addition to the ladder diagram printout, the following 4 items of information associated with the ladder program can also be printed:

1. Registers used in the ladder program. Individual printouts, listing each type of register used and its current contacts, can be obtained. The register types include: holding registers; output registers; input registers; output groups (used as registers); input groups (used as registers).
2. The I/O labels (type and reference number) assigned to individual inputs and outputs.
3. I/O contact references which list the network numbers where coils are examined by contacts.
4. An on-going printout of the value of a register or the state of a coil over a period of time can also be initiated

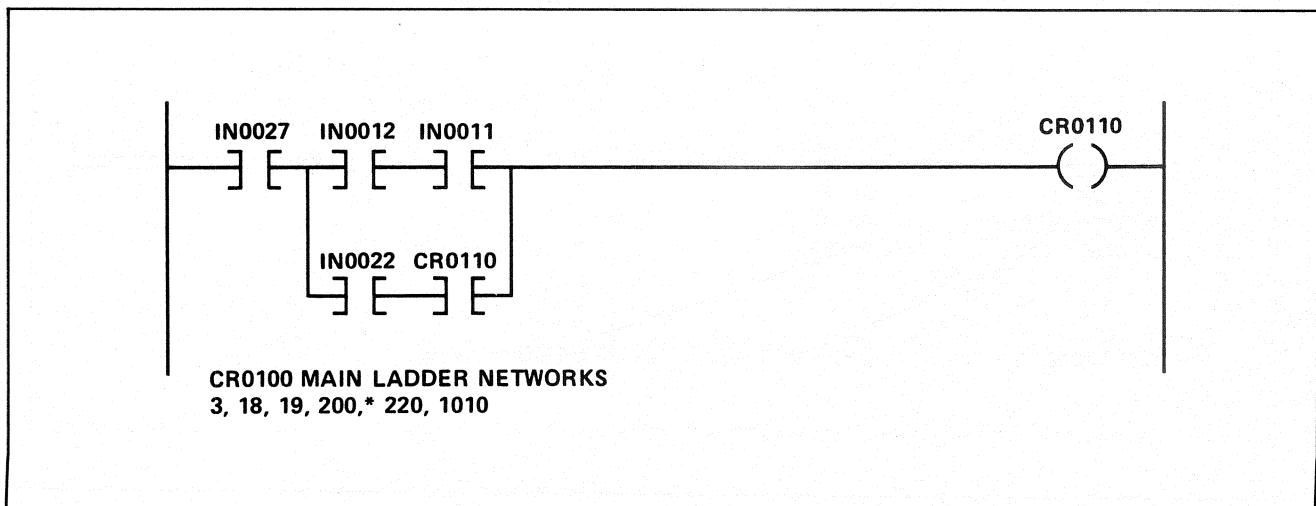


Figure 4-4. I/O Cross Reference Numbers



from the Print mode. The time interval—such as 10 seconds—must be defined, as must the coil or register to be examined. When initiated, the on/off status of the coil or the content of a register is displayed. Along with it, the elapsed time (in tenths of a second) between each change appears. The function continues until the operator terminates it.

#### 4-2-5. EXECUTIVE FUNCTION MODE

The Executive Function mode allows the Advanced Program Loader to perform the following housekeeping functions:

- Numbering and renumbering of networks
- Clearing the user application program ladder diagram
- Displaying the status of the associated programmable controller
- Displaying the programmable controller's fault tables
- Setting the time of the watchdog timer
- Configuring hardware and software characteristics of a specific programmable controller
- Configuring communication ports of the Loader and WESTNET II Data Highway

Section 7 describes the operational characteristics of each of these housekeeping functions.

#### 4-2-6. USER DIAGNOSTICS

The User Diagnostics mode allows the user to check and display the status of various hardware components associated with the HPPC-1500/-1700 system and the Loader. The diagnostics are divided into the following 3 areas:

- SIM status
- Module fault listings
- Communication ports of the Loader

#### 4-3. CONTROL FUNCTIONS

The Control function can be thought of as submodes of the Executive mode, described in Paragraph 4-2. Many of the Control functions can be entered from two or more of the Executive modes. They are referred to as Control functions because these modes are initiated by depressing and holding the Ctrl (control) key, and then pressing some other key. The Control functions consist of the following:

- Search/Continue Search functions (4-3-1)
- Label function (4-3-2)
- Register function (4-3-3)
- Store/Recall Screen functions (4-3-4)
- Program-to-Monitor Mode Change function (4-3-5)
- Enter the Executive Mode function (4-3-6)
- Help function (4-3-7)

#### 4-3-1. SEARCH FUNCTION

The Search/Continue Search functions allow programmed elements or registers contained in the ladder diagram to be located and displayed on the screen. When a search is initiated:

- The type and the reference number of the element to be searched for are entered, and the search is initiated.
- The first network in the program containing the element being searched is displayed.
- If contacts are being searched, the search can be continued, and each network containing the contact is displayed in sequence.

The Search function also provides for the:

- Search and display of networks by searching for a specific network number.
- Listing of the I/O reference numbers or registers not used in the ladder diagram. Any of the following unused functions can be displayed: contacts; coils; holding registers; input and output registers; input and output groups (used as registers).

#### 4-3-2. LABEL (DOCUMENTATION) FUNCTION

The Label, or documentation, function assigns "labels," or user identifications, up to 6 characters in length to the actual inputs and outputs contained in the ladder diagram. Also, comments up to 3 lines in length can be entered and displayed. Labels appear directly above the input and output reference numbers, while comments are located on the bottom 3 lines of the screen. (See Figure 4-5.) The characters assigned as labels can be any of the ASCII characters entered from the central, unshaded keys of the Keyboard. The labels assigned are displayed in the Monitor mode and can be printed on hardcopy.

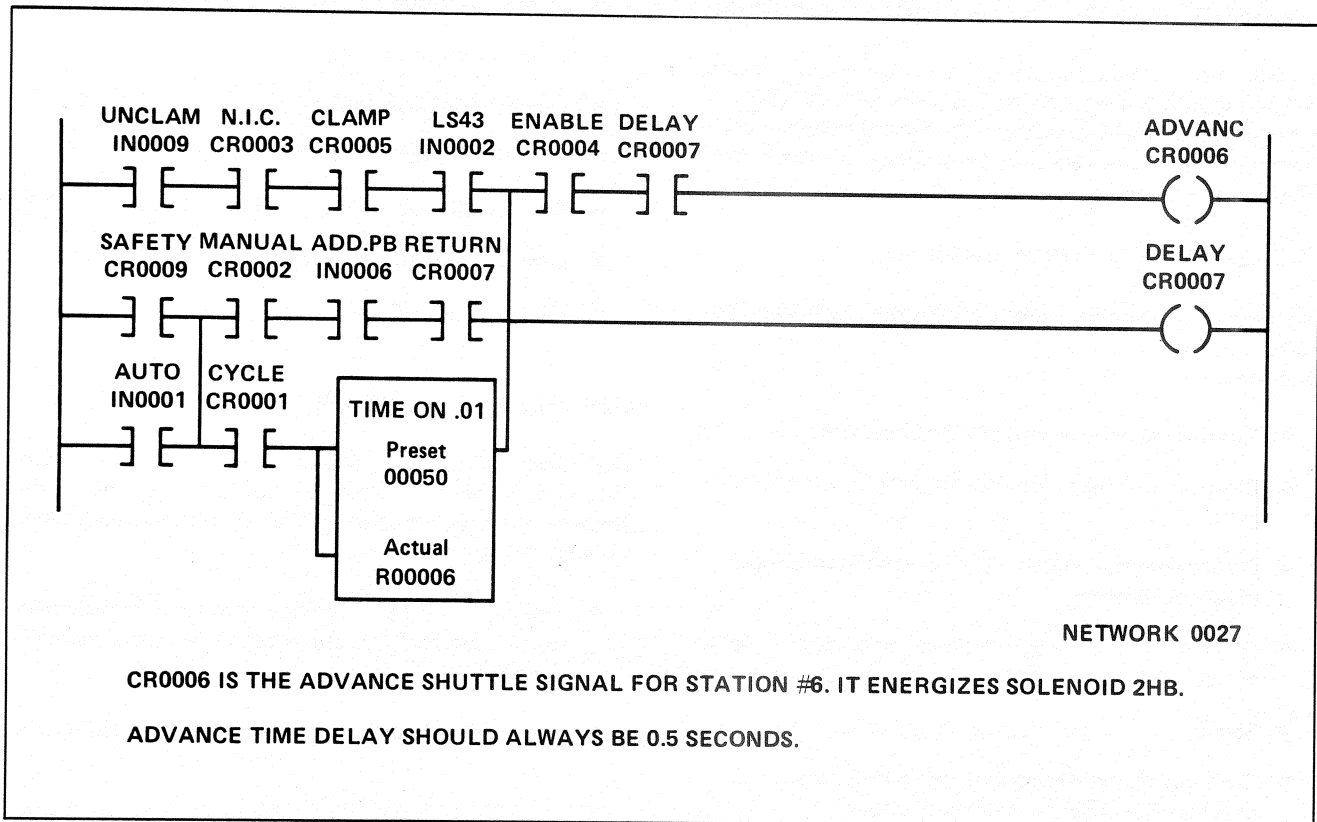


Figure 4-5. Network With Labels

### 4-3-3. REGISTER FUNCTION

The register function allows the monitoring of any register used in the ladder diagram. The register number and its contents are displayed on the screen. The contents can be displayed in any of the following formats:

- Decimal
- Binary
- Hexadecimal
- ASCII
- DP DEC (double-precision decimal)

### 4-3-4. STORE/RECALL SCREEN FUNCTION

The Store Screen function and Recall Screen function allow storing of the current contents of the screen on a diskette. Subsequently the screen can be recalled for use.

### 4-3-5. PROGRAM-TO-MONITOR CHANGE FUNCTION

The Program-to-Monitor Mode Change function provides a quick means to change between the Program and Monitor modes while displaying the same network. This function is initiated by pressing and holding the Ctrl key, and then pressing the E key.

### 4-3-6. ENTER EXECUTIVE MODE FUNCTION

The Enter Executive Mode function causes the Advanced Program Loader to enter the Executive Mode. To effect this, press and hold the Ctrl key, and then press the E key.

### 4-3-7. HELP FUNCTION

The Help function initiates a printout on the screen of all the keys and control functions which are available for use at the time the Help function is made active. To initiate the function, press and hold the Ctrl key, and then press the Q key. This is a useful function, especially for novice programmers.



## Section 5

# Advanced Program Loader Startup

### 5-1. INTRODUCTION

The purpose of this Section is to assist the user in starting up the Advanced Program Loader. General hardware, environmental, and diskette-handling information as well as specific startup procedures are contained here as follows:

- Environmental considerations (5-2)
- Loader cabling (5-3)
- Diskette care and insertion (5-4)
- Producing backup diskettes (5-5)
- Verifying a copy diskette (5-6)
- Write/protect notch (5-7)

The above information is more general in nature. The following information is specific for Loader startup:

- Initial NLSW-1581 Master diskette and DOS diskette merging (5-8)
- Advanced Program Loader startup (5-9)
- Default configuration (5-10)

#### Note

If a first-time Advanced Program Loader user is already familiar with general diskette-handling procedures, skip to Paragraph 5-5.

#### Note

If the user has a merged Westinghouse Master and a DOS diskette, skip to Paragraph 5-9.

### 5-2. ENVIRONMENTAL CONSIDERATIONS

The Program Loader **must** be operated within the limits determined by its manufacturer. These are:

- Temperature: 60° to 90°F  
(16° to 32°C)
- Humidity: 8 to 80% R.H.

Note that these are more restrictive than the operating range specifications for the HPPC-1500/-1700.

Additionally, it is critical **not** to subject the unit to:

- Caustic, dirty, or corrosive atmospheric conditions
- Extreme electromagnetic radiation, such as can be found near welding or inductive heating machines

A single particle of dirt can not only ruin a diskette, but it can also damage the magnetic recording head. If, because of the harsh ambient environment, it is not possible to operate the Loader near the HPPS-1500/-1700 processor, other arrangements must be made.

One practical solution to a hostile industrial environment is an air-conditioned control room or office. As an alternative, the Advanced Program Loader can establish communication, through a Serial Interface Module (SIM), with the processor, or in one of the following 2 ways:

- Up to 150 ft (45 m) distant by means of a user-fabricated SIM-to-I/O Processor Cable
- Up to 10,000 ft (3,048 m) distant by means of a high-speed communication link.

Complete details of extending the standard SIM-to-I/O Processor Cable's (Catalog No. NLC-10C) length to 150 ft are given in Appendix B of the HPPC-1500/-1700 Systems Manual (Catalog No. NLAM-B821). Also refer to Figure 5-1(a) in this manual which illustrates the arrangement. Note that this is essentially a "local" arrangement and requires only one additional Serial Interface Module (SIM).

The arrangement that extends the distance between the Loader and the processor to 10,000 ft is essentially a remote system. Thus a great deal more hardware is required. See Figure 5-1(b).

With either of these connections, it is not necessary for the SIM to be connected to other I/O hardware, as would be the case at an I/O drop. The SIM can be used simply to allow the Loader to communicate actively with the HPPC-1500/-1700 (on-line operation) from an extended local or a remote location.

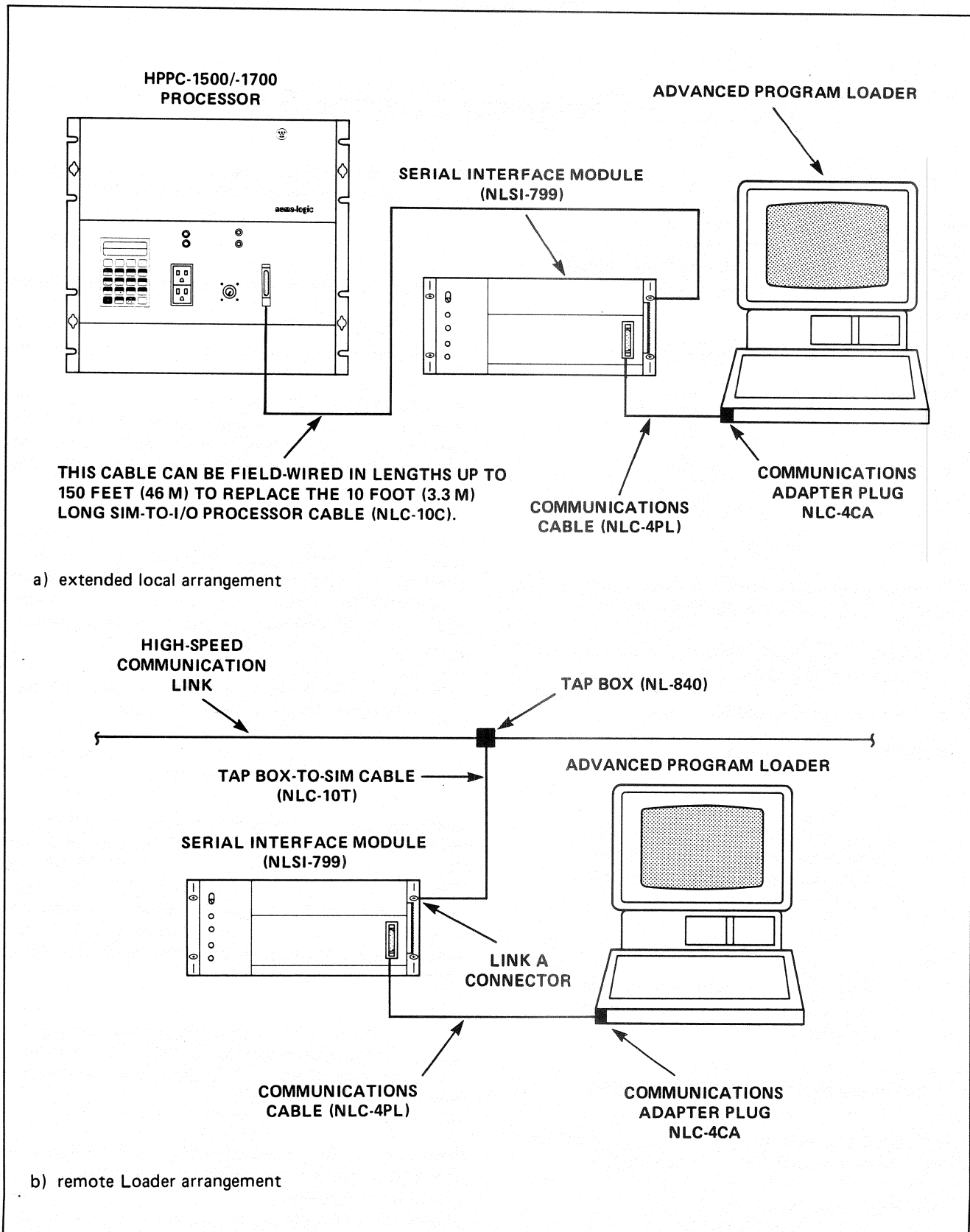


Figure 5-1. Loader-to-SIM Connections





**Note**

For more specific information about hardware arrangements, refer to the HPPC-1500/-1700 Systems Manual, especially Section 13 and Appendix B.

**5-3. ADVANCED PROGRAM LOADER CABLING**

Before applying AC power to the Advanced Program Loader, ready the hardware by performing all necessary cable connections as described in Section 3.

**CAUTION**

Insure that the AC power switches of the personal/portable computer, along with any of the associated peripheral devices such as a printer, are turned off before connecting and disconnecting any cables. Failure to do so can result in equipment damage.

**CAUTION**

Use of the Loader with unapproved peripheral devices can cause equipment damage. Use only approved peripheral devices.

The Loader may be operated in one of the following 2 ways:

- **On-line**, where the Loader communicates directly with the HPPC-1500/-1700 processor. The Loader actually enters or edits the ladder diagram into the memory of the processor. It is also able to monitor the current states of the inputs and outputs, if any. Figure 5-2 shows the on-line connection between the Loader and processor. If the Loader is to be operated remotely, as described in Paragraph 5-2, it can be connected as shown in Figure 5-1(b).

- **Off-line**, where the Loader is not connected to or communicating with the HPPC-1500/-1700 processor. When operated off-line, the Loader is used to perform functions such as:

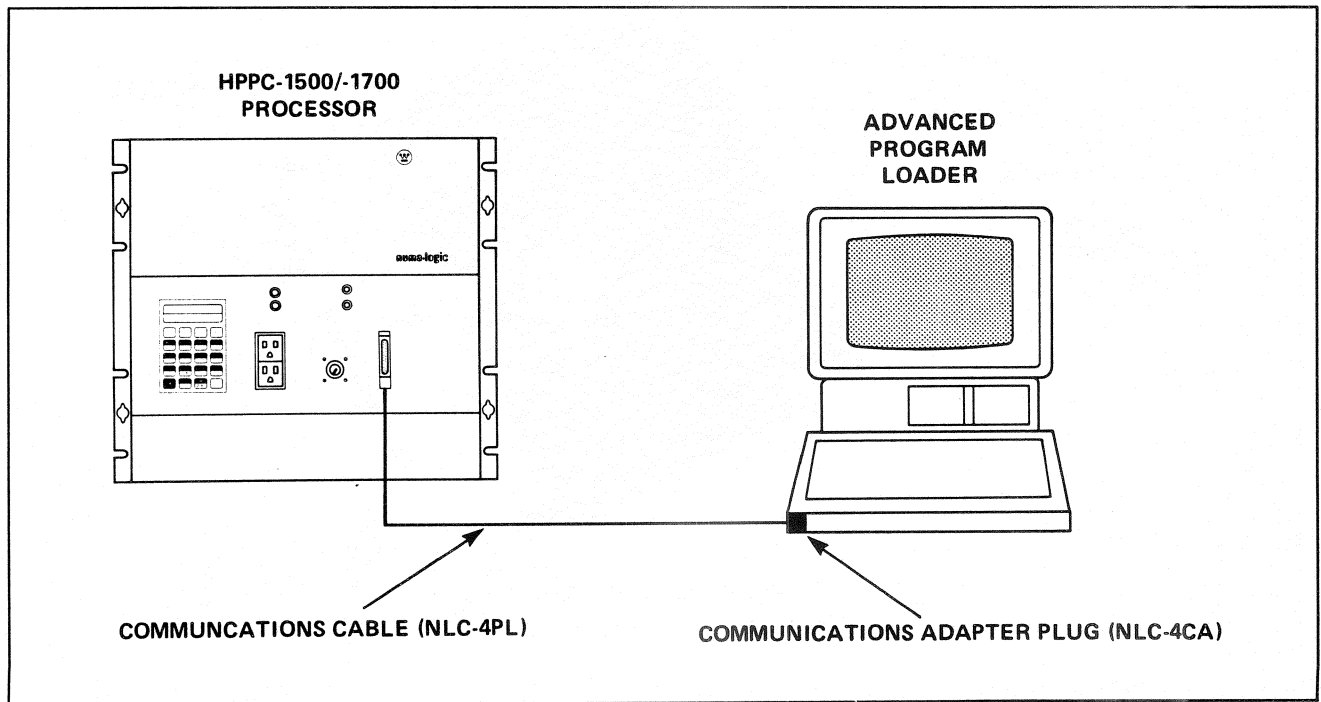
- Initially keying in a ladder diagram program
- Producing a hardcopy printout of the ladder diagram
- Storing the ladder diagram on a diskette

Here, data is stored only in the Loader's memory.

**5-4. DISKETTES**

The diskette's function is to magnetically store both the DOS and the Westinghouse software. Furthermore, it may be used to store a copy of the user's ladder diagram program.

This kind of storage may be in the form of a simple backup diskette that duplicates the current contents of



**Figure 5-2. Simple Loader-to-Processor Connection**



the processor's memory. The backup can then be stored against the possible loss of the memory's contents—as may occur during module substitution.

The storage function also extends to program development in an off-line operation.

Lastly, the function is useful as the ladder diagram is being entered. Should there be a loss of AC power, all the entries may be lost. However, by storing the program on a diskette at intervals of 15 to 30 minutes, the loss would be minimized.

Once a ladder diagram is stored on diskette, it can easily be reloaded, and the program-entry process can resume from the point where the entries were lost.

For individuals not familiar with personal computers, the following information is **extremely** important. Without a basic understanding of proper diskette-handling procedures, improper operation could result.

#### 5-4-1. CARE

A diskette is permanently sealed in a black plastic cover which protects it; aids with keeping it clean; and allows it to spin freely. This cover should **never** be opened. (See Figure 5-3.)

Although the diskette is somewhat flexible, it should never be bent. Always try to hold the diskette with your right thumb at the corner over the label.

Never allow anything to touch the diskette's gray or brown surface which is visible through cutouts in the cover. An invisible scratch or even a fingerprint can cause errors when the data is read.

The following are general guidelines for diskette use:

- When they are not in use, store diskettes in the original paper envelope.
- Store the diskettes in an upright position. Use the notebook pockets provided with the Westinghouse Software Programming Packages.
- Do not place the diskettes on dirty or greasy surfaces, and do not allow dust to collect on them.
- When writing on the diskette's cover, use a felt tip pen, and do not press down hard.
- When applying additional labels, write on them **before** fixing them to the cover.
- Keep diskettes away from stray magnetic sources

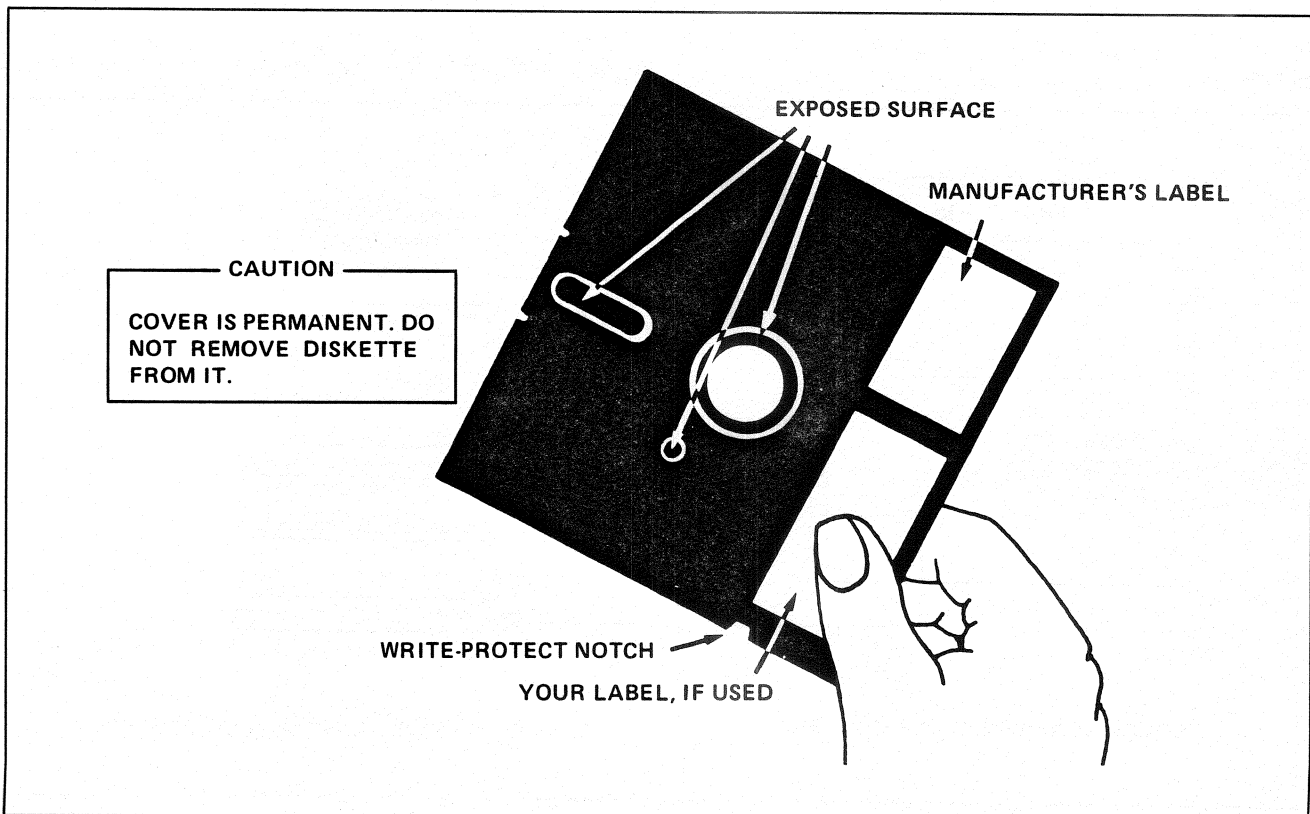


Figure 5-3. Common Diskette Features



such as a TV set, telephones, dictation equipment, electronic calculators, electric motors, and magnets.

- Keep diskettes away from extremes of heat and cold, which could cause warping or improper operation. (The first sign of heat damage is a warped cover.)
- If the diskette is to be unused for several hours, open the drive door so that the drive head does not unnecessarily rest on the diskette's surface for long periods of time.

#### 5-4-2. INSERTION PROCEDURES

The following steps should be followed to properly insert a diskette into a drive.

**Step 1** – Open the drive door by gently pulling at the spring-loaded tab on its face. (See Figure 5-4.)

**Step 2** – Pick up the diskette and hold it so that your right thumb covers the manufacturer's label. (See Figure 5-5.)

**Step 3** – Carefully begin to insert the diskette with the manufacturer's label upwards or to the left, depending on which type of computer is used. (The edge with the oval cutout enters the drive first.)

**Step 4** – Gently push the diskette **all the way** into the

drive. Do not force or bend it. If it is pushed too hard, it could be permanently damaged.

**Step 5** – Carefully push the drive door's spring-loaded tab to the right. The door will close over the disk.

#### Note

Various types of personal computers have different drive door mechanics. Consult the unit's Operations Guide for details.

To remove the diskette, open the drive door, and carefully draw it **straight out**.

#### CAUTION

**Never remove a diskette while the drive's red IN USE light is on. This may damage the diskette, and will certainly destroy the data stored on it. (In most cases the diskette will be usable, but the data must be reloaded.)**

#### 5-5. PRODUCING BACKUP DISKETTES

When first receiving one of the Westinghouse Software Programming Packages, it is an excellent practice to make a second, backup copy of the diskettes. At the same time, make a copy of the DOS diskette.

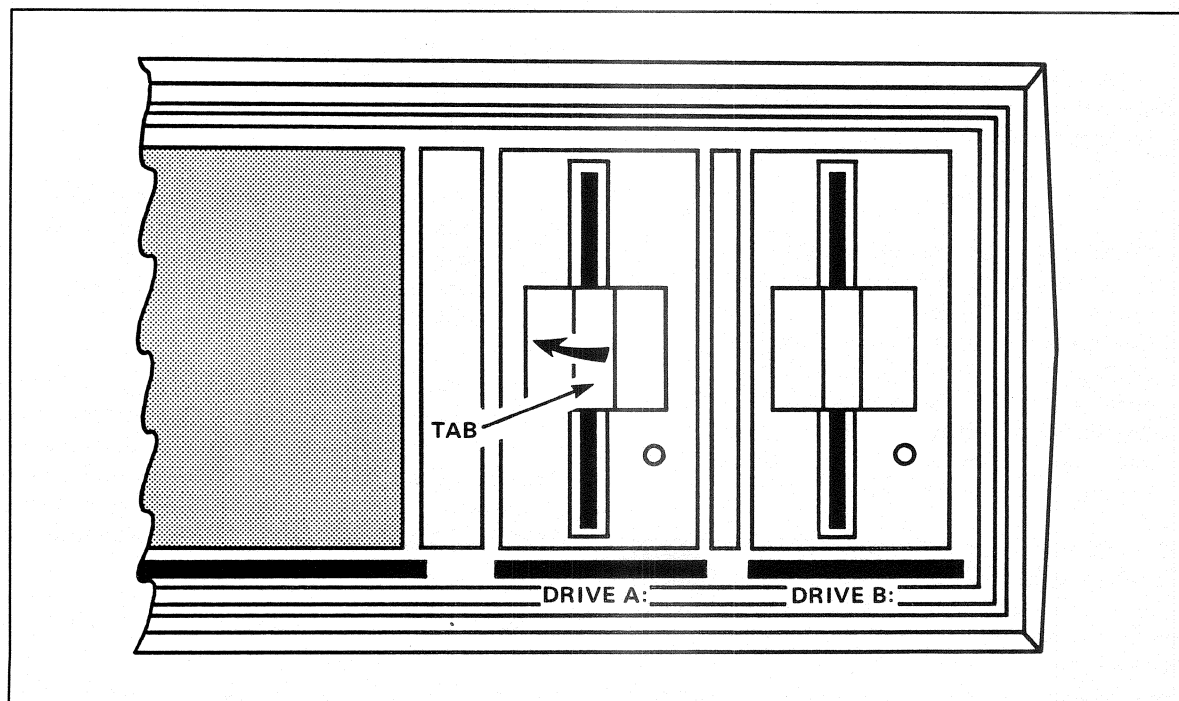


Figure 5-4. Opening Drive Doors (Typical Unit)

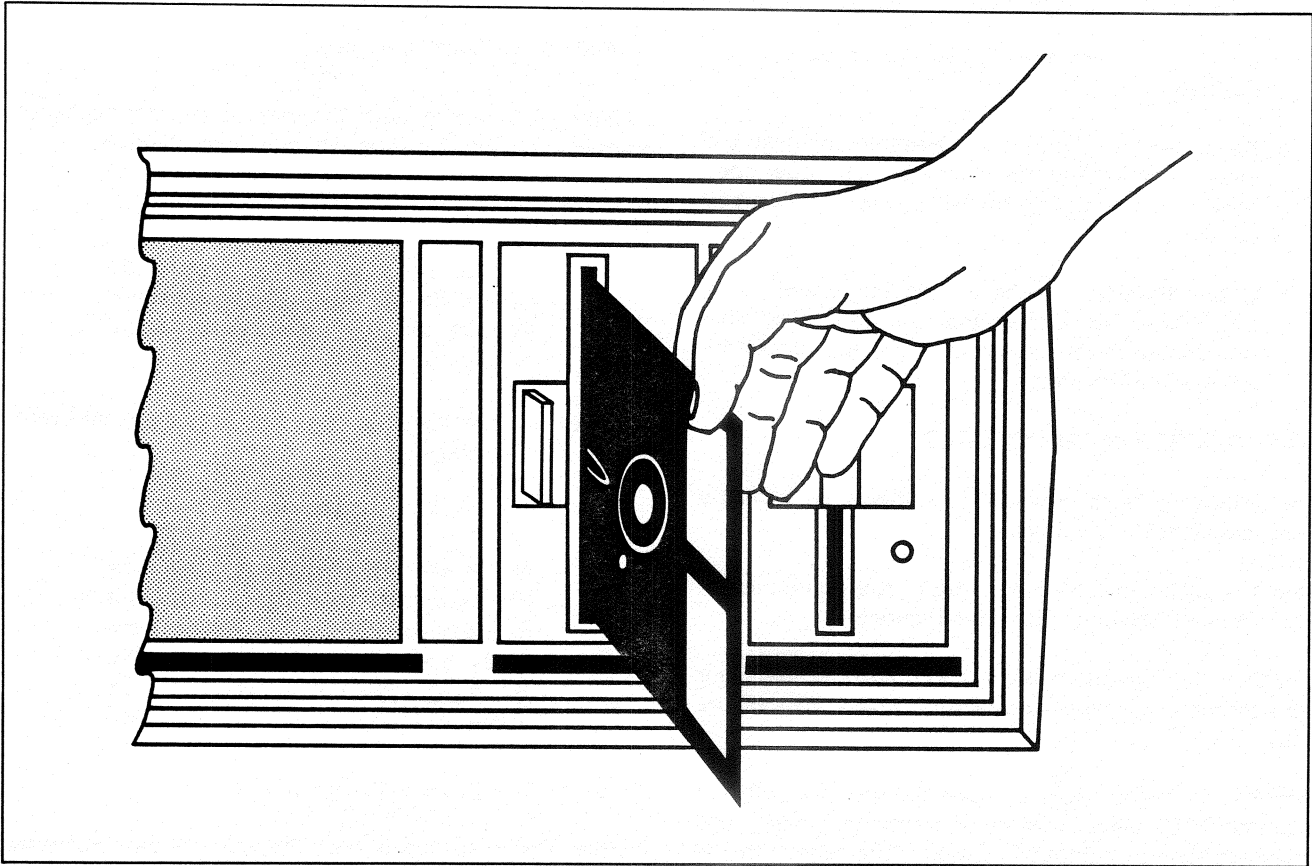


Figure 5-5. Proper Installation Method

**Note**

Before a blank diskette is first used, it is necessary to format it. Refer to Paragraph 5-12 for more information.

**Note**

The copy procedures outlined here are to be followed only at the initial start-up when the Software Programming Package is first used. They initially use DOS programs for operation. Later, once startup is accomplished, the Westinghouse software's Disk mode, described in Section 14, is to be used to copy, verify, and record.

Keep in mind that both the NLSW-1581 and -1581H Software Programming Packages contain the On-Line Ladder Executive and Off-Line Ladder Executive diskettes, which can be copied. The DOS diskette, provided by the computer manufacturer, can also be copied, as can any of the diskettes used for the ladder diagram programs and user documentation.

The Westinghouse Master diskette, however, places certain restrictions on any copies made of it. These are detailed in Paragraph 5-11.

**Note**

Westinghouse recommends that separate diskettes be used to store ladder diagram and/or documentation programs. **Do not** attempt to add them to the Master diskette.

The procedures from this point to the end of the Section begin with required operation that "boots" the DOS programs into the Loader. Following that, the explanation moves on to describe how to copy any of the diskettes. (This may be the DOS or one of the Ladder Executive diskettes.) Next, keying sequences for the actual Loader startup are given.

Follow this procedure to produce a backup diskette.

**Step 1** — Remove the shipping cardboard from both drives, if this has not already been done.



**Step 2** – Turn AC power on. If the Loader has been off for one minute, or more, there is a period when only the built-in fan is heard. A small cursor appears at the upper left-hand corner. Then, after certain internal, automatic self-diagnostic checks are made, there is an audible beep, and the light on Drive A blinks briefly. An error message may be displayed, but ignore it. Wait for these events to occur before proceeding.

**Step 3** – Insert the DOS diskette provided by the computer manufacturer into Drive A and close the drive door. (Drive A automatically becomes the "default drive.")

**Step 4** – With power already on, "boot" the DOS diskette into the computer. (To boot means to load a single portion of the DOS programs into the computer.) To do this, sequentially press and briefly hold down all of these keys:

- Ctrl (Control)
- Alt (Alternate)
- Del (Delete)

(See Figure 5-6.) Then release the keys and wait. Within a few seconds, there will be an audible beep, and the red light on Drive A lights. At this point the screen displays the following typical message:

```
Current date is Day 1-01-198X
Enter new date: _
```

(The letter X here represents a specific year.)

**Step 5** – For this typical instruction, do not enter a

date. Press the Enter key (↵) twice. The display adds this typical message:

```
Current time is 0:00:50.64
Enter new time:
```

```
The IBM Personal Computer DOS
Version 2.00(C) Copyright IBM Corp
```

This display ends with an A>\_ and a blinking cursor, which is the DOS prompt to enter a DOS command.

**Step 6** – Enter the following DOS command to access the program used to copy a diskette. (It is necessary to type some of these words on the alpha keys.) It is entered immediately after the A>\_ prompt:

```
diskcopy a: b:Enter key (↵)
```

**Note**

Observe the spacing of entries within this command. If an incorrect entry is made, the message "Invalid parameter" is displayed.

Immediately after the "Invalid parameter" message, the A>\_ prompt is again displayed. The proper entry can be attempted again without any other manipulations or backup keying.

Assuming that the entry is correctly made, the DOS program is accessed by the Loader from the diskette, and the red light on Drive A is lit.

**Step 7** – Eventually the red light on Drive A goes off.

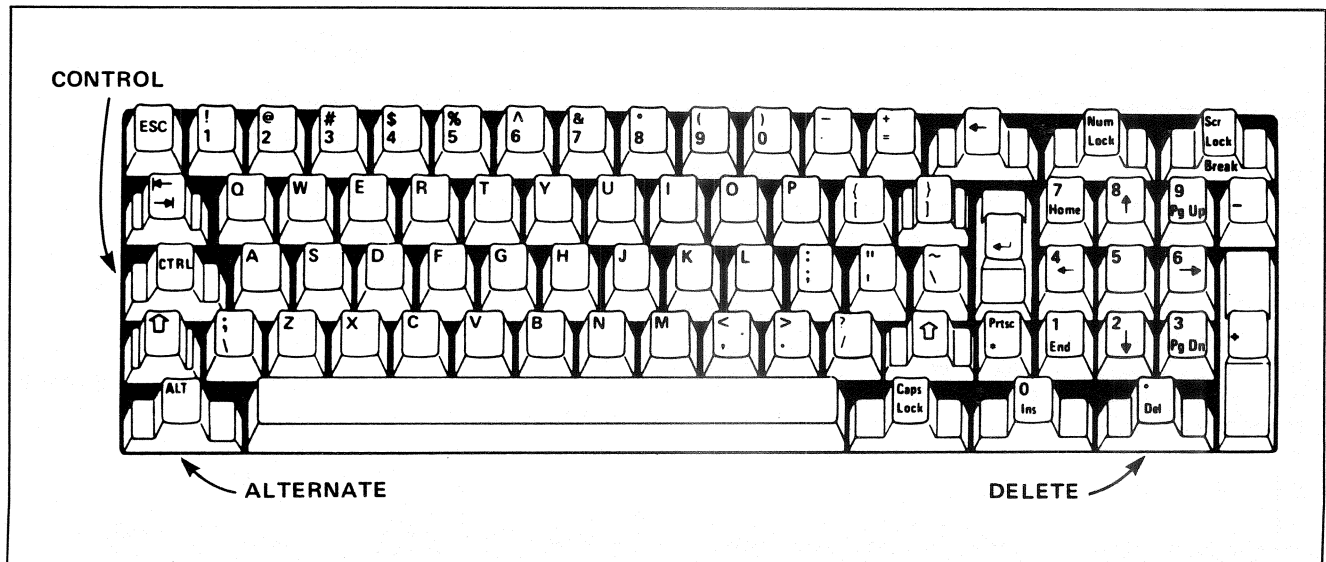


Figure 5-6. Startup Key Locations



The display then shows:

Insert source diskette in drive A:  
Insert target diskette in drive B:  
Strike any key when ready

**Step 8** — Remove the DOS diskette from Drive A.

**Step 9** — Place a blank ("target"), formatted diskette in Drive B. (See Paragraph 5-12.)

**Step 10** — Place the "source" diskette to be copied in Drive A. (This may be the DOS or one of the other diskettes.)

**Step 11** — Press any key.

The following message is displayed:

Copying 9 sectors per track, 2 side(s)

The red lights on the drives light alternately for about a minute.

### CAUTION

**Make no attempt to remove either diskette during this part of the operation. The source and target software data could be lost. If it must be interrupted, press and hold the Ctrl key, and then press the Break key. Wait for the red light to go off. Only then remove the diskettes.**

Eventually the following message is displayed:

Copy complete.  
Copy another (y/n)?\_

**Step 12** — Press n for no.

The display returns to the A>\_ prompt. It is now possible to remove the 2 diskettes, or to verify that the copy operation was successfully carried out.

**Step 13** — Using the paper labels provided with the blank diskette, identify the copies. Also, if the copies are to be write/protected, install the tab supplied over the write/protect notch of the diskette. (See Paragraph 5-7 for additional write/protect information.)

## 5-6. VERIFYING A COPY OPERATION

It is a good practice to verify that any data copied is correctly copied, regardless of the type of data on the diskette. Follow these steps:

**Step 1** — Remove the source diskette from Drive A.

**Step 2** — Place the DOS diskette in Drive A.

**Step 3** — Enter the following command after the A>\_ prompt:

comp a:\*. \*Enter key (↵)

After the Enter key is pressed, the DOS program, used to compare 2 diskettes, is entered into the Loader's memory. The following message is displayed:

Enter 2nd file name or drive id

**Step 5** — Remove the DOS diskette from Drive A.

**Step 6** — Place the original ("source") diskette in Drive A.

**Step 7** — Place the copy ("target") diskette in Drive B. (It may be in already.)

**Step 8** — Enter the following command to initiate the comparison:

b:Enter key (↵)

The above command is to be used with 2 floppy disk drives. If some other type of drive is used, enter the appropriate command. In the case of a hard disk, enter the letter c, not b, in the command format.

The Loader compares the diskettes. If the comparison is successful, the screen displays this message:

Files compare OK

### CAUTION

**Make no attempt to remove either diskette during this part of the operation. The source and target software diskette data could be lost. If the operation must be interrupted, press and hold the Ctrl key, and then press the Break key. Wait for the red light to go off. Only then remove the diskettes.**

After the comparison is complete, the following message is displayed:

Compare more diskettes (y/n)?\_

**Step 9** — Press n for no. The A>\_ prompt returns.

**Step 10** — Remove both diskettes. Store the original



diskettes in a protected location in case the copy diskettes are damaged or malfunction.

For more specific information on the Westinghouse Master diskette, see Paragraph 5-11.

### 5-7. WRITE-PROTECT NOTCH

Each diskette has a write-protect notch on one of its edges. (See Figure 5-3.) If the notch is not covered, the diskette can be written over or erased. Blank diskettes are supplied with adhesive tabs that may be placed over this notch in order to protect the data from unwanted change.

Place a tab over the copy (target) diskette to prevent accidental erasure or writing-over. If the original (source) diskette does not have a tab over it, be sure to place one on it immediately.

There are certain restrictions that should be understood with respect to the Westinghouse Master diskette. (See Paragraph 5-11.) **Never** place a tab over the Master diskette's write-protect notch, since it will not function correctly in the Loader.

### 5-8. MERGING WESTINGHOUSE AND DOS SOFTWARE

Due to copyright restrictions, the Westinghouse Master software diskette cannot be factory-shipped with the DOS programs contained on it. Thus the user must perform a two-step operation involving the merging of these diskettes. Since the exact method of merging the DOS programs with the Westinghouse Master software may vary, the actual procedures are printed on the screen by the Westinghouse software contained on the Master diskette.

#### Note

An attempt to store any kind of program on the Westinghouse Master diskette **before** it is merged with a DOS diskette prevents the subsequent merging process.

The steps that follow briefly describe the loading and merging of the DOS and Westinghouse software using the directions prompted by the screen. Follow these steps:

**Step 1** – Connect the Communications Cable (NLC-4PL) between the Loader and the HPPC-1500/-1700, as described in Section 3. This action assumes on-line activity will follow. If off-line use is anticipated, there is no need to connect the Cable.

**Step 2** – Place the DOS diskette in Drive A and close the door.

**Step 3** – Only now turn on AC power.

The Loader automatically executes a power-on self-test for approximately 30 to 90 seconds. If the test is successful, the Loader beeps for one second, and the drive automatically begins accessing the DOS diskette. (This is called "auto booting.") When the DOS data is loaded, the screen displays the request for a new date entry as shown here:

```
Current date is Day 1-01-198X
Enter new date: _
```

If the screen does not display any characters after approximately 90 seconds, verify that the brightness control is turned fully clockwise.

#### Note

If the power-on self-test fails, the display shown above will not be present. A hardware problem exists. Consult the appropriate Operations Guide for further instructions.

**Step 4** – Enter the new date followed by the Enter key. (The Enter key has the symbol ↵ on it.) To accept the current date displayed, simply press the Enter key.

When Step 3 is completed, the screen displays a request for a new time, as shown here:

```
Current date is Tue 1-01-198X
Enter new date:
Current time is 0:16:58.92
Enter new time:
```

**Step 5** – Enter the new time followed by the Enter key. To accept the current time displayed, simply press the Enter key.

The screen now displays the DOS title, as shown here:

```
The IBM Personal Computer DOS
Version 2.00(C) Copyright IBM Corp
```

```
A>_
```

The title is followed by what is referred to as the A prompt (A>\_). The A prompt signifies that the disk drive used in conjunction with commands typed in will be Drive A.

**Step 6** – Remove the DOS diskette and install the



Westinghouse software diskette labeled MASTER into disk Drive A.

**Note**

This is a copy-protected diskette, and thus the original **must** be used.

**Step 7** – Install either the On-Line or Off-Line Ladder Executive diskette into disk Drive B.

**Step 8** – Enter the following command immediately after the A>\_ prompt to access the Westinghouse software. (It is necessary to type the word "start" on the alpha keys.)

startEnter key (↵)

The screen now displays the appropriate instructions to allow Westinghouse and DOS software to be merged.

**Note**

Earlier NLSW-1581 Master software versions may be accessed by commands other than "start." If the start command does not cause instructions to be printed, initiate a printout of the directory. Type: DIR and Enter key (↵). Look for the name of the program used to initiate the printout. Programs such as INSTALDO, INSTRUCT, README, or TYPEME may be present. Simply type the name of the program followed by the Enter key (↵) to initiate the screen prompts.

When the merging of DOS and the Master software has been completed, the Master diskette will contain the DOS programs. The Master diskette and either the On-Line or Off-Line diskette are used whenever the Loader is started up, as described next.

### 5-9. LOADER STARTUP WITH MERGED DOS AND MASTER DISKETTE

This Paragraph explains the procedure to be followed to start up the Advanced Program Loader. It assumes that the DOS and Westinghouse Master software diskettes have been merged, as described in Paragraph 5-8. Since the personal computer does not retain its memory when AC power is removed, the following procedures must be followed **each time** AC power is restored.

**Step 1** – Connect the Communications Cable (NLC-4PL)

between the Loader and the HPPC-1500/-1700, as described in Section 3. This action assumes on-line activity will follow. If off-line use is anticipated, there is no need to connect the Cable.

**Step 2** – Turn on AC power.

**Step 3** – Install the merged Master diskette in Drive A.

**Step 4** – Install either the On-Line or Off-Line diskette in Drive B.

**Step 5** – Sequentially press and briefly hold down all 3 of the following keys:

- Ctrl
- Alt
- Del

Release the keys.

The Loader automatically executes a power-on self-test for approximately 30 to 90 seconds after AC power is applied. If the test is successful, the Loader beeps for one second, and the drive begins accessing the programs from the diskette. After a period of time, the following message will be displayed:

Current time is 0:15  
Enter new time: \_

**Step 6** – Enter the new time followed by the Enter key (↵). Alternately, press the Enter key to accept the time shown. The screen will display the message:

Current date is Day 1-01-198X  
Enter new date: \_

**Step 7** – Enter the new date followed by the Enter key (↵). Alternately, press the Enter key to accept the date shown.

The software will be accessed from the diskette. When completed, the Executive mode's main menu, shown in Figure 5-7, is displayed.

**Step 8** – Remove the merged Master and DOS diskette from Drive A. (This is optional, since the diskette may remain in the drive if necessary.)

**Step 9** – Remove either the On-Line or Off-Line Ladder Executive diskette from Drive B. (They are not required for subsequent programming. Removing them gives added protection.)



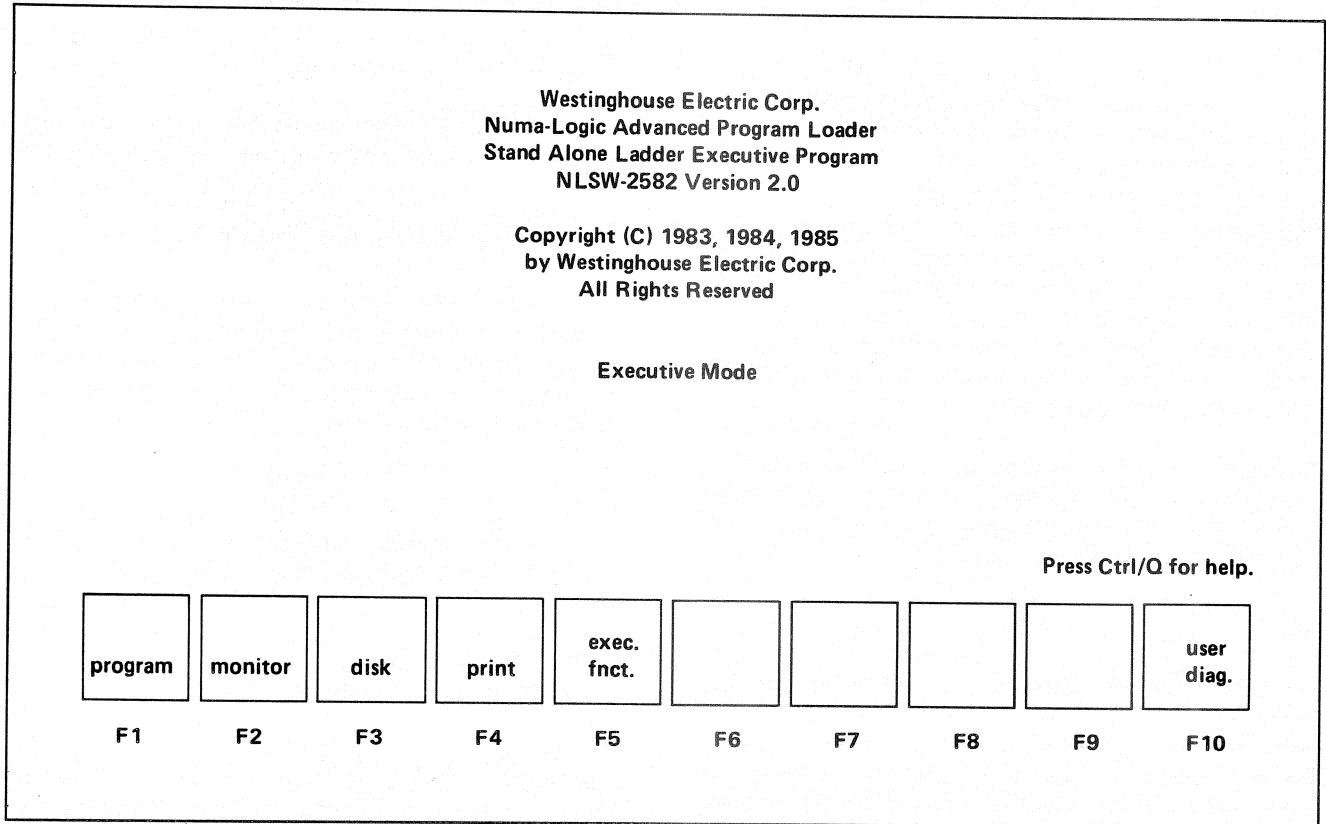


Figure 5-7. Executive Mode's Main Menu

Actual programming procedures are described in Section 8 of this manual.

**Note**

When the Westinghouse On-Line Executive Ladder software is first accessed from the floppy diskette, the HPPC-1500/-1700 processor must be configured before the Program mode can be entered. Section 7 describes how to configure an entire system using the Loader. Paragraph 5-11 describes a quick, default configuration method that can easily be used now.

**5-10. DEFAULT CONFIGURATION**

During on-line Loader operation, the Program mode cannot be entered until the processor is "configured." The configure function defines hardware characteristics of the HPPC-1500/-1700 controller such as the size of the memory and the addresses of the inputs and outputs. The "default configuration" is a feature of the Westinghouse software which allows selection of a preassigned configuration requiring a minimal number of key-ins.

To select the default configuration when the Executive mode's main menu is first displayed, as shown in Figure 5-7, press the following keys sequentially, but wait for the screen to change after each key-in.

- F5, to select the Executive Function mode
- F7, to select the configuration function
- F1, to define the operation as an initial configuration

The screen now displays:

Do you wish to continue (y/n)?

- Press the y (yes) key to continue.
- Press F1, to select the default configuration
- Press and hold the Control (Ctrl) key, and then press the E key to return to the Executive mode's main menu.

The Program mode can now be entered by means of the F1 function key.



### Note

When the default configuration is selected, any existing ladder diagram programming in the processor's memory is cleared.

There may be a desire to communicate with the HPPC-1500/-1700 processor through the PROGRAM LOADER port on the Serial Interface Module (SIM). This is in general acceptable, but, before the system is configured, difficult. It is preferable to connect the Loader with the COMMUNICATIONS INTERFACE PORT on the HPPC-1500/-1700.

Should it be necessary to communicate through a SIM, it is necessary to configure that SIM with at least 1 Input Register (IR), 1 Output Register (OR), 1 Input Group (IG), and 1 Output Group (OG).

### 5-11. MASTER DISKETTE AS A BACKUP

For simplicity, the restrictions and qualifications that involve the Westinghouse Master diskette are placed here. In Paragraph 5-5, the practice of copying all disks was recommended. Although the Master diskette can be copied, the uses to which that copy can be put are highly restricted. For example, the copy of the Master diskette cannot be used to run the Loader.

The major use that a copy of the Master performs is to reload the original Master diskette if it somehow was erased. In such cases the reloaded Master can operate the Loader.

#### 5-11-1. RELOADING A MASTER

If it becomes necessary to reload a Master diskette, follow these steps:

**Step 1** — Place the original Westinghouse Master diskette in Drive A.

**Step 2** — Place the backup ("copy") diskette of the Master in Drive B.

**Step 3** — Enter the following command:

```
copy b:.* a:/vEnter key (↵)
```

**Step 4** — The Master diskette, unless physically damaged, will be reloaded.

#### 5-11-2. MASTER DISKETTE USE GUIDELINES

The following are guidelines to be observed when using the Master diskette.

1. **Never** reformat a Westinghouse Master diskette as described in Paragraph 5-12. (This destroys encrypted software and renders the Master useless.)

2. Never apply an adhesive tab over the write-protect notch on the Master diskette. (See Paragraph 5-7 and Figure 5-3.)

### 5-12. FORMATTING A DISKETTE

Before a blank diskette is used for the first time, it is necessary to perform a formatting operation on it. This process "initiates" the diskette for use by the computer. Thus, in a sense, it is frequently one of the very first steps in many computer operations.

#### CAUTION

**Never format a DOS or Westinghouse Software Package diskette. There is no need, and the data contained on them will be lost.**

#### 5-12-1. GENERAL INFORMATION

The format command has many functions which are detailed in the "Operations" chapter of the Guide to Operations manuals. Among the most important is causing a check for possible malfunctioning spots on the diskette. At times a slightly defective diskette can be used after the format command is executed, since the process identifies and skips such areas.

The format command may also be used to erase all previously entered data on the diskette. Thus the command should **not** be used each time a diskette is used. Generally, formatting once is sufficient—unless there is some software or mechanical problem.

#### 5-12-2. COMMAND ENTRY

The following procedure describes the formatting process.

**Step 1** — Boot the DOS programs into the Loader, as described in Paragraph 5-5, Steps 1 thru 5.

These steps result in an A>\_ displayed on the screen.

**Step 2** — Key in the format command immediately after the A>\_.

```
format a:Enter key (↵)
```

At this time the red indicator light goes on, and the screen displays this message:

```
Insert new diskette for drive A:  
and strike any key when ready_
```



**Step 3** — Remove the DOS diskette and lay it aside.

**Step 4** — Insert the blank diskette to be formatted into Drive A.

**Step 5** — Press any key.

At this time the indicator light goes on, and following message is displayed briefly:

Formatting . . . \_

When the formatting is completed, this message is displayed:

Format complete

Format another (Y/N)?

**Step 6** — Press Y (yes) to format a second diskette. Alternately, press N (no).

The display returns to the A>\_. The newly formatted diskette can be removed as soon as the red indicator light on the drive goes off.

#### CAUTION

On some personal computers, including most IBMs, if a drive is not specified in the "argument" of the format command, formatting is initiated on the default ("current") drive. This could be Drive B on the hard disk drive. Thus the contents will be inadvertently erased. Always specify the intended drive immediately after the word format. (The entry procedure above, specifies Drive A correctly.)

## Section 6

# Keyboard Operations

### 6-1. INTRODUCTION

The Advanced Program Loader's Keyboard is the input device used by the operator to:

- Enter, edit, and monitor the ladder diagram when the Westinghouse Advanced Program Loader software is being executed in the personal/portable computer
- Direct the Disk Operating System (DOS) software to perform functions such as loading the Westinghouse Advanced Program Loader software, and making backup copies of diskettes

Some uses of the DOS software are described in the step-by-step procedures contained in Section 5. For additional DOS operations, refer to the appropriate portable computer's Operations Guide.

This Section describes in a general way the operation of the Keyboard as related to the Westinghouse Advanced Program Loader software.

### 6-2. KEYBOARD LAYOUT

The Keyboard can be divided into the following groups of keys:

- Alphanumeric
- Control

- Cursor/Number Pad
- Function (F1 thru F10 keys)

Each group is described separately in the following Paragraphs.

#### 6-2-1. ALPHANUMERIC KEYS

The alphanumeric keys, located in the central portion of the Keyboard, correspond to the normal typewriter key QWERTY layout. That is, the keys Q, W, E, R, T and Y appear in the second row. (See Figure 6-1 where the alphanumeric keys are shown unshaded.) These keys are used whenever the entry of alphanumeric data is required. Each of the 2 shift keys, when pressed, allows the upper case characters to be entered. Also, they allow the upper case cursor/number pad group to be used during the Program mode to enter numeric data.

The Shift key appears as:



The Tab key is also considered part of the alphanumeric keys. Whenever the Tab key is pressed, it causes horizontal elements to be added on the screen at the rightmost contact element position, **not** at the current cursor's

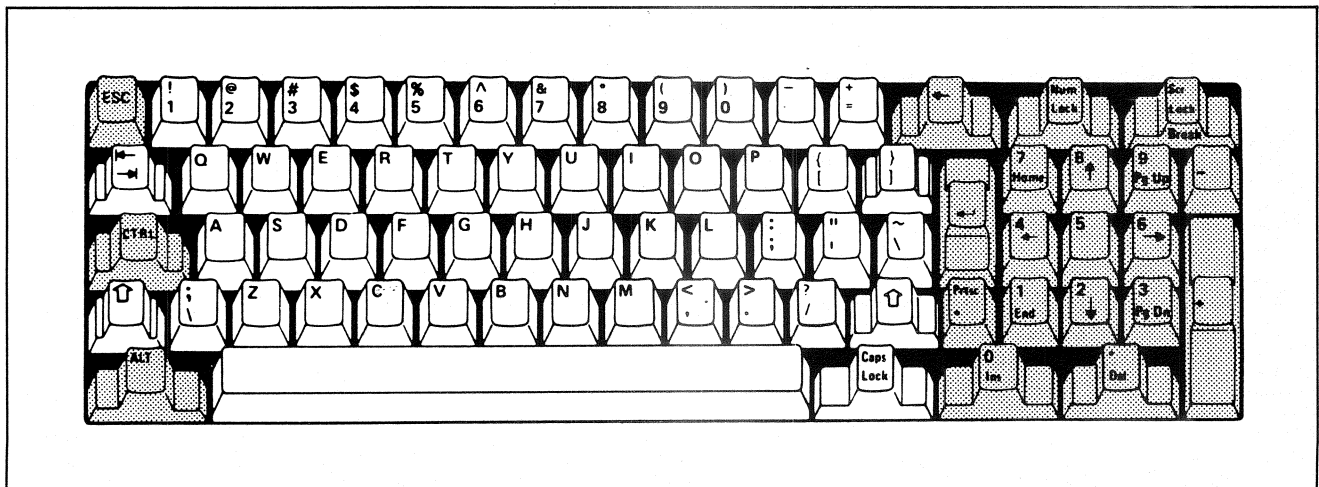


Figure 6-1. Alphanumeric Keys (Unshaded Area)



position. (In this way, the repetitive entry of certain symbol keys can be skipped.)

The Tab key appears as:



### 6-2-2. CONTROL KEYS

The control keys are associated with software-dependent operations. Table 6-1 lists some of the functions associated with the control keys. Figure 6-2 shows the control keys unshaded.

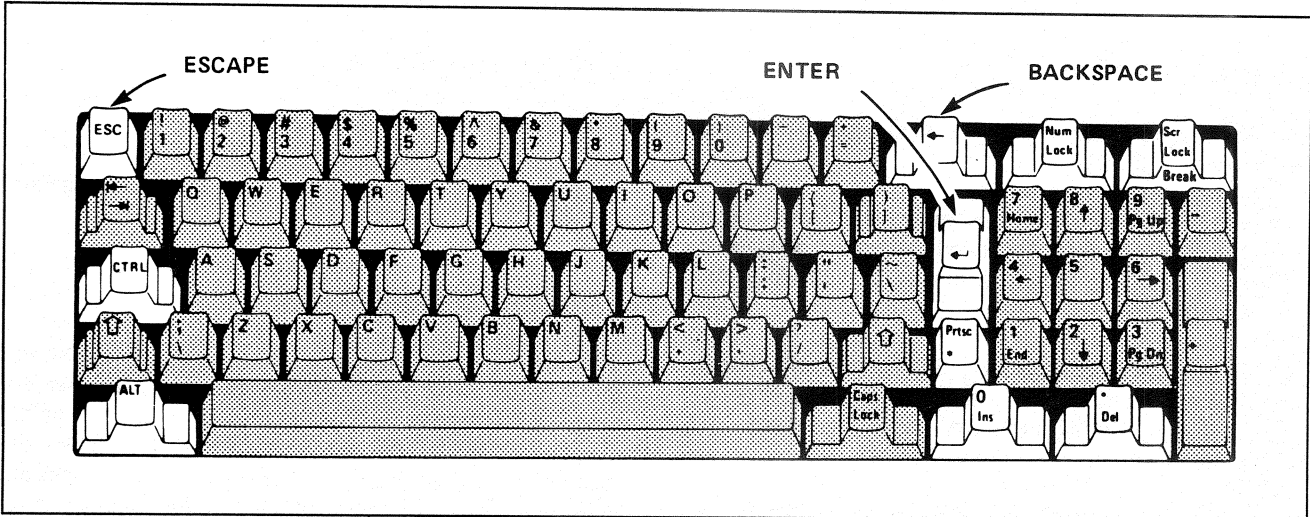


Figure 6-2. Control Keys (Unshaded Area)

TABLE 6-1. CONTROL KEYS

Key	Name	Function
	Enter	Signals the Loader that the information just entered through the Keyboard is complete and ready to be used. For example, during programming, the Enter key is pressed just after the element and its address are keyed in.
	Backspace	Moves the cursor left one space and deletes the character located there when in the Program mode.
	Control	The Ctrl key is pressed and held while a second key is pressed. It performs software-dependent commands or functions. Some examples of the use of the Control key with the Advanced Program Loader software follow: ①
	Control, C	Clears the ladder diagram area of the display screen.
	Control, E	Returns the screen to the Executive mode's main menu display.
	Control, F	Saves the current screen on diskette for later retrieval.
	Control, G	Accesses a screen formerly filed on a diskette.
	Control, K	Displays labels and comments associated with the documentation feature.
	Control, L	Allows entering of labels and comments associated with the documentation feature.

(Cont'd.)



TABLE 6-1. CONTROL KEYS (Cont'd.)

Key	Name	Function
	Control, N	Renumbers the networks contained in the ladder diagram.
	Control, P	Displays the status of the programmable controller.
	Control, Q	Initiates the display of all keys which can currently be used.
	Control, S	Initiates the search operation.
	Control, T	Toggles between the Program and Monitor modes while displaying the same network.
	Control, W	Allows a documentation-type label to be entered for a coil or contact.
	Control, X	Initiates a global search-and-replace operation.
	Control, Z	Continues a search for predesignated element in the ladder diagram during search operations.
	Escape	Used in the Program mode to move an element. To move an element or elements, place the cursor on the element to be repositioned, press the Escape key and a cursor control key (→, ↓).
	Number Lock	When pressed once during the Program mode, this key causes the upper-case characters of each key to be continuously entered. The use of the Number Lock key is <b>not</b> recommended.
	Control, Alternate, Delete	Sequentially pressing and briefly holding these 3 keys in the order listed causes the DOS software to be accessed from the DOS diskette. This is a hardware function of the computer not related to any software contained in the personal computer's memory.
<p>① Note: Proper key pressing requires that the first key (Ctrl) be pressed and held, and only then should the second key be pressed. Both are then released to initiate the function.</p>		

### 6-2-3. CURSOR/NUMBER PAD KEYS

The cursor/number pad keys are used with the Advanced Program Loader software in the Program mode to position the cursor and to display or manipulate the ladder diagram program. (See Table 6-2.) Figure 6-3 shows the cursor/number pad keys unshaded.

The upper-case characters for the numbers 1 thru 9 of the cursor/number pad keys can be used during the Program mode to enter numeric data if the shift key is pressed and held.

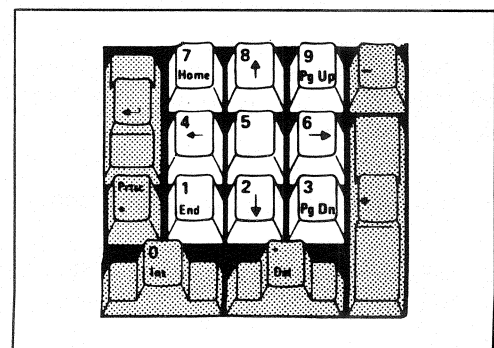


Figure 6-3. Cursor/Number Pad Keys (Unshaded Area)



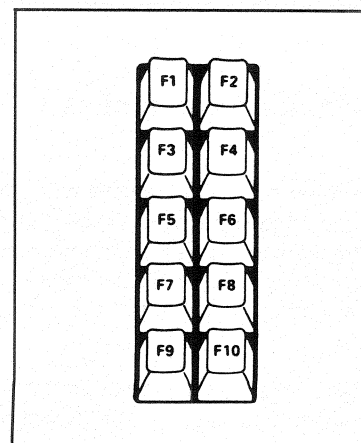
**TABLE 6-2. CURSOR/NUMBER PAD KEYS**

Key	Mode	Description
	Program	Move cursor up one cell.
	Program	Move cursor to the right one cell.
	Program	Move cursor to the left one cell.
	Program	Move cursor down one cell.
	Program	Move cursor to the top left cell position (home position).
	Program/ Monitor	Causes the screen to display the previously programmed network in the ladder diagram.
	Program/ Monitor	Causes the screen to display the next network in the ladder diagram.
	Program	Sequentially pressing the Insert key and then the Enter key causes the network displayed on the screen to be entered into: <ul style="list-style-type: none"> <li>• The HPPC-1500/-1700 memory during on-line programming</li> <li>• The memory of the personal computer during off-line programming</li> </ul>
	Program	Sequentially pressing the Delete key and then the Enter key causes the network displayed on the screen to be deleted from: <ul style="list-style-type: none"> <li>• The HPPC-1500/-1700 memory during on-line programming</li> <li>• The memory of the personal computer during off-line programming</li> </ul>
	Program	Sequentially pressing and briefly holding these 3 keys in the order listed causes the DOS software to be accessed from the DOS diskette. This is a hardware function of the computer not related to any software contained in the personal computer's memory.

**6-2-4. FUNCTION KEYS**

The function keys, F1 thru F10, provide specialized functions which are dependent on the mode of the Loader. (See Figure 6-4.) For this reason there is no universal designation list that can be made for the keys. For example, the F1 key is used to:

- Enter contacts when in the Program mode
- Store a ladder diagram program on a diskette when in the Disk mode
- Renumber the networks when in the Executive Function mode



**Figure 6-4. Function Keys**



In every case, the bottom lines of the screen display the function of the F1 thru F10 keys. For example, Figure 6-5 shows the uses of the function keys for the "primary screen" of the Program mode. (The primary screen is the very first screen displayed when entering any of the

modes.) As the various operations are performed, the function interpretation display near the bottom of the screen is updated to reflect the current designation of the function keys.

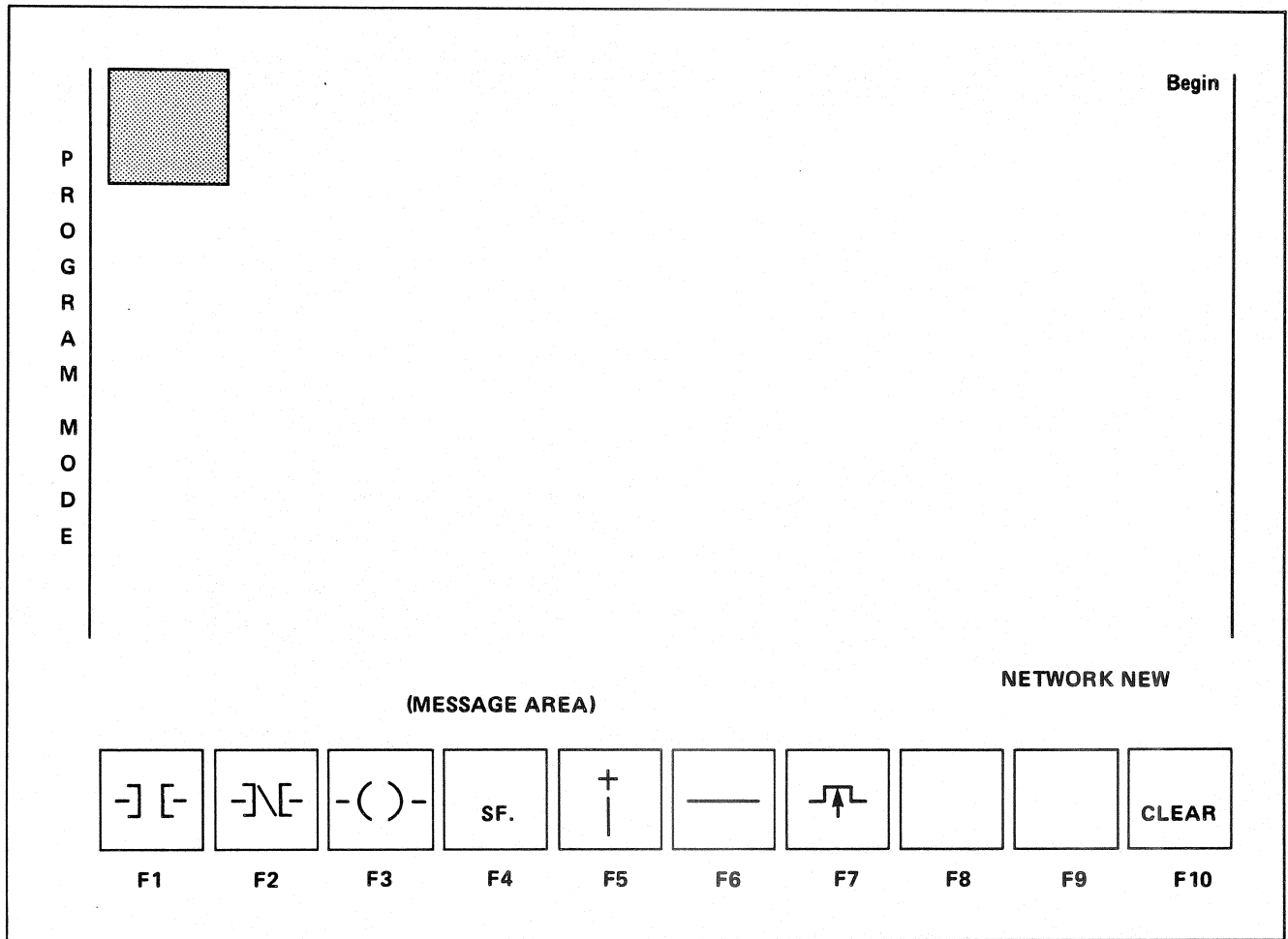


Figure 6-5. Program Mode Primary Screen



## Section 7

# Executive Function Mode

### 7-1. INTRODUCTION

The Executive Function mode of operation provides housekeeping functions such as clearing memory or displaying the fault tables.

#### Note

Do not confuse the Executive Function mode with the Executive mode. Refer to Figure 4-1 and Paragraph 4-2. Note that these are two entirely different modes.

The only way to enter the Executive Function mode is from the Executive mode's main menu. Press and hold Ctrl, and then press E. Release both. The Executive mode's main menu is displayed. Then, to enter the Executive Function mode, press the soft key F5. At this time the primary screen, as shown in Figure 7-1, can be viewed.

(The Executive Function mode **cannot** be accessed directly from the other modes of operation, including the Program, Monitor, and Disk modes.)

The primary screen offers 9 "soft key"—that is, function key—choices, each of which represents a specific housekeeping function. The functions are:

**F1, Network Renumber.** The network renumber executive function either assigns sequential numbers to, or rennumbers sequentially, each network contained in the ladder diagram. (7-2)

**F2, Clear Memory.** The clear memory executive function allows the clearing of the user memory. (7-3)

**F3, PC Status.** The PC status executive function displays selected hardware and software status for the HPPC-1500/-1700 system. (7-4)

**F4, Fault Table.** The fault table executive function displays the fatal and nonfatal fault tables associated with the HPPC-1500/-1700 system. (7-5)

**F5, Repack.** The repack executive function is a means of utilizing holding registers (R) which become unused after deleting a standard or advanced function—as may happen during editing. (7-6)

**F6, Set Params.** The set parameters executive function allows setting of the duration of the watchdog timer and the parameters associated with the History Transfer Processor Module(s). (7-7)

**F7, System Configuration.** The system configuration executive function defines certain memory and I/O requirements of the HPPC-1500/-1700 system. (7-8)

**F8, Highway Configuration.** The highway configuration executive function defines the HPPC-1500/-1700 characteristics for use by the WESTNET II Data Highway. (7-9)

**F9, Communication Port Configuration.** The communication port configuration executive function specifies characteristics of the Advanced Program Loader's optional communication ports. (7-10)

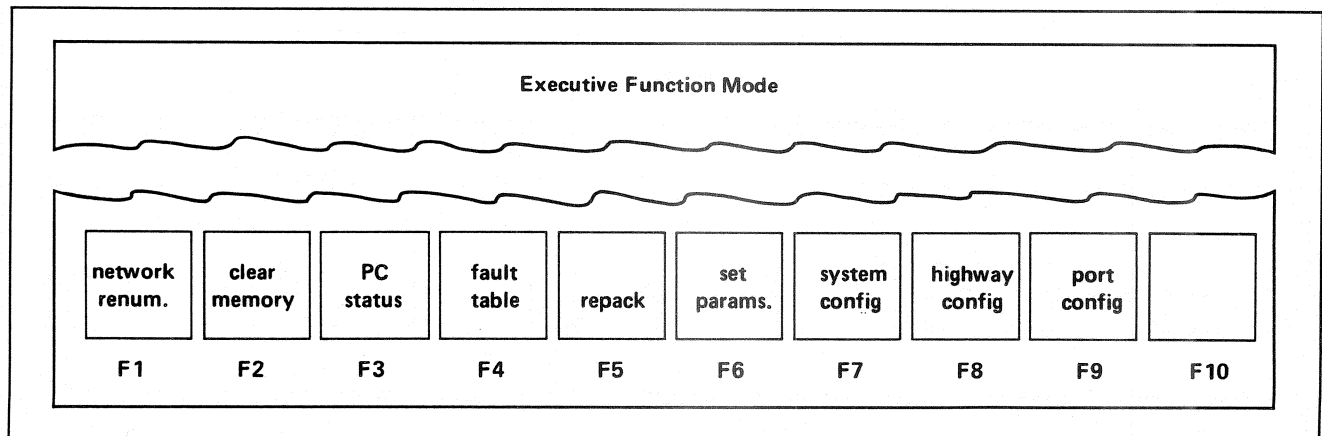


Figure 7-1. Executive Function Mode Primary Screen



Each of the functions is detailed in the following Paragraphs.

### 7-2. NETWORK RENUMBER (F1)

As the user enters a ladder diagram, no "network" numbers are assigned until the network renumber executive function is performed. Furthermore, after an editing function, where networks are added or removed, new network numbers are reassigned only after the network renumber function is performed. Network numbers appear in the Program or Monitor modes in the lower right portion of the display just above the function key display. (Refer to Section 8 for details.)

When the primary screen of the Executive Function mode is displayed, press the F1 function key to initiate the renumbering function. The only change in the primary screen's display is the momentary additional message RENUMBERING . . . followed by RENUMBERING COMPLETE.

#### Note

The HPPC-1500/-1700 processor key-switch must be in the STOP:PROGRAM position to renumber networks.

### 7-3. CLEAR MEMORY (F2)

The clear memory executive function clears the main ladder diagram and associated ladder diagram documentation, if used, from memory. Pressing the F2 function key when the primary screen of the Executive Function mode is displayed initiates the Clear Memory screen, shown in Figure 7-2. As can be seen in the Figure, the following 4 clear memory functions can be selected.

(For more information on documentation, refer to

Section 12, Ladder Diagram Documentation. Note that not all user programs use the optional labels, or documentation.)

**F1, All Memory.** The all memory selection clears the ladder diagram and all associated documentation. When the Clear Memory screen is displayed, press the F1 key, and the display prompts:

Clear Memory

All user memory  
Press (Y/N) to confirm

Press the Y (yes) key to initiate the clear memory function. Press the N (no) key to redisplay the Clear Memory screen, shown in Figure 7-2. (No clearing occurs.)

**F2, Ladder & Regs.** The ladder and registers selection clears only the ladder diagram and the holding registers associated with the user's application ladder diagram. When the Clear Memory screen is displayed, press the F2 key, and the display prompts:

Clear Memory

Ladder and registers  
Press (Y/N) to confirm

Press the Y (yes) key to initiate the clearing function. Press the N (no) key to redisplay the Clear Memory screen, shown in Figure 7-2. (No clearing occurs.)

**F3, Smart Modules.** The smart modules selection clears only the optional user-written programs associated with a specified smart module. Smart modules are optional, microprocessor-based modules placed in the mainframe chassis. Not all HPPC-1500/-1700 systems use smart modules. (Refer to Paragraph 3-22 for more information.)

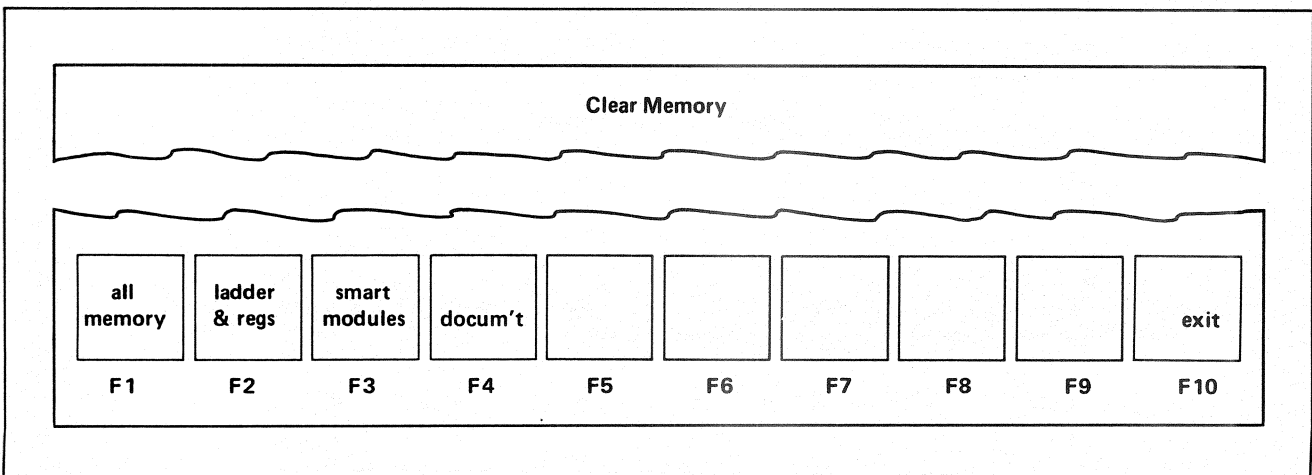


Figure 7-2. Clear Memory Screen



When the Clear Memory screen is displayed, press the F3 key, and the display prompts:

Clear Memory

Smart module user memory  
Enter Smart Module Number:  
Press (N) to exit

Entering the smart module "number" followed by the Enter key (↵) initiates the clearing function for that module. Pressing N (no) redisplay the Clear Memory screen, shown in Figure 7-2. (No clearing occurs.)

The specific "number," or identification, of an individual smart module is determined by switch settings on that module. The method for determining these numbers is detailed in Instruction Leaflets shipped with the module. In order to relate the number with a specific smart module, it is necessary to examine each module to determine exactly what number is assigned.

**F4, Documentation.** The documentation selection clears only the optional, user-written documentation associated with the application ladder diagram. When the Clear Memory screen is displayed, press the F4 key, and the display prompts:

Clear Memory

Documentation  
Press (Y/N) to confirm

Press the Y (yes) key to initiate clearing of the documentation. Press the N (no) key to redisplay the Clear Memory screen, shown in Figure 7-2. (No clearing occurs.)

**F10, Exit.** Any of the clear memory functions can be "exited" by pressing the F10 function key. (This assumes that a prompt is not waiting for an operator entry. If a prompt is in progress, the screen adds an ILLEGAL KEY message briefly. Merely complete the prompt, and press F10 again.)

When F10 is pressed, the Executive Function mode's primary screen is redisplayed.

#### 7-4. PC STATUS (F3)

The PC status function of the Executive Function mode displays the status of the HPPC-1500/-1700 system. The status display is initiated by pressing the F3 key when the primary screen of the Executive Function mode is displayed. Figure 7-3 shows the PC status display. The display is self-explanatory, except as noted in the following 6 items.

1. Average Scan Time represents either the average

ladder diagram scan or the I/O scan time, whichever is longer. Note: Since both scans are initiated together, the longer scan is the one displayed in milliseconds. No operator interaction is required.

2. Watchdog Timer Preset represents the preset time of the watchdog timer, as described in Paragraph 7-7.

3. History Bits Remaining indicates the number of storage points available for transitional elements. This number is automatically decremented as each transitional element is programmed. The total number of transitional elements in the program must be configured—that is, entered into the Loader—as described in Paragraph 7-8-1.

4. # of UDSF Routines Programmed lists the number of optional user-defined special function subroutines reserved for use in the user memory. The total number of UDSF subroutines must be configured, as described in Paragraph 7-8-1. Not all programs use these subroutines.

5. LP Software Version displays the version of the software contained in the Logic Processor Module Assembly. No operator interaction is required.

6. IOP Software Version displays the version of the software contained in the primary I/O Processor Module. The primary Module is identified by switch selection at installation. (See the Systems Manual, Paragraph 13-9-2-2.)

If a second, optional I/O Processor Module is used, it too is identified by a different switch setting. The line in Figure 7-3 occupied by SM#2 would display IOP#2 and the software version.

The lines devoted to SM#2 thru SM#5 represent optional microprocessor-based modules that may be installed in the mainframe chassis. Not all systems use these. If any are installed, the corresponding software version(s) would be displayed.

In addition to the PC status display information discussed above, the function keys can also be pressed to provide the following functions.

**F1 thru F4.** The F1 thru F4 function keys are used during on-line operation to override the processor's key-switch, provided the keyswitch is in the RUN:MODIFY position. (See Figure 7-3, note 3.)

**F7, Repack.** Pressing the F7 function key initiates the repacking of memory. Repacking refers to the renumbering of the highest holding register used (HHRU) and the reordering of history bits and the documentation memory. (The processor's keyswitch must be in the STOP:PROGRAM position before the repacking occurs.)



# WESTINGHOUSE NUMA-LOGIC ADVANCED PROGRAM LOADER V2.0

## High Performance Programmable Controller

Keyswitch: Stop/Program

Mode: Fault

Override: Off

Redundant: Active-Ladders must match ①

EDIT LOCKOUT: APL at IOP1 ②

User Memory Size (K words): 016

Program Memory Remaining: 002128 words

History Bits Remaining: 1047 bits

Docum't Memory Remaining: 0 words

# of UDSF Routines Programmed: 02

Input Groups Configured: 32

Output Groups Configured: 32

Input Registers Configured: 64

Output Registers Configured: 64

Highest Holding Register Used: 748

LP Software Version 2.1

IOP Software Version 1.0

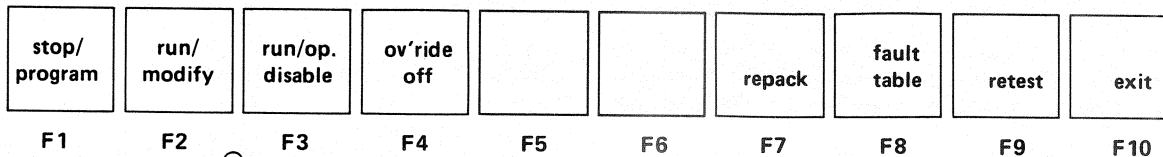
SM #3 Not Found

SM #4 Not Found

SM #5 Not Found

Average Scan Time (msec): 15

Watchdog Timer Preset (msec): 100



- ① Optional line displayed only when redundancy hardware associated with the History Transfer Processor Module is contained in the system. Displays whether the ladder diagram programs in the Modules are the same or different.
- ② This line will only be displayed if the Program mode is initiated from a SIM or processor, and an attempt is made to enter the Program mode from a different SIM or processor. (APL means Advanced Program Loader.)
- ③ F1 thru F4 keys provide remote mode control of the HPPC-1500/-1700 to the Loader's operator, assuming the programmable controller's keyswitch is in the RUN:MODIFY position and the Loader is set for on-line operation.

Figure 7-3. PC Status Display

**F8, Fault Table.** Pressing the F8 function key initiates the display of the fault table. (This is the same fault table display which can be initiated by pressing the F4 key when the primary screen of the Executive Function mode is displayed.) Paragraph 7-5 contains a description of the fault table display.

**F9, Retest.** Pressing the F9 function key retests the fatal and nonfatal faults. If the faults are no longer present, they are reset. This, in turn, turns off the FAULT LED located on the Logic Processor Module, and enables normal operation. (The processor's keyswitch must be in the STOP:PROGRAM position before a retest occurs. Also, some faults require 2 retests before complete clearing of the faults is accomplished.)

(This function is identical in result with the Retest (K1) function available on the Front Access Panel. See the Systems Manual, Paragraph 12-6-1.)

**F10, Exit.** The PC status function is exited by pressing the F10 function key. This returns the display to the primary screen of the Executive Function mode.

### 7-5. FAULT TABLE (F4)

The fault table function of the Executive Function mode provides a display of fatal and nonfatal faults. Press the F4 key when the primary screen of the Executive Function mode is displayed to enter the fault table function. Once entered, the screen shown in Figure 7-4



is displayed. Observe the Figure and note the following 2 points:

1. Fault registers 1 thru 4 are displayed on the initial screen. Other fault registers may be observed by pressing the F2 thru F4 keys. Tables 15-3 and 15-4 of the HPPC-1500/-1700 Systems Manual contain a complete listing of all faults.

2. Active faults blink, allowing users to tell exactly which faults are occurring. More than one fault can blink. All must be cleared before normal processor operation can resume. Note: Fault bits followed by the letter F can be set non-fatal by means of the F5 function key. (See F4, set fatal and reset fatal, below.)

The function keys that are active during the display of the fault tables are listed here.

**F1, System Faults.** Initiates the display of the fatal fault

registers 1 and 2 and programmable fault registers 3 and 4. This is the primary fault screen shown in Figure 7-4.

**F2, IOP 1 Faults.** Initiates the display of the registers associated with I/O Processor Module No. 1. These are fault registers 5, 6, and 7.

**F3, IOP 2 Faults.** Initiates the display of the fault registers associated with I/O Processor Module No. 2. These are fault registers 8, 9, and 10.

**F4, Set Fatal; F5, Reset Fatal.** Allow setting or resetting of the programmable fault registers. The programmable fault registers are register numbers 3, 4, 5, and 8. Note 1 of Figure 7-4 shows the F4 and F5 keys' usage. The F displayed to the right of programmable faults indicates that these are programmed as fatal. When they are set nonfatal, the letter F does not appear to the right of the fault.

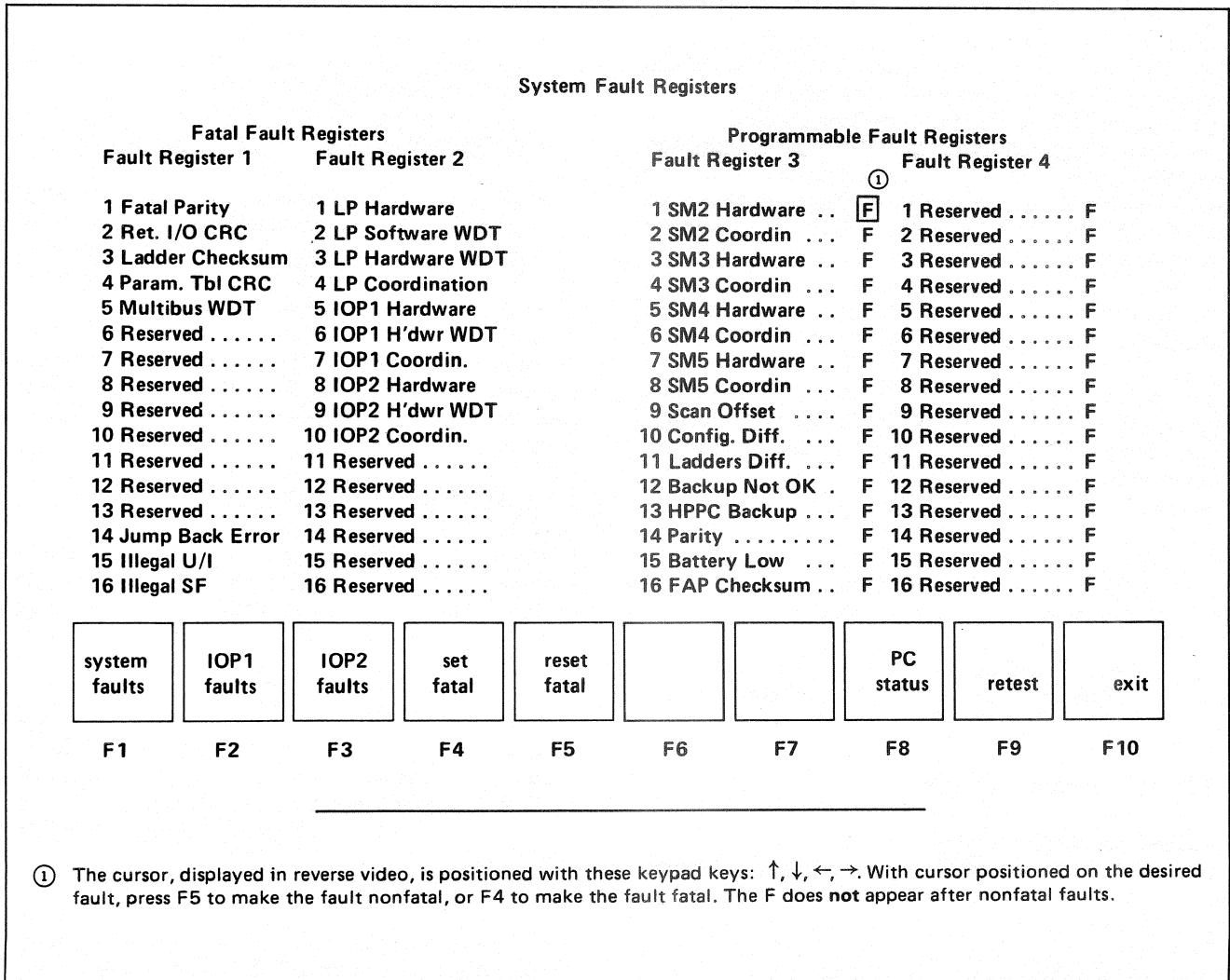


Figure 7-4. Primary Fault Table Screen



### Note

If the programmable faults are not "re-set fatal" using the F5 function key, they default to the fatal state, and an F is displayed to the right of the fault listing. Also, when the fault tables are displayed, any active fault blinks.

**F8, PC Status; F9, Retest.** These functions are identical to the ones of the same names described in Paragraph 7-4, above.

**F10, Exit.** The fault table function is exited by pressing the F10 function key. This assumes that all prompts are satisfied, and the display is not waiting for an entry.

### 7-6. REPACK (F5)

The repack function of the Executive Function mode is used to "repack" the memory. Repacking is a process that can be performed after one, or more, holding registers (R) associated with standard and/or advanced functions has been deleted from the ladder diagram—as may happen during editing. Repacking consolidates the remaining used registers and renumbers the highest holding register used (HHRU) with a lower number that reflects the current number used. (Refer to Paragraph 5-4-1-4 in the HPPC-1500/-1700 Systems Manual for more details on HHRU.)

The process works in a similar fashion after history bits associated with Transitional function (007) are removed.

In order to initiate the repack function, the processor's keyswitch must be in the STOP:PROGRAM position. With the primary screen of the Executive Function mode displayed, press the F5 key.

### Note

The repack and retest functions can be initiated if the processor's keyswitch is in the RUN:MODIFY position if the F1, stop/program, function key is initiated from the PC status display. (See Figure 7-3, note 3.)

### 7-7. SET PARAMETERS (F6)

The set parameters function allows the user to set the trip point of the HPPC system's software watchdog timer. A watchdog timer fault occurs when the time preset by the user in this function is less than either:

- The ladder diagram scan time, or
- The I/O scan time

(This fault is located in Fault Register 2, and is bit 2, LP Software WDT.)

For more information, refer to the Systems Manual, Paragraph 5-8.

The set parameters function also allows the user to enter parameters associated with the History Transfer Processor Module option.

### 7-7-1. SET PARAMETERS ENTRY

To initiate the set parameters function, press the F6, set params, key when the primary screen of the Executive Function mode is displayed. The Loader displays the screen shown in Figure 7-5. This screen provides the following entries:

- Watchdog timer time, which defaults to 250 msec. (See Paragraph 7-7-2 for scan considerations.)
- History transfer block pointers and lengths, as described in the HPPC-1500/-1700 Systems Manual, Paragraph 16-6.
- Smart module allocation block pointer
- History transfer with different ladders. (Select yes or no.) Use the F3, ladders diff, or F4, ladders match, function keys to select this parameter. (Ladders here refer to the ladder diagram programs in the 2 Logic Processor Modules.)

The numeric entries are chosen with the ↑ and ↓ keys of the cursor/number pad to select the desired line or category. Then simply enter the desired number followed by the Enter key (↵).

### 7-7-2. SCAN CONSIDERATIONS

The watchdog timer function must be programmed by the user so that its time exceeds either the I/O scan time or the ladder diagram scan time, whichever is longer. Considerations for each of the scans are described as follows:

1. The ladder diagram scan can be measured, as explained in the Systems Manual, Paragraph 8-25-2, Lock Scan programmable function, Application Note. Also the ladder diagram scan time can be calculated, as listed in the Systems Manual, Section 10, Programming Considerations.
2. The I/O scan time is directly dependent on the number of SIMs and the amount of I/O hardware contained in the system. A rule of thumb is to multiply the number of SIMs contained in the system by 5.5 msec. Table 7-1 lists a more detailed rule of thumb breakdown of the



Set Parameters

Software Watchdog Timer Time (mS) ..... 250

History Transfer Block 1 Pointer ..... R00001  
 History Transfer Block 1 Length ..... 00256  
 History Transfer Block 2 Pointer ..... R00000  
 History Transfer Block 2 Length ..... 00000

Smart Module Allocation Block Pointer ..... R00000

Allow Transfer with Different Ladders ..... No

F1

cont.

ladders  
diff.

ladders  
match

F5

F6

F7

F8

F9

exit

Figure 7-5. Set Parameters Primary Screen

timing requirements of the various types of I/O hardware:

**7-8. SYSTEM CONFIGURATION (F7)**

The system configuration function allows the user to define hardware and software characteristics of a specific HPPC-1500/-1700 system. Characteristics such as a user's application ladder diagram documentation and allocation are defined and stored in the processor's memory.

**Note**

When the memory is cleared, such as when the Memory Module is replaced or the backup battery is removed when AC power is off, the system configuration function must be performed again before the HPPC-1500/-1700 system can be placed in the RUN mode.

**TABLE 7-1. SIM TIMING REQUIREMENTS**

Item	I/O Time
Each SIM	[Number of discrete input groups (IG) and/or output groups (OG) and number of registers used as IG/OG, if used, x 0.03 msec. ① ] + 2.5 msec.
Time/System	2.5 msec. + sum of all SIM times
① These IG, OG, and registers refer <b>only</b> to those actually configured for the specific SIM.	



**Note**

In order to initially configure the HPPC system, the keyswitch must be in the STOP:PROGRAM position. Subsequent changes may be made to the configuration with the keyswitch in the RUN:MODIFY position if the

Loader overrides the PC status. (See Figure 7-3, note 3.)

Table 7-2 is intended to be used as a record of the data associated with the system configuration function. It is suggested that the 2 copies be kept for each HPPC-1500/-1700 system. One copy of the completed data sheet should be kept on file and another located with the processor.

**Individual HPPC-1500/-1700 Configuration Notes**





TABLE 7-2. SYSTEM CONFIGURATION DATA SHEET (1 of 2)

Total Transitional Elements	_____	HPPC-1500/-1700 processor identification:
History Transfer Block 1 Pointer	R _____	
History Transfer Block 1 Length	_____	_____
History Block 1 Length	_____	Location: _____
History Transfer Block 2 Pointer	R _____	_____
History Transfer Block 2 Length	_____	Programmer responsible: _____
Smart Module Allocation Block Pointer	_____	_____
Total Number of UDSF Subroutines	_____	Location: _____
Allow transfer with different ladders (yes/no)	_____	Phone: _____
Memory for Main Ladder Diagram Program	_____	
Memory for Documentation	_____	
Memory for Smart Module #2	_____	
Memory for Smart Module #3	_____	
Memory for Smart Module #4	_____	
Memory for Smart Module #5	_____	

<u>IOP #1 Configuration:</u>		<u>IOP #2 Configuration:</u>	
Input Groups	_____ to _____	Input Groups	_____ to _____
Output Groups	_____ to _____	Output Groups	_____ to _____
Input Registers	_____ to _____	Input Registers	_____ to _____
Output Registers	_____ to _____	Output Registers	_____ to _____

① In addition to software configurations of the I/O Processor Module(s), History Transfer Processor Modules, and/or other "smart modules," if used, the individual modules require identifying switch settings. Settings for the I/O Processor Modules are given in the Systems Manual, Section 13, Installation. Settings for the History Transfer Processor Module are given in the Systems Manual, Section 16. Settings for other "smart modules" are given in literature that accompanies each. Also refer to the HPPC-1500/-1700 Systems Manual, Appendix E, Paragraph E-7.



TABLE 7-2. SYSTEM CONFIGURATION DATA SHEET (2 of 2)

<b>I/O Processor Module No. 1 (IOP #1) ①</b>			
<b>SIM #1</b>	<b>SIM #2</b>	<b>SIM #3</b>	<b>SIM #4</b>
IG _____ to _____	IG _____ to _____	IG _____ to _____	IG _____ to _____
OG _____ to _____	OG _____ to _____	OG _____ to _____	OG _____ to _____
IR _____ to _____	IR _____ to _____	IR _____ to _____	IR _____ to _____
OR _____ to _____	OR _____ to _____	OR _____ to _____	OR _____ to _____
<b>SIM #5</b>	<b>SIM #6</b>	<b>SIM #7</b>	<b>SIM #8</b>
IG _____ to _____	IG _____ to _____	IG _____ to _____	IG _____ to _____
OG _____ to _____	OG _____ to _____	OG _____ to _____	OG _____ to _____
IR _____ to _____	IR _____ to _____	IR _____ to _____	IR _____ to _____
OR _____ to _____	OR _____ to _____	OR _____ to _____	OR _____ to _____
<b>I/O Processor Module No. 2 (IOP #2) ①</b>			
<b>SIM #</b>	<b>SIM #</b>	<b>SIM #</b>	<b>SIM #</b>
IG _____ to _____	IG _____ to _____	IG _____ to _____	IG _____ to _____
OG _____ to _____	OG _____ to _____	OG _____ to _____	OG _____ to _____
IR _____ to _____	IR _____ to _____	IR _____ to _____	IR _____ to _____
OR _____ to _____	OR _____ to _____	OR _____ to _____	OR _____ to _____
<b>SIM #</b>	<b>SIM #</b>	<b>SIM #</b>	<b>SIM #</b>
IG _____ to _____	IG _____ to _____	IG _____ to _____	IG _____ to _____
OG _____ to _____	OG _____ to _____	OG _____ to _____	OG _____ to _____
IR _____ to _____	IR _____ to _____	IR _____ to _____	IR _____ to _____
OR _____ to _____	OR _____ to _____	OR _____ to _____	OR _____ to _____
① I/O Processor Module No. 1 (IOP1) could have SIMs #9 thru 16, if used, associated with it. IOP2, if used, could have SIMs #1 thru 8 associated with it.			



The system configuration function is initiated by pressing the F7 key when the primary screen of the Executive Function mode is displayed. At this time the various function key selections shown in Figure 7-6 are available. Observe the Figure and note the following 3 points:

1. When the F7 key is pressed, 2 main function key choices are initially given to the user:

- F1, for initial configuration
- F2, for edit configuration

This display is shown in Figure 7-7.

2. The initial configuration assumes the configuration has not been performed. It provides either a default configuration, or allows for manual entry of a specific configuration. The default assigns predefined configuration values, as listed in the left portion of Figure 7-6.

3. The edit configuration, entered when a valid system configuration exists, allows any of the configuration characteristics to be changed, as shown in Figure 7-8.

As can be seen by observing Figure 7-6, the configuration, whether entered from the initial (manual) or edit configuration function, consists of the following:

- Transitional elements, history transfer parameters,

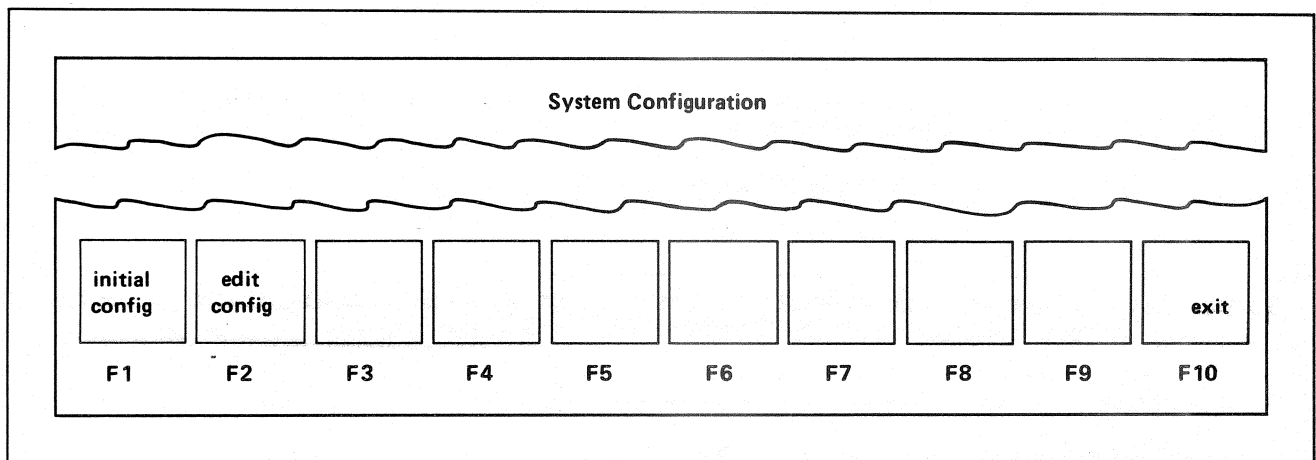


Figure 7-7. System Configuration Type Selection

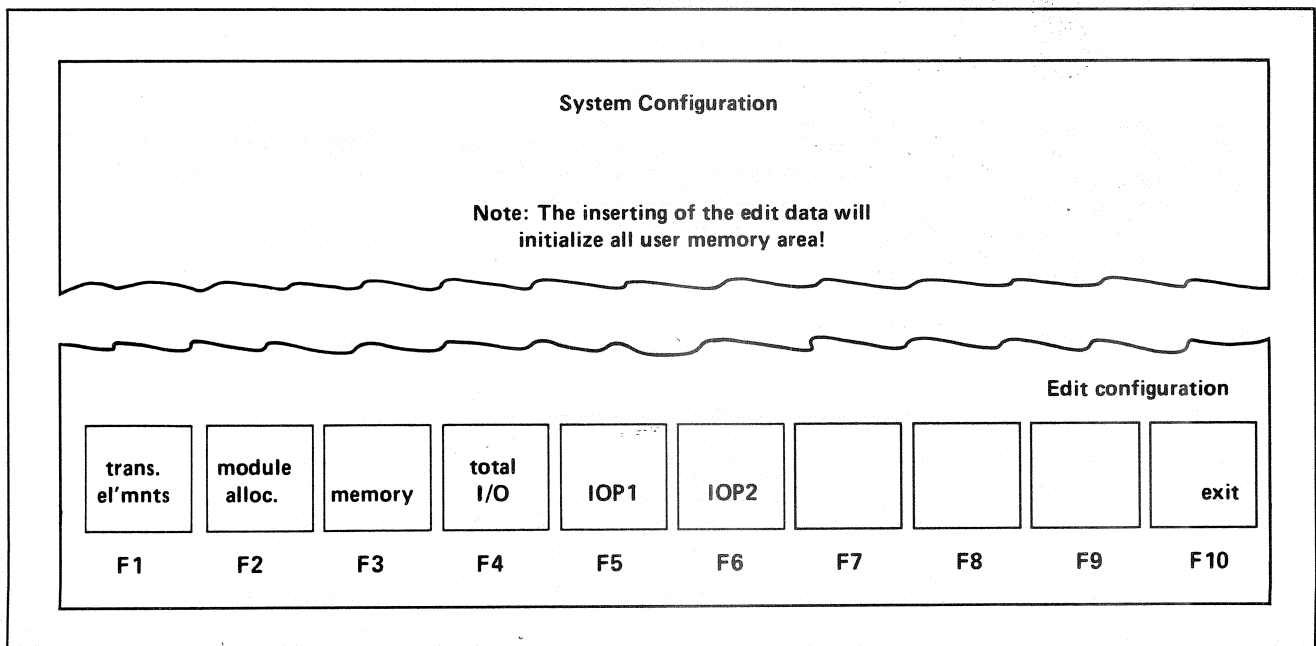


Figure 7-8. Edit Configuration Screen

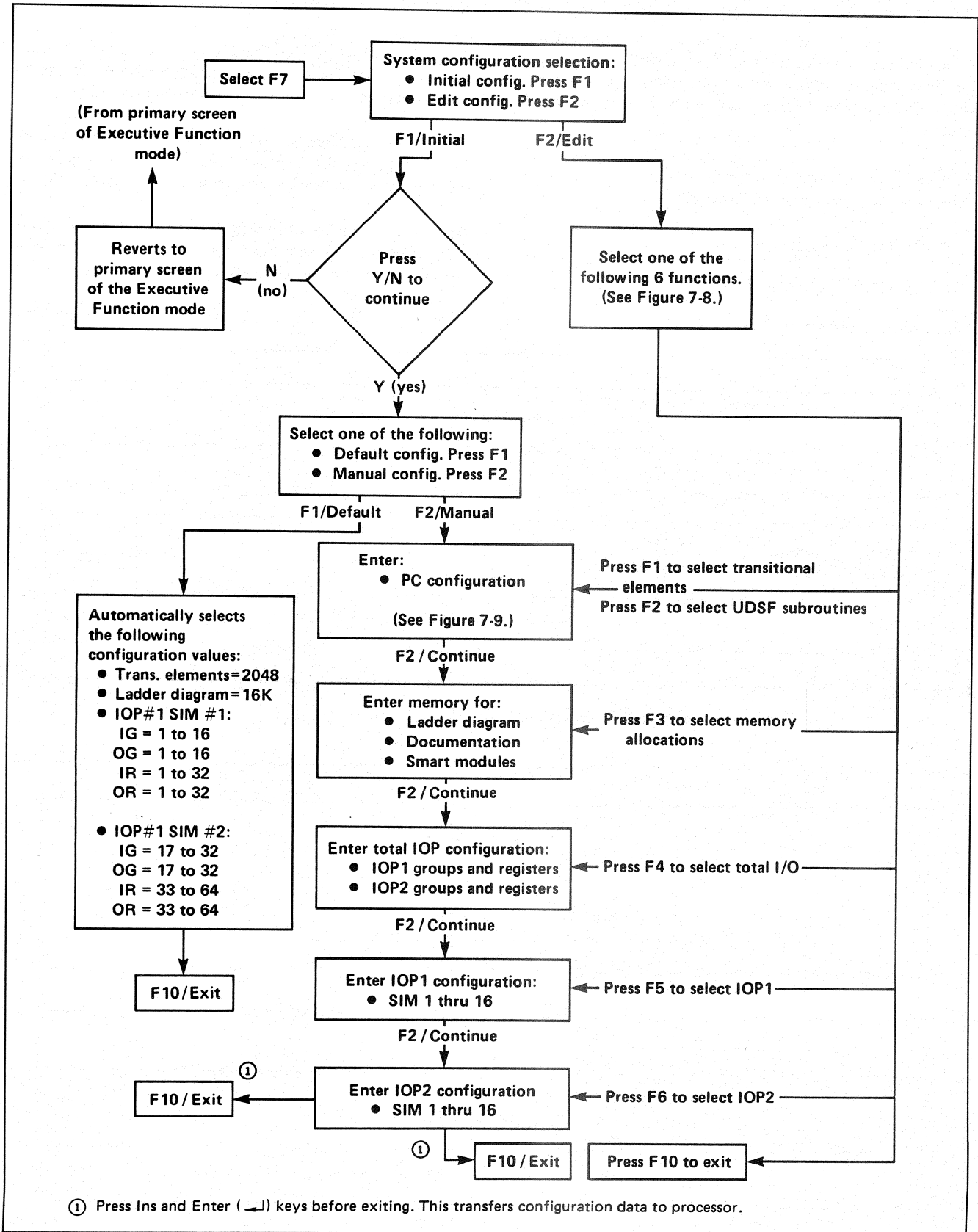


Figure 7-6. System Configuration Entry Patterns



smart module block pointer, and user-defined special function (UDSF) routines (7-8-1)

- Memory allocation (7-8-2)
- Total IOP configuration (7-8-3)
- IOP1 and IOP2 configuration (7-8-4)

**Note**

When the numbers associated with the configuration are either being initially entered or when they are being edited, the **configuration values are stored temporarily** in the memory of the Advanced Program Loader. Thus it is necessary to enter these values into the processor **before** exiting the system configuration function. (Otherwise they will be lost.)

Configuration values are entered into the processor by pressing the:

- Ins key (Insert), followed by the
- Enter key (↵)

**Note**

Changing the system configuration results in the main ladder diagram being cleared.

**7-8-1. TRANSITIONAL ELEMENTS (F1), UDSF SUBROUTINES (F2)**

The PC configuration provides for the entry of the following items:

- Transitional elements used in the main ladder diagram
- Number of UDSF subroutines in the main ladder diagram
- History transfer data associated with the History Transfer Processor Modules. (See the HPPC-1500/-1700 Systems Manual, Paragraph 16-6, for details.)
- Smart module holding register allocations. The smart module reserves a contiguous block of holding registers used for communication between the ladder diagram and the smart module. The first register of the block is entered as the smart module allocation block pointer. See the specific smart module data sheet for details.

The PC configuration is entered by the user either initially during the manual system configuration, or at any time using the edit system configuration, as shown in Figure 7-6.

When the initial (manual) PC configuration is first entered, the screen shown in Figure 7-9 is displayed. Observe the Figure and note the following 5 points:

1. The cursor, displayed in reverse video, is positioned as described in Notes 1 and 2 of Figure 7-9.
2. The number of transitional elements, ranging from 0000 to 9984, is entered when the cursor is positioned on the Transitional Elements line.
3. The number of user-defined special function subroutines, ranging from 00 to 32, is entered when the cursor is positioned on the UDSF subroutines line.
4. The F3, ladders diff., and F4, ladders match, function keys are used to determine the last parameter on the screen: Allow Transfer with Different Ladders. This parameter is also associated with the History Transfer Processor Modules redundant system operation.
5. Press the F2, continue function, key to "step" to the next configuration function—the memory block configuration in this case.

**7-8-2. MEMORY BLOCK CONFIGURATION (F3)**

The user memory block configuration, shown in Figure 7-10, allows the user to allocate the available memory among the following functional areas:

- Main ladder diagram for the application program
- Ladder diagram documentation, if used
- Smart modules' user memory, if used

Readers are encouraged to review Section 5, User Memory, of the HPPC-1500/-1700 Systems Manual before reading further.

These functional areas of memory can be assigned to Memory Block #1, as indicated on the first screen. Alternately, functional areas of memory can be assigned to consecutively numbered memory blocks such as Memory Block #1 and Memory Block #2. Block #2 is accessed with F1, next block, key. (When the user memory is not contiguous, a memory block exists for each segment.)

**Note**

The ladder diagram program must be assigned to Memory Block #1. The





### Memory Block #1 Configuration

Memory Available ..... 000K ①

Memory for Ladder Program ..... 011K ② ③

Memory for Documentation ..... 003K

Memory for IOP #1 ..... 000K

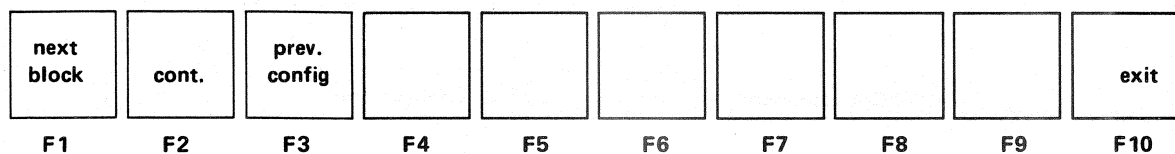
Memory for Smart Module #2 ..... 000K

Memory for Smart Module #3 ..... 000K

Memory for Smart Module #4 ..... 000K

Memory for Smart Module #5 ..... 000K

Edit (or Initial) configuration



- ① Memory which has not been assigned. This should be 000K when the configuration is complete.
- ② Cursor displayed in reverse video. Enter memory sizes followed by the Enter key (↵), or the key pad keys ↑ or ↓ to change the display.
- ③ When all entries or edits have been completed, press the Ins key followed by the Enter key (↵) to configure the processor with this data.

Figure 7-10. Memory Allocation

and is contained in 2 different memory blocks whenever:

- The lower numbered Memory Module contains less than 32K of memory, yet the switch settings are consecutively numbered. For example, if the rotary switch setting on a 16K Memory Module is set at 0, and, on a second 16K Memory Module, it is set at 1, a gap is created, and two 16K memory blocks exist.
- The first Memory Module is 32K, and its switch setting is 0, but the second Module is set at any number other than 1. Here, too, a gap is created.

When the memory block configuration is active with the screen shown in Figure 7-10 displayed, configure the memory as follows:

1. The cursor, displayed in reverse video, directs the next entry as listed in the notes of Figure 7-10.
2. The Memory Available display line lists the memory not currently allocated. This display is automatically updated after each memory allocation is made.
3. Pressing the F1, next block, function key initiates the next memory block configuration such as Memory Block #2, #3, etc. (If the HPPC system contains only a single Memory Module, or several Memory Modules forming 1 contiguous memory block, there is no change.)
4. Pressing the F2, continue, function key initiates the next configuration function, total I/O Configuration in this case.
5. Pressing the F3, previous configuration, function key initiates the previous configuration function, PC Configuration in this case.



### 7-8-3. TOTAL I/O CONFIGURATION

The Total I/O Configuration defines which I/O "words" are assigned to I/O Processor Modules No. 1 and 2. (See Figure 7-11.) The Total I/O Configuration function is entered either through the initial (manual) configuration function, or at any time through the edit configuration function. (See Figure 7-6.) When the Total I/O Configuration is initiated, the screen shown in Figure 7-11, is displayed. Observe the Figure and note the following 3 points:

1. The cursor, displayed in reverse video, directs the next entry.
2. The Total I/O words configured line, located in the

lower portion of the screen, displays the updated number of words configured after each entry is made.

3. The F2, continue, or F3, previous configuration, function keys can be used to step to the next or previous configuration functions, respectively.

A description of the relationship between the I/O modules and I/O groups and registers is described in the HPPC-1500/-1700 Systems Manual, Paragraph 13-18.

### 7-8-4. SIM CONFIGURATION

The SIM Configuration allocates I/O words for the 16 possible SIMS that may be used with I/O Processor Module No. 1. A total of 512 words are available. It also

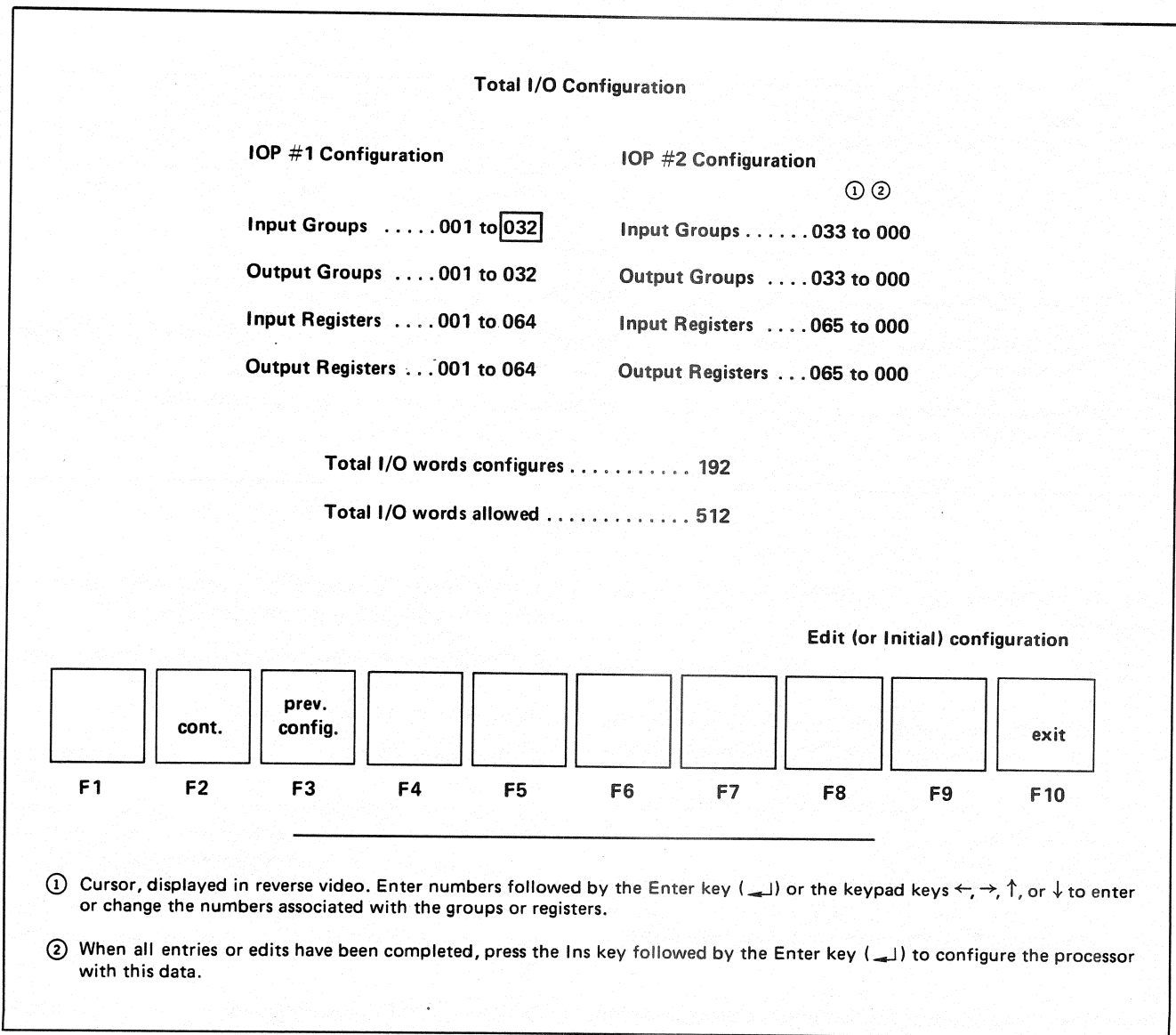


Figure 7-11. Total I/O Configuration





allocates I/O words for additional SIMs when an optional I/O Processor Module No. 2 is used. The allocation of I/O words to SIMs and I/O Racks is described in Paragraph 13-18 of the HPPC-1500/-1700 Systems Manual.

The SIM Configuration is entered either through the initial (manual) configuration function or at any time through the edit configuration function, as shown in Figure 7-6. When the SIM Configuration is initiated, the screen shown in Figure 7-12 is displayed. Observe the Figure and note the following 5 points:

1. The cursor, displayed in reverse video, directs the next entry, as shown in the notes of Figure 7-12.

2. The I/O words for 1 of the 16 possible SIMs are displayed at any given time. They can be entered or edited. If Figure 7-12, for example, the SIM #1 configuration is shown. Pressing the F2, next SIM, function key

displays SIM #2, allowing the I/O words assigned to SIM #2 to be entered or edited.

3. The previous SIM number can be redisplayed by pressing the F1, previous configuration, function key.

4. If the system uses 2 I/O Processor Modules, the second can be configured by pressing the F4, next IOP, function key. The display then displays the IOP #2 configuration. Each time the F4, next IOP, function key is pressed, the IOP not shown is displayed.

5. At any time the F3, previous configuration, function key can be pressed to display the last configuration in the sequence—total I/O configuration in this case.

### 7-9. HIGHWAY CONFIGURATION

The highway configuration function is associated with the WESTNET II data highway system. It specifies the

**SIM Configuration**

<p><b>IOP #1 Configuration</b></p> <p>Input Groups . . . . . 001 to 032</p> <p>Output Groups . . . . . 001 to 032</p> <p>Input Registers . . . . . 001 to 064</p> <p>Output Registers . . . . . 001 to 064</p>	<p><b>SIM #1 Configuration</b></p> <p style="text-align: center;">① ②</p> <p>Input Groups . . . . . 001 to <span style="border: 1px solid black; padding: 2px;">000</span></p> <p>Output Groups . . . . . 001 to 000</p> <p>Input Registers . . . . . 001 to 000</p> <p>Output Registers . . . . . 001 to 000</p>
--	---

**Edit (or Initial) configuration**

prev. SIM	next SIM	prev. config	next IOP							exit
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	

---

① Cursor, displayed in reverse video, directs the entry of data. Enter the numbers followed by the Enter key (↵) or the keypad keys ←, →, ↓, or ↑ to enter or change the numbers assigned to groups or registers on the screen.

② When all entries or edits to the screen have been completed, press the Ins key followed by the Enter key to load the data into the processor.

Figure 7-12. SIM Configuration, IOP 1



HPPC-1500/-1700 system's characteristics for use by the WESTNET II. Full details are included in the documentation accompanying the WESTNET II hardware.

## 7-10. PORT CONFIGURATION

The port configuration function specifies the characteristics of the communication ports of the Advanced Program Loader so that a wide variety of peripheral line printers may be used with the HPPC system. A listing of ports is given in Table 7-3.

To enable the port configuration function, press the F9, port configuration, function key when the primary screen of the Executive Function mode is displayed. See Figure 7-13 and note the following 3 points:

1. Serial port A, as shown in the Figure, is automatically displayed first when the port configuration function is selected.
2. The cursor, shown in reverse video, is positioned with keypad keys to select the baud rate, stop bits, data bits and parity check characteristics for each port. See the notes of Figure 7-13 for a description of the cursor control. When the cursor is positioned on the baud rate, for example, the function keys are used to select baud rates from 110 (F1 key) to 19.2K (F9 key). See notes 2 thru 6 of Figure 7-13 for the function key selections for each characteristic.
3. Port B selections are limited to the baud rate only as listed in note 3 of Figure 7-13.

### Note

The port configuration function characteristics, unlike the other configuration characteristics, are **not** stored in the processor. They are a function of the Loader and are stored in it automatically when the port configuration screen is changed. As a result after port configuration data is entered, there is **no** need to press the Ins and Enter (↵) keys.

When the HPPC-1500/-1700 is connected to the recommended Centronics 150 Series printer, the following configuration is required:

- Baud rate: 9600
- Stop bits: 2
- Data bits: 8
- Parity check: none

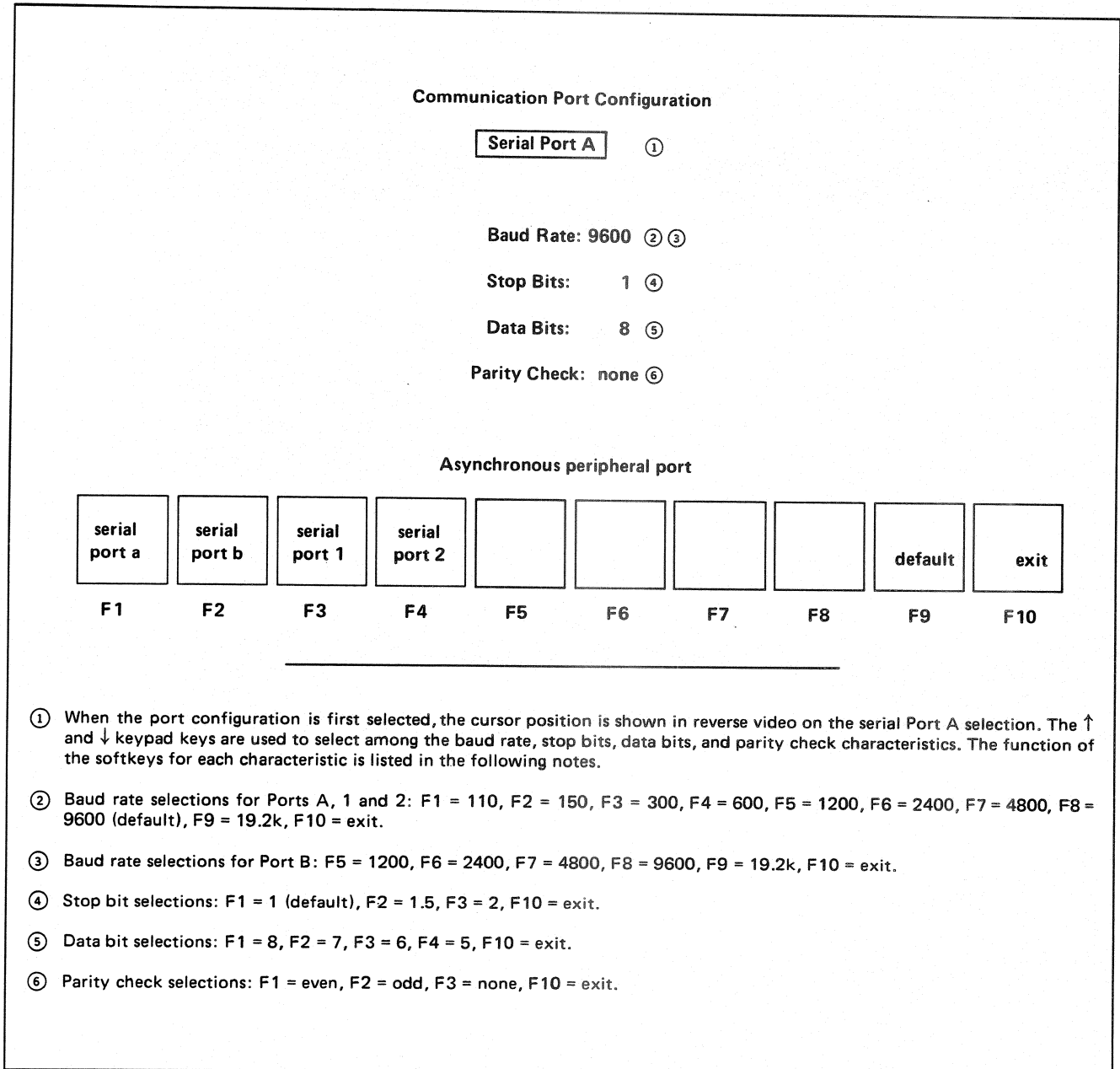
Note that this configuration varies from the default display shown in Figure 7-13, where 1 stop bit is shown.

Individual printers may require entries other than those of the default display. Refer to the manufacturer's specifications.

Refer also to the Systems Manual, Paragraph 3-20, and Table 2-1, "Peripheral Communications Ports," for more information on the optional Serial Ports 1 and 2.

**TABLE 7-3. COMMUNICATION PORTS**

Port Designation	Description
Port A	An asynchronous serial port used to interface between the Advanced Program Loader and another peripheral device such as a printer.
Port B	A synchronous port used to communicate with the HPPC-1500/-1700 systems.
Port 1 ①	IBM serial port
Port 2 ①	IBM serial port
① Available by means of optional computer manufacturers' boards which plug into the Advanced Program Loader. Boards are available to provide either a serial or parallel configuration for compatibility with peripheral devices. Consult the specific computer manuals for details.	



**Figure 7-13. Communication Port Configuration**



## Section 8

# Program Mode

### 8-1. INTRODUCTION

The Advanced Program Loader's Program mode is used to enter and edit the application ladder diagram program.

This Section describes the various aspects associated with the loading of the ladder diagram into either the memory of the processor, referred to as on-line programming, or into the memory of the Loader, referred to as off-line programming.

The Section is divided into the following subjects:

- Program mode screen format (8-2)
- Ladder diagram construction guidelines (8-3)
- Ladder diagram entry examples (8-4)
- User-defined special function entry (8-5)
- Editing guidelines (8-6)

The information contained in this Section builds upon information discussed in earlier Sections, especially Paragraphs 4-2-1 and 6-2. It is suggested that before a programmer attempts to load a ladder diagram, this and subsequent Sections be read and thoroughly understood. Also, this Section assumes that:

- The specific ladder diagram has been written, as described in the HPPC-1500/-1700 Systems Manual (Catalog No. NLAM-B821), especially Sections 6 thru 10.
- Loader hardware is correctly modified, as described in Section 3 of this Manual.
- The Loader has been properly initialized and, also, the desired Westinghouse On-Line Ladder Executive or Off-Line Ladder Executive software diskette has been entered into the Loader's memory, as described in Section 5 of this Manual.
- The configuration has been performed as described in Paragraph 7-8 of this Manual.

#### Note

Changes in the configuration after the ladder diagram has been entered will

cause the ladder diagram to be cleared from memory.

#### Note

A listing of the current possible key operations can be displayed at any time by pressing and holding the Ctrl key and then pressing the Q key.

#### Note

During on-line operation, it is often desirable to alternate between the Monitor and Program modes while observing the same network. Press and hold the Ctrl key, and then press the T key (for toggle) to change to either the Program or Monitor mode.

### 8-2. PROGRAM MODE SCREEN FORMAT

The "primary screen" of the Program mode is shown in Figure 8-1. Observe the Figure and note the following 9 points which explain the entry process in a general way.

1. The function keys F1 thru F7 are used to enter program elements, as described in more detail here.
2. The F10; clear, function key is used to remove elements from the display.
3. The cursor consists of an illuminated area. This is where the next element will be entered as directed by the function keys. This area is also referred to as a "cell" since it can contain the most basic program elements such as a contact or coil.
4. The message area, located directly above the function keys, displays messages of interest to the programmer during the ladder diagram entry or editing process. If, for example, an illegal key is pressed, the message ILLEGAL KEY is displayed there.
5. With the Program mode's primary screen displayed, press the F1 or F2, contact function, keys to load either a normally open or normally closed contact. Following this, the function keys are used to select the specific type of contact, as shown in Figure 8-2(a).

Along with each contact, a 4-digit reference number

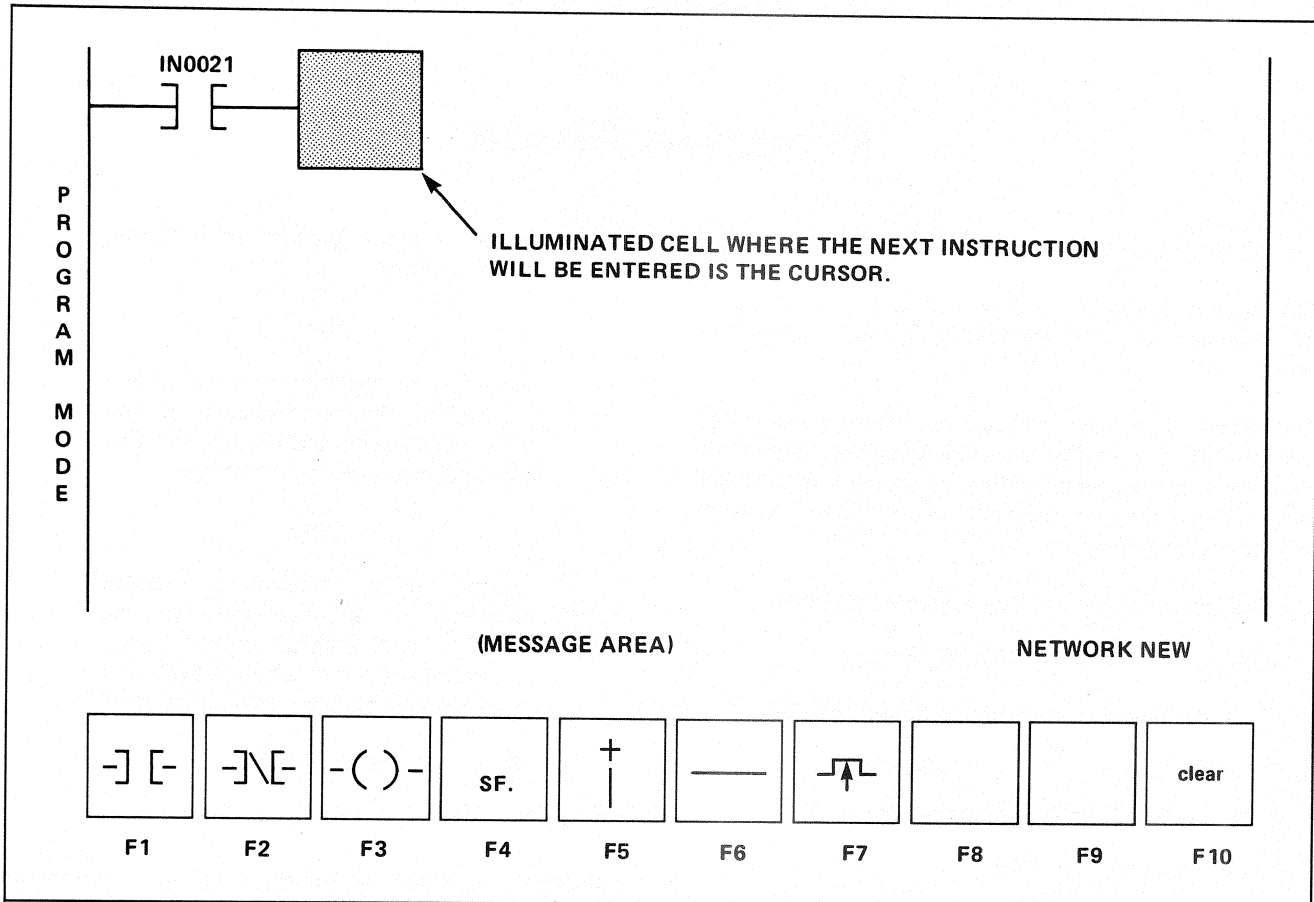


Figure 8-1. Program Mode's Primary Screen

must also be entered. (Leading zeros may be suppressed.) The Enter key (↵) is pressed after each reference number.

6. With the Program mode's primary screen displayed, press the F3, coil, function key to load a coil. At this time the function keys are used to select the type of coil as shown in Figure 8-2(b). Additional types of coils are selected by pressing the F9, etc., function key. See Figure 8-2(c).

Along with each coil, a 4- or 5-digit reference number must also be entered. (Leading zeros may be suppressed.)

**Note**

When entering a coil, the operator **must** locate the cursor in an empty cell with no elements between it and the right portion of the screen.

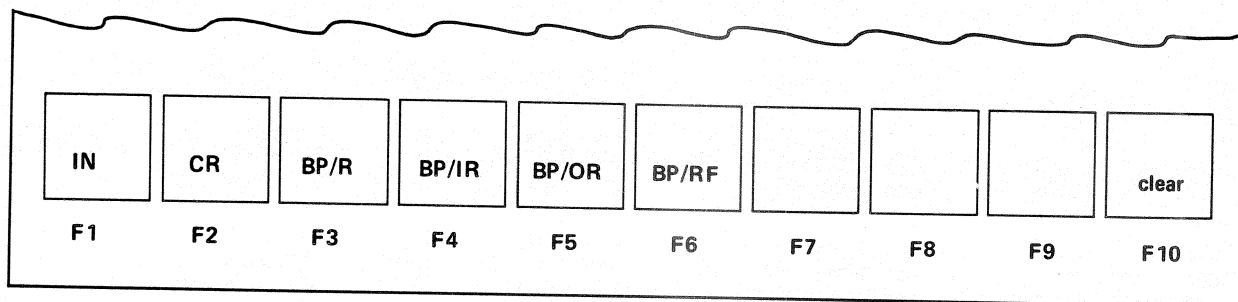
7. Alternate between the function key selection screens shown in Figures 8-2(b) and (c) by repeatedly pressing the F9, etc., key.

8. With the Program mode's primary screen displayed, press the F5, F6, or F7 function keys to load the vertical branch element, horizontal element, or transitional element, respectively.

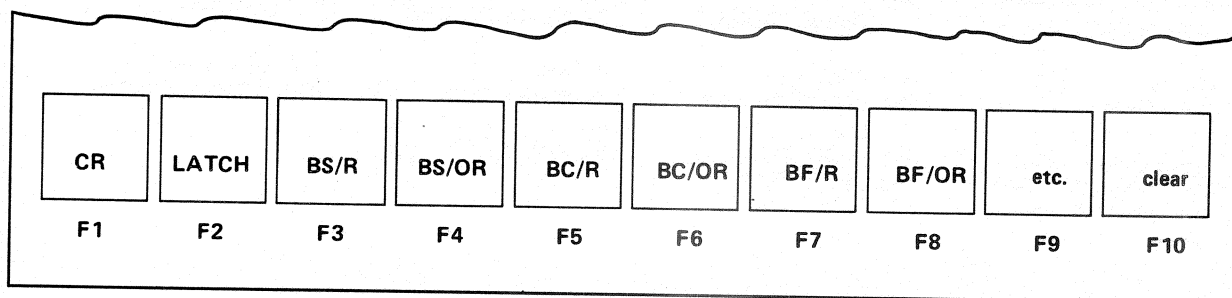
9. Pressing the F4, SF (special function), key when the cursor is properly positioned to receive an entry, initiates the display of the standard and advanced function entry screen, shown in Figure 8-3. Press the F9, page, key to display the balance of the functions, as shown in Figure 8-4.

In order to select a specific programmable function, simply enter the 3-digit code displayed at the left of each column. (Leading zeroes can be omitted in the entry.) Then press the Enter key (↵).

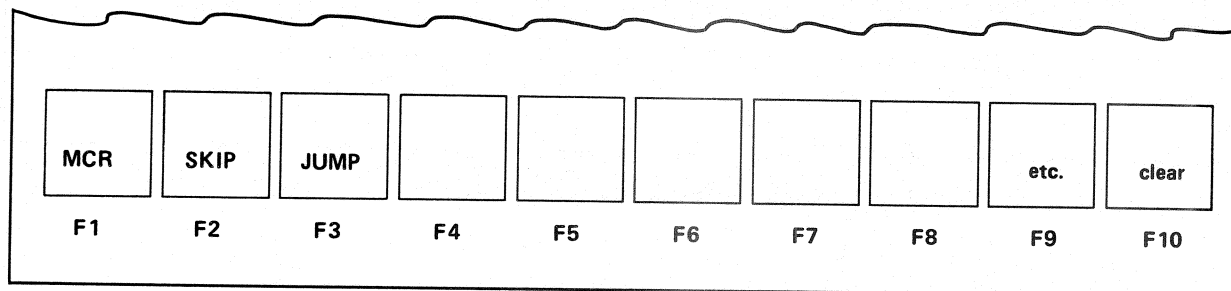
The entry of the standard or advanced function can now be completed by selecting the appropriate registers, operands, and/or constants. Paragraph 8-4 gives specific examples of the entry of networks containing standard and advanced functions.



a) contacts function keys



b) coil function keys



c) additional coil function keys

Figure 8-2. Secondary Function Key Selections



COILS	TIMERS	MATH FUNCTIONS	CONVERSIONS
001 BIT SET	028 TIME ON 1.0	068 ADD A + B=C	045 BIN-BCD R
002 BIT CLEAR	029 TIME ON 0.1	069 ADD * A + B=C	046 BIN-BCD * R
003 BIT FOLLOW	030 TIME ON .01	070 SUB A - B=C	074 BIN-BCD T
004 SKIP COIL	031 TIME OFF 1.0	071 SUB * A - B=C	047 BCD-BIN R
005 MCR COIL	032 TIME OFF 0.1	072 MULT A x B=C	075 BCD-BIN T
006 JUMP COIL	033 TIME OFF .01	073 DIV A / B=C	048 ANALOG IN
009 SFOUT COIL	034 ONE SHOT 1.0	042 SQUARE ROOT	049 ANALOG OUT
010	035 ONE SHOT 0.1	093 AVERAGE	118 SCALE
011 CR COIL	036 ONE SHOT .01	043 NEGATE	
012 LATCH COIL	037 ONE SHOT SCN	044 NEGATE *	

MOVE FUNCTIONS	COMPARISONS	SHIFT REGISTERS	COUNTERS
050 MOVE R-R	053 COMPARE R-R	040 SHIFT LEFT 1	038 UP COUNTER
094 MOVE R-T	091 COMPARE T-T	041 SHIFT RIGHT 1	039 DOWN COUNTER
095 MOVE T-R	092 COMPARE T-R	089 SHIFT LEFT N	
076 BLOCK MOVE	067 LIMIT TEST R	090 SHIFT RIGHT N	
096 DRUM CONTROL	113 LIMIT TEST T		
119 N-BIT MOVE			
077 BYTE MOVE			

ENTER SF OPCODE NUMBER 000

								page	exit
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10

Figure 8-3. SF Selections; First Screen

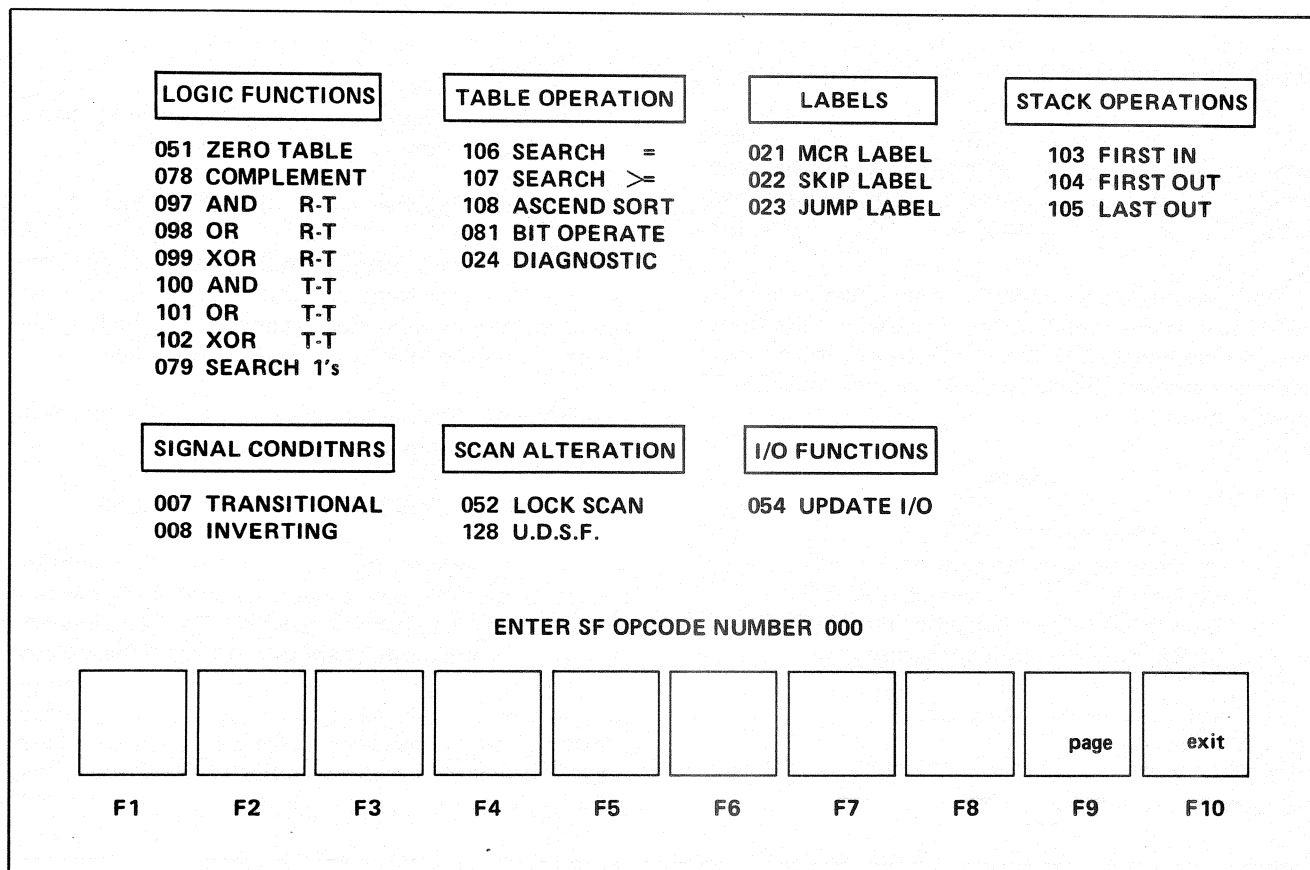


Figure 8-4. SF Selections; Second Screen

### 8-3. LADDER DIAGRAM CONSTRUCTION GUIDELINES

The Loader provides "free format" construction of a ladder diagram. Free format refers to the ability of the Loader to move the cursor to any position on the screen in order to enter the next element. When entering networks, the following 11 guidelines should be kept in mind:

1. The cursor displays the position where the next instruction is to be entered.
2. As each network entry is completed, it must be inserted into either:
  - Processor's memory, for on-line programming
  - Loader's memory, for off-line programming

Alternately, the network displayed on the screen can be cleared by pressing and holding the Ctrl key and then pressing the C key. The network, or portion of the network, will be cleared from the screen and will not be loaded into memory.

3. The Loader reconstructs networks as they are inserted into the memory of the processor or the Loader. In order to make the most efficient use of memory, unnecessary horizontal elements and vertical branch elements are removed automatically. (See Paragraph 8-7 for details.)

4. When 1 or more networks are added, the message NEW NETWORK is displayed on the screen in the area used to display the network number. (See the lower right portion of Figure 8-1. Paragraph 7-2 describes how to assign or reassign network numbers from the Executive Function mode.)

5. Outputs from standard or advanced function blocks can be left unconnected in a network. (That is, they need not run to a coil.) However, any contacts, Transitional (007) elements, horizontal elements, or vertical branch elements **must** be connected to either an input of a standard or advanced function or to a coil. An incomplete contact matrix **cannot** be inserted into memory.

6. Vertical branches **cannot** be programmed immediately to the right of standard or advanced function





blocks. Simply install a horizontal element such as a contact in front of the desired vertical branch element.

7. When initially entering elements, be sure to insert each interconnected group of elements as a separate network. Westinghouse recommends programming each group of interconnected elements in a separate network.

8. When loading ladder diagrams containing one or more UDSF special function blocks, the UDSF subroutines **must be entered before** the UDSF blocks in the main ladder are entered. (Paragraph 8-5 contains other UDSF considerations.)

**Note**

The values of registers can be loaded or modified from the Monitor mode, as described in Paragraph 9-3-5-2. They may also be loaded or modified in the Program mode after inserting a network. Press the Ctrl and R keys to enter the register operation.

9. The Tab key creates a horizontal line or path from the cursor's current position to the:

- Rightmost contact location, just in front of the coil, or
- Position in front of a previously entered contact at the right of the **same** horizontal path

(See Figure 6-1 for the location of the Tab key.)

10. The Backspace key, located just above the Enter key, causes the element in the cursor cell to be erased and, also, it moves the cursor one space to the left. (See Figure 6-2 for the location of the Backspace key.)

11. The F10, clear, function key is used to remove any element or programmable function.

**8-4. LADDER DIAGRAM ENTRY EXAMPLES**

The ladder diagram entry examples shown in Figures 8-5 thru 8-15 each displays a network containing contacts and a standard or advanced function. The key sequences used to enter the network are shown directly below each network. Because of the free format entry, it is possible to enter the same exact network using a key sequence different from the one shown. The keystroke differences are in the way the cursor is positioned between elements and the order of the element entries.

**PROGRAM**

IN0025

TIME ON 1.0

Preset R00050

CR0042

Actual R00051

To enter the network on the screen, press the following keys in this sequence:

F1, F1, 2, 5, Enter, →, F4, 2, 8, Enter, F1, 5, 0, ↓, F1, 5, 1, ←, F1, 4, 2, Enter

To insert the network into memory, press the following keys:

Insert. Wait for message INSERT PENDING. Then press Enter (↵).

Figure 8-5. Timer Entry Example

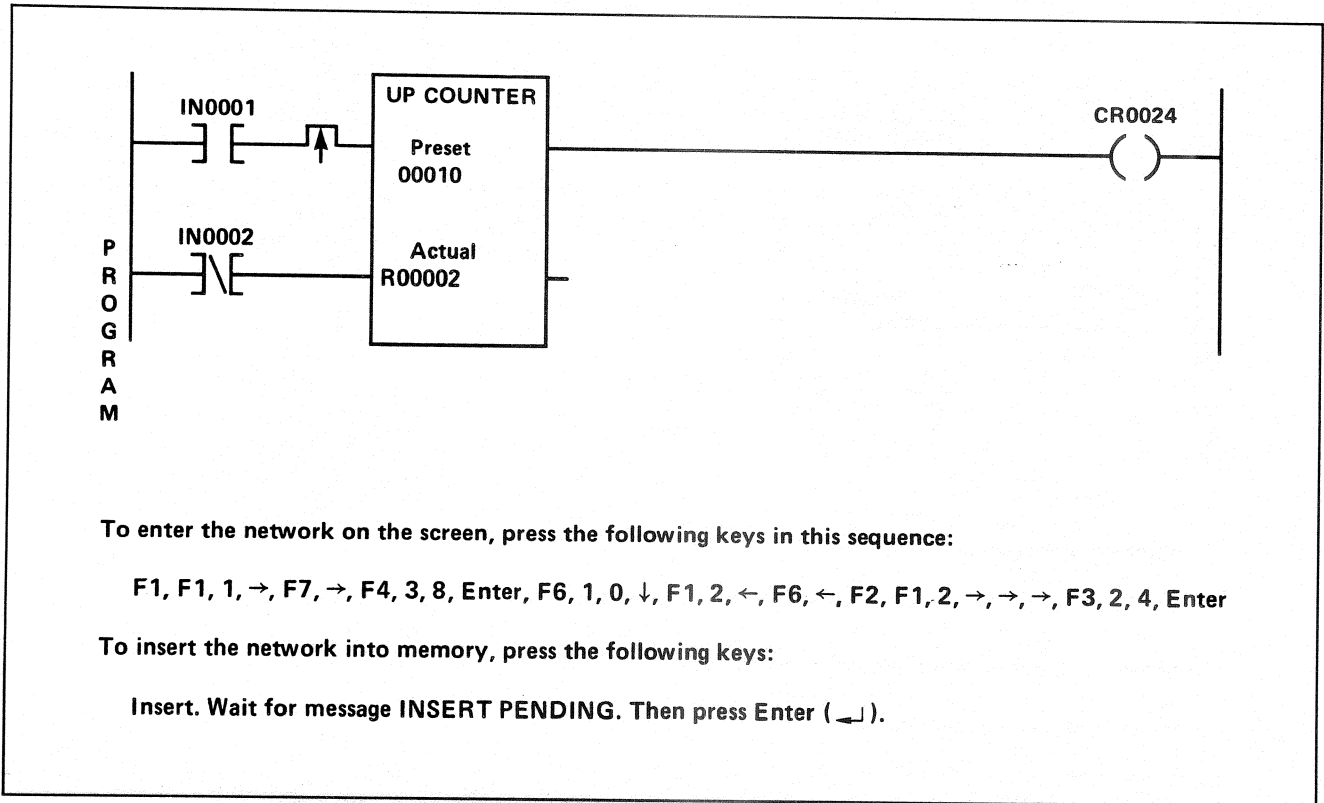


Figure 8-6. Counter Entry Example

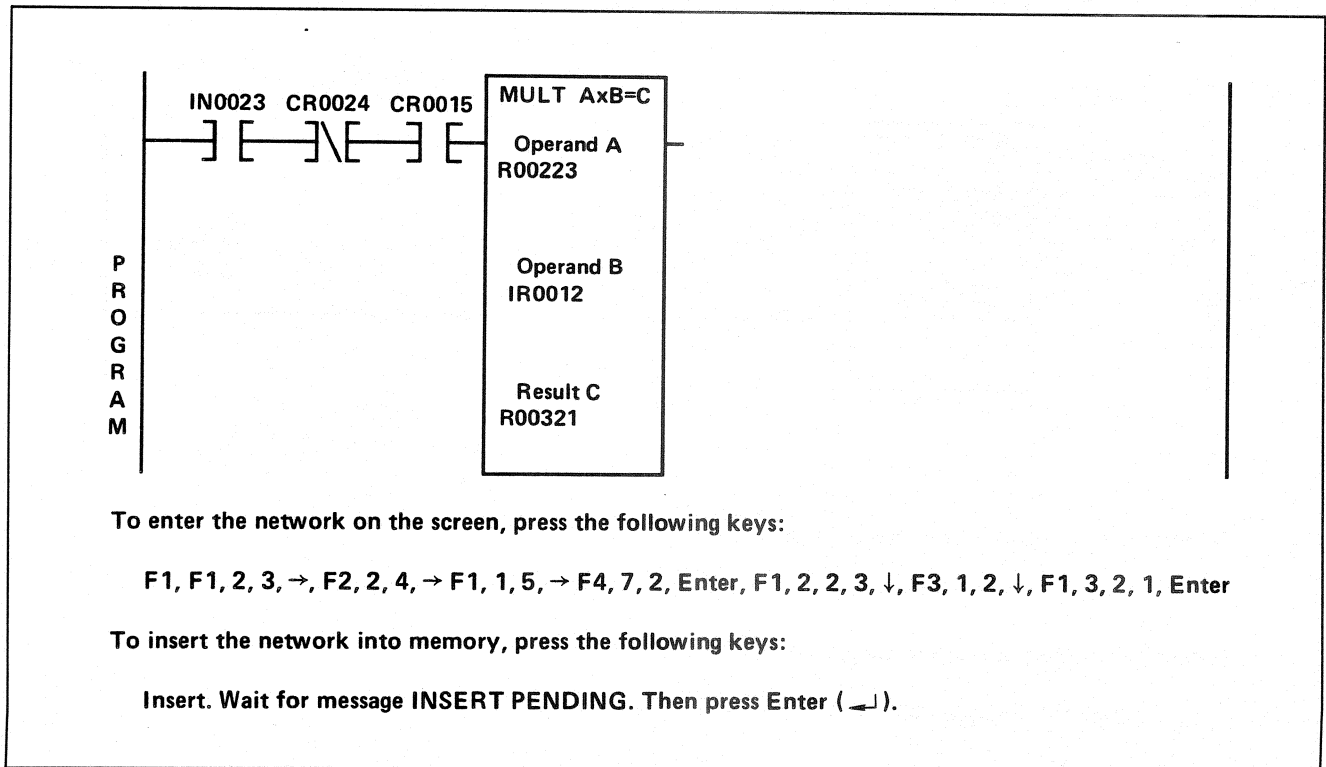


Figure 8-7. Math Entry Example

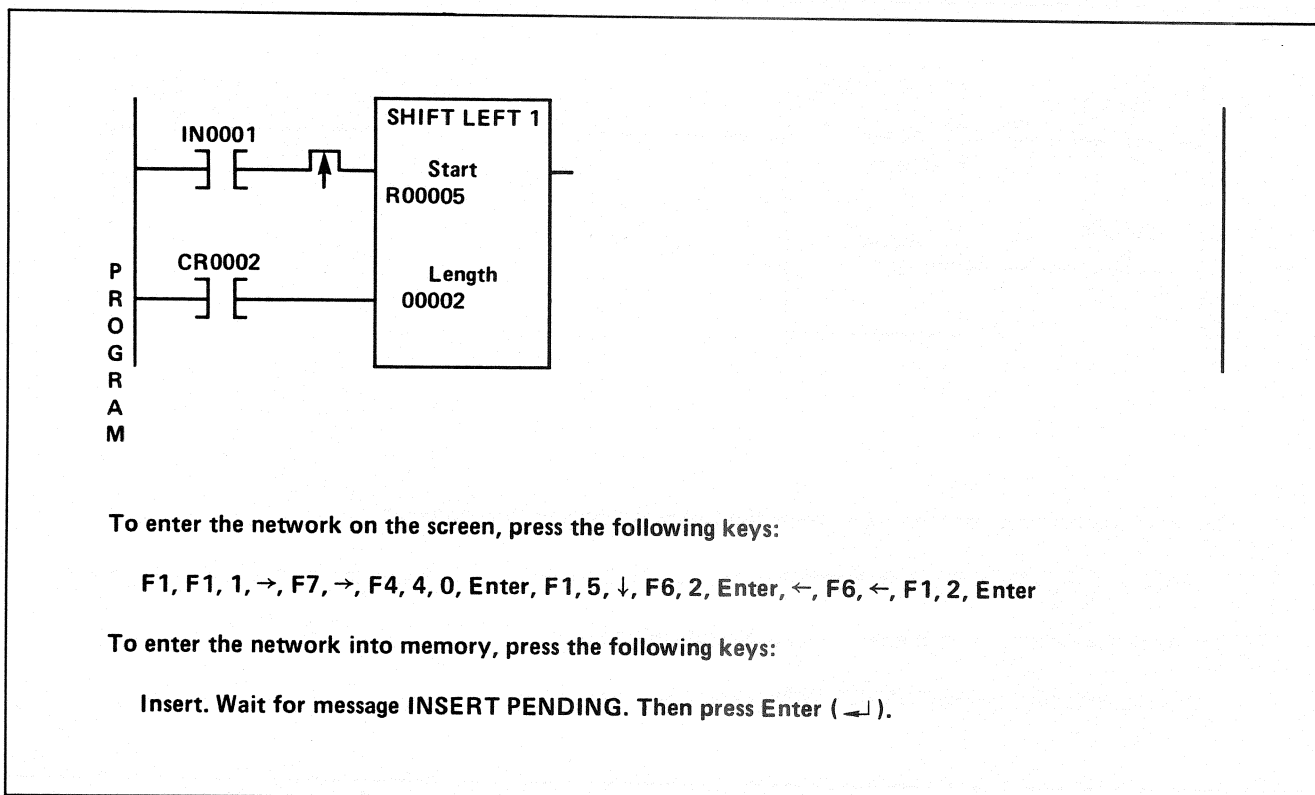


Figure 8-8. Shift Register Entry Example

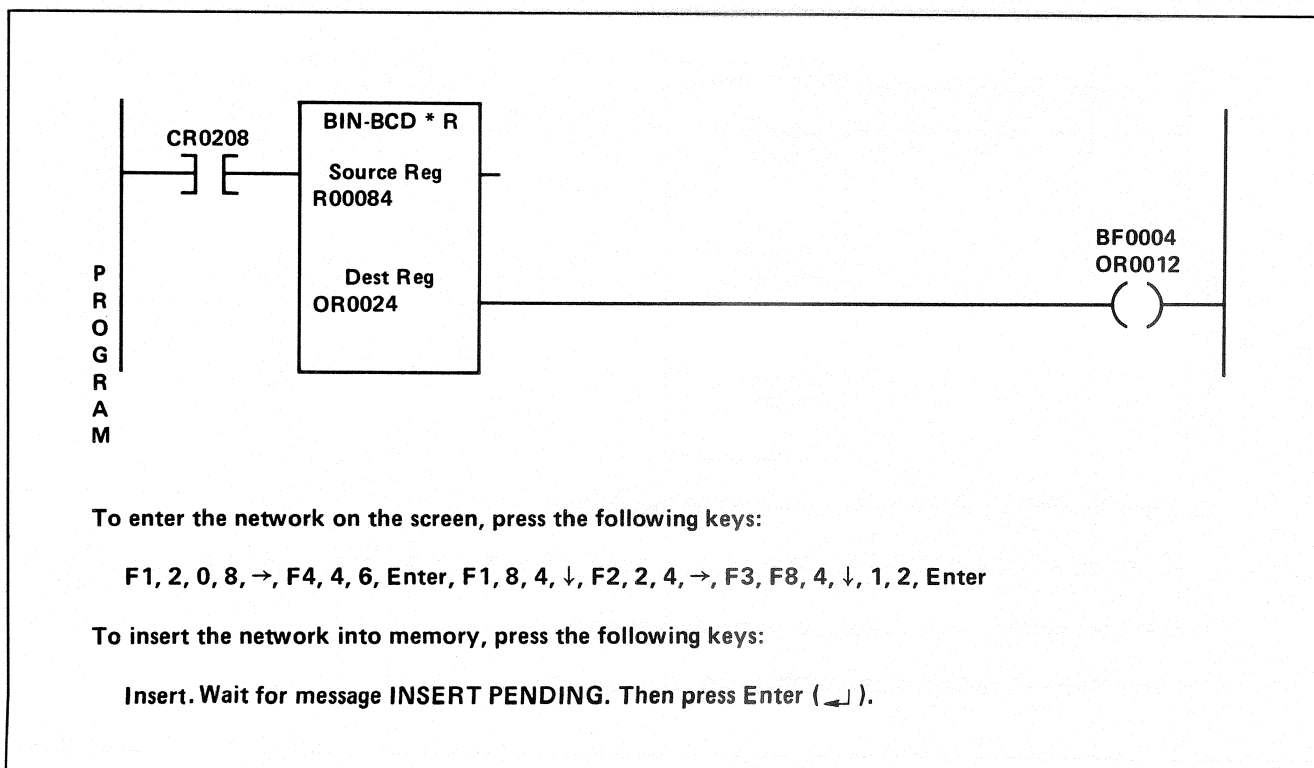


Figure 8-9. Conversion Entry Example

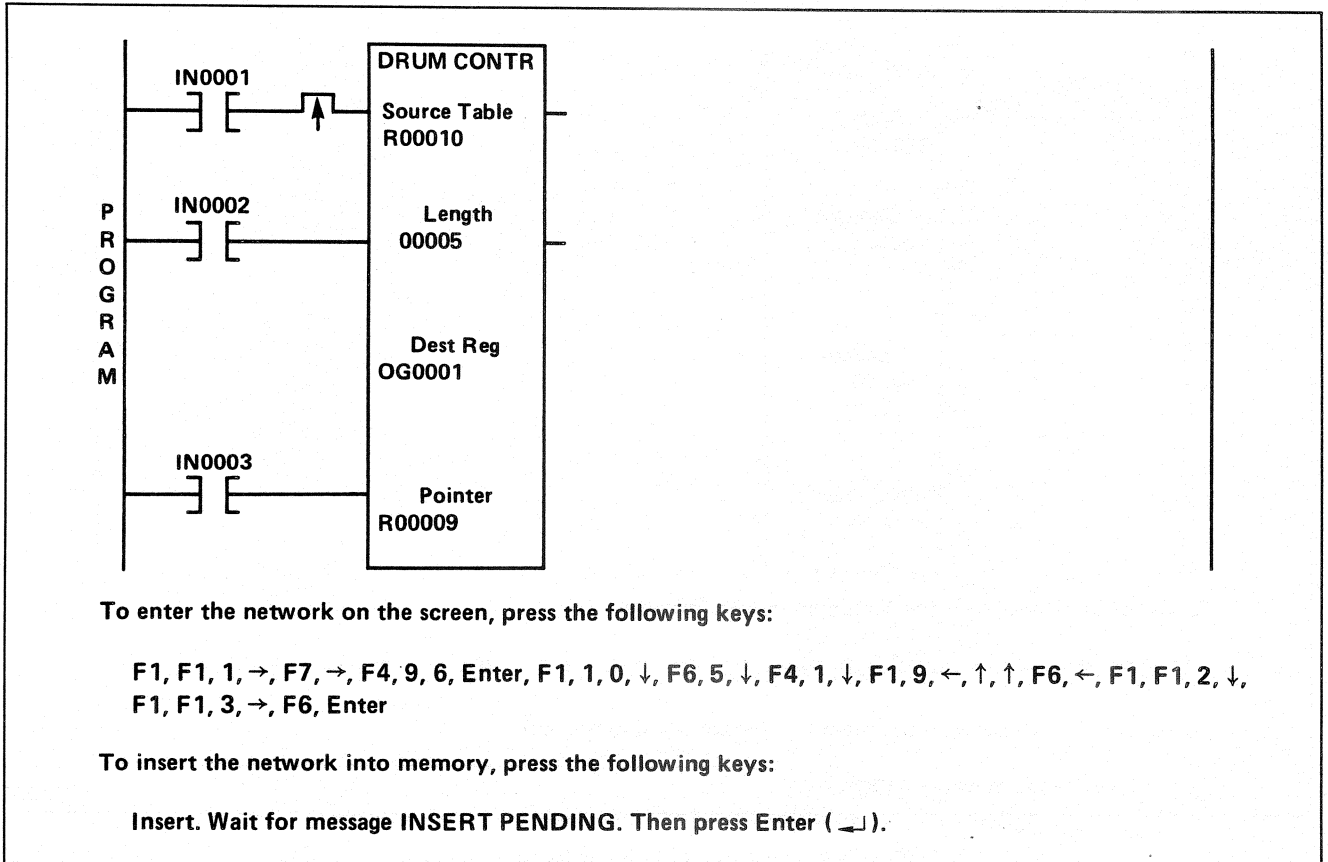


Figure 8-10. Move Function Entry Example

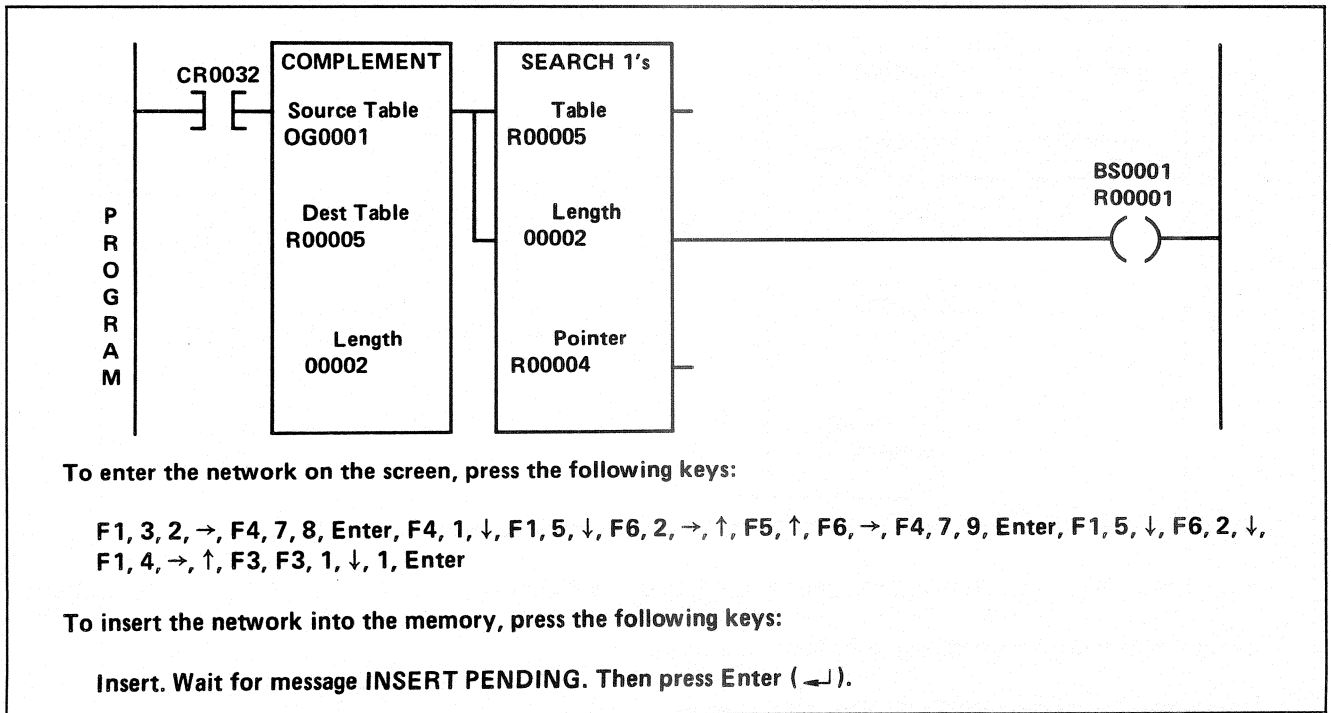


Figure 8-11. Logic Functions Entry Example

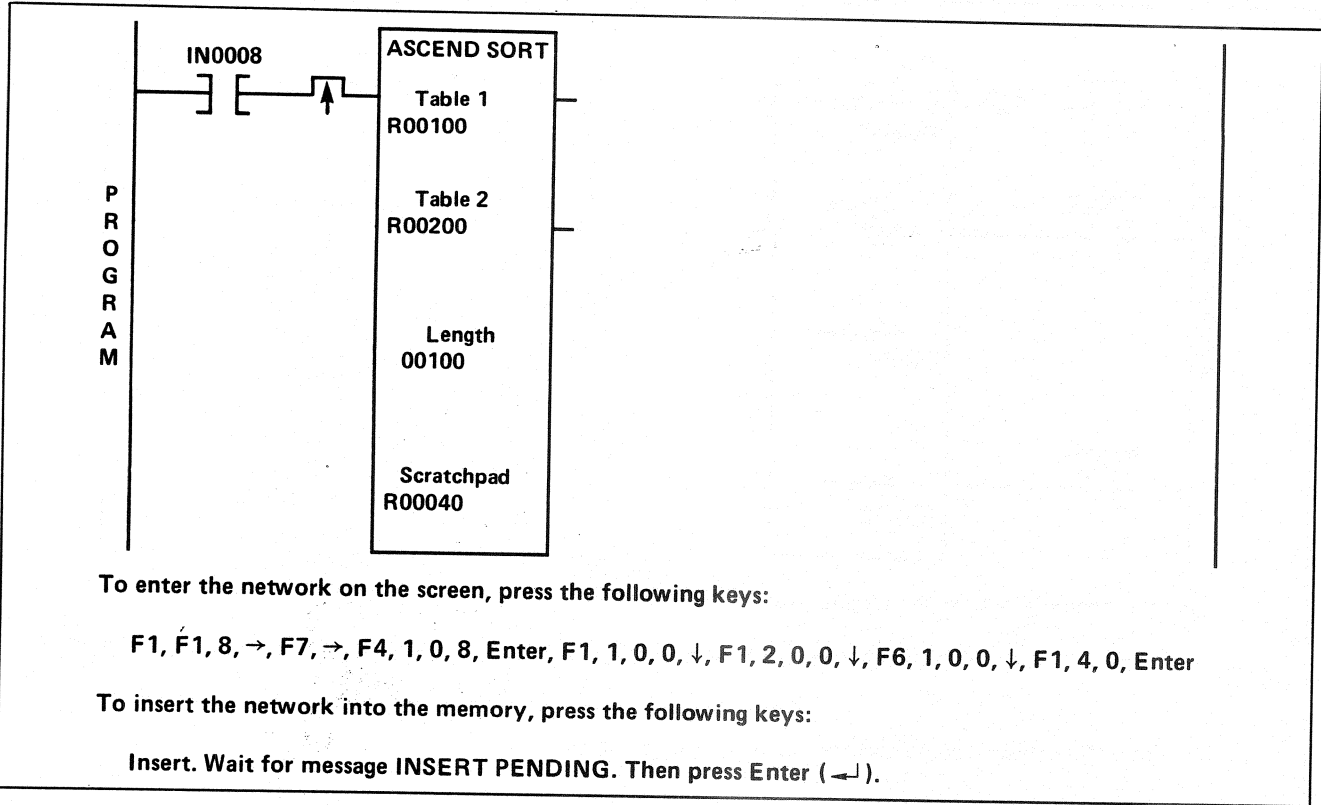


Figure 8-12. Table Operation Entry Example

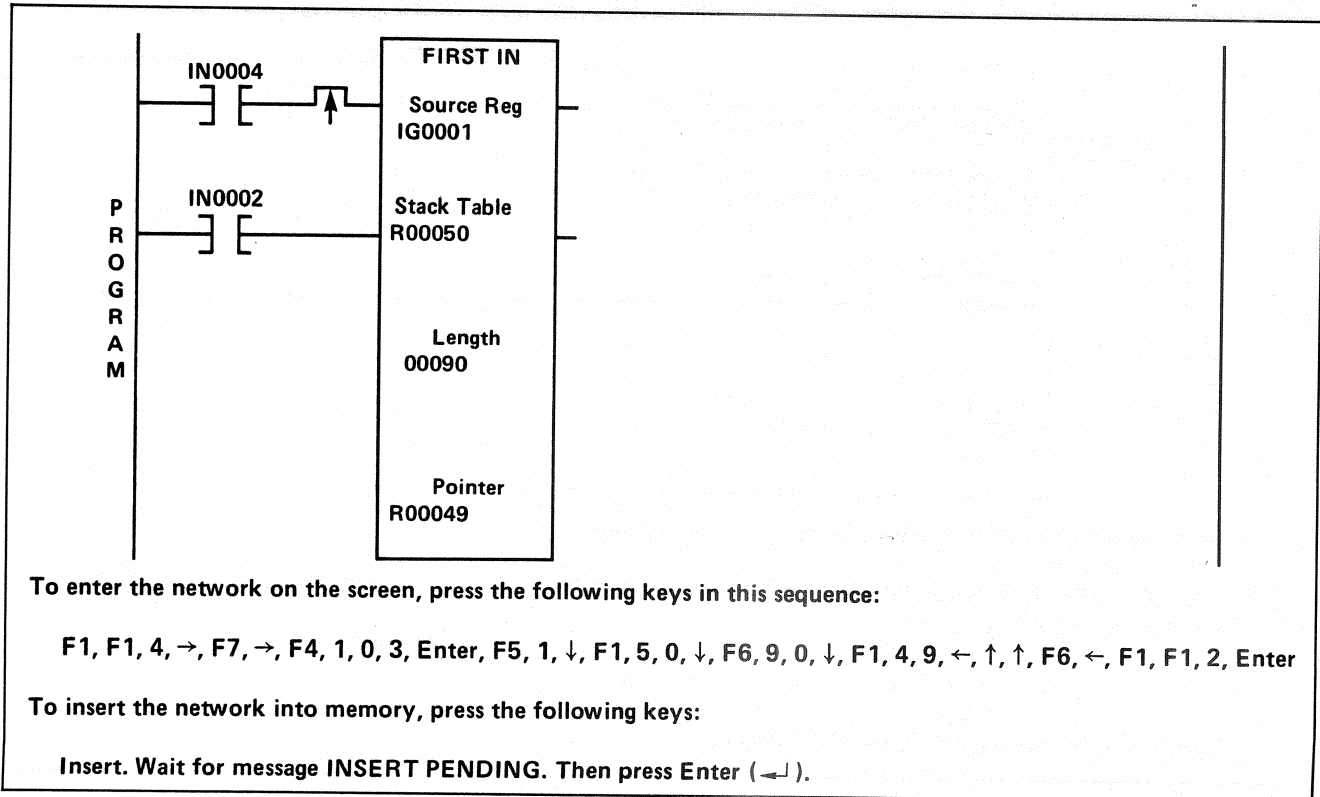


Figure 8-13. Stack Operations Entry Example

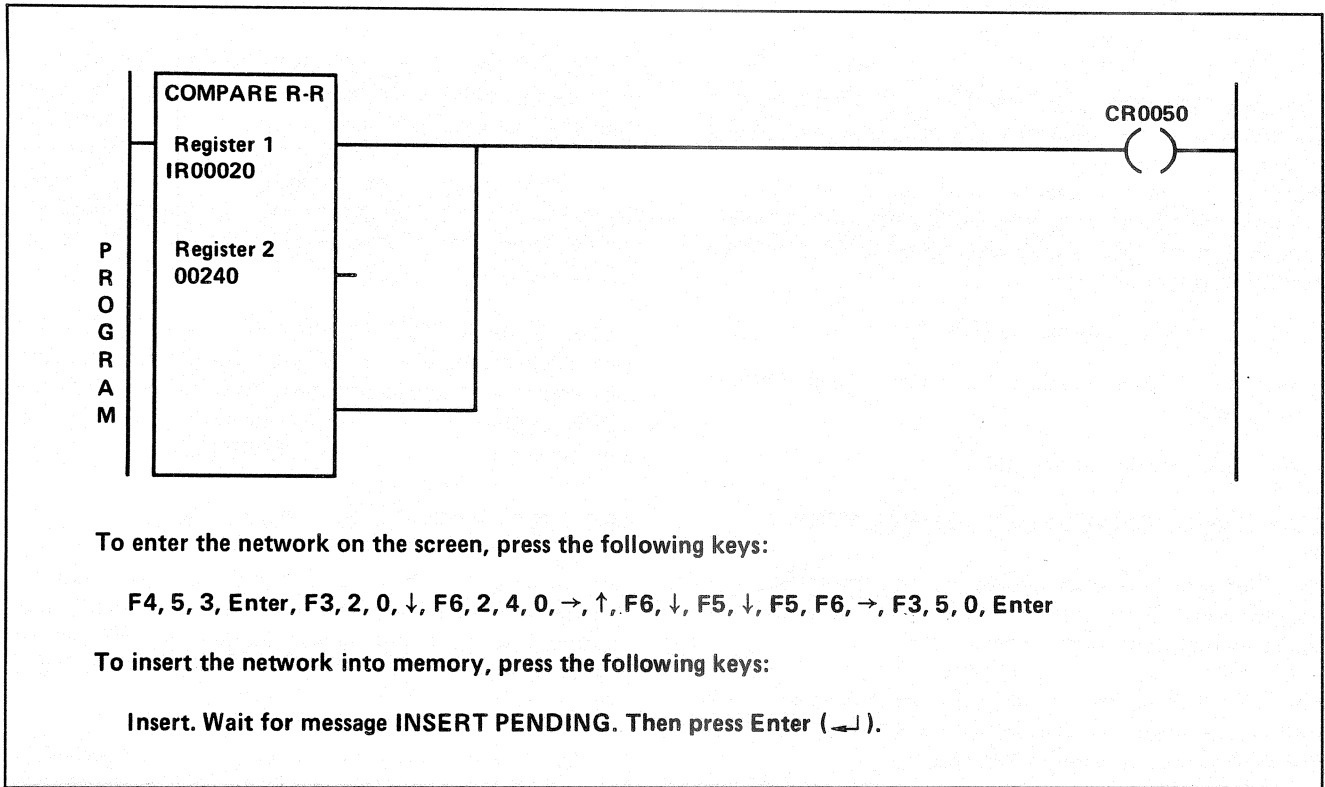


Figure 8-14. Comparison Entry Example

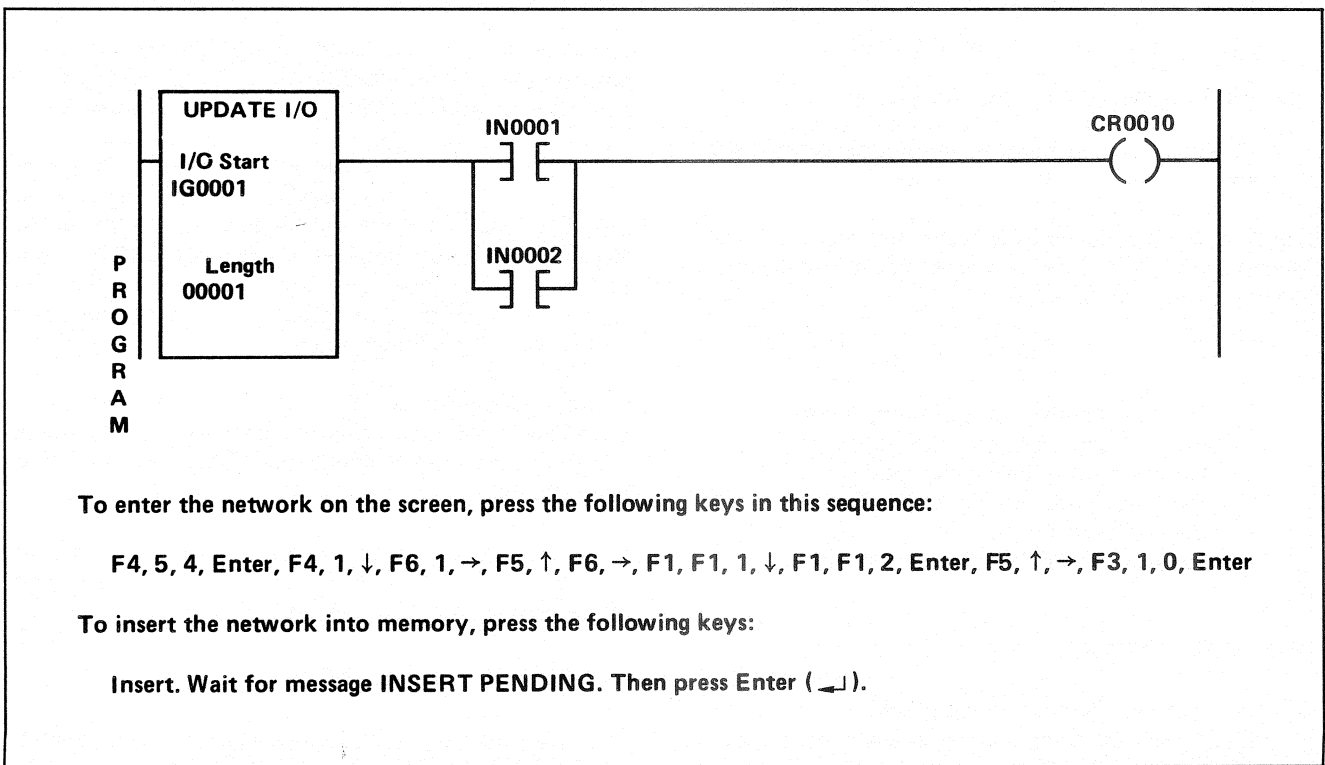


Figure 8-15. I/O Function Entry Example



## 8-5. USER DEFINED SPECIAL FUNCTION ENTRY

The User Defined Special Function block is entered into the ladder diagram in much the same manner as any other standard or advanced function block. In addition, the actual user-defined subroutines must be entered into the memory of the processor before entering the main ladder diagram. This Paragraph contains the following UDSF information:

- User-defined subroutine (8-5-1)
- User Defined Special Function (UDSF) blocks (8-5-2)
- UDSF considerations (8-5-3)

### 8-5-1. USER-DEFINED SUBROUTINE ENTRY

To enter a user-defined subroutine into the memory of the processor or to store the subroutine on a diskette, the following steps must be performed:

**Step 1** – The number (1 thru 32) of the user-defined subroutine must be configured using the Executive Function mode, as listed in Paragraph 7-8-1.

**Step 2** – In the Program mode, search to the area in the processor memory where the ladder diagram subroutine is to be stored as described here:

- Press and hold the Ctrl key, and then press the S key. (This initiates the Search function.)
- Press the F6, UDSF, function key.
- Enter the 2-digit number of the user-defined subroutine followed by the Enter key (↵).

**Step 3** – The Loader is now ready to accept the user-defined subroutine. Enter it as you would any group of ladder diagram networks.

#### Note

The user-defined subroutines, numbered 1 thru 32, are positioned in memory before the regular ladder diagram. The page up (Pg Up) and page down (Pg Dn) keys can be used to locate and display the user-defined subroutine.

### 8-5-2. UDSF BLOCK ENTRY

The User Defined Special Function blocks (UDSF) are entered in much the same manner as any other standard or advanced function. However, during the entry process, the following 2 additional considerations must be observed:

1. The UDSF function block inputs SFIN1 thru SFIN5 are located on the left side of the function block. Care must be exercised when connecting the inputs to insure that the contacts connect to the correct input. The labels SFIN1 thru SFIN5 shown in Figure 8-16 are **not** actually identified on the ladder diagram display. Simply count the inputs. The highest input on the left side is the enable input; the second input from the top is the SFIN1 input; etc.

2. The outputs SFOUT1 thru SFOUT5 are also not specifically identified on the ladder diagram display. Care must be taken to use the correct output from the UDSF function block. The top output is the enable output; the second from the top is SFOUT1; etc.

### 8-5-3. UDSF ENTRY CONSIDERATIONS

Certain Advanced Program Loader and processor characteristics must be understood before the UDSF subroutines and main application ladder diagram can be loaded and run. Consider the following UDSF entry items:

1. UDSF subroutines can be entered into the processor only when the keyswitch is in the STOP:PROGRAM position.

2. The UDSF subroutine **must** be entered into memory **before** any application ladder diagram containing the related UDSF block is programmed. However, an application ladder diagram could be entered first if it does **not** contain a related UDSF block. Later editing could add the block, but **only** after the subroutine entry.

3. Once the UDSF subroutine ladder diagram is entered into memory, no editing (adding or removing new elements or register data) of the SFOUT, SFIN, or SF Registers is possible until **all** the related UDSF blocks in the application ladder diagram have been deleted. The subroutines may then be edited, after which the related SF blocks can be entered again.

4. Networks in the UDSF subroutines containing Transitional (007) elements cannot be changed until **all** related UDSF blocks in the application ladder diagram have been deleted.

5. In the Monitor mode, the UDSF subroutines are displayed, but do not show the conduction status of contacts, or the contents of registers.

### 8-6. EDITING GUIDELINES

The information presented earlier in this Section assumed the desired ladder diagram element entries have been made correctly and the networks entered were correctly programmed. Naturally incorrect entries will be

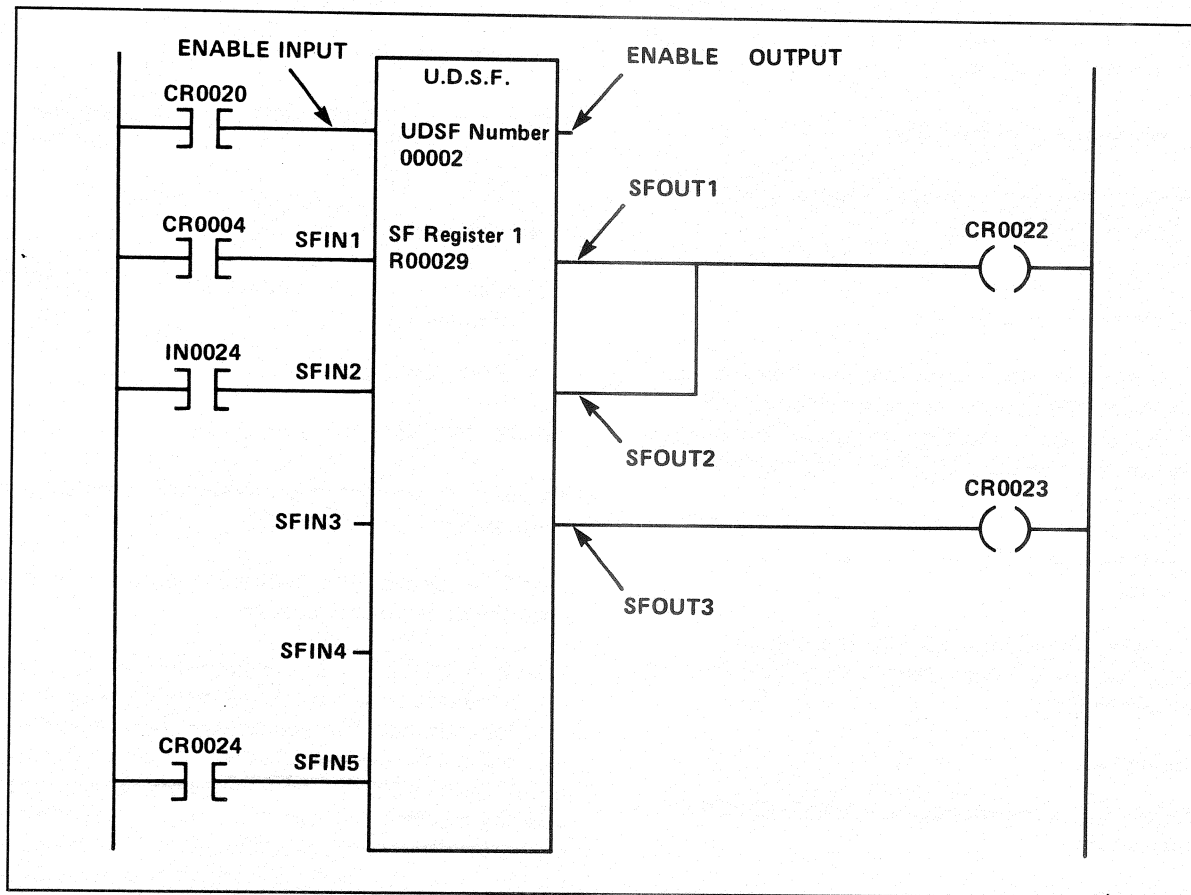


Figure 8-16. UDSF Block

made. Changes to the ladder diagram, referred to here as edits or editing, are desired when initially entering the ladder diagram or during an initial system startup to correct oversights or entry errors not uncovered earlier.

**Note**

When initially programming networks on the screen, but before the networks have been entered into memory, elements can be inserted, removed, or replaced, as described in Paragraph 8-6-1. When the changes have been made and the network is completed, enter the network into memory by sequentially pressing the Insert and Enter keys.

The editing information in this Paragraph is divided into the following types:

- Editing elements (8-6-1)
- Inserting, deleting networks (8-6-2)
- Global search and replace (8-6-3)

**Note**

During the editing process, it is often desirable to alternate between the Program and Monitor modes while observing the same network on the screen. Press and hold the Ctrl key, and then press the T key to toggle between the 2 modes. Each time this keying is initiated, the mode changes from Program to Monitor or Monitor to Program while continuing to display the same network.

**8-6-1. EDITING ELEMENTS**

Elements can be removed completely, or changed to entirely different elements. Additionally, elements can be inserted.

In the case of standard or advanced functions, either the functions themselves can be changed, or the registers, tables, operands, or results associated with the function can be changed.





Elements are removed, inserted, or changed, as described in the following Paragraphs.

### 8-6-1-1. REMOVING ELEMENTS

Perform the following to remove an element from a previously programmed network:

**Step 1** — Display the desired network from memory onto the screen of the Loader.

**Step 2** — Position the cursor on the element to be removed. Note: To remove a standard or advanced function block, the cursor must be positioned on the top-most line of the function. Use the ↑ key of the cursor/number pad keys.

**Step 3** — Press the F10, clear, function key to remove the element.

**Step 4** — After the modification to the network is completed, replace the original network with the edited network by pressing the:

- Insert key
- Delete key (The message CHANGE PENDING is displayed.)
- Enter key (↵)

### 8-6-1-2. CHANGING ELEMENTS

To change an element from one type to another type, perform the following:

**Step 1** — Display the desired network from memory onto the screen of the Loader.

**Step 2** — Position the cursor directly on the element to be changed. In the case of standard or advanced functions, position the cursor on the topmost line of the function.

**Step 3** — Using the desired function keys, enter the new element just as had been done when initially entering the element. For example:

- To replace a normally open contact element with a normally closed contact element, press the F2, normally closed, function key.
- To replace a standard or advanced function block, position the cursor on the top line of the block and press the F8, SF, function key. Then program the desired special function as before. Note: To program an element in place of the function block,

press the F10, clear, function key before entering new elements.

**Step 4** — After the modification to the networks is completed, replace the original network with the edited network by pressing the:

- Insert key
- Delete key (The message CHANGE PENDING is displayed.)
- Enter key (↵)

### 8-6-1-3. INSERTING ELEMENTS

To insert an element into a previously programmed network, perform the following:

**Step 1** — Display the desired network from memory onto the screen of the Loader.

**Step 2** — Using the arrow keys (←, →, ↑, ↓,) of the cursor/number pad keys, position the cursor in the cell location desired. The area where the element is to be inserted must be clear of other elements. This includes not only the cell on which the cursor is positioned, but also any adjacent cells which are required by the element being inserted. For example, when inserting an Up Counter function (038), 2 horizontal cells by 3 parallel rows of cells must be available. Position the cursor in the upper right corner of the 2x3 cell area.

#### Note

It is often necessary to create vertical or horizontal spaces where the new elements are to be inserted. Paragraph 8-6-1-4 and 8-6-1-5 describe how to insert horizontal and vertical elements.

**Step 3** — Enter the new element in the same manner as when initially programming the element.

**Step 4** — After the modification to the network is completed, replace the original network with the changed network by pressing the following:

- Insert key
- Delete key (The message CHANGE PENDING is displayed.)
- Enter key (↵)

### 8-6-1-4. INSERTING A HORIZONTAL SPACE

To insert a horizontal element, or "space," in a previously programmed network, perform the following:

**Step 1** — Display the desired network from memory onto the screen of the Loader.

**Step 2** — Position the cursor on the element where the new horizontal element (space) is desired.

**Note**

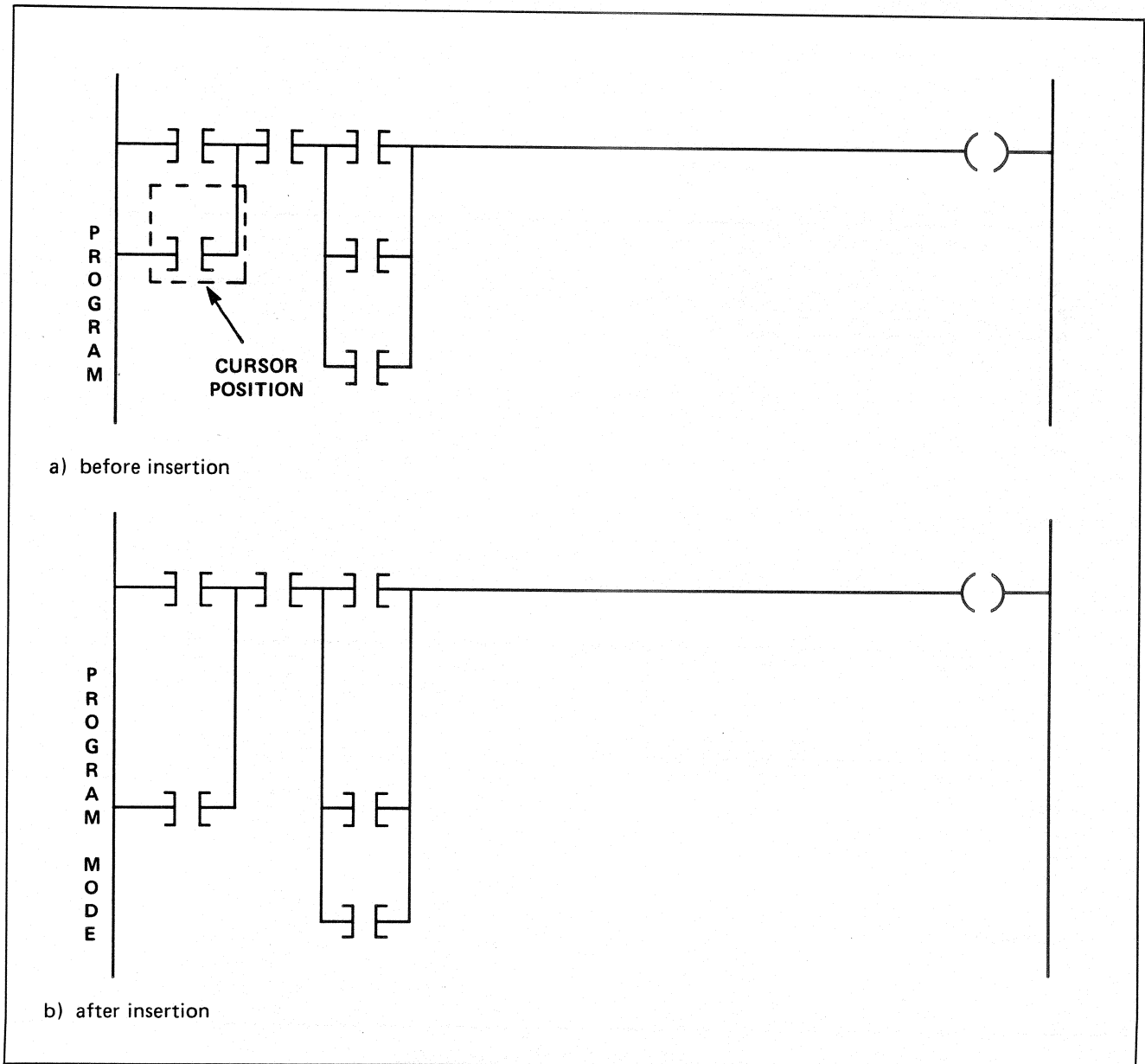
A horizontal space will not be inserted when the cursor is positioned on a standard or advanced function block.

**Step 3** — Press the Esc (Escape) key followed by the ↓ key of the cursor/number pad keys. The network will be

rearranged such that a new horizontal element can be inserted. Note: The space for the horizontal element will be inserted across the entire screen, as shown in Figure 8-17.

**Step 4** — After elements are entered into the new horizontal position, replace the original network with the changed network by pressing the following:

- Insert key
- Delete key (The message CHANGE PENDING is displayed.)
- Enter key (↵)



**Figure 8-17. Inserting a Horizontal Space**



### 8-6-1-5. INSERTING A VERTICAL SPACE

To insert a vertical space in a previously programmed network, perform the following:

**Step 1** — Display the desired network from memory onto the screen of the Loader.

**Step 2** — Position the cursor on any element on the line where a vertical space is desired.

**Step 3** — Press the Esc (Escape) key followed by the → key of the cursor/number pad keys.

The vertical space is inserted in the position where the cursor was located. The space is also inserted in any and all branch circuits located on the same parallel path as the cursor. (See Figure 8-18.)

**Step 4** — After elements are entered into the new vertical position, replace the original network with the changed network by pressing the following keys:

- Insert key
- Delete key (The message CHANGE PENDING is displayed.)
- Enter key (↵)

### 8-6-2. INSERTING, DELETING NETWORKS

Networks can be inserted or deleted from the memory of the processor or the Loader's memory by performing the operations described here.

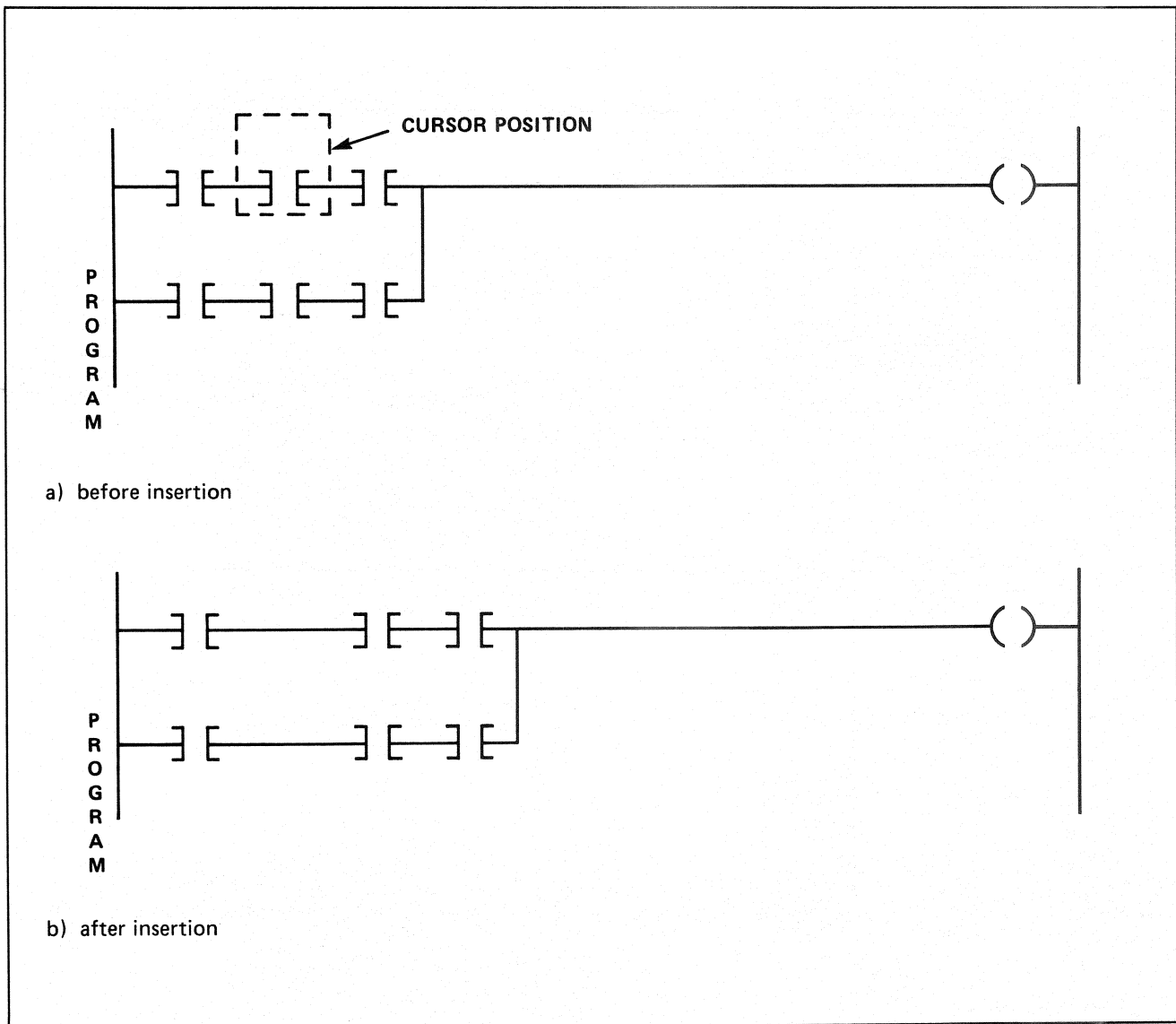


Figure 8-18. Inserting a Vertical Space



### 8-6-2-1. DELETING A NETWORK

To delete a network, perform the following:

**Step 1** — Display the network to be deleted from memory on the screen of the Loader.

**Step 2** — Press the Del (Delete) key of the cursor/number pad group of keys. The message DELETE PENDING is displayed on the screen.

**Step 3** — Press the Enter key (↵) to delete the network.

### 8-6-2-2. INSERTING A NETWORK

In order to insert a new network into the processor's memory (on-line) or the memory of the Loader (off-line), the network is first entered into the screen of the Loader in the desired location as follows:

**Step 1** — Use any of the search methods described in Section 11 to locate and display the network **just before** the position where the new network is to be installed.

**Step 2** — Clear the screen by pressing and holding the Ctrl key, and then pressing the C key.

**Step 3** — Program the new network on the screen of the Loader.

**Step 4** — Press the Ins (Insert) key of the cursor/number pad group of keys. The message INSERT PENDING is displayed on the screen.

**Step 5** — Press the Enter key (↵) to insert the network displayed on the screen of the Loader.

#### Note

The new network is inserted in the Loader's current ladder diagram program location just after the network displayed in Step 1, above.

### 8-6-3. GLOBAL SEARCH AND REPLACE

The global search-and-replace function allows the selection of any specified contacts, coils, registers, or IG/OG groups used one or more places in the ladder diagram in order to replace it with a different type of element and/or reference number. The elements replaced are located in the networks of the UDSF or main ladder portion of memory, as specified by the operator. The ability to automatically search and replace selected elements is a powerful editing tool which, in addition to saving time, also eliminates editing errors often produced when replacing elements one at a time.

### WARNING

**IT IS THE USER'S RESPONSIBILITY TO ASSURE THAT IMPROPER SEARCH AND REPLACEMENTS ARE NOT MADE. INCORRECT OPERATION CAN MODIFY THE LADDER DIAGRAM ELEMENTS, THEREBY CREATING HAZARDOUS CONDITIONS WHICH MAY RESULT IN SERIOUS OR FATAL INJURIES AND/OR EQUIPMENT DAMAGE.**

To perform a global search-and-replace function, follow these steps:

**Step 1** — With the Loader in the Program mode, press and hold the Ctrl key, and then press the X key. The following message appears:

Renumber networks (Ctrl, N).

**Step 2** — Press and hold the Ctrl key, and then press the N key to renumber the networks.

**Step 3** — Select the area of memory to perform the search-and-replace function as follows:

- F1, UDSF memory, or
- F2, ladder memory

**Step 4** — Enter the network number of the starting network followed by the Enter key (↵).

**Step 5** — Enter the number of the last network desired.

**Step 6** — Press the Enter key (↵).

At this time the screen is ready to accept the current element or register to be searched for and replaced.

**Step 7** — Select the element, register, or IG/OG group from the function keys shown in Figure 8-19.

#### Note

After the contact type or register is selected, the entry of the contact elements, register, or IG/OG group numbers is identical to the initial entry discussed in Section 8, Program Mode. All entries are completed by pressing the Enter key.

**Step 8** — The Loader is now ready to accept the element or register which will replace the one defined in Step 7.

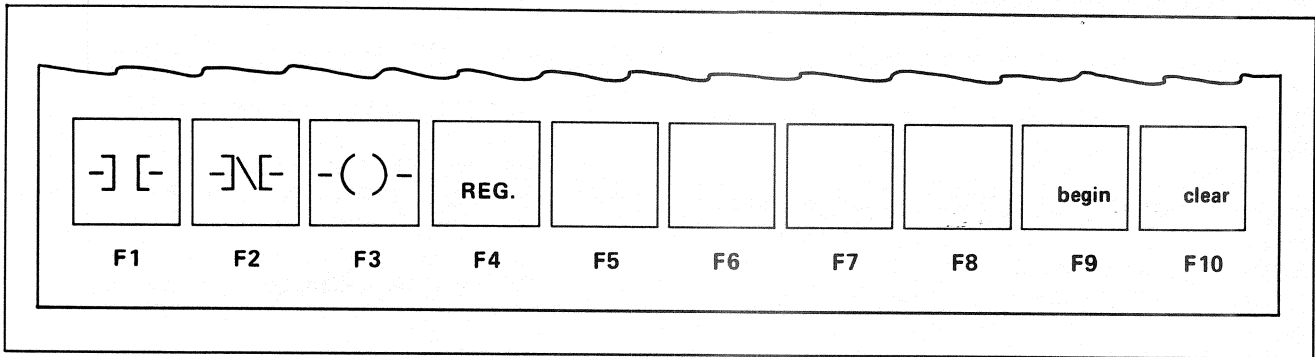


Figure 8-19. Element or Register Selection

**Note**

Repeat Steps 7 and 8 as many times as desired to search and replace additional elements. The actual replacement will not occur until Step 9, listed next, is completed.

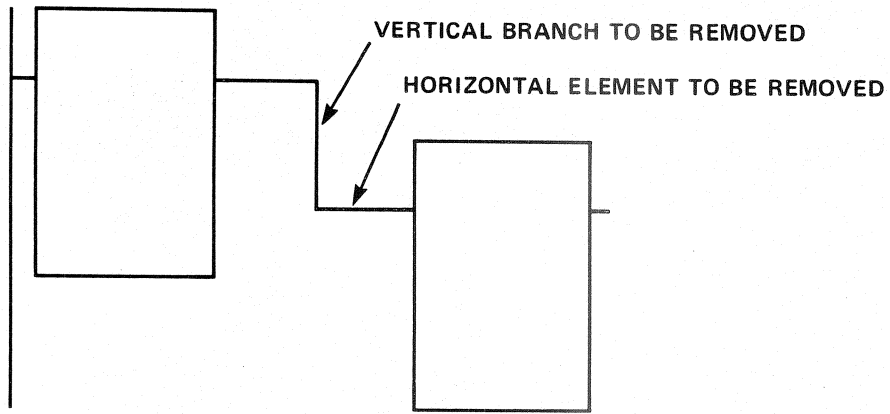
**Step 9** — Press the F9, begin, function key to initiate the search-and-replace function.

**8-7. NETWORK RECONSTRUCTION**

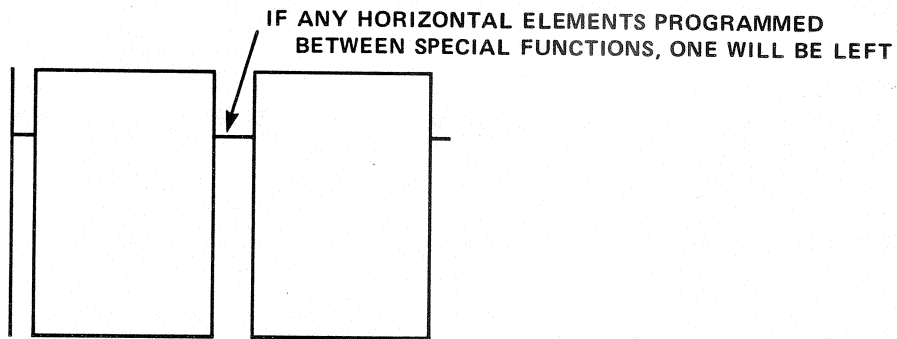
The Advanced Program Loader performs a "reconstruc-

tion," if possible, on each network as it is inserted into memory. This allows for more efficient use of memory by eliminating unnecessary horizontal elements and vertical branch elements. As the result, the spacing or positioning of the elements in the inserted network often is changed from the network actually constructed by the programmer. Also, when possible, any special function blocks or other elements contained in a network are moved to the left portion of the network.

An example of the horizontal element and vertical branch element removal is shown in Figure 8-20. The reconstruction of Figure 8-20(a) results in the element positioning shown in Figure 8-20(b).



a) partial rung before reconstruction



b) partial rung after reconstruction

Figure 8-20. Reconstruction Example



# Section 9

## Monitor Mode

### 9-1. INTRODUCTION

The Monitor mode provides the following 5 capabilities:

1. Monitoring of ladder diagram networks. Any network in the main ladder diagram program can be displayed to observe the following:

- Contacts and adjoining horizontal and vertical branch elements. These appear intensified, indicating conduction or power flow, or at normal intensity, indicating nonconduction.
- Register or IG/OG group reference numbers contained in standard or advanced function blocks. Along with these, the respective values contained in those registers or groups may also be seen. (See Figure 9-1.) As the values change, the display is updated.

- Outputs from standard and advanced function blocks appear intensified when conducting, or at normal intensity when nonconducting.

2. Monitoring the status of any specified type of contact. The contact appears intensified when conducting, or at normal intensity if nonconducting. The specified contact appears by itself rather than as part of a network. This is referred to as a "free contact."

3. Monitoring the status of any specified register to IG/OG group. Each one specified appears by itself rather than as part of a standard or advanced function block in a network. This can be referred to as a "free register."

4. Loading or changing the data contained in any specified register or IG/OG group.

5. Overriding the status of IN contacts or CR coils and associated CR contacts. This is a "forcing operation."

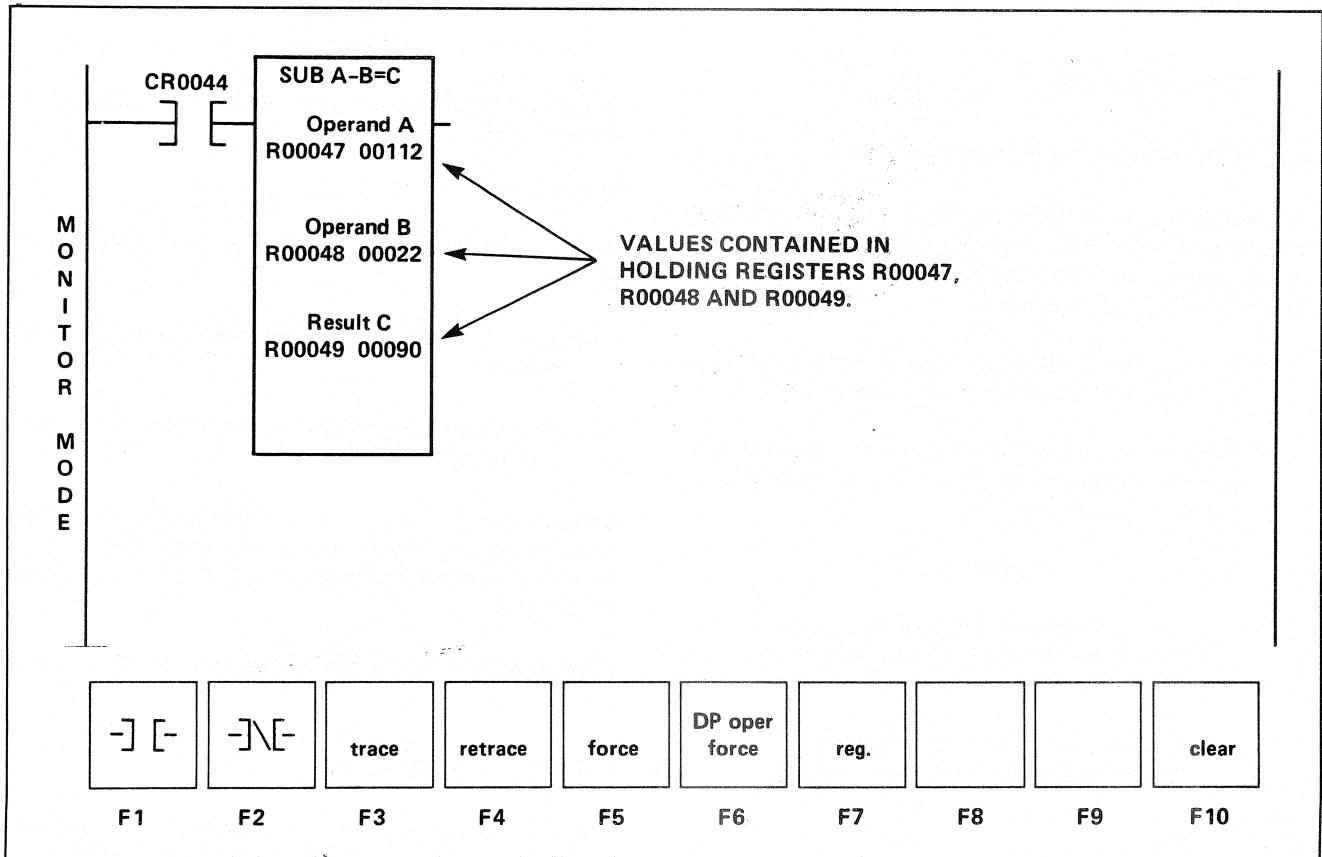


Figure 9-1. Monitor Mode's Primary Screen



This Section describes the various Monitor mode capabilities and operations as follows:

- Searching (9-2)
- Monitoring contacts (9-3-1)
- Trace/retrace operation (9-3-2)
- Forcing operations (9-3-3)
- Monitoring double-precision registers (9-3-4)
- Register operations (9-3-5)

#### Note

When monitoring the UDSF ladder portion of the ladder diagram, the status of register and power flow is disabled.

#### Note

In many instances while observing a single network, it is desirable to alternate between the Monitor and Program modes. Press and hold the Ctrl key, and then press the T key (for toggle) to change to either the Program or Monitor mode.

## 9-2. MONITOR MODE SEARCHES

Immediately after entering the Monitor mode, the function keys of the primary screen, as shown in Figure 9-1, are displayed. At this time the various networks contained in the ladder diagram can be accessed by:

- Pressing the Pg Dn (page down) and Pg Up (page up) keys of the cursor/number pad keys.
- Performing various Search function operations for specific elements or networks, as described in detail in Section 11.

#### Note

In many instances, it is desirable to use a Search function alternately with the Monitor or Program mode. For this reason the Search function can be accessed directly from the Monitor or Program mode by pressing and holding the Ctrl key, and then pressing the S key.

In addition to aiding with the searching of the ladder

diagram, the Monitor mode function keys provide other capabilities, as described next.

## 9-3. MONITOR MODE SCREEN

The function keys associated with the Monitor mode's primary screen are displayed when the mode is first entered. (See Figure 9-1.) Observe the Figure and relate it to the function key description contained in Table 9-1. The operations associated with each of the function keys are described in the following Paragraphs.

### 9-3-1. FREE CONTACT MONITORING

The term "free contact monitoring" describes the ability of the Monitor mode to display a contact by itself on the screen, **not** as part of a network. To do this, the operator must first position the cursor in any clear area of the screen, and then perform the following:

**Step 1** – Press the F1, normally open, or F2, normally closed, function key.

The screen displays the normally open or normally closed contact type selected. The function key selections, shown in Figure 9-2, are then displayed.

**Step 2** – Select a specific type of contact by pressing one of the F1 thru F6 keys, as shown in Figure 9-2.

**Step 3** – Enter the desired reference number for the contact type.

**Step 4** – Press the Enter key (↵).

At this time the status of the contact selected is displayed as follows:

- Conducting, which is indicated by an intensified contact
- Nonconducting, which is indicated by a contact at normal intensity

**Step 5** – If desired, select or monitor additional contacts by repositioning the cursor with the arrow keys (←, →, ↑, ↓) of the cursor/number pad keys. Then repeat Steps 1 thru 4, above.

Previously selected contacts continue to display their conducting or nonconducting status.

### 9-3-2. TRACE/RETRACE

The F3, trace, and F4, retrace, function keys allow the searching through successive networks in the ladder diagram for specified CR coils.





TABLE 9-1. FUNCTION KEY DESCRIPTION

Function key	Description	Reference Paragraph
F1 F2	Monitors a normally open (F1) or normally closed (F2) contact. The contact is displayed by itself on the screen—not as part of a network.	9-3-1
Trace F3 Retrace F4	The trace (F3) and retrace (F4) function keys allow specific CR type coils to be displayed in the networks in which they are programmed. When the cursor is positioned on a CR contact, pressing the F3, trace, function key causes the network with the associated coil to be displayed. Pressing the F4, retrace, returns the screen to the network displayed before the trace was pressed.	9-3-2
Force F5	The force (F5) function key allows the forcing of inputs or outputs to either on or off states. Also, a listing of any inputs or outputs in a forced state can be displayed.	9-3-3
DP oper force F6	The double-precision operation force (F6) function key allows the values of double-precision registers to be displayed in standard or advanced function blocks contained in the networks.	9-3-4
Reg. F7	The register (F7) function key allows the display and changing of the values of registers or IG/OG groups isolated from the display of any network.	9-3-5

With the Monitor mode's primary screen displayed, the operator positions the cursor on a contact of the coil to be searched. Press the F3, trace, function key to display the network in the ladder diagram containing the associated coil. If additional coils with the same reference number exist in the ladder diagram, press the F3, trace, function key again to display the next successive network in the ladder.

The F3, trace, key can be pressed repeatedly until all of the coils with the same reference number have been displayed. At this time the message SEARCH NOT FOUND is displayed.

The F4, retrace, function key is pressed to reverse the trace operation. Each time the retrace function key is pressed, the network containing the previous coil traced

is displayed. The retrace operation continues until the first network of the trace operation is again displayed. Pressing the retrace function key again causes the message RETRACE STACK EMPTY to be displayed.

### 9-3-3. FORCE

The F5, force, function key allows the overriding of the normal, processor-controlled operation of IN contacts or CR coils where:

- Coils are "forced" into and held in an on or off state
- Contacts are "forced" into and held in a conducting or nonconducting state

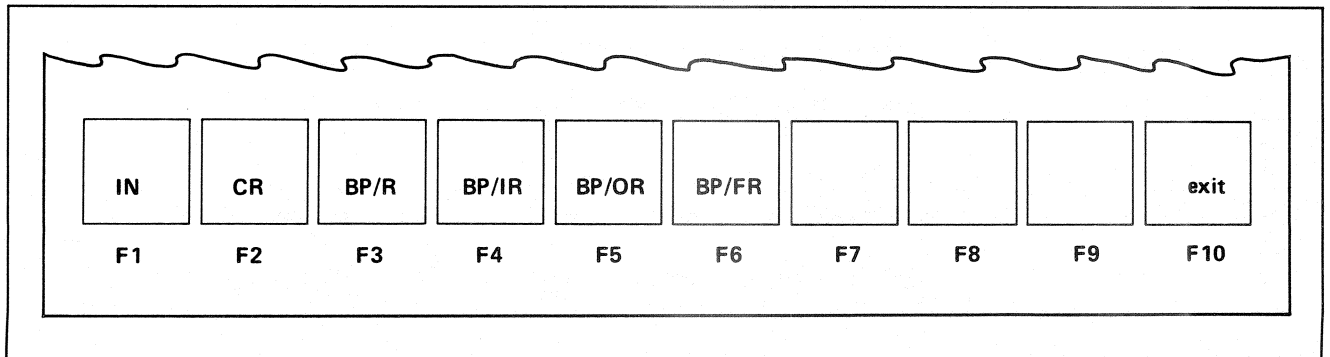


Figure 9-2. Secondary Contact Screen



When coils and contacts are forced, a variety of resulting conditions can occur. See Table 9-2.

**WARNING**

THE OUTPUT CIRCUIT CONTAINED IN THE OUTPUT MODULE WHICH IS ASSOCIATED WITH A CR COIL IN A FORCED ON CONDITION IS ENERGIZED, AND THE OUTPUT CIRCUIT ASSOCIATED WITH A CR COIL IN A FORCED OFF CONDITION IS DE-ENERGIZED. FORCING OUTPUTS CAN CAUSE EQUIPMENT DAMAGE AND/OR PERSONNEL INJURY BY CREATING UNEXPECTED MA-

CHINE MOVEMENTS OR PROCESS OPERATIONS. ONLY QUALIFIED PERSONNEL FAMILIAR WITH THE HPPC-1500/-1700 AND THE ASSOCIATED MACHINE OR PROCESS SHOULD ATTEMPT ANY FORCING OPERATIONS.

**WARNING**

FORCED I/O CAN BE CHANGED FROM THE OFF TO ON STATE OR ON TO OFF STATE IF THE INPUT GROUP (IG) OR OUTPUT GROUP (OG) IS MODIFIED BY MEANS OF THE REGISTER OPERATION AS DESCRIBED IN PARAGRAPH 9-3-5.

**TABLE 9-2. FORCED ELEMENT RESULTS**

Forced Element	Forced Condition	Resulting Conditions
IN -] [- or IN -]N[-	On	<ul style="list-style-type: none"> <li>All normally open contacts with the same reference number are forced to the conducting state.</li> <li>All normally closed contacts with the same reference number are forced to the nonconducting state.</li> <li>All networks containing contacts with the same reference number are affected. The associated coils may turn on or off in response to the force, depending on other elements in the networks.</li> </ul>
IN -] [- or IN -]N[-	Off	<ul style="list-style-type: none"> <li>All normally open contacts with the same reference number are forced to the nonconducting state.</li> <li>All normally closed contacts with the same reference number are forced to the conducting state.</li> <li>All networks containing contacts with the same reference number are affected. The associated coils may turn on or off in response to the force, depending on other elements in the networks.</li> </ul>
CR -( )- or CR -] [- CR -]N[-	On	<p>Same as results listed above for the IN -] [- forced On plus the following:</p> <ul style="list-style-type: none"> <li>CR coil with the same reference number is forced to a conducting state.</li> </ul>
CR -( )- or CR -]N[- CR -]N[-	Off	<p>Same as results listed above for the IN -] [- forced Off plus the following:</p> <ul style="list-style-type: none"> <li>CR coil with the same reference number is forced to a nonconducting state.</li> </ul>



### WARNING

FORCED I/O CAN BE CHANGED FROM AN OFF TO ON STATE OR AN ON TO OFF STATE IF THE INPUT GROUP OR OUTPUT GROUP IS MODIFIED BY A STANDARD OR ADVANCED FUNCTION BLOCK. THIS CAN OCCUR WHEN THE PROGRAMMABLE FUNCTION MODIFIES THE INPUT OR OUTPUT GROUP CONTAINING THE FORCED CONTACTS OR COILS. THE RESULTING STATE CHANGE CAN CAUSE PERSONNEL INJURY AND/OR EQUIPMENT DAMAGE BY CREATING UNEXPECTED MACHINE MOVEMENTS OR PROCESS OPERATIONS.

### WARNING

THE CR COILS AND OTHER OUTPUTS ASSOCIATED WITH THE LADDER DIAGRAM ENERGIZE AND DE-ENERGIZE IN RESPONSE TO THE LOGIC OF FORCED IN CONTACTS, REGARDLESS OF THE ACTUAL STATE OF THE INPUT CIRCUIT CONTAINED IN THE INPUT MODULES. FORCING INPUTS CAN CAUSE EQUIPMENT DAMAGE AND/OR PERSONNEL INJURY RESULTING FROM OUTPUTS TURNING ON OR OFF IN RESPONSE TO THE FORCED INPUTS. ONLY QUALIFIED PERSONNEL FAMILIAR WITH THE HPPC-1500/-1700 AND THE ASSOCIATED MACHINE OR PROCESS SHOULD ATTEMPT ANY FORCING OPERATIONS.

### WARNING

FORCED IN CONTACTS OR CR COILS REMAIN FORCED, EVEN AFTER THE LOADER IS DISCONNECTED FROM THE SYSTEM. FAILURE TO CLEAR FORCED CONTACTS AND COILS CAN CAUSE UNEXPECTED FUNCTIONING OF THE OUTPUTS, RESULTING IN EQUIPMENT DAMAGE AND/OR PERSONNEL INJURY. ALWAYS REMOVE FORCED CONDITIONS AFTER MAINTENANCE OR PROGRAM DEBUGGING OPERATIONS HAVE BEEN COMPLETED.

Coils and contacts are forced with the results listed in Table 9-2.

With the Monitor mode's primary screen displayed, to force an IN contact or CR coil perform the following:

**Step 1** – Press the F5, force, function key.

The resulting screen displays the function key force selections shown in Figure 9-3.

**Step 2** – Position the cursor on the desired IN contact, CR contact, or CR coil.

Note: It may be desirable to use the Search function to locate the network containing the IN contact or CR coil prior to step 1 listed above.

**Step 3** – Press the F1, force on, function key to:

- Force a normally open IN contact to conduct
- Force a normally closed IN contact to be non-conducting

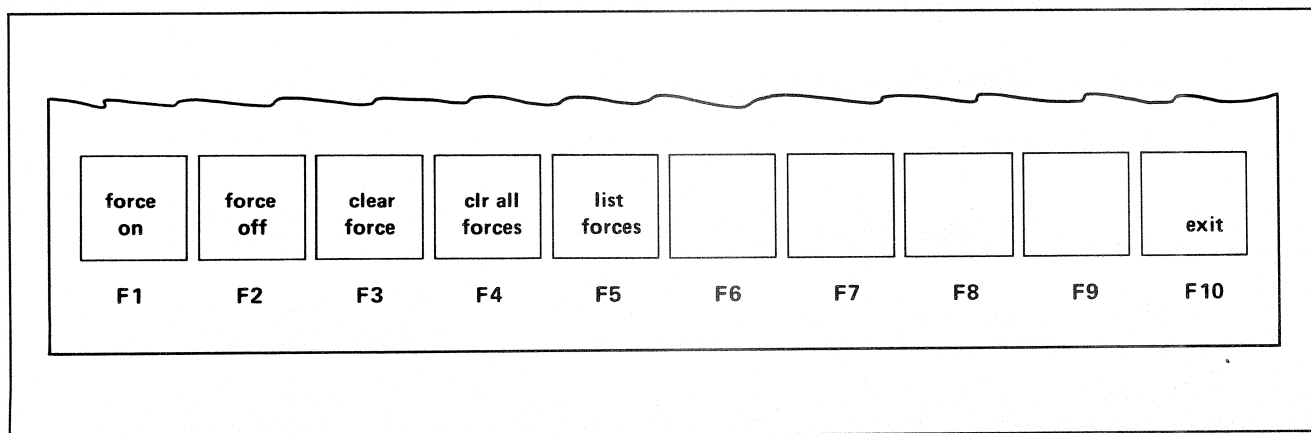


Figure 9-3. Force Function Key Selections



- Force a CR coil on, or energized. At this time all the associated contacts of the coil will be forced as well.

Alternately, press the F2, force off, function key to:

- Force a normally open IN contact to be non-conducting
- Force a normally closed IN contact to conduct
- Force a CR coil off, or de-energized

**Note**

Forcing a CR contact forces an associated coil, if any, to the same on or off status. This occurs even if the coil is contained in a different network than the forced CR contact.

**Step 4** – Press the F3, clear force, function key to remove an existing force on any contact on which the cursor is positioned.

The F4, clear all forces, function key removes all forces which have been entered.

The F5, list force, function key displays each force currently in effect. This should be used to verify that all forces have been removed.

The F10, exit, function key returns the screen to the primary screen of the Monitor mode.

**9-3-4. DOUBLE-PRECISION OPERATION**

The double-precision function key selection (F6, DP oper display) causes the actual values in double-precision registers to be displayed in any standard or advanced function blocks containing double-precision registers.

**Note**

The letters dp normally appear in the standard or advanced function block next to the double-precision register, as shown in Figure 9-4(a).

Each time the F6, DP oper display, function key is pressed, the display alternates between the normal display shown in Figure 9-4(a) and the display of the double-precision values **without** the register number as shown in Figure 9-5(b).

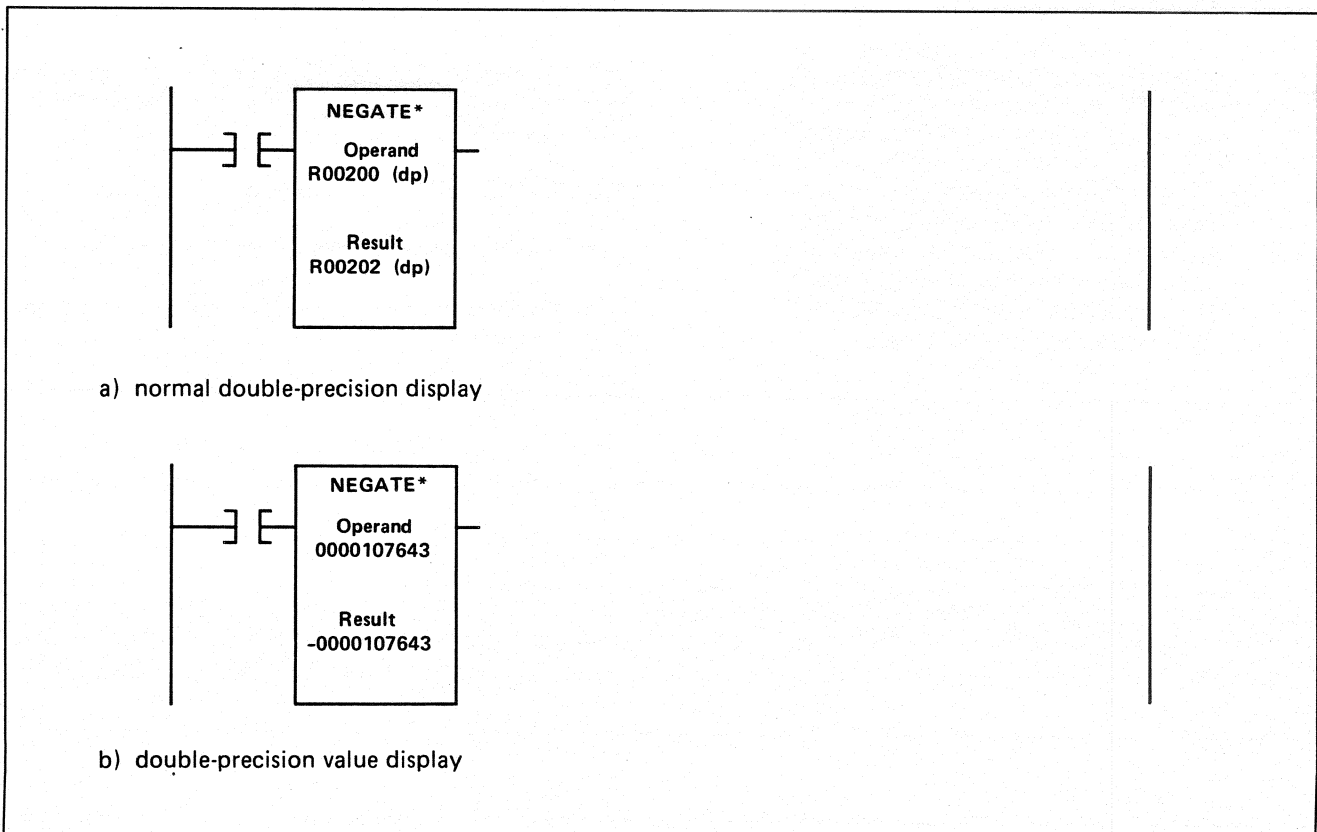


Figure 9-4. Double Precision Display



### 9-3-5. REGISTER OPERATIONS

The register operation, initiated by pressing the F7, register, function key of the Monitor mode's primary screen, provides the capability to:

- Monitor the values of registers or IG/OG groups (9-3-5-1)
- Load or change the values of registers or groups (9-3-5-2)

#### 9-3-5-1. REGISTER OR GROUP MONITORING

Perform the following items to monitor the value of a desired register or group:

**Step 1** – With the Monitor mode's primary screen displayed, position the cursor in a clear area of the screen.

**Step 2** – Press the F7, reg, function key.

The function key listing shown in Figure 9-5 is displayed.

**Step 3** – Select the desired numbering system for the value of the register or group to be displayed by pressing one of the following keys:

- F1, decimal
- F2, binary
- F3, hexadecimal
- F4, ASCII
- F5, double-precision decimal

Pressing one of the F1 thru F5 function keys selects the type of numbering system or code used in the display of values for the register or group. It also causes the display of the screen shown in Figure 9-6.

**Step 4** – Press the F1, single, function key to display one register or group. Alternately, press the F2, table, function key to display a table of registers or groups.

Note: When the F2 key is pressed, the message ENTER TABLE LENGTH is displayed.

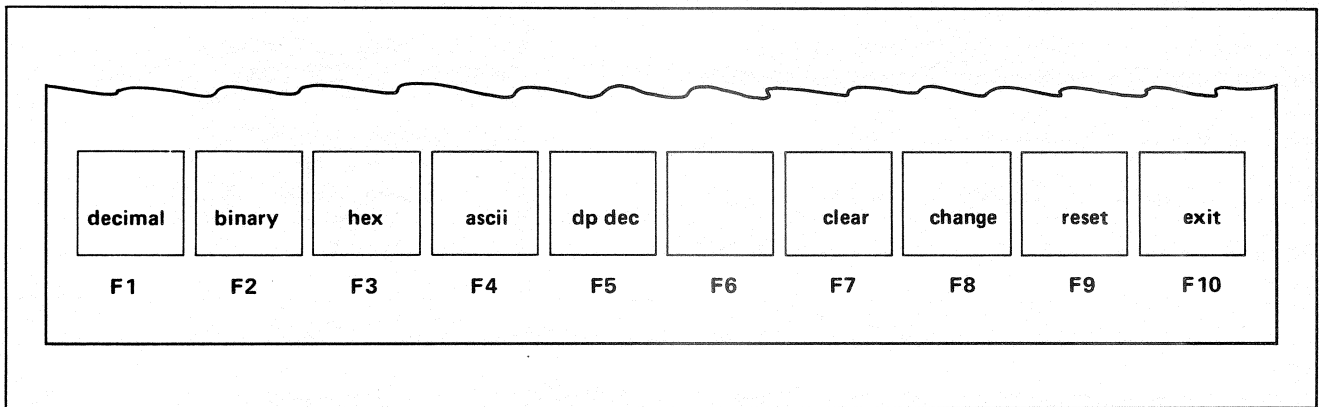


Figure 9-5. Secondary Register Screen

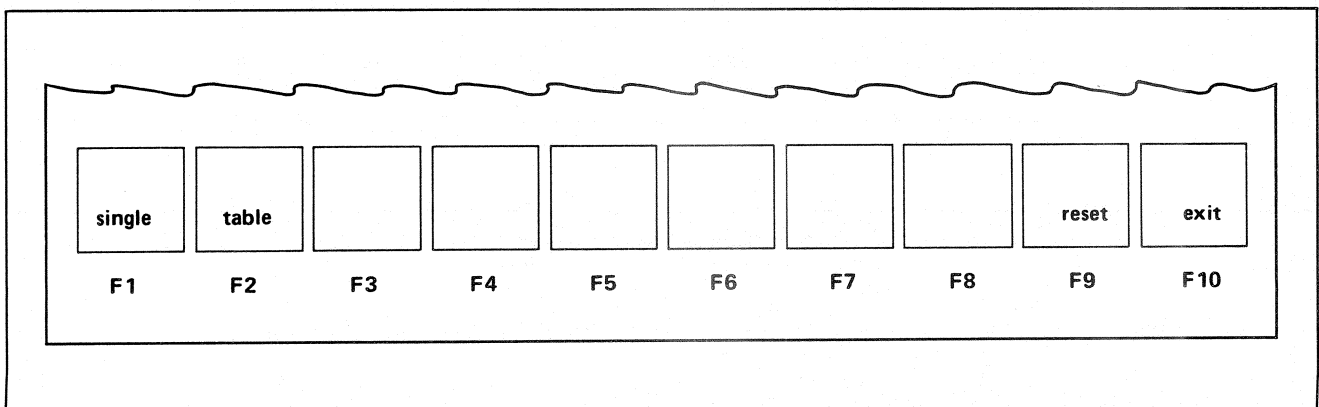


Figure 9-6. Single/Table Register Screen



**Step 5** – If the F2, table, function key is selected, the desired number of registers or groups to be displayed must be entered. Then press the Enter key (↵).

Note: A maximum of 42 registers or groups can be displayed on the screen at any time. When registers require more room on the screen, the Loader defaults to 21 registers or groups.

After the single or table selection is completed, the screen shown in Figure 9-7 is displayed.

**Step 6** – Press one of the F1 thru F5 keys to select the desired register or group type.

**Step 7** – Enter the desired reference number of the register or group to be monitored.

If a table is selected, enter the first register or group number in the table.

**Step 8** – Press the Enter key (↵).

The register or group reference number selected along with its value are displayed on the screen. The value is displayed in the selected numbering system or code. To reselect a different register or group, press the F7, clear, function key. Then repeat Steps 3 thru 8, listed above, or use the Pg Up or Pg Dn keys of the cursor/number pad keys to scroll the registers up or down.

### 9-3-5-2. LOADING REGISTER OR GROUP VALUES

To load or change the value of a register or IG/OG

group, the desired register or group must first be monitored on the screen, as described in Steps 1 thru 8 of Paragraph 9-3-5-1. Then perform the following:

**Step 1** – Position the cursor on the register or group to be changed.

**Step 2** – Press the F8, change, function key.

**Step 3** – Enter the new value.

**Step 4** – Press the Enter key (↵).

The new value is loaded into the register or group on which the cursor was positioned.

Alternately, when changing many values in a table, use the ↑ and ↓ keys of the cursor/number pad keys to select each register or group and enter the new value. When the entries have been completed, press the Enter key (↵) once to load or change the values.

### WARNING

**CHANGING THE VALUE OF AN INPUT GROUP (IG) OR OUTPUT GROUP (OG) OVERRIDES ANY FORCED CONDITIONS ASSOCIATED WITH THE GROUPS. THIS CAN CAUSE UNEXPECTED MACHINE MOVEMENTS OR PROCESS OPERATIONS, RESULTING IN PERSONNEL INJURY AND/OR MACHINE DAMAGE.**

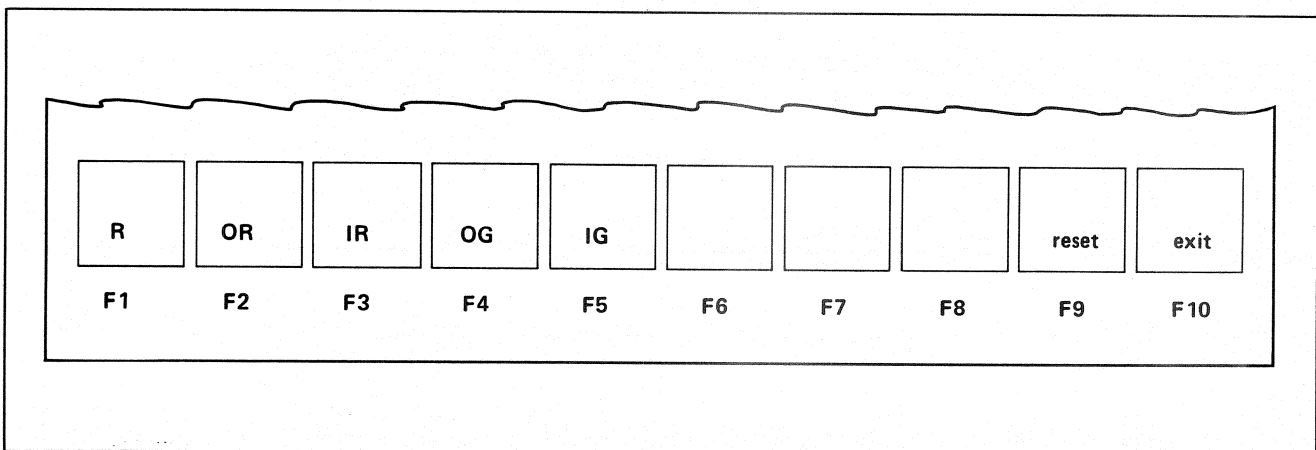


Figure 9-7. Register/Group Select Screen



## Section 10

# Registers, Groups, and Constants

### 10-1. INTRODUCTION

Standard and advanced programmable functions often manipulate groups of data which are 16 bits (single-precision) or 32 bits (double-precision) in length. Understanding how these groups of bits interrelate to each other, and, also, how they relate to register inputs and outputs is fundamental to monitoring and loading the functions. The groups of data associated with the standard and advanced functions are described in this Section as follows:

- Constants (10-2)
- Holding registers (R) (10-3)
- Output registers (OR) (10-4)
- Input registers (IR) (10-4)
- Output groups (OG) (10-5)
- Input groups (IG) (10-5)

During the discussions of the various types of registers and IG/OG groups, the reader should keep the following items in perspective:

1. Data in the processor operated on by the standard and advanced functions is always in binary form—that is, 1s (ones) and 0s (zeros).
2. The individual binary 1s and 0s are combined to form binary numbers. The numbers can be positive (bit 16=0), or negative (bit 16=1). When binary numbers are negative, the processor assumes the data is in 2s complement binary form.
3. The various standard and advanced functions primarily manipulate binary data. However, the 1s and 0s in registers or IG/OG groups can actually represent any of the following types of data:

- Binary data in either a positive or a 2's complement form
- Binary coded decimal (BCD)
- Hexadecimal
- ASCII data
- Sign-magnitude data

The BCD, hexadecimal, and ASCII data originates primarily as "input data" from various input modules. Usually this data is either stored in holding registers (R) or converted to binary for use with various standard and advanced functions. The sign-magnitude data originates from an I/O module such as an Analog Input Module. It may also be output from the processor to an Analog Output Module. The Analog Out (048) and Analog In (049) programmable functions convert binary data to and from sign-magnitude type data, respectively.

The Advanced Program Loader is used to load and monitor the registers or groups associated with the standard or advanced functions. Also, a single register or group, or a table of registers or groups, can be displayed as specified by the operator in the Monitor mode. Section 9 describes how to perform the various monitoring operations, while Paragraph 9.3.5 describes how to load a register with data.

### 10-2. CONSTANTS

The constants associated with registers or IG/OG groups are entered into, and appear in, the standard or advanced function block without reference to a register or group number. (See Figure 10-1.) These constant values are stored in the memory of the processor, but their actual storage locations are transparent to the programmer or maintenance personnel. Constants are fixed values assigned by a programmer. They perform functions associated with the standard and advanced functions.

The value of each constant is entered in the Program mode. It is a decimal value in the range from -32,768 to +32,767 for a single-precision value, or from -2,147,483,648 to +2,147,483,647 for a double-precision value.

### 10-3. HOLDING REGISTERS

Holding registers (R) are used in the ladder diagram to provide any of the following capabilities:

- To hold data results such as the actual value of a timer or counter
- To store values used as constants by the ladder diagram which are stored in a known location

Holding registers are assigned to specific registers for use with standard and advanced function blocks. The data

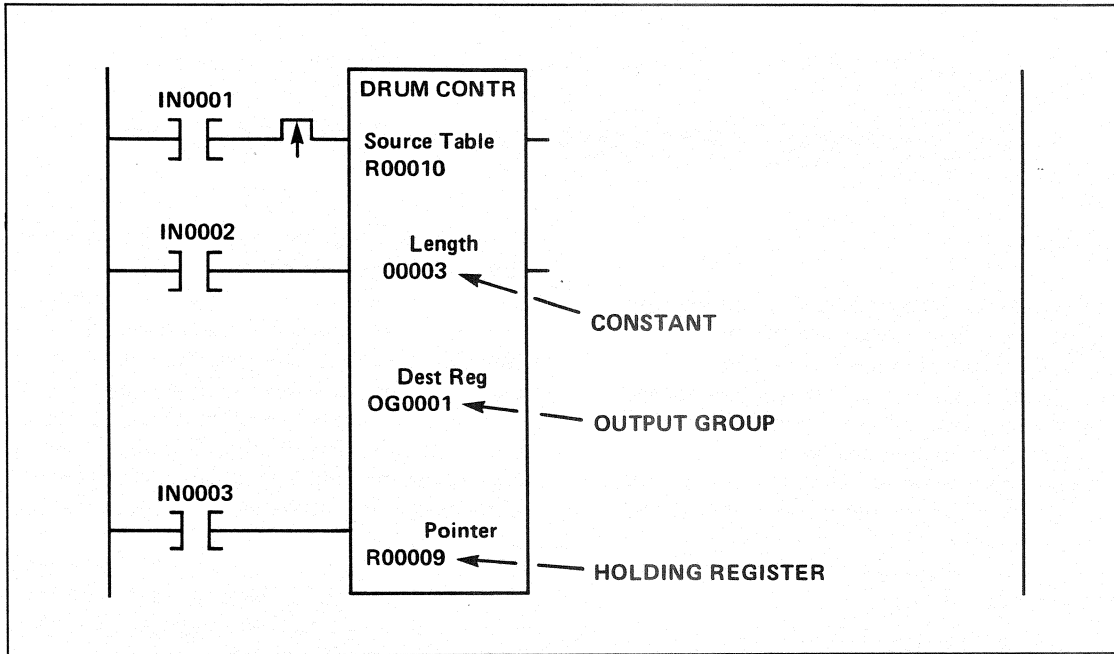


Figure 10-1. Constant Example

contained in these registers is supplied in either of the following 2 ways:

1. The standard or advanced programmable functions can load data into a holding register. An example is when a holding register is used to contain the result of a math type programmable function.
2. The Monitor mode's F7, Reg, function key is initially used to enter constant values that will not be changed by the Loader into a holding register, as described in Paragraph 9.3.5.2.

The processor automatically reserves all holding registers from R00001 to the highest assigned in the ladder diagram, whether or not all are used. For example, when R00200 is assigned to a programmable function, space is reserved in memory for 200 holding registers even if the other 199 are not used. For this reason registers should be assigned in an orderly sequence starting with R00001.

#### 10-4. INPUT, OUTPUT REGISTERS

The input registers (IR) and output registers (OR), each consisting of 16 bits of data, are programmed in the standard and advanced functions, but they are also closely linked or associated with real-world I/O hardware. The following 4 points must be kept in mind:

1. A Register Input Module is used to transfer the input data to the processor. This data is recognized by the processor as being located in input register reference

numbers such as IR0001 and IR0032. Input register reference numbers can range from IR0001 to IR0512.

2. A Register Output Module receives data from the processor. This data is associated with an output register type reference number such as OR0001 or OR0025. Output register reference numbers can range from OR0001 to OR0512.

3. Switches contained in the I/O Racks determine which slots of the individual I/O Rack corresponds to IR or OR reference numbers.

4. The transfer of register type data between the I/O modules and the processor is controlled by the I/O scan.

#### 10-5. INPUT, OUTPUT GROUPS

An input group (IG) consists of 16 bits of data corresponding to 16 discrete input circuits contained on a single Input Module of the double-height kind. It may also correspond to the circuits contained on 4 single-height modules. Input groups, preceded by the letters IG, range from IG0001 to IG0512.

An output group (OG) consists of 16 bits of data corresponding to circuits contained on Output Modules, as noted above. Output groups, preceded by the letters OG, range from OG0001 to OG0512.

The relationship between groups and discrete I/O reference numbers is shown in Figure 10-2. Observe the Figure and note the following 3 points:





1. Each input group corresponds to 16 discrete input reference numbers. For example, IG0001 corresponds to discrete inputs IN0001 thru IN0016.
2. Each output group corresponds to 16 discrete output reference numbers. For example, OG0002 corresponds to discrete outputs CR0017 thru CR0032.
3. When an input group or output group is used with a

standard or advanced programmable function block, all 16 bits of data are accessed at once at the time the function is enabled.

All input and output groups contained in the ladder diagram must be configured as described in Paragraph 7-8. If the group is not configured, any attempt to enter a programmable function containing the unconfigured address into memory causes the message INVALID REFERENCE NUMBER to be displayed.

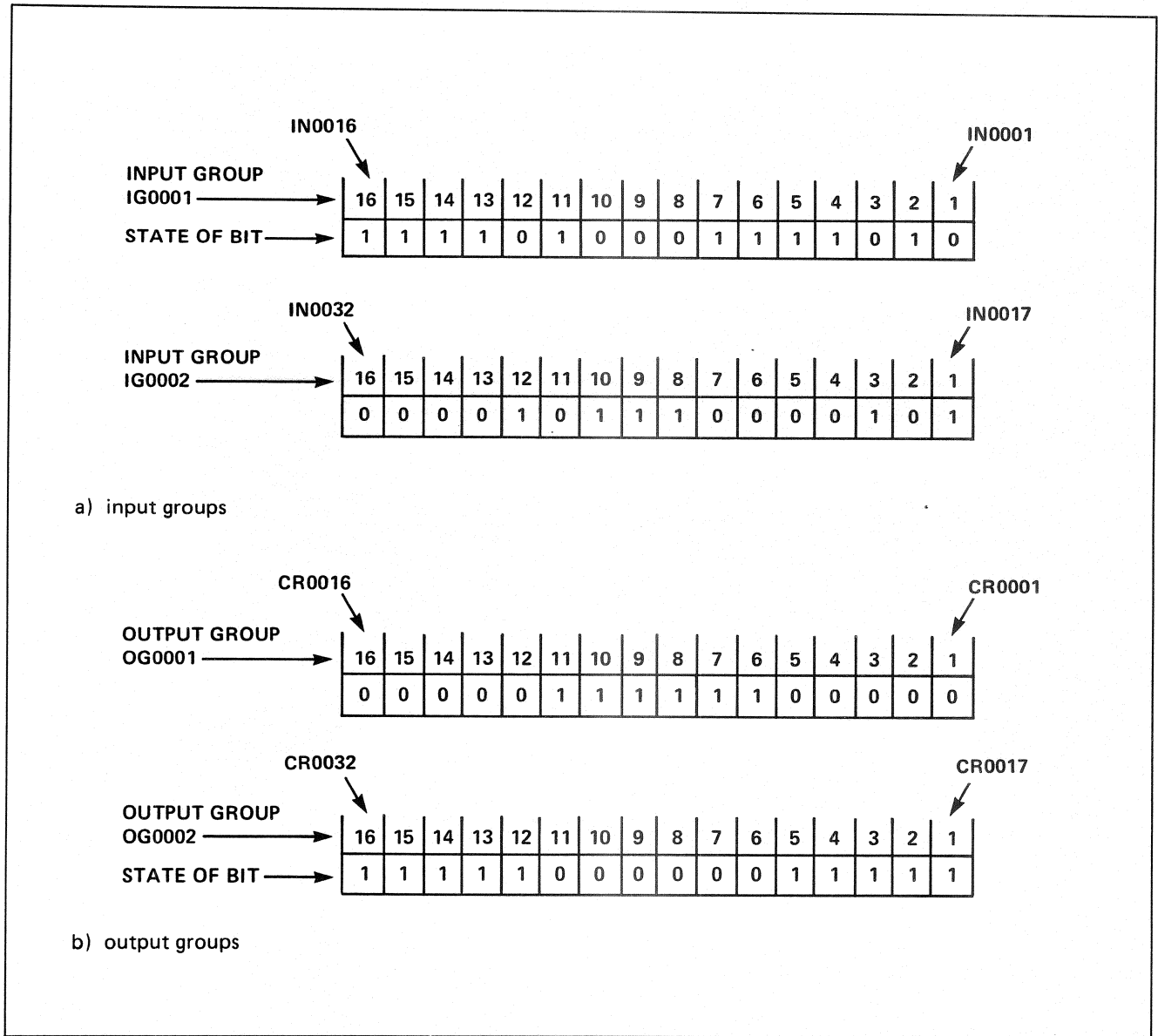


Figure 10-2. I/O Group Related to Discrete Addresses



# Section 11

## Search Function

### 11-1. INTRODUCTION

The Search function allows the locating of specified elements or networks contained in the ladder diagram from either the Program or Monitor modes. A listing relating Search function capabilities to specific function keys is contained in Table 11-1. Observe the Table and note the following 4 points:

1. The Search function's primary screen provides the F1 thru F7 selections. (See Figure 11-1.)
2. In addition to searching for contacts, coils, programable functions, user-defined special function sub-routines, and networks, the Search function also allows the locating of a specified register or IG/OG groups used in the ladder diagram. It also allows the listing of any I/O configured, but not actually used, in the ladder diagram.
3. The Paragraph containing a description of each function key selection is listed on the right column of the Table.

4. To initiate the Search function and display the screen shown in Figure 11-1:

- Press and hold the Ctrl key
- Press the S key

#### Note

The Search function can be initiated from either the Program or Monitor modes. When the Search function is completed, the Loader returns to its previous mode.

A summary of Search Function related commands is listed in Table 11-2.

### 11-2. SEARCHING FOR CONTACTS

The F1, contact, function key, when selected from the Search function's primary screen, allows the selection of, and the searching for, any contact type and related reference number throughout the ladder diagram.

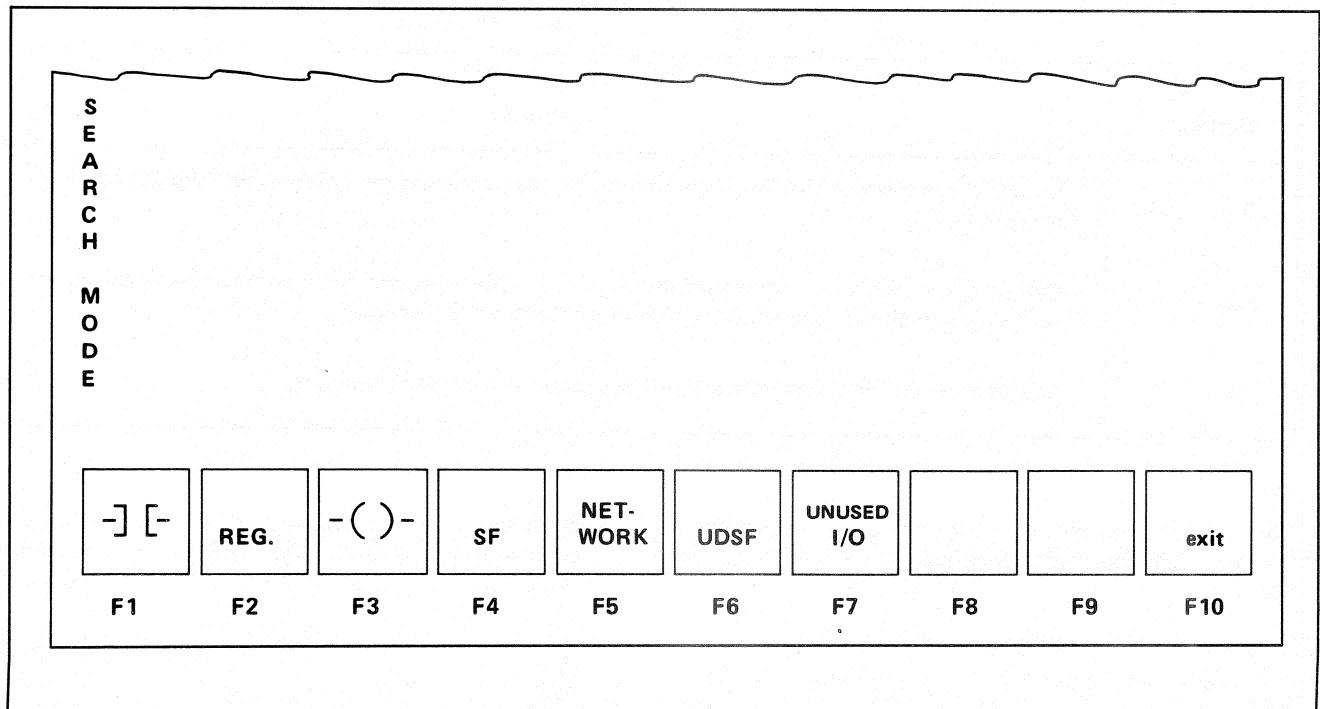


Figure 11-1. Search Function's Primary Screen



TABLE 11-1. SEARCH SELECTIONS

Function Key	Description	Reference Paragraph
F1 -] [-	Search for any contact type and address contained in the ladder diagram.	11-2
F2, Reg.	Search for any register or IG/OG group contained in the ladder diagram.	11-3
F3 -( )-	Search for any coil type and address contained in the ladder diagram.	11-4
F4, SF	Search for the specified programmable functions in the ladder diagram.	11-5
F5 Network	Search for a specified network in the ladder diagram.	11-6
F6 UDSF	Search for the specified user-defined special function subroutine.	11-7
F7 Unused I/O	List I/O configured but not used in the ladder diagram and/or the holding registers not used.	11-8

TABLE 11-2. SEARCH RELATED COMMANDS

Keying Sequence	Explanation
Ctrl S	Causes the display of the Search function's primary screen directly from the Program or Monitor mode.
Ctrl Z	Causes the search to be <b>continued</b> through the ladder diagram for a contact, coil, register, or IG/OG group already searched for, found, and currently displayed.
N	Causes a search for a new network not yet assigned a network number.

The following procedure describes how to search for a contact when the Search function has been initiated and the screen shown in Figure 11-1 is displayed:

**Step 1** – Press the F1, contact, function key to display the screen and function key selection shown in Figure 11-2.

**Step 2** – Press one of the F1 thru F7 function keys to

select a special type of contact. When this selection has been made, the contact "type" along with a dummy reference number appear in the center of the screen.

**Step 3** – Key in the specific reference number of the contact.

**Step 4** – Press the Enter key (↵).

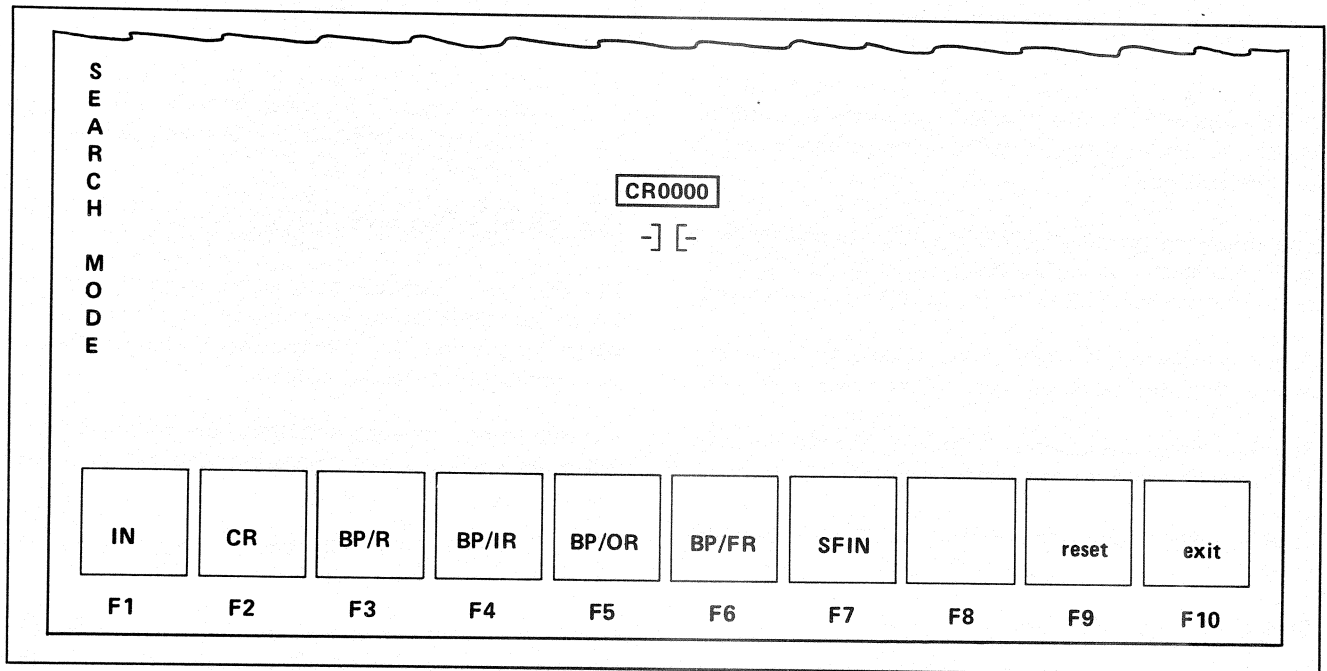


Figure 11-2. Contact Type Selection

Note: When entering contacts containing BP (bit pick) types and register numbers, the Enter key must be pressed after each of the 2 reference numbers.

**Step 5** – Select the portion of the ladder diagram to be searched from the function key portion of the screen shown in Figure 11-3. This screen is displayed immediately after entering the contact's reference number.

Note: **Only** the F1 thru F4 keys need be pressed to initiate this type of search. Also, although the F3, all memory, function key can be pressed, alternately the Enter key (↵) can be pressed to achieve the same "all memory" result.

The search is initiated immediately after selecting the F1 thru F4 function keys described in Step 5, listed above. The first network containing the contact searched for is displayed on the screen. If the contact is not contained in the ladder diagram, the message SEARCH WORD NOT FOUND is displayed.

**Note**

To continue searching through the ladder diagram program for the same contact, press and hold the Ctrl key, and then press the Z key.

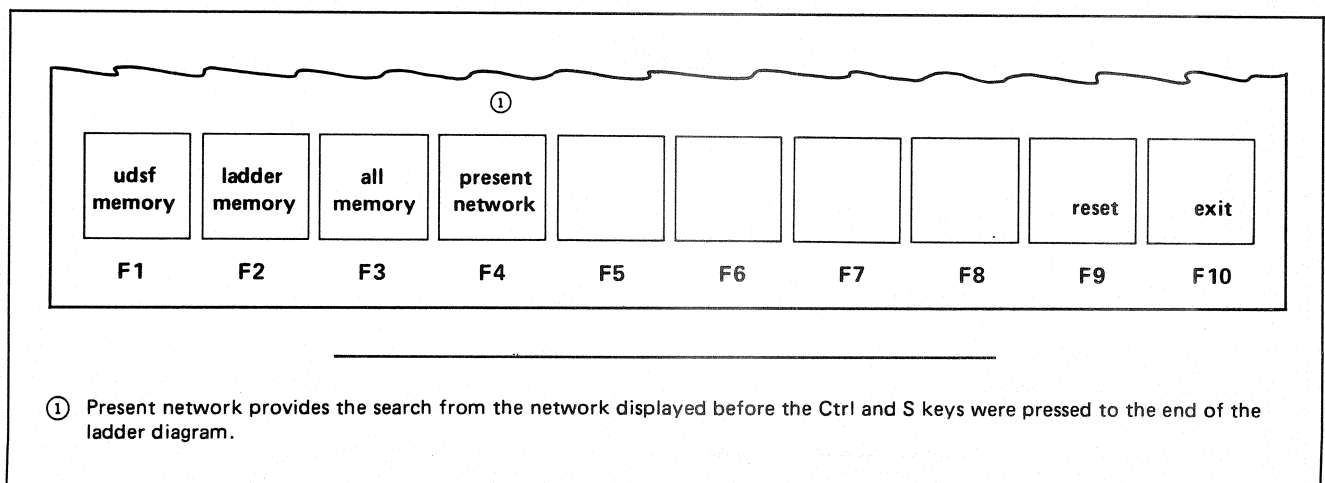


Figure 11-3. Ladder Diagram Portion Selection



### 11-3. SEARCHING FOR REGISTERS

The F2, REG., function key, when selected from the Search function's primary screen, allows the operator to search for any register or IG/OG group programmed in the ladder diagram.

The following procedure describes how to search for a specified register or IG/OG group when the Search function's primary screen, shown in Figure 11-1, is displayed.

**Step 1** – Press the F2, REG., function key to display the register or group selection screen shown in Figure 11-4.

**Step 2** – Press one of the F1 thru F5 function keys to select the desired type of register or group.

**Step 3** – Key in the reference number of the register or group.

**Step 4** – Press the Enter key (↵).

**Step 5** – Select the portion of the ladder diagram to be searched for from the screen shown in Figure 11-3. This screen is displayed immediately after entering the register or group reference number.

The search is initiated immediately after pressing one of the F1 thru F4 function keys, described in Step 5, listed above. The first network in the ladder diagram containing the register or group being searched for is displayed on the screen. If the register or group is not contained in the ladder diagram, the message SEARCH WORK NOT FOUND is displayed.

### Note

To continue searching through the ladder diagram for the same register or group, press and hold the Ctrl key, and then press the Z key.

### 11-4. SEARCHING FOR COILS

The F3, coil, function key, when selected from the Search function's primary screen, allows the operator to search for any coil type and associated reference number programmed in the ladder diagram.

The following sequence describes how to search for a coil when the Search function is initiated and the screen, shown in Figure 11-1, is displayed.

**Step 1** – Press the F3, coil, function key to display the screen shown in Figure 11-5.

**Step 2** – Press one of the F1 thru F8 function keys to select the specific type of coil to be searched. When this selection has been made, the coil displayed in the center of the screen indicates the selection.

**Step 3** – Key in the reference number of the coil.

**Step 4** – Press the Enter key (↵).

Note: When entering coils containing BP (bit pick) types and register numbers, the Enter key must be pressed after each of the 2 reference numbers.

**Step 5** – Select the portion of the ladder diagram to be

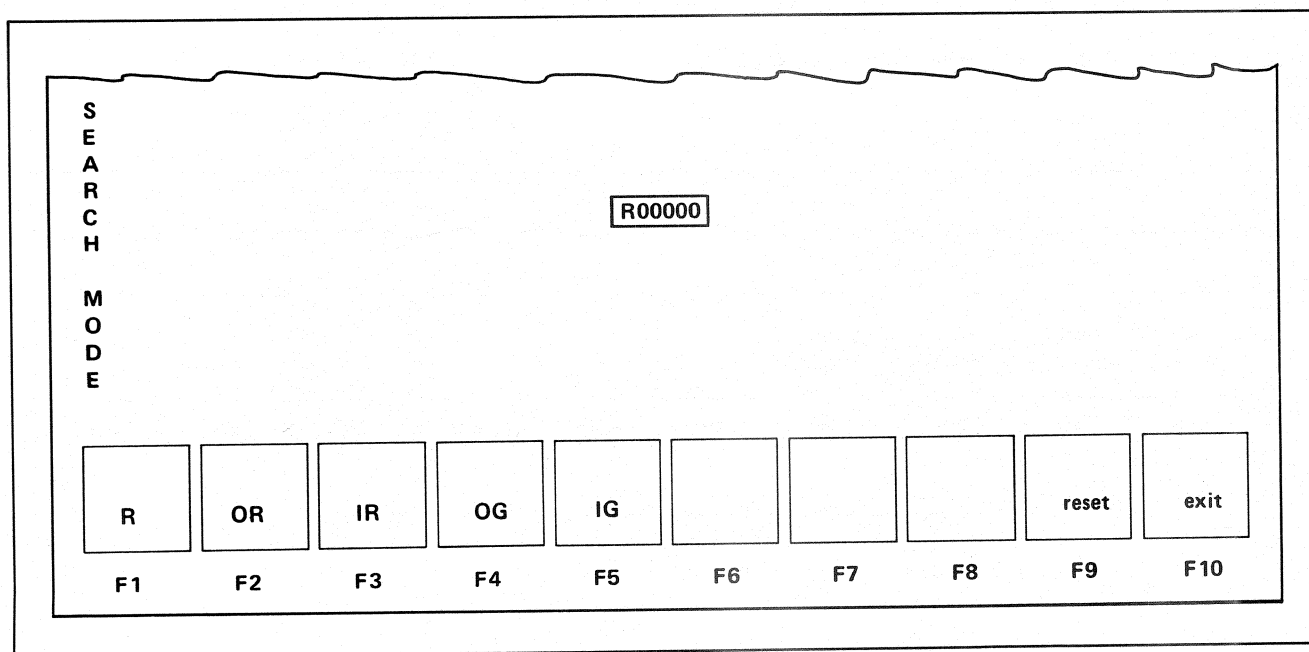


Figure 11-4. Register or IG/OR Group Selection

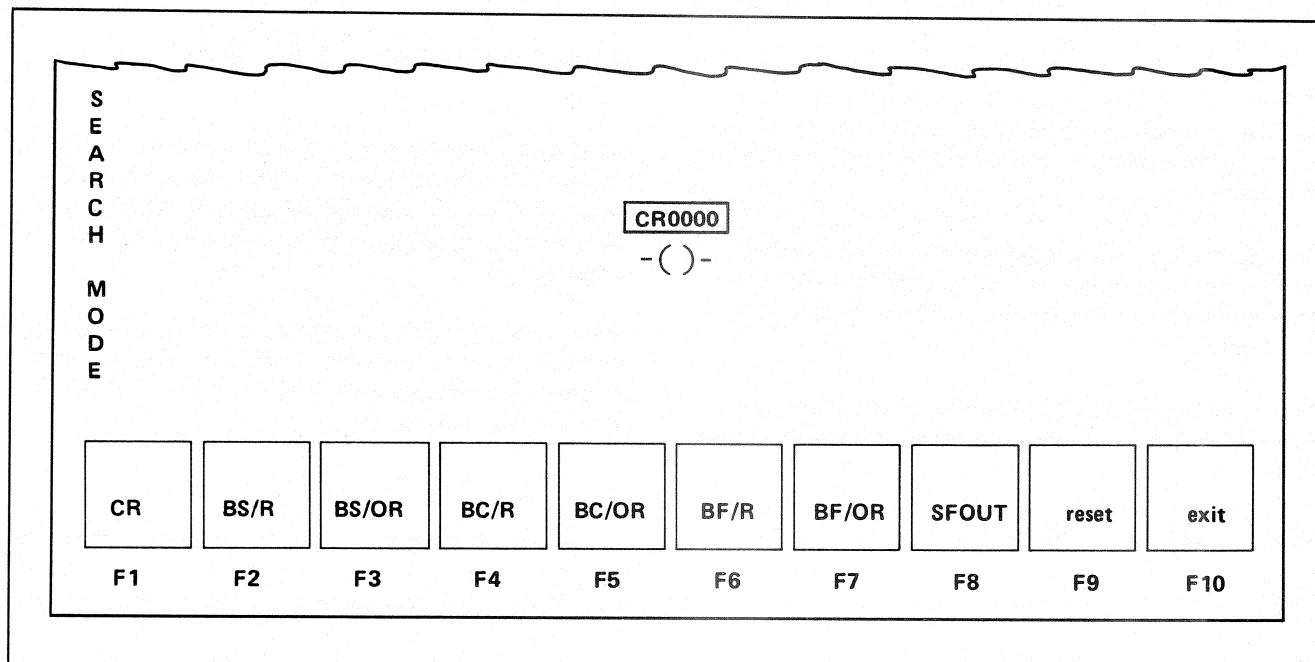


Figure 11-5. Coil Type Selection

searched from the screen shown in Figure 11-3. This screen is displayed immediately after entering the coil's reference number.

The search is initiated immediately after selecting one of the F1 thru F4 function keys described in Step 5, listed above. The first network containing the coil searched is displayed on the screen. If the coil is not contained in the ladder diagram, the message SEARCH WORD NOT FOUND is displayed.

**Note**

To continue searching through the ladder diagram for the same coil, press and hold the Ctrl key, and then press the Z key.

**11-5. SEARCHING FOR PROGRAMMABLE FUNCTIONS**

The F4, SF, function key, when selected from the Search function's primary screen, allows the searching for any standard or advanced programmable function block contained in the ladder diagram.

The following procedure searches for selected programmable functions when the Search function has been initiated and the screen, shown in Figure 11-1, is displayed:

**Step 1** – Press the F4, SF, function key to display the listing of programmable functions available.

**Note:** This is the same screen used when entering the programmable functions. (Pressing the F9, page, function key displays the second screen containing programmable functions.)

**Step 2** – Enter the 3-digit code assigned to the specific programmable function desired.

**Step 3** – Then press the Enter key (↵).

**Note:** Leading zeroes can be omitted.

**Step 4** – Select the portion of the ladder diagram to be searched from the screen shown in Figure 11-3.

This screen is displayed automatically after entering the 3-digit programmable function's code.

The search is initiated immediately after selecting one of the F1 thru F4 function keys described in Step 4, listed above. The first network containing the programmable function selected for the search is displayed on the screen. If the programmable function is not contained in the ladder diagram, the message SEARCH WORD NOT FOUND is displayed.

**Note**

To continue searching through the ladder diagram for the same programmable function, press and hold the Ctrl key, and then press the Z key.



## 11-6. SEARCHING FOR NETWORKS

The F5, NETWORK, function key, when selected from the Search function's primary screen, allows the searching for, and display of, a specified network number on the screen.

The following procedure describes how to search for a specific network number when the Search function has been initiated and the screen, shown in Figure 11-1, is displayed:

**Step 1** – Press the F5, NETWORK, function key—shown in Figure 11-1—to display the screen shown in Figure 11-6.

**Step 2** – Enter the network number.

**Step 3** – Press the Enter key (↵).

### Note

If the network searched for is a new network not assigned a number, simply press N to initiate the search for the new networks.

**Step 4** – Select the portion of the ladder diagram to be searched from the screen shown in Figure 11-3.

This screen is displayed automatically after selecting either a specific network number of N (for new network).

The search is initiated automatically after selecting one of the F1 thru F4 function keys described in Step 4, above.

Note: Only the F1 thru F4 keys need be pressed to initiate this type of search. Also, although the F3, all memory, function key can be pressed, alternately the Enter key (↵) can be pressed to achieve the same "all memory" result.

The network specified is displayed on the screen or, if the network is not contained in the portion of the ladder searched, the message SEARCH WORD NOT FOUND is displayed on the screen.

## 11-7. SEARCHING FOR UDSF

The F6, UDSF, function key, when selected from the Search function's primary screen, allows the display of the networks containing user-defined special function subroutines.

The following procedure describes how to search for a specific user-defined special function subroutine when the Search function has been initiated and the screen, shown in Figure 11-1, is displayed:

**Step 1** – Press the F6, UDSF, function key to display the screen which requests the desired UDSF number.

**Step 2** – Enter the UDSF subroutine number (1 thru 32).

**Step 3** – Press the Enter key (↵).

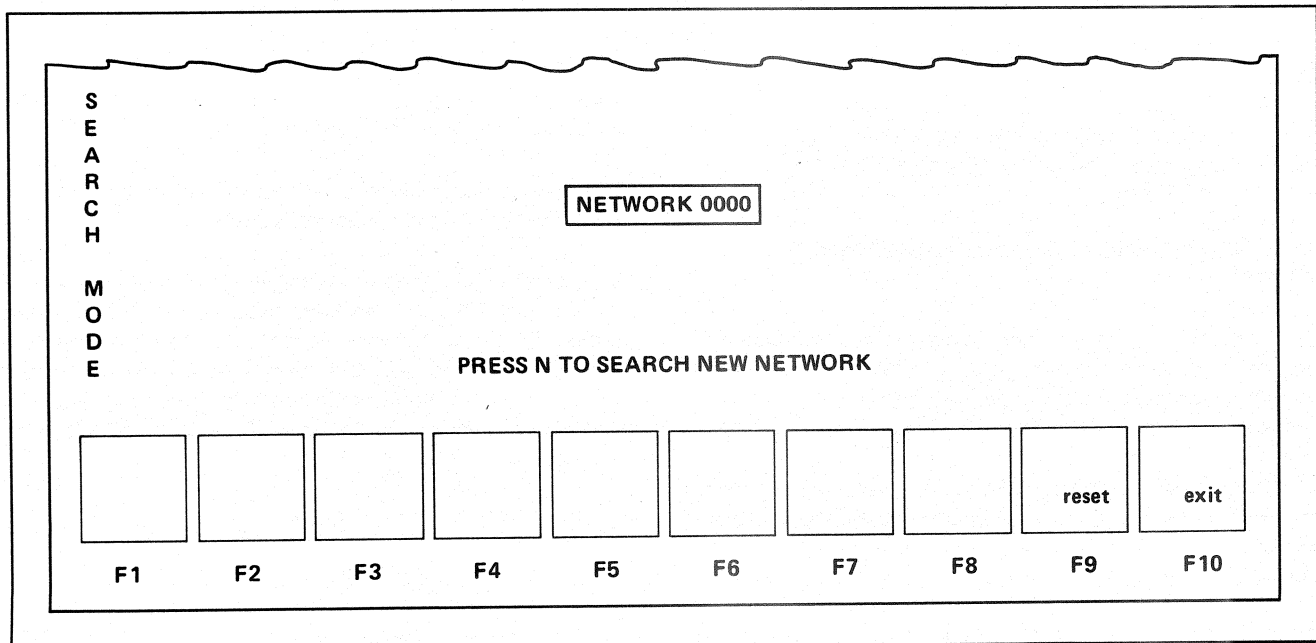


Figure 11-6. Network Search Screen



The beginning of the selected UDSF routine is displayed.

**Step 4** – Press the Pg Dn key to display the first network contained in the subroutine.

If the subroutine was not configured, the message SEARCH WORD NOT FOUND is displayed.

### 11-8. LISTING UNUSED I/O

The F7, UNUSED I/O, function key, when selected from the Search function's primary screen, allows the display of reference numbers of unused:

- Inputs (IN)
- Coils (CR)
- Holding registers (R)
- Output registers (OR)
- Input registers (IR)
- Output groups (OG)
- Input groups (IG)

The unused IN, CR, OR, IR, OG, and IG consist of any I/O configured as described in Paragraph 7-8, but not contained or actually used in the ladder diagram program.

The unused holding registers (R) consist of gaps in the holding registers not used by the programmer. Note: All holding registers from R00001 through the highest assigned by the programmer are automatically reserved by the processor when only one holding register is actually programmed. The holding register listing displays available holding registers which can be used without increasing the amount of memory configured for the ladder program.

The following procedure describes how to search for specific unused I/O when the Search function has been initiated and the screen, shown in Figure 11-1, is displayed:

**Step 1** – Press the F7, UNUSED I/O, function key to display the screen shown in Figure 11-7.

**Step 2** – Press one of the F1 thru F7 keys to search for the specified unused I/O or holding registers from reference number R00001.

**Step 3** – Press the Enter key (↵).

#### Note

To assure that a discrete I/O point is not used, search for both the discrete point and the associated IG/OG group. For example, if CR0017 thru CR0033 are not used, the output group OG0002 may still be used to control these outputs. Both must be unused before the I/O points or output group (OG) can be used in some other part of the program. (See Figure 10-2.)

**Step 4** – Optionally, a reference number of the contact, coil, register, or IG/OG group other than 0001 or 00001 can be entered. Then press the Enter key (↵).

This begins the unused I/O search at the number specified. The display subsequently lists the unused contacts, coils, registers, or groups.

#### Note

Groups of unused I/O are displayed with a dash between the first and last unused number: CR0022-CR0040 indicates that CR0022 thru CR0040 are unused.

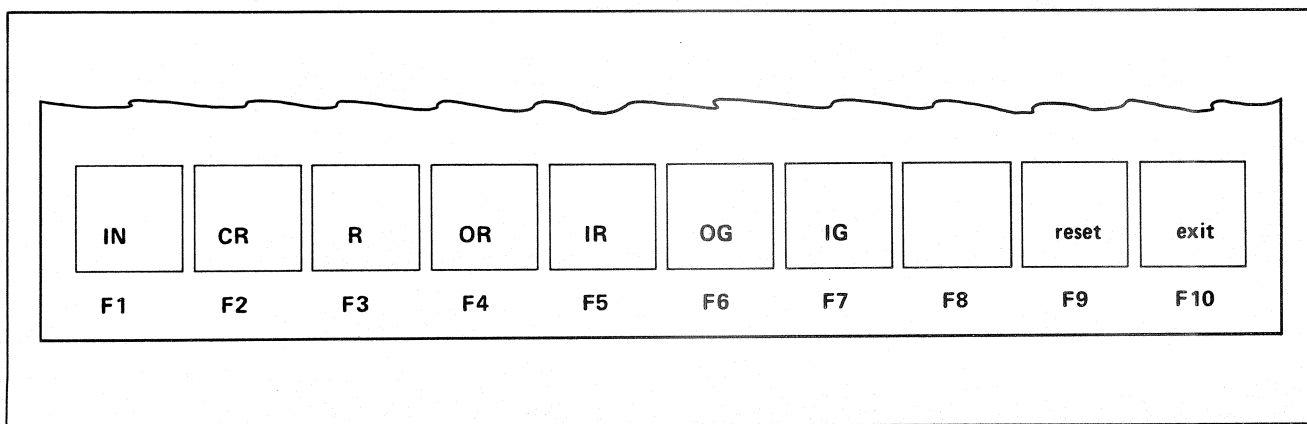


Figure 11-7. Unused I/O Selections





# Section 12

## Ladder Diagram Documentation

### 12-1. INTRODUCTION

Using the Advanced Program Loader, a programmer can assign identifying "labels" directly over coils and contacts in the ladder diagram. He may also write in man-readable comments directly under the ladder diagram networks. This ability is called the documentation feature of the HPPC-1500/-1700.

#### Note

The word "label" used with the documentation feature must be distinguished from the word "label" used with the reference number associated with a contact or coil. Refer to Figure 12-1 which shows the difference.

The labels and comments are structured as follows:

- Labels consist of up to 6 ASCII characters, and are assigned to IN or CR contacts. They appear above the contact and CR coil addresses.
- Comments consist of up to 3 lines (80 characters per line) of ASCII characters. The comments are printed below the network's elements.

#### Note

Memory must be reserved for I/O labels and comments during the configuration of the HPPC-1500/-1700 system, as described in Paragraph 7-8-2. If memory is not reserved for

documentation, or, if the labels and comments exceed the memory reserved, the message INSUFFICIENT MEMORY is displayed on the Loader's screen during the entry of the label or comment.

This Section describes the following label-related functions:

- Displaying labels, comments (12-2)
- Entering a single label directly from the Program or Monitor mode (12-3)
- Entering labels and comments from the Label function (12-4)

A summary of label keying sequences is given in Table 12-1.

### 12-2. DISPLAYING LABELS, COMMENTS

Labels and comments previously entered into the processor's memory are displayed at any time with the following procedure:

Step 1 – Display the network desired.

Step 2 – Press and hold the Ctrl key.

Step 3 – Press the K key briefly.

Step 4 – Release both keys.

The network is now shown with labels, if any.

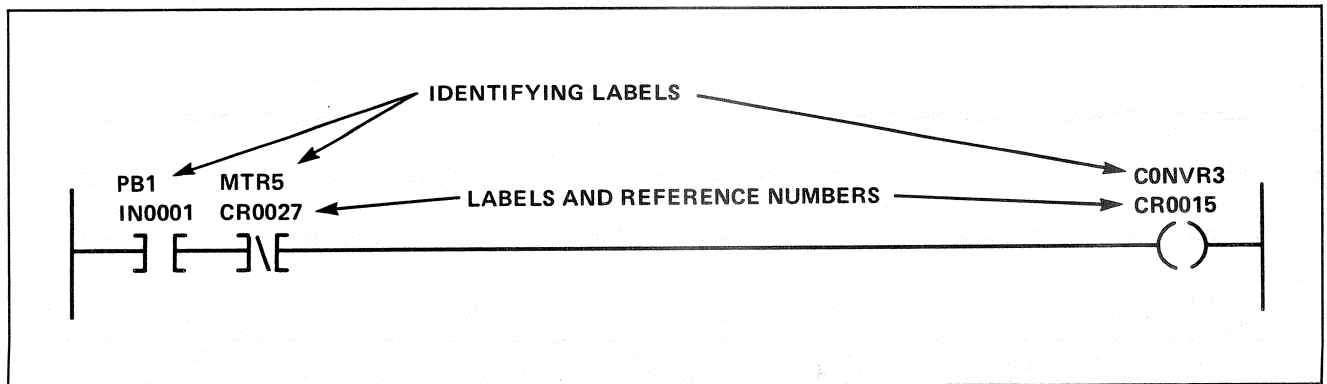


Figure 12-1. Distinguishing the Word "Label"



TABLE 12-1. SEARCH FUNCTION SUMMARY

Keying Sequence	Description
Ctrl K	Display previously entered labels and/or comments.
Ctrl W	Enter or change a <b>single</b> label from the Program or Monitor mode and return immediately to that mode.
Ctrl L	Enter one or a number of labels and/or comments from the Program or Monitor mode and return immediately to that mode. (Press F10, exit, to return to the mode.)

Programming or monitoring can continue without any special commands.

### 12-3. SINGLE LABEL ENTRY

The entry or changing of a single label using the Ctrl and W keys is performed directly from the Program or Monitor mode as follows:

**Step 1** – With the desired network displayed, position the cursor on the IN or CR contact or CR coil to be identified.

**Step 2** – Press and hold the Ctrl key.

**Step 3** – Press the W key briefly.

The screen displays the message ENTER LABEL DATA. (If a label was already assigned to the specified contact or coil, it is displayed.)

**Step 4** – Key in the desired label.

**Step 5** – Press the Enter key (↵).

After the Enter key is pressed, the screen returns to the previous mode.

### 12-4. LABEL FUNCTION

Entry of labels and comments from the Label function is initiated from the Program or Monitor modes by pressing and holding the Ctrl key, and then pressing the L key. The function key listing shown in Figure 12-2 is displayed when the Label function is initiated. Each of the function keys is described in the following subparagraphs.

#### 12-4-1. LABEL ENTRY

To display a label, perform Steps 1 and 2, listed below. To enter or edit a label, perform Steps 1 thru 4, below. The items listed here used to display or enter a label when the screen shown in Figure 12-2 is displayed.

**Step 1** – Press the F1, CR, function key or the F2, IN, function key to initiate the display of CR or IN at the top of the screen.

**Step 2** – Enter the desired reference number.

**Step 3** – Press the Enter key (↵).

Any current label is displayed next to the contact or coil addressed.

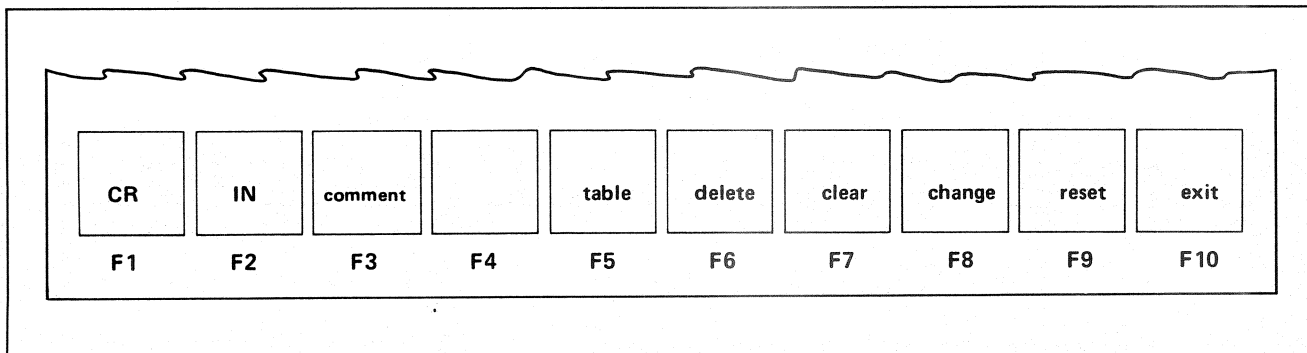


Figure 12-2. Label Function Screen



**Step 4** – Press the F8, change, function key.

**Step 5** – Enter the desired label from the alphanumeric area of the Keyboard.

**Step 6** – Press the Enter key (↵).

**Note**

The display of a table of labels can be initiated by pressing the F5, table, function key after Steps 1 and 2, listed above, are completed. Up to 21 consecutively numbered contact or coil reference numbers and their corresponding labels are displayed. The first coil or contact reference number of the table is entered in Step 2. When a table is displayed, the cursor keys (↑, ↓) of the cursor/number pad keys can be used to scroll the table displayed to the desired CR or IN number.

**Note**

A second column of labels can be displayed by positioning the cursor to the right of the first column using the → key of the cursor/number pad keys. The 2 columns of labels are viewed and modified independently.

**Step 7** – Press the F10, exit, function key to return to the previous mode.

The function of the F6 through F10 function keys follows:

- F6, delete, function key deletes a label displayed after performing Steps 1 and 2, above.
- F7, clear, function key clears or removes the contact or coil label from the position where the cursor is located.
- F8, change, function key is used to enter or edit labels, as listed in Step 4, above.

- F9, reset, function key can be used during the entry of labels to reset the label displayed on the screen but **not yet** entered into memory. Note: The reset key must be pressed **before** the Enter key is pressed.

- F10, exit, function key returns the Loader to its previous mode—either the Program or Monitor mode.

#### 12-4-2. COMMENT ENTRY

The following items describe how to enter up to 3 lines of comments after a network. Each line can contain up to 80 alphanumeric characters.

**Step 1** – In the Program or Monitor mode, display the network in which the comments are desired.

**Step 2** – Press and hold the Ctrl key.

**Step 3** – Press the L key.

The screen shown in Figure 12-2 is displayed.

**Step 4** – Press the F3, comment, function key.

The cursor is positioned at the lower portion of the screen.

**Step 5** – Enter the desired comment from the alphanumeric area of the Keyboard.

**Note**

The cursor/number pad keys (↑, ↓, →, ←) are operational at this time, and the comments can be edited or modified at any time until the Enter key is pressed.

**Step 6** – Press the Enter key (↵).

Repeat these Steps for each network in which comments are desired.

**Step 7** – Press the F10, exit, function key to return to the previous mode.



## Section 13

# Print Mode

### 13-1. INTRODUCTION

This Section describes the following Advanced Program Loader Print mode operations:

- Printing all, or portions of, the ladder diagram with or without cross reference numbers, and/or documentation labels and comments (13-4-1)
- Printing a list of the I/O documentation labels used in the ladder diagram (13-4-2)
- Printing an I/O cross reference list of network numbers containing specified contacts or coils (13-4-3)
- Printing the contents of specified registers or IG/OG groups at specified time intervals, or printing them only when values of specified registers or groups change state (13-4-4 and 13-4-5)
- Printing the states (0 or 1) of specified contacts or coils at specified time intervals, or printing the time when the specified contacts or coils actually change state (13-4-6)

In addition, Paragraph 13-2 describes the capabilities of the Print mode's primary screen. Paragraph 13-3 describes how to configure the communication ports.

Before actually initiating the printing operation, connect cables to the Printer as listed in Paragraph 3-9.

#### Note

The Centronics 150 Series printer, optionally available from Westinghouse, connects to Port A of the Loader. (Port A is an output of the AST Advanced Communication Board.) In addition, optional ports associated with the personal computer designated on the Loader screen as port 1, port 2, or parallel port can be used. Consult the computer manufacturer's Guide to Operations for details. Also, Appendix B lists specific hardware interface characteristics.

### 13-2. PRINT MODE'S PRIMARY SCREEN

The Print mode is entered by pressing the F4, print, function key from the Executive mode of the Loader. When the key is pressed, the following message is displayed:

Re-number ladder networks before printing? (Y/N)

Press Y (yes) if networks are to be renumbered—as may be the case after editing. After some brief messages concerning the status of the renumbering operation, the screen shown in Figure 13-1 is displayed.

#### Note

The processor must be in one of the **program** keyswitch positions in order to renumber networks.

Press N (no) if network renumbering is not desired or necessary. At this time, the screen shown in Figure 13-1 is displayed directly without a renumbering operation.

When the Print mode's primary screen, shown in Figure 13-1, is displayed, one of the categories listed in Table 13-1 is selected using the ↑ and ↓ keys of the cursor/number pad keys in order to position the cursor. In cases where the selection categories are more involved, the Table references Paragraphs containing additional information.

### 13-3. PORT CONFIGURATION

To configure a port for communication with the Loader, use the following procedure.

**Step 1** — Select the desired port by pressing the appropriate F1 thru F4 function key when the Print mode's primary screen, shown in Figure 13-1, is displayed, and the cursor is positioned on the Port category line.

**Step 2** — Press the F9, port config, function key.

The screen shown in Figure 13-2 is displayed.

**Step 3** — Use the ↓ and ↑ keys of the cursor/number pad keys to select the following communications characteristics:

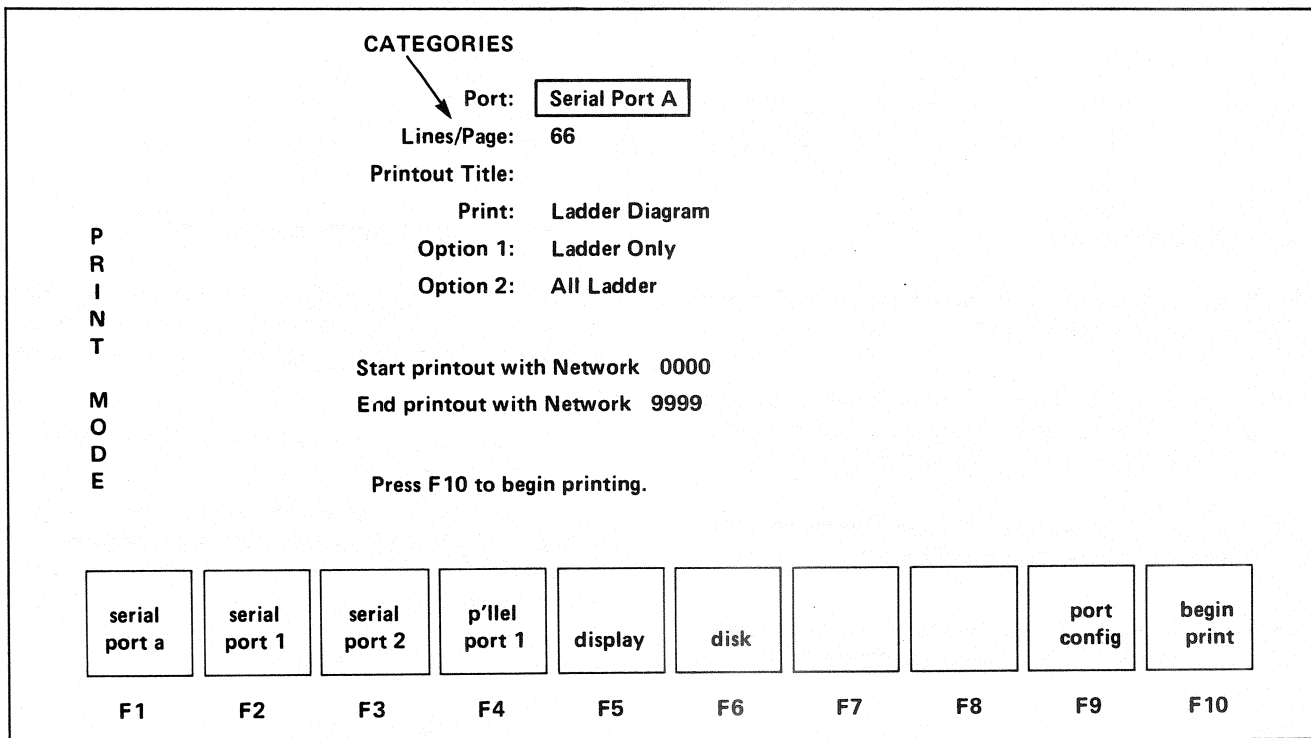


Figure 13-1. Print Mode's Primary Screen

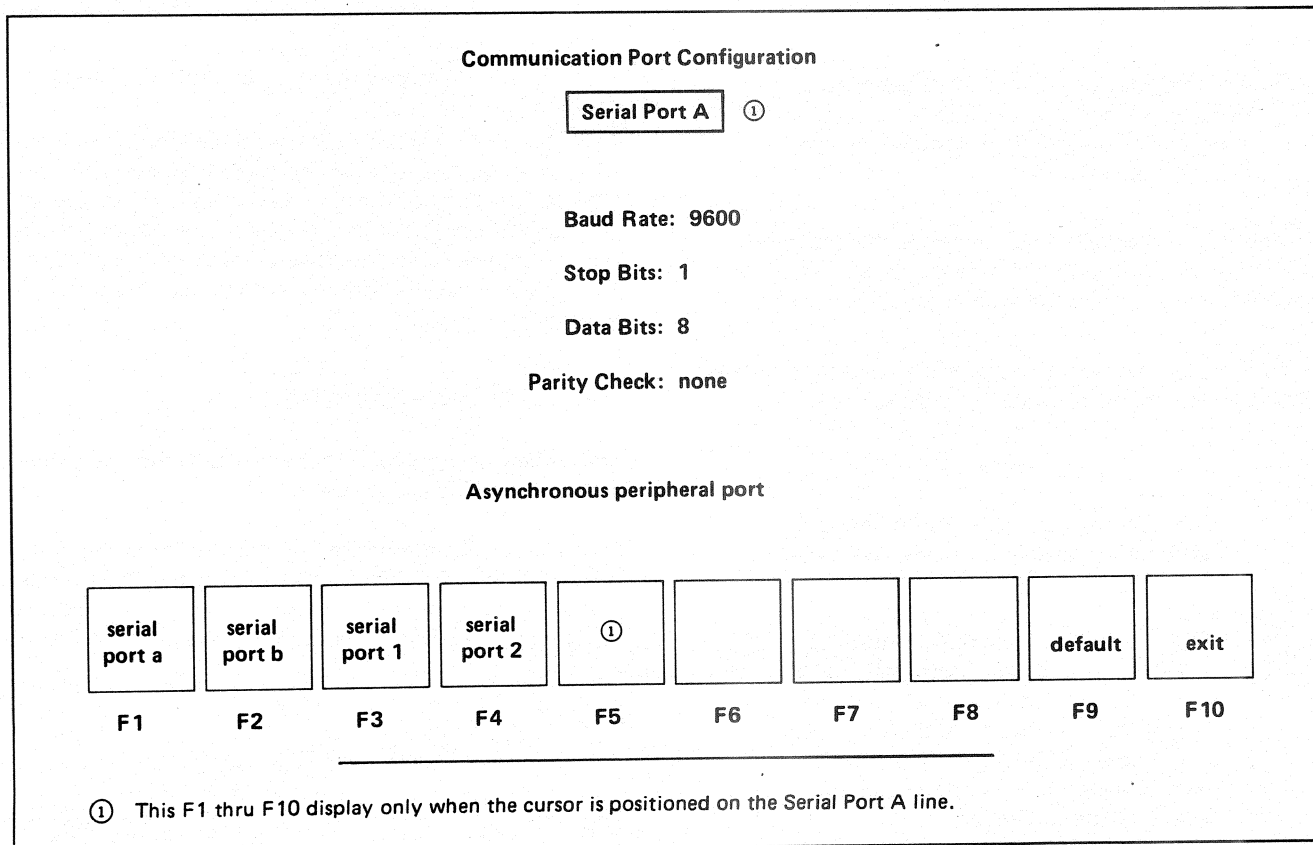


Figure 13-2. Port Configuration Screen



TABLE 13-1. PRINTOUT SELECTIONS

Selection Categories ①	Key Selections	Description
Port Selection ②	F1, serial port a	Port A for use with Centronics, or equivalent, serial printer. This is an asynchronous port provided by the AST Advanced Communication Board but accessed on the Communications Adapter Plug. ③
	F2, serial port 1	Serial port provided only with IBM/COMPAQ optional modules. ③ (DOS recognizes as COM1.)
	F3, serial port 2	Serial port provided only with IBM/COMPAQ optional modules. ③ (DOS recognizes as COM2.)
	F4, parallel port 1	Parallel port provided only with IBM/COMPAQ optional modules. ③ (DOS recognizes as LPT1).
	F5, display	Displays networks sequentially on the screen. No printout occurs.
	F6, disk	Stores networks in ASCII on the diskette or disk.
Lines/Page	Default is 66	Allows entry of the number of lines per page to compensate for different formats or horizontal perforations.
Printout Title	Initially blank	Enter title name followed by the Enter key (↵). This name appears at the beginning of the printout.
Print	Cursor or print selection provided by the following function keys: F1, ladder diagram F2, I/O labels F3, I/O network references F4, registers F5, register timing F6, contact timing F7, control characters	Par. 13-4-1 Par. 13-4-2 Par. 13-4-3 Par. 13-4-4 Par. 13-4-5 Par. 13-4-6 Par. 13-4-7
Start printout network #	After positioning cursor, enter desired network number followed by the Enter key (↵).	Allows beginning or ending of the ladder diagram printout with any network numbers.
End printout network #		
<p>① Using the ↑ and ↓ keys of the cursor/number pad keys, position the cursor on the category to initiate the selections or entries associated with each category.</p> <p>② Defaults to Port A.</p> <p>③ See the HPPC-1500/-1700 Systems Manual, Table 2-1 and Paragraph 3-20.</p>		



- Baud rates: selectable from 110 to 19.2K baud
- Stop bits: either 1, 1.5, or 2
- Data bits: 5, 6, 7, or 8
- Parity check: even, odd, or none

In each case when the cursor is positioned on the characteristic, the function keys are used to enter the desired specification.

Alternately, the F9, default, function key can be selected to enter the following default specifications:

- 9600 baud
- 1 stop bit
- 8 data bits
- No parity check

**Note**

Port B is the serial port used for communication with the HPPC-1500/-1700 only. Although it can be configured for rates other than the default baud rate of 19.2K, this is **not** normally necessary—unless the HPPC-1500/-1700 system and Loader are communicating through an intermediary device such as a modem.

**13-4. PRINT CATEGORY SELECTIONS**

The fourth line of the Print mode's primary screen is referred to as the "Print category." When the cursor is placed on it by means of the ↑ or ↓ cursor/number pad keys, the F1 thru F7 selections automatically change to those shown in Figure 13-3.

Choices of the available selections are made with the F1 thru F7 function keys. A quick summary of the

selections is given in Table 13-1 at "Print Category." An extended description of the selections is given in the following subparagraphs.

The Print category selections each has one or two sub-selections which are displayed on the fifth and sixth lines of the Print mode's primary screen. These are listed as Option 1 and Option 2. Again, the options are sub-selections of the Print category selections available on the F1 thru F7 function keys. (See Figure 13-3.)

For example, when the F1, ladder diagram, function key is selected, it is necessary to go on to make a further selection. Option 1 is chosen for the type of ladder diagram printout. Option 2 is used to select the portion of the ladder diagram to be printed.

**Note**

The default Print screen selections are shown in Figure 13-1. If no selections are made and the F10, begin print, function key is pressed, the ladder diagram including UDSF subroutines are printed using Serial Port A.

**13-4-1. LADDER DIAGRAM**

The ladder diagram can be printed out on hardcopy in a number of ways. To do so, follow this procedure.

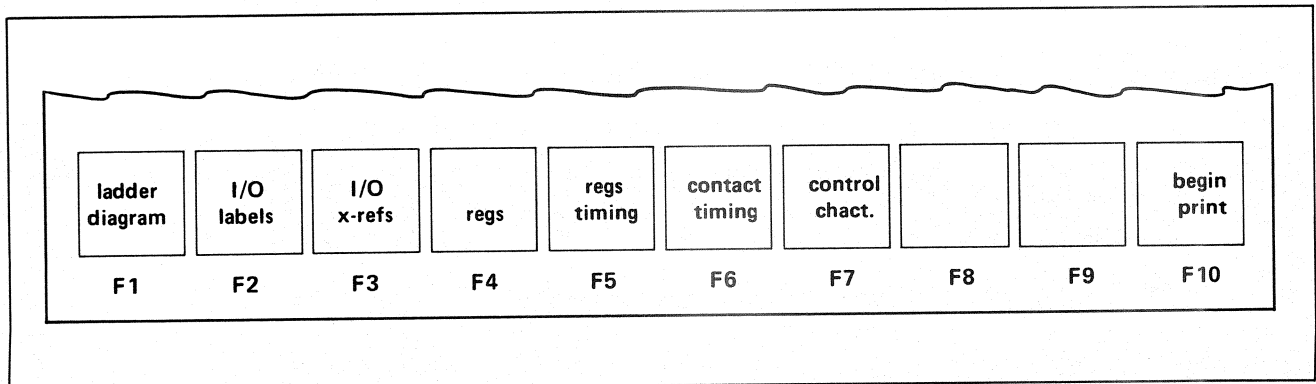
**Step 1** — Display the Print mode's primary screen, as shown in Figure 13-1.

**Step 2** — Move the cursor down to the fourth line called Print category.

At this time the F1 thru F7 blocks change to those shown in Figure 13-3.

**Step 3** — Press the F1, ladder diagram, function key.

If the following steps are not followed, this becomes a



**Figure 13-3. Print Category Key Selections**



default selection, and only the ladder diagram program is printed.

**Step 4** — Use the ↑ and ↓ keys of the cursor/number pad keys to select either Option 1 or Option 2, which are the fifth and sixth lines on the screen.

At this time the F1 thru F4 blocks change to indicate the available subselections. (See Figure 13-4.)

Options 1 and 2 ladder diagram subselections are explained separately here.

**Option 1**, consists of the following 4 choices:

- Ladder diagram only
- Ladder diagram with I/O network cross referencing. After each network containing a coil, the list of network numbers containing CR contacts with the same reference number is printed.
- Ladder diagram with I/O documentation labels. The documentation labels associated with each CR coil or IN contact are printed **above** the reference number.
- Ladder diagram with I/O network cross referencing and documentation labels

**Option 2**, consists of the following 3 choices:

- The complete ladder diagram program
- Only the main ladder diagram (not the UDSF ladder diagram)
- Only the user-defined special function (UDSF) subroutines portion of the ladder diagram

The 2 options are selected by first locating the cursor on the desired option, and then pressing the appropriate function key, as shown in Figure 13-4.

### 13-4-2. I/O DOCUMENTATION LABELS

The I/O documentation labels selection of the Print category allows the separate printing of IN and/or CR labels used in the ladder diagram. Use the following procedure to print the I/O labels.

**Step 1** — Press the F2, I/O labels, function key when the Print category of the Print mode's primary screen is displayed. (See Figure 13-3.) This provides the following I/O label printing Option 1 selections:

- IN labels only: Press the F1 function key
- CR labels only: Press the F2 function key
- IN and CR labels: Press the F3 function key

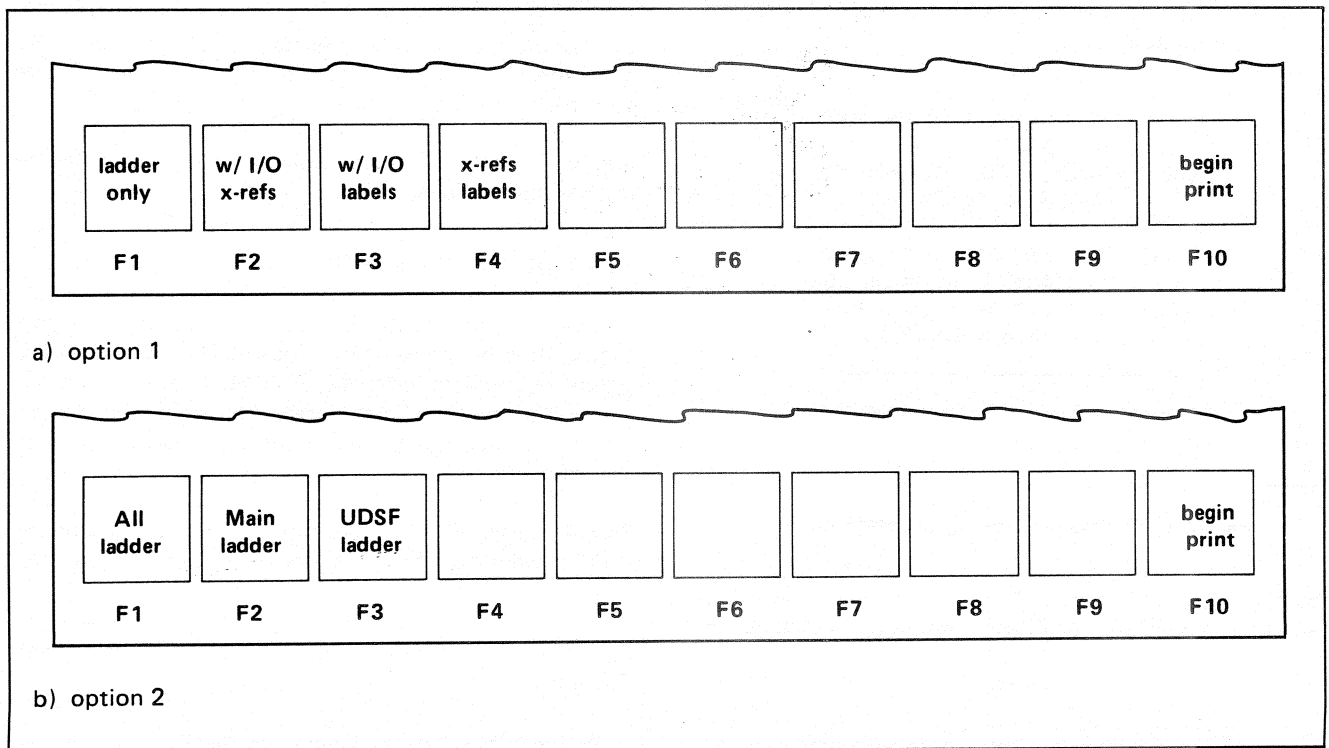


Figure 13-4. Ladder Diagram Selection





**Step 2** — Position the cursor on the Option 1 selection, and then press the F1, F2, or F3 functions keys, as noted above.

**Note**

The Option 2 selection is not used with the I/O label print selection.

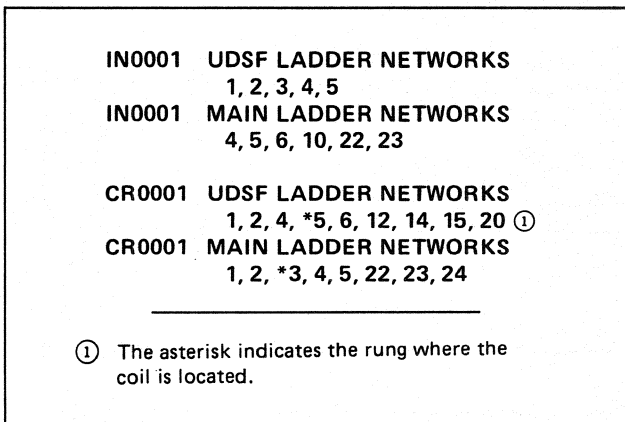
**Step 3** — Press the F10, begin print, function key to initiate the printout.

**13-4-3. I/O NETWORK REFERENCE NUMBERS**

The I/O network cross reference numbers selection of the Print category provides a printed listing of each network in which IN or CR contact is used, as shown in Figure 13-5. Use the following procedure to print I/O network cross reference numbers.

**Step 1** — Press the F3, I/O X-refs, function key when the Print category of the Print mode's primary screen is displayed. (See Figure 13-3.) This provides the following three Option 1 selections:

- IN network cross reference numbers, F1 function key
- CR network cross reference numbers, F2 function key
- Both IN and CR network cross reference numbers, F3 function key



**Figure 13-5. I/O Network Cross References**

**Step 2** — Position the cursor on the Option 1 selection, and press the F1, F2, or F3 function key as noted above.

**Note**

The Option 2 selection is not used with the I/O network reference number print selection.

**Step 3** — Press the F10, begin print, function key to initiate the printout.

**13-4-4. REGISTERS**

The registers selection of the Print category allows the printing of the number and contents of selected registers or IG/OG groups. The following procedure describes how to initiate a printout of registers and contents:

**Step 1** — Press the F4, regs, function key when the Print category of the Print mode's primary screen is displayed. (See Figure 13-3.)

**Step 2** — Choose one of the 2 available options. These are:

- Option 1, register or group selection, provides the selection of the R, OR, IR, OG, or IG register or group types
- Option 2, selects the numbering system of the register or group contents

**Step 3** — Position the cursor on the Option 1 and/or 2 categories.

**Step 4** — Press the desired function key from the selections available, as shown in Figure 13-6.

**Step 5** — Optionally, new starting and ending register or group reference numbers to be printed can be entered by positioning the cursor on the start or end printout lines and entering other reference numbers. (See Figure 13-6(b).)

**Step 6** — Press the F10, begin print, function key to initiate the printout.

**13-4-5. REGISTER TIMING**

The register timing selection of the print category allows the printing of the value of a specified register or IG/OG group at specified intervals of time. It also allows the printing of the time immediately after the values change. To initiate the register timing print operation, perform the following:

**Step 1** — Press the F5, regs timing, function key of the Print category of the Print mode's primary screen. (See Figure 13-3.)

**Step 2** — Choose one of the two available selections. These are:

- Exception timing, where the specified register and value are printed whenever the value changes (F1 function key)

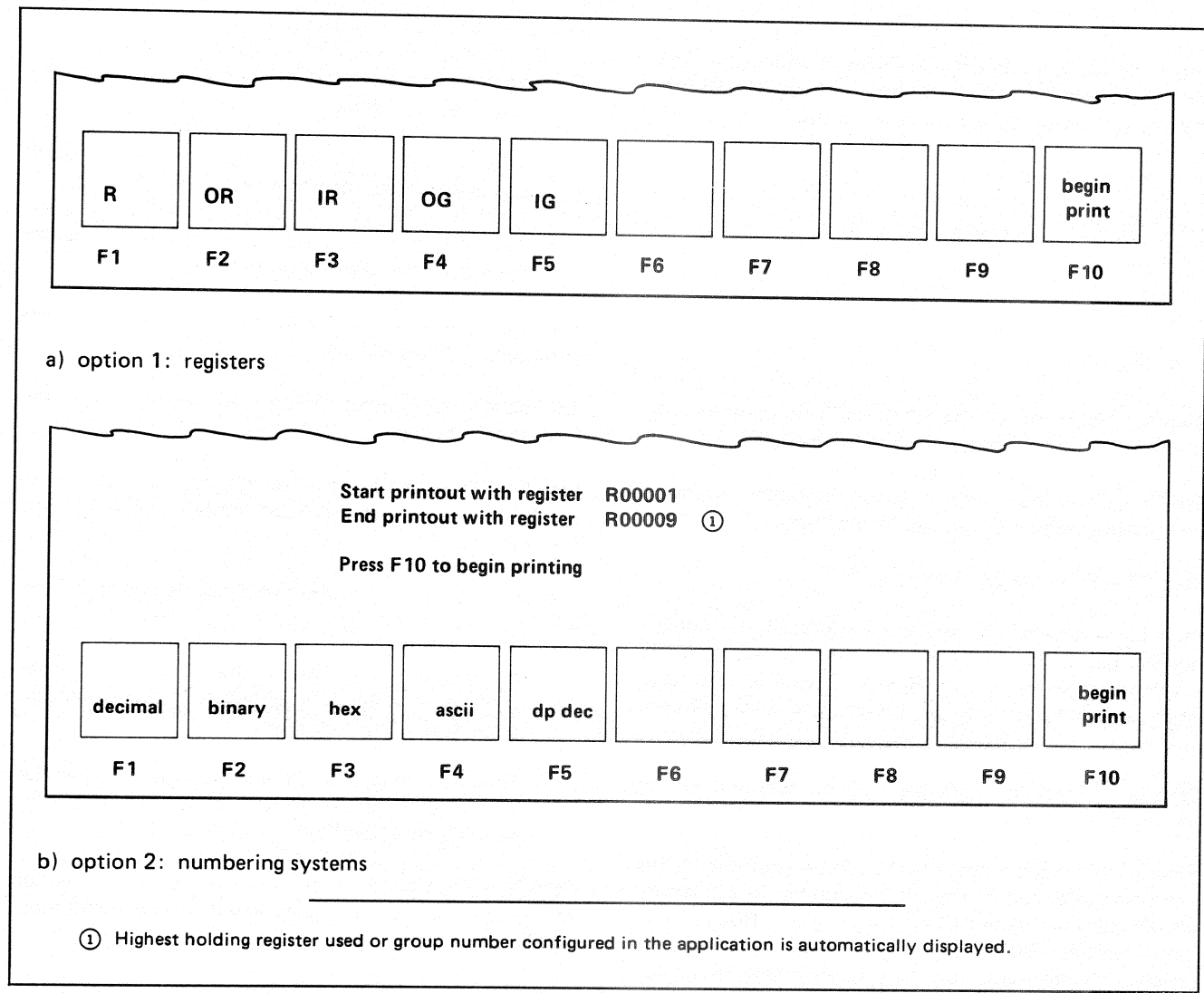


Figure 13-6. Register Selection Options

- Interval timing, where the specified register and value are printed at specified time intervals (F2 function key)

Time is measured in tenths of a second from the initiation of the operation.

**Step 3** – Position the cursor on the Option 1 selection of the Print category using the ↓ key of the cursor/number pad keys.

**Step 4** – Select the exception timing or interval timing by pressing the:

- F1, except timing, function key, or
- F2, interval timing, function key

**Step 5** – Optionally, if the F2 interval timing was selected, the ↓ key of the cursor/number pad keys can be used to select the time in tenths of a second intervals. Enter the desired time from 0001 to 9999 where, for example, 0050 provides after 50 intervals, each a tenth of a second, elapse. (This equals 5 seconds.)

**Step 6** – Press the F10 function key. The function keys now display the following numbering system selections:

- F1, decimal
- F2, binary
- F3, hexadecimal
- F4, ASCII
- F5, double-precision decimal



**Step 7** — Press one of the F1 thru F5 function keys to select the desired numbering system in which the register's value is displayed. The function keys now display the register and group selections as follows:

- F1, R
- F2, OR
- F3, IR
- F4, OG
- F5, IG

**Step 8** — Press one of the F1 thru F5 function keys to select the register or group type to be printed.

**Step 9** — Enter the register or group reference number to be printed. Leading zeroes can be omitted.

**Step 10** — Press the Enter key (↵).

**Step 11** — Optionally, use the → key of the cursor/number pad keys to move the cursor to the right. Select a second register or group. Repeat Steps 8, 9, and 10 to enter a second register or group type and reference number.

**Step 12** — Press the F10, begin print, function key to initiate the printout.

Figure 13-7 shows a portion of a typical printout for the exception selection of the register timing. In this example the decimal values of holding register R0011 and input register IR0005 are shown. Note: Whenever the registers change value, the new value is shown and the latest time is printed. All the time printouts are referenced to 000.0 seconds, when the printout was initiated.

### 13-4-6. CONTACT TIMING DIAGRAM

The contact timing diagram selection of the print category allows the printing of:

- The on (1) or off (0) state of a specified contact or coil at specified time intervals
- The time when a contact or coil actually changes state (called exception timing)

Time is measured in tenths of a second from the initiation of the operation.

To initiate the contact timing diagram operation, perform the following:

**Step 1** — Press the F6, contact timing, function key of the Print category of the Print mode's primary screen. (See Figure 3-3.)

**Step 2** — Choose one of the two available options. These are:

- Exception timing, where the actual times when changes of states of specified coils or contacts are printed (F1 function key).
- Interval timing, where the actual states of specified coils or contacts are printed at specified time intervals (F2 function key).

**Step 3** — Position the cursor on the Option 1 selection of the Print category using the key of the cursor/number pad keys.

**Step 4** — Select the exception or interval timing by pressing:

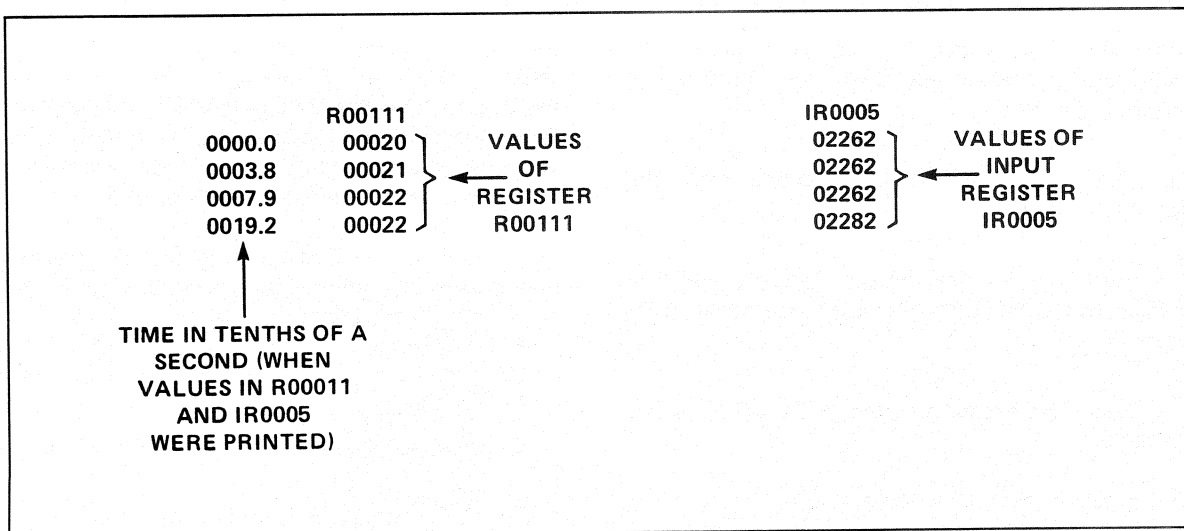


Figure 13-7. Register Timing Exception Example



- F1, except timing, function key
- F2, interval timing, function key

**Step 5** – Optionally, if the F2, interval timing, function key is selected, the ↓ key can be used to select the time in tenths of a second intervals. Enter the desired time from 0001 to 9999 where, for example, 0050 provides a printout after 50 intervals, each a tenth of a second, elapse. (This equals 5 seconds.)

**Step 6** – Press the F10 function key. The function keys now display the following selections:

- F1, IN
- F2, CR
- F3, BP/R
- F4, BP/IR
- F5, BP/OR

**Step 7** – Press the corresponding function key to select the desired contact or coil type.

The contact or coil is displayed on the screen.

**Step 8** – Enter the reference number desired followed by the Enter key (↵). Note: With bit pick reference numbers, enter the BP and then the reference number.

**Step 9** – Optionally, use the → key of the cursor/number pad keys to move the cursor to the right, and select a second coil or contact. Repeat Steps 6, 7, and 8 to enter the type and reference number.

**Step 10** – Press the F10, begin, function key. Each time the screen is filled, the information is printed.

#### 13-4-7. CONTROL CHARACTER

The control character selection of the Print category allows the sending or transmitting of 2 hexadecimal

digits to the port specified on the primary print screen. (This is required to set up the printer.)

To initiate the control characters operation, perform the following:

**Step 1** – Press the F7, control charac, function key of the Print category of the Print mode's primary screen. (See Figure 3-3).

At this time the following message appears on the screen:

Enter code in HEX.

**Step 2** – Enter the 2-digit hexadecimal code to be transmitted.

**Step 3** – Press the Enter key (↵). The following message appears on the screen:

Press F10 to transmit the character.

#### Note

The port category selection determines the device to which the hexadecimal code is transmitted. The primary screen shown in Figure 13-1 may be accessed to change the port device.

**Step 4** – Each time the F10 function key is pressed, the specified characters are transmitted to the port selected in the Port category of the primary print screen.

#### 13-5. PRINT SCREEN

The current screen displayed by the Loader can be printed at any time by pressing and holding the Shift key (⇧), and then pressing the Prtsc key located in the control group of the Advanced Program Loader's Keyboard. (See Figure 6-2.) The Print Screen operation may be initiated from any mode of the Loader.



# Section 14

## Disk Mode

### 14-1. INTRODUCTION

The Disk mode allows the creation, storing, and accessing of files on a diskette or hard disk. The files associated with the Disk mode contain ladder diagram type data which can be transferred between the diskette and the:

- Processor, during on-line operation
- Memory of the Advanced Program Loader, during off-line operation

See Paragraph 5-3 for a description of off-line and on-line operation.

This Section contains the following information:

- File characteristics (14-2)
- Disk drive selections (14-3)
- Storing a ladder diagram and/or associated data on a diskette (14-4)
- Loading data from a diskette (14-5)
- Verifying data was transferred properly (14-6)
- Deleting files from a diskette (14-7)
- Directory file operation (14-8)

#### CAUTION

**Use blank but formatted diskettes for the operations associated with the Disk mode. Never attempt to store screens, ladder diagram programs, or documentation data on the DOS or Westinghouse Software Programming Package diskettes.**

All of the various Disk mode operations are accessed from the Disk mode's primary screen, shown in Figure 14-1. This screen is displayed by pressing the F3, disk, function key when the Executive mode's main menu is displayed. Observe the Disk mode's primary screen, shown in Figure 14-1, and note the following 4 items:

1. The actual files, if any, contained on the diskette used to store them are shown on the lower half of the display just above the function key listings. (These files

are typical and have been added for illustration purposes.)

2. The Current Path notation at the top of the screen lists which directory is being displayed, as described in more detail in Paragraph 14-8. A back slash located on the first line indicates the root directory.

3. The operator prompt area, located near the top of the screen, contains messages used to prompt the operator during the various entries.

4. Drive B is the default drive accessed automatically when the Disk mode is entered.

The following information is not an integral part of the Disk mode, but it is closely associated with it. These procedures allow a user to store and to recall a **single** screen. The Disk mode is generally used to store and retrieve much larger amounts of data, including entire programs.

A **single** screen displayed in the Program or Monitor mode can be easily saved on a diskette and, subsequently, retrieved from it. Follow these procedures:

**Step 1** — Place a formatted diskette in Drive B. (Be sure it has enough unused area to accept additional data.) Alternately, select the hard disk drive.

**Step 2** — With the specific screen displayed, press and hold the Ctrl key.

**Step 3** — Press the F key in the alphanumeric area of the Keyboard to initiate the storing of a screen on a diskette or hard disk, and then release both keys.

Alternately, press the G key to initiate the retrieval of a previously stored screen.

At this time, one of the following messages is briefly displayed in the message area of the screen:

SAVE SCREEN

GET SCREEN

This message is quickly replaced by the following prompt which appears at the lower right of the screen:

[Drive:] [\Path ] Filename[ .Ext] B>\_



operator is shown in Figure 14-2. Observe the Figure and note the following 4 points:

1. The file name and file extension are separated by a period.

2. The file name can consist of up to 8 ASCII characters. All ASCII characters are legal except the ?, \*, or space characters. If spaces are entered in a file name, they are ignored. The ? and \* characters have limited use with Disk mode operations. For this reason they are not described further. (See the DOS description of the Computer Operations Guide for details. This manual is shipped as part of the personal computer and is not available from Westinghouse.)

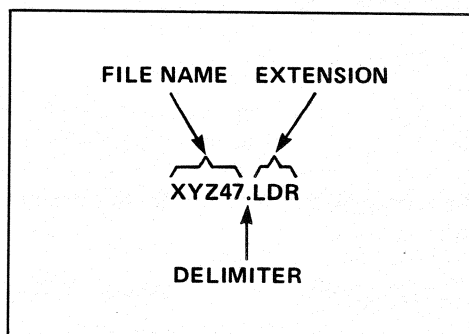


Figure 14-2. File Name Example (Typical)

3. The extension is an optional entry. If nothing is entered, an extension is automatically assigned to the file name by the loader. Although an operator can assign one, it is not recommended.

4. The following extensions are automatically assigned by the Advanced Program Loader with the Disk mode:

- LDR – Complete ladder diagrams with register and configuration data
- LDO – Ladder diagrams only
- REG – Register data from the ladder diagram
- DCM – Documentation portion of a ladder diagram
- USF – Only user-defined special function (UDSF) subroutine portion of the ladder diagram
- ULD – Universal ladder diagram used to load data into either the UDSF or main ladder diagram areas
- SCR – Screen display used to save data currently on the screen

- MLD – Main ladder diagram only
- FLT – Faulted ladder saved

### 14-3. ACTIVE DRIVE SELECTION

The Disk mode automatically defaults to Drive B contained in the Loader. At times it may be desirable to change the drive being used to Drive A, C, or D. To do so, use the following procedure with the Executive mode screen displayed:

**Step 1** – Insert a formatted diskette into the desired disk drive. (Drive B is the default disk drive for the Disk mode, unless changed.)

**Step 2** – With the Executive mode's main menu displayed, press the F3, disk, function key.

At this time the Disk mode's primary screen is displayed.

**Step 3** – Press the F5, dir, function key to display the directory of disk files.

**Step 4** – Press the F2, change dir., function key to display a slightly different screen with instructions.

The blinking cursor is now located on the third line of the display.

**Step 5** – Key in one of the following:

- a: To select Drive A.
- b: To select Drive B. (This is the automatic default drive for the Disk mode.)
- c: To select Drive C. (Optional disk drive)
- d: To select Drive D. (Optional disk drive)

**Step 6** – Press the Enter key (↵).

The disk prompt now shows the letter (a, b, c, or d), identifying the newly selected "current" drive. This drive remains the current drive unless it is changed or unless AC power is removed from the Advanced Program Loader.

For subsequent operations, the blinking cursor associated with the file entry operations is preceded with the newly selected disk drive letter.

### 14-4. SAVE OPERATION

The F1, save, function key of the Disk mode's primary screen allows the "saving," or transferring, of large amounts of ladder diagram type information—not



limited to a single screen—on a diskette. The transfer is from either the:

- Memory of the processor (for on-line operation)
- Memory of the Loader (for off-line operation)

Table 14-1 lists and describes the various save operations.

The following procedure describes how to load a ladder diagram or associated data onto a diskette.

**Step 1** — Insert a formatted diskette into the active drive. (Drive B is the normally default drive.) Be sure the diskette has enough blank area to accept the data.

**Step 2** — With the Executive mode's main menu displayed, press the F3, disk, function key.

The Disk mode's primary screen, as shown in Figure 14-1, is displayed.

**Step 3** — Press the F1, save, function key.

The screen displays the function keys shown in Figure 14-3. The operator prompt on the second line of the display tells which extensions are available.

When the extension is not specified, the Advanced Program Loader selects an appropriate extension. It is suggested that the operator allow the Loader to automatically select the extension.

**Step 4** — Select the F1 thru F6 functions keys to store the ladder diagram or selected ladder diagram type data, as described in Table 14-1. The operator prompt on the second line of the display reflects the chosen type of save function.

**Step 5** — Key in the file name.

Optionally, an extension can be entered, although it is recommended to allow the Loader to add the extension.

**Step 6** — Press the Enter key (↵).

**Step 7** — Depending on the specific operation, network numbers or other information can be optionally supplied. In each case the operator prompt area lists the optional entries.

**Step 8** — After completing these entries, if necessary, press the Enter key (↵) to initiate the save operation.

When the save operation is complete, this prompt will be displayed.

Do you want to make a backup? (Y/N)

**Step 9** — Press Y (for yes) to initiate a backup on either a different diskette or on the same diskette with a different name, as prompted by the Loader.

Alternately, press N (for no).

The Loader redisplay the screen shown in Figure 14-1,

**TABLE 14-1. SAVE OPERATIONS**

Function Key	Description
F1 ladder & regs	Transfers the ladder diagram, registers, and configuration data to a diskette.
F2 ladder only	Transfers only the ladder diagram to a diskette along with the configuration.
F3 extract main	Transfers only the selected portion of the main ladder diagram to the diskette along with the minimum configuration required.
F4 extract udsf	Transfers only the user-defined special function portion of the ladder diagram to a diskette along with the minimum configuration required.
F5 regs only	Transfers only register data to a diskette.
F6 docum't	Transfers only documentation-related data to a diskette.



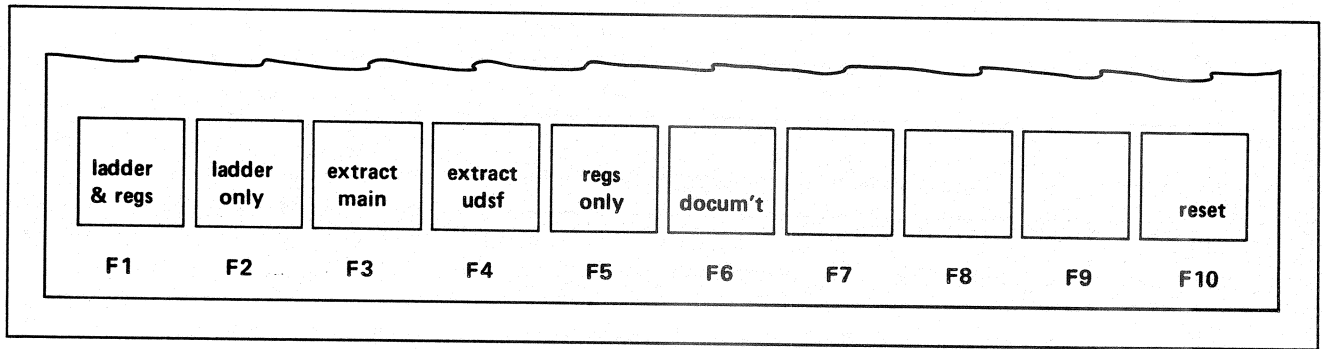


Figure 14-3. Save Function Keys

and it also displays the following in the message area:

SAVE COMPLETE

Further operations can now be carried out.

#### 14-5. LOAD OPERATION

The load operation enters ladder diagram type files contained on a diskette into the memory of the processor. Files from the diskette can be loaded directly, or they can be merged with ladder diagram networks already contained in the processor's memory.

Table 14-2 contains a listing of the specific load operations. Any appropriate data stored on a diskette, as described in Paragraph 14-4, can be accessed and loaded or merged with other ladder diagrams contained in the memory of the processor.

#### Note

Ladder diagram files with LDR extensions **cannot** be used with the merge operation.

The actual loading operations are described as follows:

- Loading or merging of ladder diagram networks, registers, and documentation (14-5-1)
- Loading of configuration data only (14-5-2)

#### 14-5-1. LOADING LADDERS, REGISTERS, DOCUMENTATION

The following procedure describes how to transfer information stored on a diskette into the memory of the processor:

**Step 1** — Insert into the currently active drive the diskette containing the file(s) to be loaded or merged. (Drive B is the default drive, unless otherwise specified.)

**Step 2** — With the Executive mode's main menu displayed, press the F3, disk, function key.

**Step 3** — Press the F2, load, function key.

The function keys shown in Figure 14-4 are displayed.

**Step 4** — Select the desired operation by pressing one of the F1 thru F6 function keys.

See Paragraph 14-5-2 for the F7, config. only, function key operation.

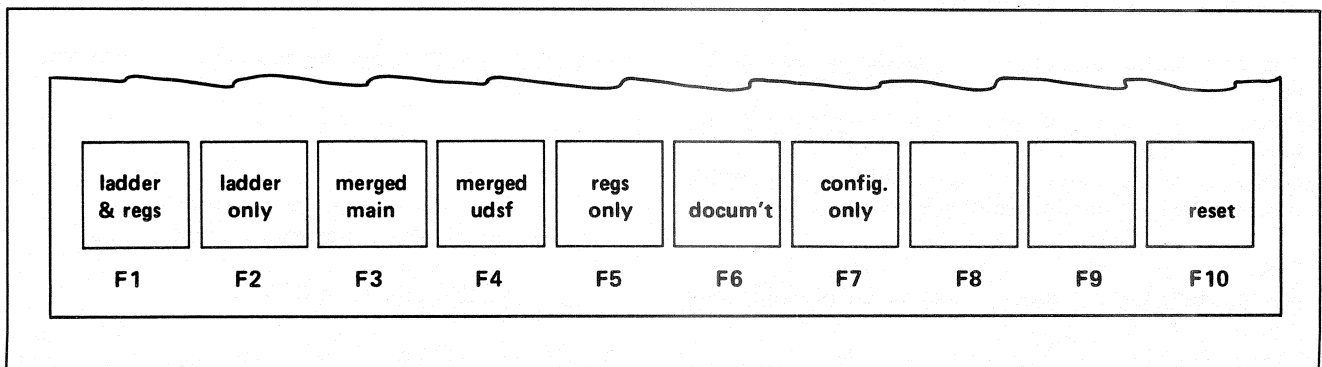


Figure 14-4. Load Function Keys



TABLE 14-2. LOAD OPERATIONS

Function Key	Description ①
F1 ladder & regs	Transfers ladder diagrams, holding registers, and configuration data from a file contained on a diskette to the memory of the processor. The files transferred have the extension LDR.
F2 ladder only	Transfers only the ladder diagram from a file contained on a diskette to the memory of the processor. These files have the extension LDO.
F3 merge main	Merges the main ladder diagram networks from a file with networks already contained in the processor's memory, as specified by the network number entry. The files to be merged from the diskette have the extension ULD or MLD. See Step 6 of the loading procedure in Paragraph 14-5-1 for details.
F4 merge UDSF	Merges UDSF networks with UDSF networks already contained in the processor's memory as specified by the UDSF subroutine number. See Step 6 of the loading procedure in Paragraph 14-5-1 for details. The files transferred have the extension USF or ULD.
F5 regs only	Transfers the holding registers from a file contained on a diskette to the processor's memory. The files to be transferred have the extension REG.
F6 docum't	Transfers the file containing documentation from a diskette to the processor's memory. The files to be transferred have the extension DCM.
F7 config. only	Transfers the configuration data from a file with any extension to the processor's memory. When the F7 function key is selected, any of the following configuration data can be selected: <ul style="list-style-type: none"><li>● Transitional elements</li><li>● Module allocation</li><li>● Memory</li><li>● Total I/O</li><li>● IOP1 data</li><li>● IOP2 data</li></ul> <p>Note: Although the ladder diagram information is also contained in the LDR (ladder) file, only the configuration data is transferred here.</p>

① Descriptions assume on-line operation. If performing load operations off-line, the data is entered into the simulated processor associated with the Off-Line Ladder Executive diskette.

**Step 5** – Optionally, if the F1, ladder & regs, or F2, ladder only, function keys are selected, the operator prompt requests the configuration contained with the ladders in the file be used or the processor's current configuration be used. Press the F1, disk config., or F2, process. config., function keys, as necessary.

**Step 6** – Optionally, if the F3 or F4 merge operations are selected, the network number or UDSF subroutine number where the merge is to occur must be entered.

This tells the Loader where in the ladder diagram to merge the new data. For example, if network 203 is

entered during this step, the new data is merged between the current network numbers 203 and 204.

**Note**

Once a merge operation is performed, renumber the network numbers using the Executive Function mode's re-number operation (F1).

**Step 7** – Optionally, if the F5, regs only, function key is selected, the operator prompt, starting with holding register number 00001, is displayed. If a register other than



R00001 is desired, key in the starting register number desired.

**Step 8** – Press the Enter key (↵).

**Step 9** – If the holding register R00001 is desired, press the F9, cont., function key.

The operator prompt on the second line of the display lists the operation to be performed and the extension or extensions available.

**Step 10** – Key in the file name.

**Step 11** – Press the Enter key (↵).

### 14-5-2. LOADING CONFIGURATION DATA

It is possible to load configuration data from files stored on diskette into a processor without performing a manual configuration process described in Section 7. Follow this procedure:

**Step 1** – Display the Executive mode's main menu.

**Step 2** – Insert into the current disk drive the diskette containing the file to be loaded into the memory of the processor. (Disk drive B is the default disk.)

**Step 3** – Press the F3, disk, function key to display the Disk mode's primary screen.

**Step 4** – Press the F2, load, function key.

The function keys shown in Figure 14-4 are now displayed.

**Step 5** – Press the F7, config. only, function key.

The following operator prompt is now displayed:

Load and edit disk parameters. Ext .LDR  
(or any other Ext)

**Step 6** – Key in the ladder diagram file name which contains the configuration data desired.

**Step 7** – Press the Enter key (↵).

The configuration data is now accessed from the file and temporarily held in the memory of the Loader for review before being inserted into the processor. The function keys shown in Figure 14-5 are displayed.

The programmer can accept the stored configuration data as is without change by moving on to Step 9.

Optionally the programmer can make modifications in the stored configuration data. If this is desired, perform Step 8.

**Step 8** – Optionally, press the F1 thru F6 function key to display the desired configuration parameters on the screen.

#### Note

The screen displayed at this time is the edit configuration screen described in Paragraph 7-8. If desired, the F1 thru F6 keys can be used to change the various configuration parameters just accessed from the diskette file. The operator selects one function key category at a time.

**Step 9** – If the configuration is to be accepted without change, simply press the Ins (insert) key and the Enter key (↵) to load the parameters displayed into the processor.

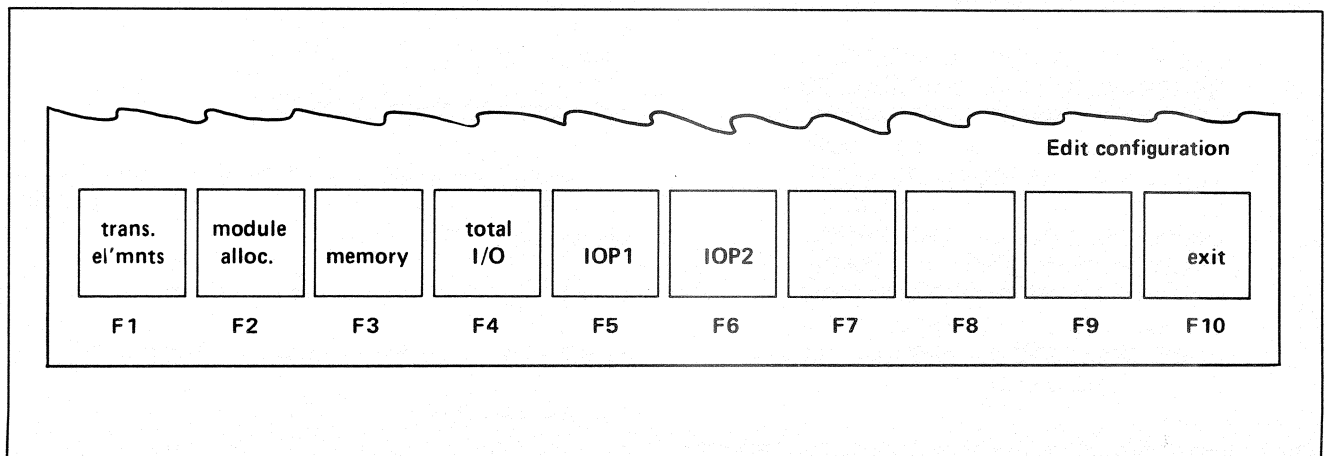


Figure 14-5. Configuration Selection



### 14-5-3. LOADING CONFIGURATION SIZE CONSIDERATIONS

When loading a ladder or ladder and register file into the processor, the configuration of the processor **must be** equal to, or larger than, the configuration on the diskette file. (Configuration size refers to parameters such as the IGs, OGs, IRs, ORs, holding registers, history transfer parameters, UDSF subroutines, or transitional elements.)

If the ladder configuration on the diskette is larger than the processor configuration, perform the following steps:

**Step 1** — Using off-line operation, extract the main ladder program, UDSF program, or both.

**Step 2** — Using off-line operation, separately extract the register data.

**Step 3** — Configure the processor as desired for either off-line or on-line operation.

**Step 4** — Either off-line or on-line, use the merge operation to enter the main and/or UDSF ladders from their files. (This assumes memory is cleared before merging.)

**Step 5** — Enter the register data from the file.

The ladder, register, and configuration data are now present. Produce a copy of the ladder for future use.

### 14-6. VERIFY OPERATION

The verify operation is used to insure that ladder diagram type data is correctly transferred between the memory of the processor and the diskette. The verify operation should be performed immediately after either a save or load operation is completed.

#### WARNING

**EACH TIME A COPY DISKETTE IS GENERATED, IT IS CRITICAL TO PERFORM A VERIFY OPERATION. THIS ASSURES THAT THE CONTENTS OF THE COPY DISKETTE EXACTLY MATCH THE ORIGINAL DISKETTE. FOLLOW THE PROCEDURES OUTLINED IN PARAGRAPH 14-6. IMPROPER MACHINE OPERATION COULD RESULT IF A COPY DISKETTE IS NOT IDENTICAL TO THE ORIGINAL.**

The following procedure describes how to perform the verify operation. It assumes the diskette containing the file to be verified is located in Drive B.

**Step 1** — Display the Executive mode's main menu.

**Step 2** — Insert the diskette to be verified into the active disk drive.

**Step 3** — Press the F3, disk, function key.

Note: Usually the diskette was just loaded or the contents were just transferred to the processor's memory. Thus the diskette is already inserted, and the disk mode is already active.

**Step 4** — Press the F3, verify, function key.

The F1 thru F5 function keys as shown in Figure 14-4 are now displayed.

**Step 5** — Select the desired function key, F1 thru F5.

If the F3, F4, or F5 functions keys are selected, the operator prompt requests additional information such as where the merged verification is to take place, or what holding register numbers are to be verified.

**Step 6** — Key in this information, if necessary.

**Step 7** — Press the Enter key (↵) to complete the entry and display the operator prompt.

The operator prompt is now displayed on the second line of the screen, and the blinking cursor is waiting for a file name entry.

**Step 8** — Enter the file name followed by the desired extension, if any.

The drive path and extensions are optionally entered. (See Paragraph 14-2 for a description of file extensions.)

**Step 9** — Press the Enter key (↵) to perform the verify operation.

Messages on the display indicate the results of the verification.

### 14-7. DELETE OPERATION

The delete operation is used to delete files from a diskette. Any file and extension can be deleted by using the following procedure.

**Step 1** — Display the Executive mode's main menu.

**Step 2** — Insert the diskette into the active disk drive.

Disk drive B is the default drive.

**Step 3** — Press the F3, disk, function key to display the Disk mode's primary screen.



**Step 4** – Press the F4, delete, function key.

The following operator prompt is displayed on the second line of the screen:

Delete file from disk.

The blinking cursor is positioned to accept the file name entry.

**Step 5** – Key in the file name. If the file has an extension other than LDR, the period delimiter and extension must also be entered.

**Step 6** – Press the Enter key (↵).

The file is deleted, and the list of files displayed at the bottom of the screen is updated.

### 14-8. DIRECTORY OPERATIONS

The directory operation of the Disk mode allows the creation and deletion of file directories for use in storing files. A file directory consists of a group of files which are either callable from the:

- Main or root directory
- Directories contained in other directories where a

“tree” type hierarchy is established. (See Figure 14-6.)

The main or root directory is identified by the back slash character (\) specified as the Current Path line of the display, as shown at the top of Figure 14-1. A directory name has the following characteristics:

- Up to 8 ASCII characters
- When entering a directory name, precede it with the back slash character (\) to initiate the search in the root directory.
- It is displayed in the file listing without the \ character. However, the extension <DIR> is listed for any directory contained in the current directory files, as shown in Figure 14-1.

#### Note

For more detailed information on the directory, refer to the DOS description of the Guide to Operations.

The directory operation of the Disk mode is initiated by pressing the F5, dir., function key when the Disk mode's primary screen is displayed. Figure 14-7 shows the function keys associated with the 4 directory operations.

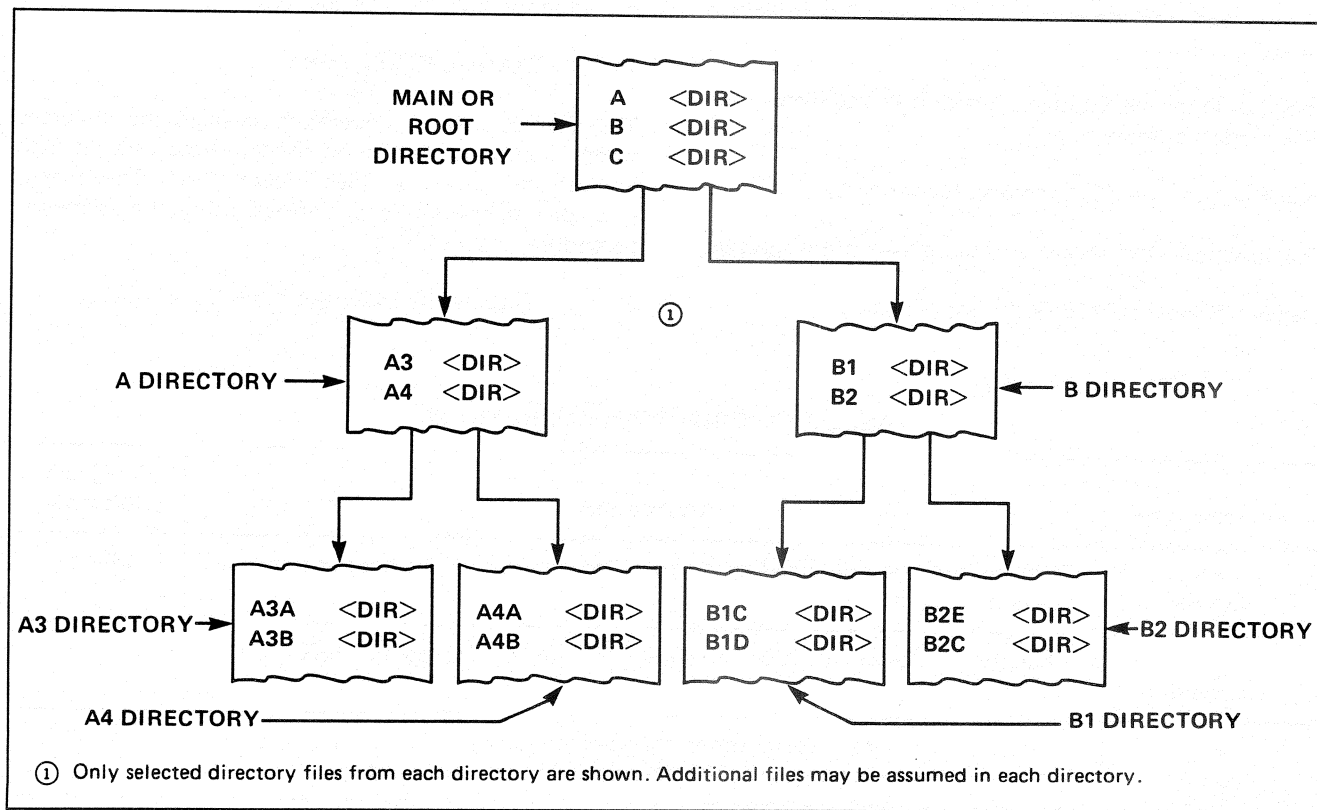
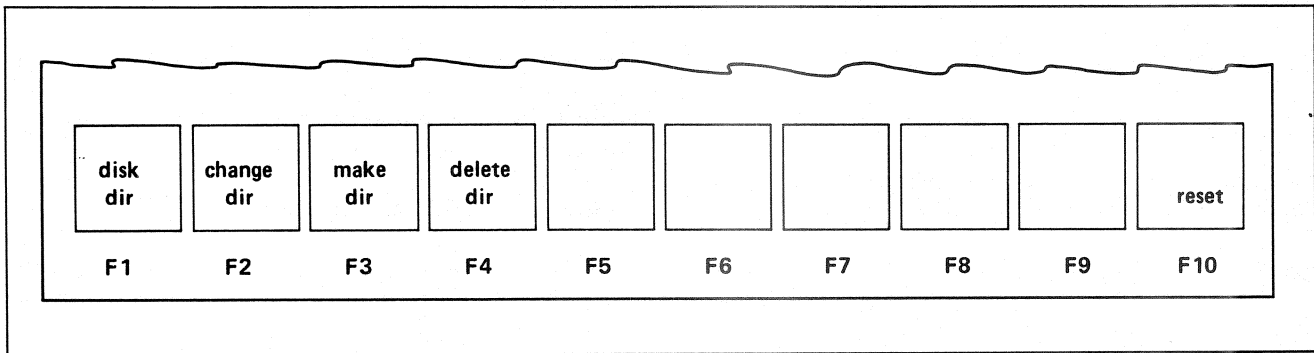


Figure 14-6. Directory Tree Example



**Figure 14-7. Directory Operation Function Keys**

Table 14-3 describes the purpose of each function key and references the paragraph containing the respective operating procedure.

**14-8-1. DISK DIRECTORY**

The disk directory operation displays the files contained in any directory as specified by the operator. The operation is performed using the following procedure.

**Step 1** – Display the Executive mode’s main menu.

**Step 2** – Insert the diskette holding the directory files to be displayed into the current disk drive. (Disk drive B is the default drive.)

**Step 3** – Press the F3, disk, function key to display the Disk mode’s primary screen.

**Step 4** – Press the F5, directory, function key.

The function keys shown in Figure 14-7 are displayed.

**Step 5** – Press the F1, disk dir, function key.

The following operator prompt is displayed near the top of the screen:

Enter the directory name

**Step 6** – Enter the name of the directory file to be displayed after the blinking cursor.

Note: The directory names have no extension.

**Step 7** – Press the Enter key (↵).

The files contained in the directory requested are displayed in the lower half of the screen.

**14-8-2. CHANGE DIRECTORY**

The change directory operation changes the directory which is currently active, as shown in the Current Path line of the directory. (See Figure 14-1.) The change directory operation is performed using the following procedure:

**Step 1** – Display the Executive mode’s main menu.

**TABLE 14-3. DIRECTORY OPERATIONS**

Function Key	Description	Paragraph Reference
F1 disk dir	Displays the files contained in the specified directory. This does not change the current path.	14-8-1
F2 change dir	Changes the Current Path or active directory to the desired directory and/or drive.	14-8-2
F3 make dir	Creates a new directory in either the root directory or any other existing directory. This new directory could be referred to as a subdirectory.	14-8-3
F4 delete dir	Removes directories from the diskette.	14-8-4



**Step 2** – Insert the diskette containing the directory to be changed into the current disk drive. (Disk drive B is the default drive.)

**Step 3** – Press the F3, disk, function key to display Disk mode's primary screen.

**Step 4** – Press the F5, directory, function key.

The screen shown in Figure 14-7 is displayed.

**Step 5** – Press the F2, change dir, function key.

The following operator prompt is displayed above the blinking cursor:

Change current path

**Step 6** – Enter the names of the desired directory path.

Note: The directory names have no extension.

**Step 7** – Press the Enter key (↵).

The Current Path line of the directory is now changed to the new directory.

Note: If the current directory does not contain the newly assigned directory in its files, it will be necessary to define the path. For example, refer to Figure 14-6 and assume Directory A is the Current Path or active directory and the desired directory is A3A. The following command would then be necessary:

\A \ A3 \ A3A Enter key (↵)

After entry, the Current Path line of the directory screen displays:

Current Path: \A \ A3 \ A3A

This shows the "current path" to the current directory A3A.

To change the current path, return to the root directory by entering \, and then redefine the new current path by placing the \ characters between each path segment.

### 14-8-3. MAKE DIRECTORY

The make directory operation produces a new directory for files. The following procedure describes how to create new directory files.

**Step 1** – Display the Executive mode's main menu.

**Step 2** – Insert the diskette which is to be loaded with a

directory into the current disk drive. (Disk drive B is the default drive.)

**Step 3** – Press the F3, disk, function key to display the Disk mode's primary screen.

**Step 4** – Press the F5, directory, function key.

The screen shown in Figure 14-7 is now displayed.

**Step 5** – Press the F3, make dir, function key.

The following operator prompt is displayed above the blinking cursor:

Make new path

**Step 6** – Enter the path, if required, and the name of the desired new directory file.

Note: The directory names have no extension.

**Step 7** – Press the Enter key (↵). The file is created in whatever current path file is active.

### 14-8-4. DELETE DIRECTORY

The delete directory operation allows the deletion, or cancellation, of a directory. The following procedure describes how to delete directories.

**Step 1** – Display the Executive mode's main menu.

**Step 2** – Insert the diskette containing the directories to be deleted into the current disk drive. (Disk drive B is the default drive.)

**Step 3** – Press the F3, disk, function key to display the Disk mode's primary screen.

**Step 4** – Press the F5, dir., function key.

The function keys shown in Figure 14-7 are now displayed.

**Step 5** – Press the F4, delete dir, function key.

The following operator prompt is displayed above the blinking cursor:

Delete existing path

**Step 6** – Enter the name of the directory file to be deleted.

Note: The directory names have no extension and must be either:



- Contained in the current directory, or have a path from the root directory specified.
- Contained in the root directory if the \ character precedes the directory name entered in the delete operation.

**Step 7** – Press the Enter key (↵).

The directory is deleted, and the list of files is updated.

The directory deleted will no longer be shown in the file listing.

**Note**

If the directory being deleted contains any files, the following message is displayed in the message area: Disk error reading drive a/ or b. Retry? (Y/N) Only empty directories may be deleted.



## Section 15

# User Diagnostics Mode

### 15-1. INTRODUCTION

The User Diagnostics mode provides a convenient method for the user to observe the following:

- The status of an individual SIM (15-2)
- Fault registers associated with the modules contained in the HPPC-1500/-1700 mainframe chassis (15-3)
- The status of the Advanced Program Loader communication hardware (15-4)

Each of the various User Diagnostics mode operations is accessed from this mode's primary screen shown in Figure 15-1. This screen is displayed by pressing the F10, user diag., function key when the Executive mode is active.

### 15-2. SIM STATUS

The SIM status provides an expansion of the status information available from the PC status screen. To initiate the SIM status display, follow this procedure:

**Step 1** — Connect the Communications Cable (NLC-4PL) from the Port B Connector of the Loader to the PROGRAM LOADER port of the SIM to be tested.

**Step 2** — Press the F1, sim status, function key when the User Diagnostics mode's primary screen is displayed.

When the SIM status is initiated, the screen shown in Figure 15-2 is displayed.

After replacing the SIM, communication hardware, I/O Bus Cable, or I/O Rack, as necessary, observe the same status screen to verify that the malfunction has been isolated.

### 15-3. MODULE FAULTS

Each of the fault registers associated with the modules contained in the mainframe chassis can be observed by pressing the F2, module fault, function key when the User Diagnostics mode's primary screen is displayed.

**Note:** It is suggested that the module faults associated with the primary fault table screen also be observed by the user, as described in Paragraph 7-4. These fault listings supply a more complete description of the individual fault bits associated with each fault register.

### 15-4. COMMUNICATION HARDWARE TEST

The communication test verifies the operation of the AST Advanced Communication Board, contained in the

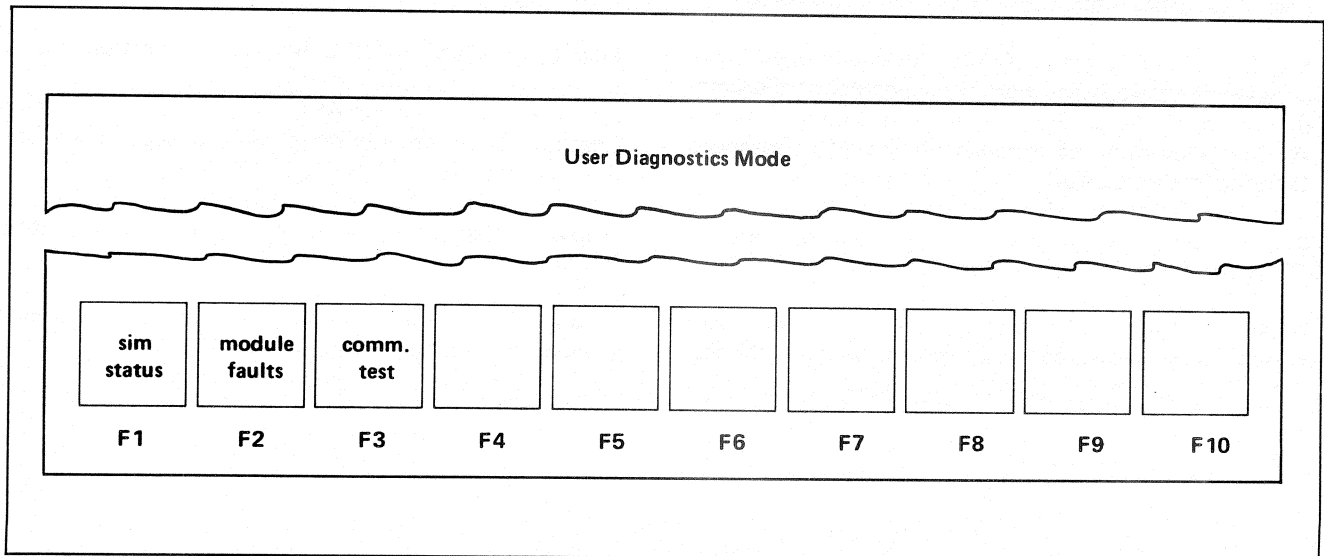


Figure 15-1. User Diagnostics Mode Primary Screen



SIM Status				
SIM Addr	01	Extended Faults		I/O Fault Data
SIM in	Run	0 Data Ram 1	0 VLED Turn On	Control Out 00000000
Outputs	ON	1 Data Ram 2	1 VLED Turn Off	Control In 00000000
Scan Time	0019	2 Vector Ram	2 I/O Control	GSEL Out 00000000
Version	1.4	3 CPU Ram	3 I/O Data Test	GSEL In 00000000
		4 Stack Ram	4 I/O Data Out	CSEL Out 00000000
		5 Comm WDT	5 I/O Card Sel	CSEL In 00000000
		6 Hardware WDT	6 I/O Card Sel	Data 1 00000000
SIM Faults		7 Link LED Timer	7 I/O Group Sel	Data 2 00000000
0 I/O Bus		0 APL Comm Timer	0 Perdy	
1 Hardware		1 Software Trap	1 Exec ROM X sum	
2 Comm Timeout		2 MPSC Chan A	2 Space	
3 Power Not OK		3 MPSC Chan B	3 Space	
4 System		4 DMA Chan 0	4 Space	
5 Space		5 DMA Chan 1	5 Space	
6 Space		6 DMA Chan 2	6 LVS Selected	
7 Space		7 DMA Chan 3	7 SIM Configured	

Figure 15-2. SIM Status Screen

personal computer, and the NLC-4PL Communication Cable. The communication test is initiated with the following procedure:

**Step 1** – Press the F3, com. test, function key while the User Diagnostics mode's primary screen is displayed.

**Step 2** – Connect the NLC-4PL Communication Cable between the Port A and Port B connectors of the Communications Adapter Plug. (Note: The Communications Adapter Plug must be installed on the AST Advanced Communication Board.)

**Step 3** – When the cable is properly installed, press the F9, begin, function key to initiate the test.

After a few seconds, the message Communication Board Passed will be displayed on the screen, assuming the test

found no malfunctions.

Alternately, if a malfunction is detected, one or more specific communication failures are displayed. When a malfunction occurs, perform the following steps in the order listed:

**Step 1** – Replace the NLC-4PL Communications Cable.

**Step 2** – Verify that the AST Advanced Communication Board has been properly setup, as described in Paragraph 3-6.

**Step 3** – Replace the AST Advanced Communication Board.

**Step 4** – Rerun the communication test to determine if the malfunction has really been isolated.



# Appendix A

## Error Messages

### A-1. INTRODUCTION

Error messages are automatically displayed by the Loader when the operator attempts an illegal or

inappropriate entry, or when a hardware malfunction occurs in the HPPC-1500/-1700. The majority of messages are self-explanatory. Messages which are not straightforward are described in Table A-1.

TABLE A-1. ERROR MESSAGE DESCRIPTIONS

Message	Description
Illegal H.B. Entry or Insufficient H.B. Area ①	Occurs when inserting ladder program elements requiring more transitional elements than are actually configured.
Serial Link Down	A malfunction occurred in the I/O Communications area.
Invalid Starting Network	Occurs in the Print mode when attempting to initiate printing, but the network specified is not contained in the ladder diagram.
Disk File Not Compatible	Data attempted to transfer is not compatible with the memory area. For example a ladder diagram file cannot load into a documentation area of memory. Also a ladder diagram file containing a Jump function cannot be loaded into a UDSF area of memory.
Operand Exceeds Boundary	In the Program mode, if "operands" such as input register (IR) or output register (OR) are programmed but had not configured, this message appears.
Target PCI Busy or Smart Module Not Found	WESTNET II Data Highway messages.

① H.B. here means the history bit area of the HPPC-1500/-1700's memory.



## Appendix B

# Printer Interfacing

### B-1. INTRODUCTION

The output of Serial Port A on the Communications Adapter Plug (NLC-4CA) follows the EIA RS-232-C Standard for interfacing data terminal equipment and data communication equipment. The optional Westinghouse Communications Cable (NLC-4PL) is designed to comply with this Standard. Thus, with certain modifications, it may be used between the Advanced Program Loader and a wide variety of asynchronous serial printers. (See Figure 3-5.)

#### CAUTION

**The unmodified, factory-shipped Communications Cable (NLC-4PL) may be used only with a Centronics 150 Series printer. Other printers probably require wiring arrangements on the male**

**connector other than the one provided. Refer to the manufacturer's documentation to determine which signals are to be used at each pin.**

In many cases it may be possible to open the male connector on the Cable and rewire according to the printer's requirements. In other cases it may be necessary to fabricate an equivalent cable. (Refer to the individual printer's user's guide.)

The signals brought out through the female connector are indicated in Figure B-1. A description of each pin assignment is contained in Table B-1.

As an aid for troubleshooting, the wiring diagram for the unmodified Communications Cable is included here. (See Figure B-1.) Table B-1 lists the Standard's pin assignments.



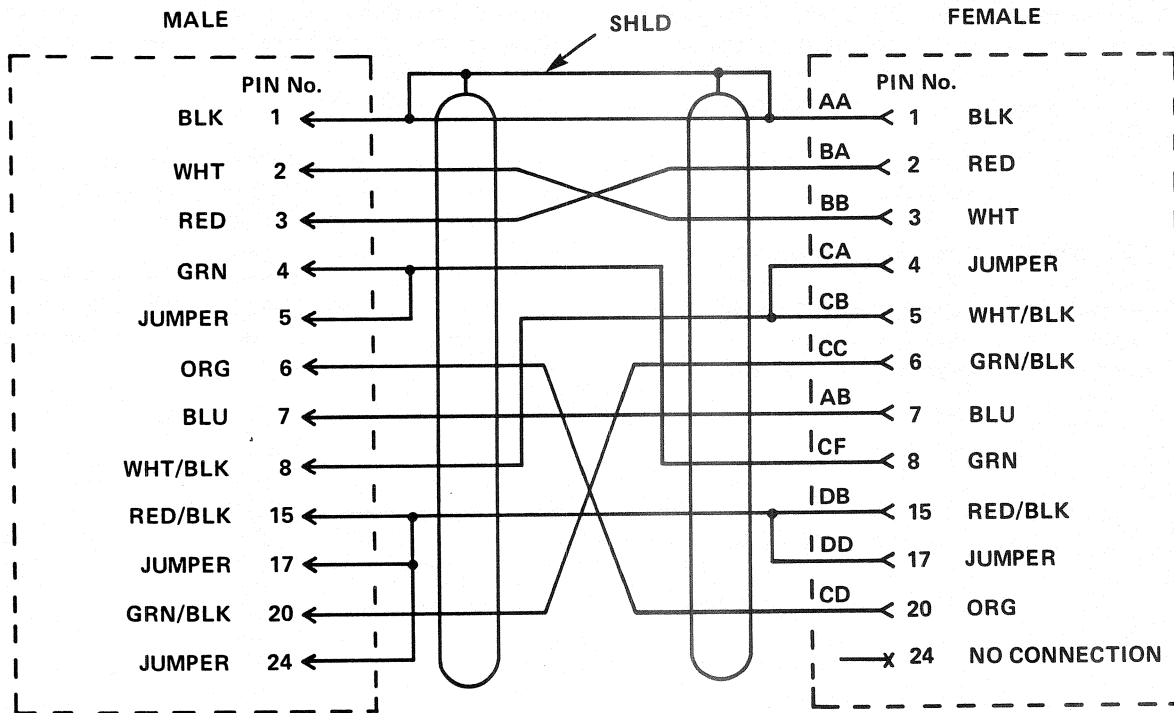
TO:

- PRINTER (CENTRONICS 150 Series only)
- ADVANCED PROGRAM LOADER



TO:

- PORT A ON THE ADVANCED PROGRAM LOADER
- HPPC-1500/-1700



CAUTION

THIS CONNECTOR WIRING ARRANGEMENT IS CORRECT ONLY FOR THE CENTRONICS 150 SERIES PRINTER. OTHER PRINTERS USUALLY NEED OTHER WIRING ARRANGEMENTS. DAMAGE CAN RESULT IF WIRING IS INCORRECT. CONSULT THE PRINTER'S USER'S GUIDE.

THIS CONNECTOR IS ALWAYS CORRECT FOR THE HPPC-1500/-1700 OR FOR THE ADVANCED PROGRAM LOADER.

Figure B-1. Communications Cable Wiring Diagram



TABLE B-1. INTERFACE CONNECTOR PIN ASSIGNMENTS

Pin No.	Circuit	Description ①
1 ②	AA	Protective Ground
2 ②	BA	Transmitted Data
3 ②	BB	Received Data
4 ②	CA	Request to Send
5 ②	CB	Clear to Send
6 ②	CC	Data Set Ready
7	AB	Signal Ground (Common Return)
8 ③	CF	Received Line Signal Detector
9	-	(Reserved for Data Set Testing)
10	-	(Reserved for Data Set Testing)
11	-	Unassigned
12	SCF	Sec. Rec'd. Line Sig. Detector
13	SCB	Sec. Clear to Send
14	SBA	Secondary Transmitted Data
15 ③	DB	Transmission Signal Element Timing (DCE Source)
16	SBB	Secondary Received Data
17 ③	DD	Receiver Signal Element Timing (DCE Source)
18	-	Unassigned
19	SCA	Secondary Request to Send
20 ②	CD	Data Terminal Ready
21	CG	Signal Quality Detector
22	CE	Ring Indicator
23	CH/CI	Data Signal Rate Selector (DTE/DCE Source)
24 ③	DA	Transmit Signal Element Timing (DTE Source)
25	-	Unassigned

① This is an inclusive list of the Standard. The Communications Cable does not make use of all the lines. (See notes 2 and 3, below.)

② These lines are used by Port A and Port B of the AST Research's Advanced Communication Board.

③ These lines are used by only Port B of the AST Research's Advanced Communication Board.



# Appendix C

## Glossary

### C-1. INTRODUCTION

The items included in the following list are chosen to aid the user to understand two types of terms. These are:

- Words or phrases of a technical nature which were used once or infrequently in the manual.
- General computer terms that may be unknown to the user, but common in the technology.

No attempt is made to include a definition that is complete and totally accurate. These are quick definitions designed to aid with the task of understanding the manual. Also, words contained in the HPPC-1500/-1700 Systems Manual glossary are not repeated here. Since that list is hardware-oriented, it may be a good idea to consult both.

**Acronym.** A word formed from the initial letters of a long or difficult term.

**Backup.** Duplicating data from a hard disk drive or diskette to a diskette which ensures availability of data in the event of loss or damage to the original.

**BASIC.** Acronym for **B**eginner's **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. It is an easy-to-use computer language that is widely used by beginning users of personal computers.

**Calculation.** A series of numbers and mathematical signs that, when entered into a computer, are executed according to a series of instructions.

**Character.** Any single letter of the alphabet, numerical, punctuation mark, or other symbol that a computer can read, write, and store.

**COBOL.** Acronym for **C**ommon **B**usiness-**O**riented **L**anguage. It is a computer language suitable for writing complicated business applications programs.

**Command.** A pulse or signal that causes a computer to start, stop, or continue a specific operation. (Command is often used incorrectly as a synonym for instruction, which is a program step that tells the computer what to do next.)

**CPS.** Characters per second. Used to measure the printing speed of a printer.

**Cursor.** A blinking line or box on a CRT screen that indicates where data entered from the keyboard will appear on the display.

**Data.** All information entered into or used by the computer.

**Diagnostic programs.** Special programs that are used to isolate equipment malfunctions and errors.

**Diskette.** A flat, flexible Mylar platter coated with magnetic material, enclosed in a protective envelope, and used for storage of software and data.

**Diskette drive.** A reading device which uses diskettes for mass storage and retrieval of data.

**Disk Operating System.** A collection of software programs that enable the computer to operate, using a disk drive system, for data entry and storage. Disk Operating System is usually abbreviated to DOS.

**Display.** Visible representation of data on a screen, usually on a cathode ray tube.

**DOS.** Acronym for **D**isk **O**perating **S**ystem. DOS is pronounced to rhyme with "boss."

**Dot matrix printer.** A printer that produces characters from a two-dimensional array of dot patterns.

**Double density.** A type of diskette that has twice the storage capacity of standard single-density diskettes, or 2 x 3400 bits per inch (bpi).

**Double sided.** A diskette that can be recorded on both of its sides.

**Drive.** A device that holds and manipulates a diskette or magnetic tape so that the computer can read data from or write data into that diskette or tape.

**Echo.** A DOS function that sends data to be displayed to the printer as well as the screen.

**Error message.** An audible or visual indication of hardware or software malfunction or of an illegal data-entry attempt.

**Extension.** With a DOS command, the three-character set that follows a file name. The extension further





defines or clarifies the file name. It is separated from the file name by a period(.).

**File.** A collection of related data or programs that is treated as a unit by the computer.

**File name.** The set of alphabetic and numeric characters which identify a particular file. A DOS file name can have a maximum of eight characters, followed by a period (.) and an optional three-letter extension. For example: FILENAME.EXT is a valid COMPAQ file name.

**Formatting.** The preparation of a blank, unused disk or diskette for use by the computer.

**Formatted disk/diskette.** A disk/diskette which can be used by the computer for the storage of data.

**Function keys.** Specific keys on the keyboard that, when pressed, instruct the computer to perform a particular operation. On the IBM and equivalent computers used, these are the keys labeled F1 thru F10 on the leftmost portion of the Keyboard.

**Global.** Used in reference to a variable (character or command); it causes the computer to locate all occurrences of that variable.

**Graphics.** A technique of using lines and symbols to display information, rather than using alphanumeric characters.

**Hard copy.** Information that is output from the computer to the printer, which is then produced on paper in a readable form.

**Hard disk.** A disk of rigid material with a magnetic coating, used for mass storage and retrieval of data.

**Instruction.** A program step that tells the computer what to do next. (Instruction is often used incorrectly as a synonym for command, which is a pulse or signal that causes a computer to start, stop, or continue a specific operation.)

**Interactive.** Capable of conducting a dialogue, through a keyboard, with a user, rather than simply responding to commands.

**Job.** A collection of tasks viewed by the computer as a unit.

**Kb.** Kilobyte. A kilobyte equals 1,024 bytes of information.

**Keyboard.** A device that transmits encoded alphanumeric character information when it senses that a key has been pressed.

**Mb.** Megabyte. A megabyte equals 1,048,576 bytes of information.

**Menu.** A list of choices from which an operator can select a task or operation to be performed by the computer.

**Modem.** Acronym for **modulator demodulator**. A modem converts data from the computer to high-frequency signals that can be transmitted through telephone lines.

**Operating system.** A program that supervises the execution of user programs by the computer.

**Peripheral.** An input/output or other type of device not under direct computer control.

**Port.** The entry channel to and from the central computer for connection of a communications line or other peripheral device.

**POST.** Acronym for **Power-On Self Test**. A series of diagnostics which are executed each time the IBM personal computer's power is turned on.

**Printer.** A device that produces the printed paper copy of a document, file, or screen display.

**Program.** A series of steps that tell a computer how to solve a problem or execute instructions.

**Prompt.** A word or series of words which appear on the CRT screen that requests input from the user.

**Random access memory.** A type of memory that provides access to its storage locations by using a system of vertical and horizontal coordinates. The computer can write information into or read information from the random access memory. Random access memory is often called RAM.

**Read-only memory.** A type of memory that contains permanent data or instructions. The computer can read from, but not write into, the read-only memory. Read-only memory is often called ROM.

**Real time.** 1. The actual time required to solve a problem. 2. The process of solving a problem during the actual time that a related physical process takes place so that results can be used to guide the physical process.

**Reverse video.** A feature of a CRT that displays dark characters on a light background, opposite of the usual display.

**Scratch diskette.** A blank but formatted diskette used during testing to prevent the disk drive from writing on





and destroying the User Diagnostics diskette.

**Self-test.** A circuit used by a device to check its own operation, usually when power is first applied.

**Software.** The programs that tell a computer how to perform its functions.

**Statement.** An instruction to the computer to perform some sequence of operations.

**System.** A collection of hardware, software, and firmware that is interconnected to operate as a unit.

**Task.** A machine run; a program in execution.

**Track.** A specific area on a moving-storage medium, such

as a diskette or magnetic tape, that can be accessed by the drive heads.

**Typematic.** Keyboard buttons that will repeat when held depressed.

**Word-wrapping.** A feature that automatically shifts text from a line that exceeds the width limits of a screen and places it on the line below. (Word-wrapping eliminates the need for carriage returns in running text.)

**Write-protect notch.** A cut-out opening in the sealed envelope of a diskette that, when covered, prevents the computer from writing on the diskette, but allows the computer to read from the diskette.



## Appendix D

# COMPAQ Computer Modifications

### D-1. INTRODUCTION

The information contained in Section 3, "Computer Modifications," applies to both the IBM and COMPAQ portable/personal computers. Thus there is no need to repeat topics such as standard and optional equipment, vendor addresses, cable connections, and communications setup. These are all common to both types of units.

There is, however, a need to detail the AST Advanced Communication Board installation procedures in relation to the COMPAQ. (The COMPAQ Operations Guide does not discuss this area.) See Figure D-1.

The purpose of this Section is to explain how to install the Advanced Communication Board, which is the only device recommended by Westinghouse for this function.

### D-2. INSTALLATION

Follow these steps to install the AST Communication Board.

**Step 1** – Turn the COMPAQ's AC power switch to the off position, and detach the AC supply cord from the unit.

**Step 2** – Stand in front of the computer, and position your arms and hands over the rear top edge, as shown in Figure D-2.

**Step 3** – With your thumbs and palms, press the lid down. At the same time pry the lid outward with your fingertips.

**Step 4** – Once loose, gently lift the top cover to gain access to the unit's input/output compartment. Lay the cover aside.

**Step 5** – Without removing them, loosen the 6 screws securing the input/output compartment cover to allow its removal. (See Figure D-3.)

**Step 6** – Remove the screw that secures the expansion slot cover. (See Figure D-4.) Remove and discard this cover. Do this in **either** of the 2 unused slots.

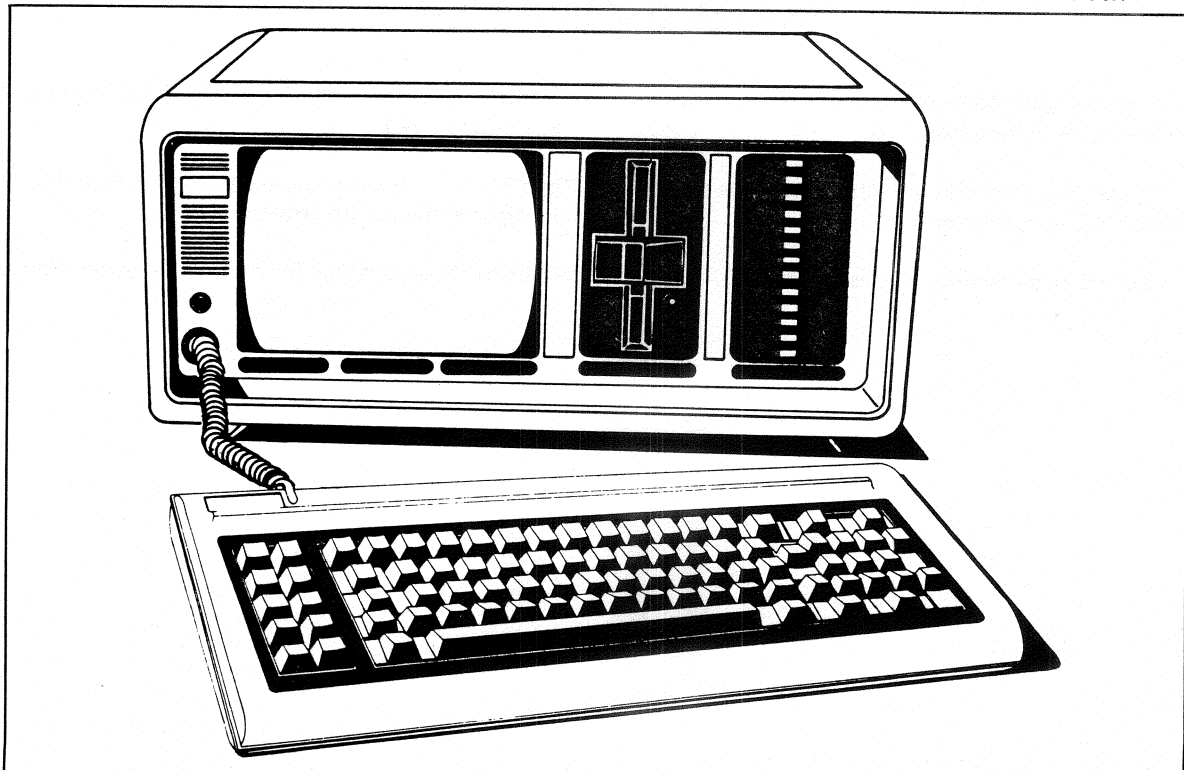


Figure D-1. COMPAQ Portable Computer (Typical)

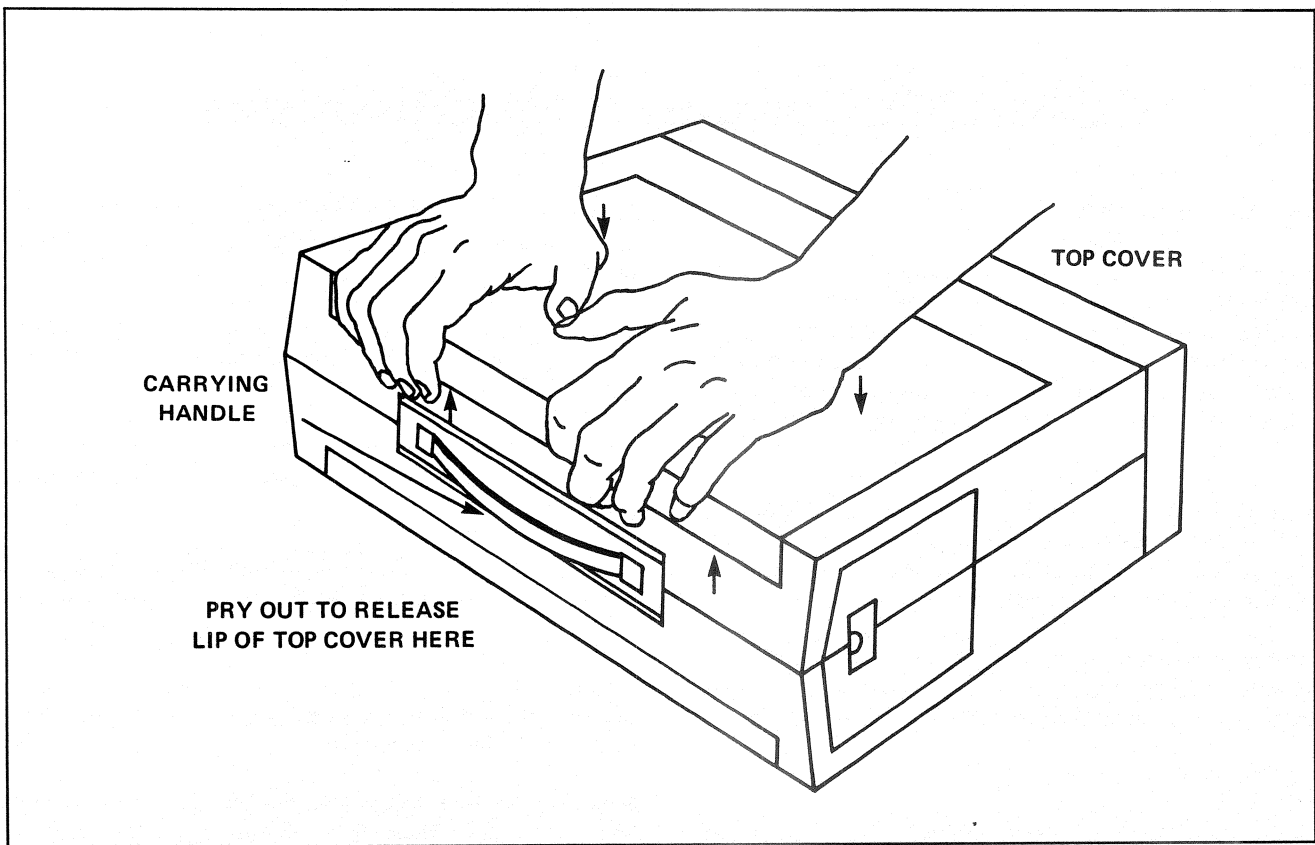


Figure D-2. COMPAQ Lid Removal

**Step 7** – Setup the AST Advanced Communication Board as described in Paragraph 3-6.

This fits into a metal fitting on the Board and secures it. (See Figure D-4.)

**Step 8** – Install the Board in the desired slot. Be sure to seat it firmly in the connector.

**Step 10** – Replace the input/output compartment cover, and tighten the screws securely.

**Step 9** – Reinstall the screw removed in Step 6, above.

Refer to Paragraph 3-8 for cable installation procedures.

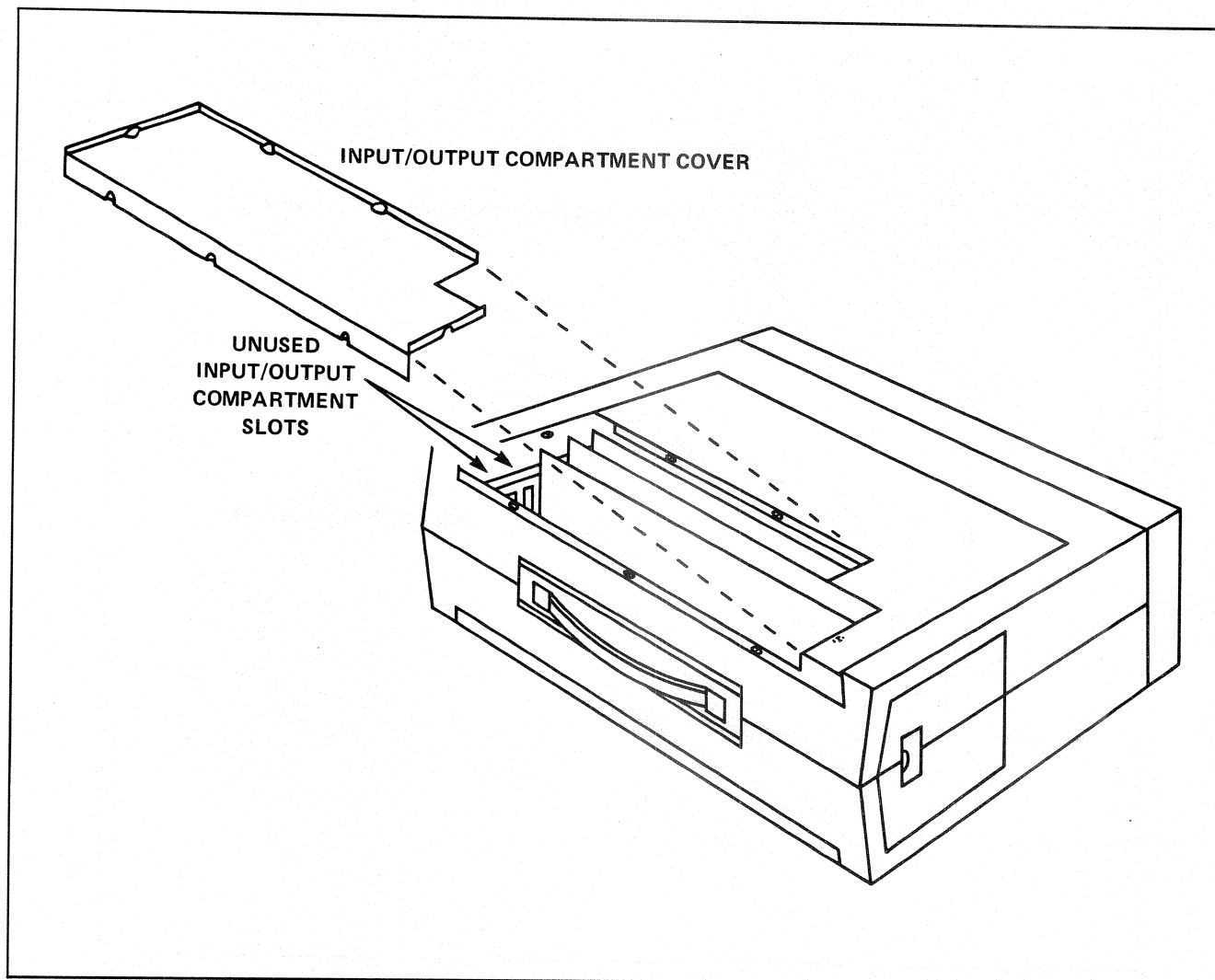


Figure D-3. Input/Output Compartment Cover

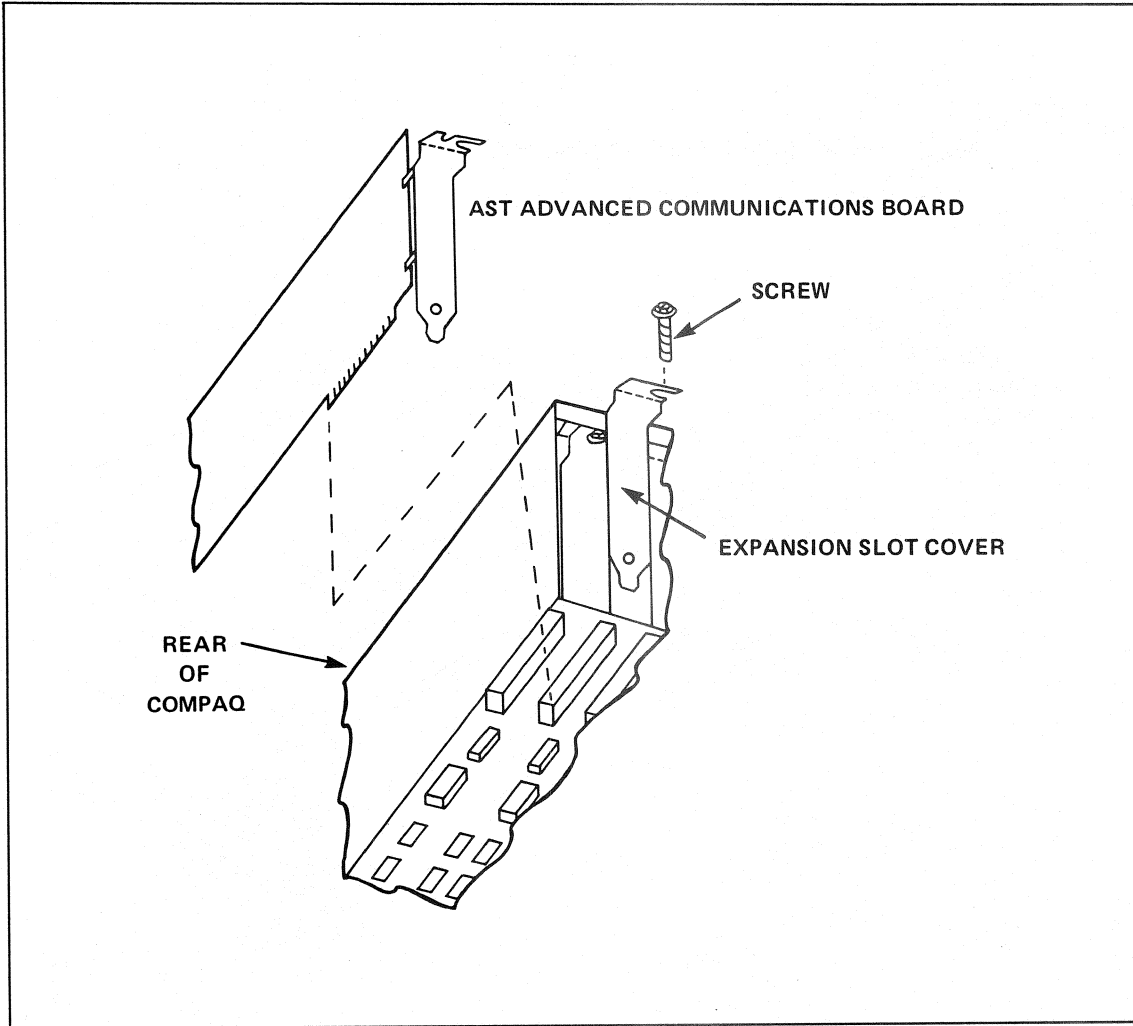


Figure D-4. Input/Output Compartment



## Appendix E

# Grounding Practices

### E-1. INTRODUCTION

This Appendix summarizes the cautions contained in the HPPC-1500/-1700 Systems Manual concerning the absolute need to have correctly grounded outlets supplying AC power to the Advanced Program Loader. Here "correctly grounded" **does not only** mean that the receptacle has a third wire that runs to a ground bus. The phrase includes the identical arrangement of both the L1 and L2 incoming lines at all receptacles where the Loader may be used.

#### NOTICE

**READ ALL OF THESE INSTRUCTIONS CAREFULLY, AND COMPLY WITH THEM, BEFORE ATTEMPTING TO CONNECT THE ADVANCED PROGRAM LOADER WITH THE HPPC-1500/-1700 SYSTEM.**

Many types of peripherals may use the L2 side of the power connection as a ground. Under certain circumstances this would cause a short when the Communications Cable, or equivalent cable, is connected between the peripheral and the HPPC-1500/-1700's COMMUNICATIONS INTERFACE PORT. It could also occur when connecting at the Serial Interface Module's PROGRAM LOADER port.

#### WARNING

**THE AC SUPPLY LINE HI/LO (L1/L2) WIRING ARRANGEMENT FOR THE HPPC-1500/-1700 CONTROLLERS AND ASSOCIATED UNITS MUST BE IDENTICAL WITH**

**THE ADVANCED PROGRAM LOADER AND ANY OTHER PERIPHERALS CONNECTED TO THE CONTROLLER. ALSO, A THIRD-WIRE GROUND MUST BE USED. SEVERE INJURY OR EQUIPMENT DAMAGE COULD RESULT DUE TO NON-IDENTICAL ARRANGEMENTS, EVEN AT REMOTE SITES.**

Study Figure 13-7 in the HPPC-1500/-1700 Systems Manual (NLAM-B821) for recommended wiring arrangements for the system.

When the peripherals are powered by the outlet sockets on the mainframe chassis' power supply, proper wiring arrangements can be assumed. The problem typically occurs where the Advanced Program Loader is plugged into a wall outlet at a remote site, and the HPPC-1500/-1700 is connected to a separate transformer connected to a 480 VAC bus from a different source.

If the convenience sockets on the HPPC-1500/-1700 power supplies are used to power the Loader, keep the following caution in mind:

#### CAUTION

**The voltage level available at the Power Supply's outlet sockets is the same as the incoming AC supply line. Do not attempt to operate 120 VAC devices from them if 240 VAC is provided by the AC supply line input. Equipment damage results.**

In cases of doubt, be sure to contact your local Westinghouse Sales Representative.

### CURSOR/NUMBER PAD KEYS

Key	Mode	Description
↑	Program	Move cursor up one cell.
→	Program	Move cursor to the right one cell.
←	Program	Move cursor to the left one cell.
↓	Program	Move cursor down one cell.
Home	Program	Move cursor to the top left cell position (home position).
Pg Up	Program/ Monitor	Causes the screen to display the previously programmed network in the ladder diagram.
Pg Dn	Program/ Monitor	Causes the screen to display the next network in the ladder diagram.
Ins, Enter (↵)	Program	Sequentially pressing the Insert key and then the Enter key causes the network displayed on the screen to be entered into: <ul style="list-style-type: none"> <li>● The HPPC-1500/-1700 memory during on-line programming</li> <li>● The memory of the personal computer during off-line programming</li> </ul>
Del, Enter (↵)	Program	Sequentially pressing the Delete key and then the Enter key causes the network displayed on the screen to be deleted from: <ul style="list-style-type: none"> <li>● The HPPC-1500/-1700 memory during on-line programming</li> <li>● The memory of the personal computer during off-line programming</li> </ul>
Ins Del Enter (↵)	Program	Sequentially pressing and briefly holding these 3 keys in the order listed causes the DOS software to be accessed from the DOS diskette. This is a hardware function of the computer not related to any software contained in the personal computer's memory.

#### Note

To display a Help screen, press and hold the Ctrl key, and press the Q key. Release both. A listing of possible keying commands will be displayed.



**Westinghouse**

**numa·logic**

**Catalog No. NLAM-B806  
Style No. B-806/16-350  
August, 1985**

**Westinghouse Electric Corporation  
Industry Electronics Division  
Madison Heights, Michigan 48071**