GFK-0075A Logicmaster 1 Family Programming and Documentation Software User's Manual

GE Fanuc Automation

Programmable Control Products

Logicmaster ™ I Family Programming and Documentation Software

User's Manual

GFK-0075A

October 1989

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PREFACE

The Logicmaster™ 1F Programming and Documentation Software packages from GE Fanuc Automation North America, Inc. are used to create ladder logic programs for the Series One™ family of programmable logic controllers (PLCs). This manual describes the Logicmaster 1 Family software package to be used with either the Series One (Model E) of Series One Plus PLC.

Programming and documentation software is also available for the Series One and Series One Junior PLCs. For the most part, this manual applies to those software packages as well. Where differences do exist, they have been described in Appendix E for the Logicmaster 1 software package and Appendix F for the Logicmaster 1 Junior software package.

USING THIS MANUAL

Chapters 1 through 11 describe the features of the Logicmaster 1 F software package. If you are starting up the system for the first time, or getting ready to do a print-out, or displaying tables of data from the Series One PLC, for example, you will refer to the chapter describing the function you want to use.

Chapters 12 and 13 are for the programmer. Use them as a reference to the basic programming instruct ions and data operation instructions.

Appendices E and F describe the Logicmaster 1 and Logicmaster 1 Junior software packages.

The manual is organized as follows:

Chapter 1. Introduction: provides an overview of the software package, the hardware requirements, and options for running Logicmaster 1F software. Chapter 1 describes the hardware requirements for using -the software, plus the system's different modes of operation. A brief description of the principal features of the product is also provided.

Chapter 2. Operation: covers the start-up procedures for floppy diskette and hard disk users. Also, the basics of operation of the Workmaster® computer, Workmaster® II computer, Cimstar™ I computer, and IBM personal computers when using Logicmaster 1F software are included.

Chapter 3. Scratch Pad: defines the entries on the Scratch Pad display, and explains how to change these entries.

Chapter 4. Display Program: explains how to use the features of Display Program: displaying a program, searching for a program element, and making on-line changes.

Chapter 5. Edit Program: explains how to use Logicmaster 1F software to enter and modify a ladder logic program: entering the Edit Program mode, editing the program, editing a rung, searching for a program element, and ladder diagram file editing.

Chapter 6. Annotation: explains how to create, display, and print annotation.

Chapter 7. Display Reference Tables: explains how to enter, use, and exit the Display Reference Tables function.

Chapter 8. Print: explains how to use the Print functions: setting up the printer, defining print-out content, printing in Foreground mode, and printing a file in Background **mode. A description of the Print menu includes a** summary **of** the **Print function keys.**

Chapter 9. Load/Store/Verify: explains the Load/Store/Verify functions: loading a program **into programmer** memory, **storing data from programmer memory, verifying the content of** a **program, and clearing memory. A summary of the Load/Store/Verify menu function keys is also provided.**

Chapter 10. Configuration Setup: explains the Communications Setup and Machine Setup functions. Refer to chapter 10 for information on CPU password protection, and locking/unlocking the CPU. A summary of the function keys is also provided.

Chapter 11. Utilities: explains how to use the Utilities functions for disk and file management, **for configuring the serial** port(s), and for **clearing parity errors in the CPU. A description of the Utilities menu includes a summary of the function keys.**

Chapter 12. Programming: explains general programming concepts and describes basic programming instructions for the Series One (Model E) and **Series One Plus PLC.**

Chapter 13. Data Operation Instructions: describes data operation instructions, which are available only with the Series One Plus PLC.

Appendix A. Setup Information: describes serial connection between the Series One (Model E) or Series One Plus CPU/DCU and the L1F software.

Appendix B. Glossary of Terms: provides definitions of pertinent terminology.

Appendix C. Keyboard Translator Chart: This appendix contains a keyboard translator chart to use with the IBM PC, PC-XT, PC-AT, or most IBM-compatible personal computers.

Appendix D. Software Function Key Flow Diagrams: provides a map to the software **function keys throughout the Logicmaster 1F software.**

Appendix E. Logicmaster 1 **Software Package: describes the differences between the Logicmaster 1 F and Logicmaster 1 software.**

Appendix F. Logicmaster 1 Junior Software Package: describes the differences between the Logicmaster 1F and Logicmaster 1 Junior software.

RELATED PUBLICATIONS

GEK-25373	*Workmaster® Guide to Operation*
GEK-90477	*Series One™/Three™ Data Communications Manual*
GEK-90527	*Cimstar™ I Industrial Computer Reference Manual*
GEK-90842	Series *One™ and Series One™ Plus User's Manual*
GFK-0401	*Workmaster® II PLC Programming Guide to Operation*

Linda R. McCoy
Technical Writer

CUT ON DOTTED LINE

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GFZ-0050A

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CHAPTER 1
INTRODUCTION

The Logicmaster™ 1 F Programming and Documentation Software packages from GE Fanuc Automation North America, inc. are used to create ladder logic programs for the Series One family of programmable logic controllers (PLCs). Program development may be done on a Workmaster®, Workmaster II, or Cimstar™ I industrial computer, an IBM PC, PC-XT, or PC-AT, or most IBM-compatible personal computers.

The Workmaster, Workmaster II, and Cimstar I computers are industrial-hardened computers: recommended for installations where programs must be transferred, monitored, or edited in the harsh conditions of the factory floor. The Workmaster and Workmaster II computers have the additional important advantage of easy portability.

The 91-key keyboard from GE Fanuc – NA was designed to satisfy the special requirements of PLC programming and monitoring. Refer to section 5 in chapter 2 for an explanation of the functions of the 91-key keyboard. Section 5 also describes the use of a standard IBM personal computer-type keyboard with Logicmaster 1 F software. Although such a keyboard lacks the additional programming keys of the 91-key keyboard, it can be used with Logicmaster 1 F software by referring to the table on page 2-31.

After a program is developed, it is simple to transfer it to either the Series One (Model E) CPU (IC610CPU104A) or the Series One Plus CPU (IC610CPU105A or IC610CPU106A). Then, the Logicmaster 1F system can be used on-line with one or more operating CPUs, to provide continuously-updated displays of reference tables and program logic. The logic display features symbolic power flow through the rungs, so program execution can be traced.

This manual describes the Logicmaster 1 Family software package to be used with either the Series One (Model E) or Series One Plus PLC. Programming and documentation software is also available for the Series One and Series One Junior PLCs. For the most part, this manual applies to those software packages as well. Where differences do exist, they have been described in Appendix E for the Logicmaster 1 software package and Appendix F for the Logicmaster 1 Junior software package.

PROGRAMMING FEATURES

Logicmaster 1F software offers a full range of programming functions, such as:

- Basic contacts, coils, timers, and counters.
- Extensive, easy-to-display Help files.
- Printout of display screens, programs, annotation, and tables.
- Program storage on diskettes or hard disk.
- The ability to combine part or all of one ladder logic program with another.
- On-line monitoring and change.

CONTENT OF CHAPTER 1

Chapter 1 contains the following sections:

Section 1. System Configuration: Section 1 lists the versions of Logicmaster 1F software that are available, and gives their hardware requirements and characteristics.

Section 2. Operating Modes: Section 2 describes the Logicmaster 1F system's three different modes of operation.

Section 3. Guide to Using Logicmaster 1F: Section 3 contains brief descriptions of ail the principal features of the Logicmaster 1F software. If you have not used Logicmaster software before, you should read this section. The individual topics contain references that will guide you through the rest of the text.

USING THE REST OF THIS BOOK

The rest of this book is arranged as a reference to the features of Logicmaster 1F software. Chapters 3 through 11 are about Logicmaster 1F software. Chapters 12 and 13 are about creating ladder logic programs. After reading the Introduction, you can refer to other chapters as you need them. For example:

- When you are starting up the software, refer to chapter 2 for instructions.
- If you are editing a ladder logic program, you can refer to chapter 5 for general editing information.
- Chapters 12 and 13 contain descriptions of all the basic programming instructions and data operation instructions.
- Appendix E describes the Logicmaster 1 software package.
- Appendix F describes the Logicmaster 1 Junior software package.

Each chapter or appendix contains related information about one aspect of programming or operating Logicmaster 1F software. To locate a major subject area, refer to the table of contents. To locate specific information about individual topics, refer to the index at the end of the book.

SECTION 1
SYSTEM CONFIGURATION

This section describes the two versions of Logicmaster 1F software that are available. It also describes the general hardware configuration required for each version.

The two versions are:

- A 3½-inch version for the Workmaster, Workmaster II, or Cimstar I industrial computer, or for any other 3½-inch disk drive-based personal computer with the appropriate hardware.

- A 5¼-inch version for use on an IBM personal computer (PC), IBM PC-XT, or IBM PC-AT, or most IBM-compatible personal computers. In this book, when we use the term IBM PC, the information also applies to the PC-XT, PC-AT, and IBM-compatible PC, unless otherwise indicated. Note that operation with compatibles is not assured.

While programs are under development, both versions are functionally similar. With a completed program transferred to a Series One (Model E) or Series One Plus CPU, both versions can be used to monitor program execution and communicate certain operator changes to the program. Both versions feature:

- Operation on a system having any combination of one to four floppy-diskette drives, and/or one or two hard disk drives.

- Support of the Enhanced Graphics Adapter (EGA) card.

USING A WORKMASTER OR WORKMASTER II COMPUTER

To run the Logicmaster 1 F software, the Workmaster or Workmaster II computer must have the following:

- 640K total available programmer memory (RAM).
- The correct version of DOS. For more information about DOS, refer to chapter 2, *Operation.*

It is advisable for additional printed circuit boards in the computer to be removed. For example, if the Workmaster computer has been used as part of a VuMaster™ system, the graphics board should be removed. Refer to GEK-25373, *Workmaster Guide to Operations,* for instructions before you disassemble the computer.

COMPATIBILITY WITH DOS

To run togicmaster 1F software, the host computer requires GE-DOS version 1 (equivalent to MS-DOS 3.2). For a hard disk system, this DOS version should be copied to the hard disk, as described in chapter 2.

NOTE

DOS must be ordered separately.

COMPATIBILITY WITH IBM PCs

Logicmaster 1F software can be used on an IBM-PC, PC-XT, PC-AT, or most IBM-compatible personal computers with the following characteristics:

- 640K total available programmer memory (RAM).
- The correct version of PC-DOS:
  - Version 2.1 or 3.1 for the IBM-PC and PC-XT.
  - Version 3.1 or 3.2 for the IBM PC-AT.
  - Version 3.3 or 4.0 for the IBM Personal System/2® computer.
- Either a color or monochrome monitor adapter card. The software will also support the Enhanced Graphics Adapter (EGA) card.

Performance of the software with other versions of DOS is not guaranteed. Neither is performance guaranteed on other types of IBM PC-compatible computers.

The system supports the IBM monochrome adapter board and the asynchronous communications adapter board. It does not support serial communications adapters not based on the 8250 UART.

An IBM PC-based Logicmaster 1 F system communicates with the Series One (Model E) or Series One Plus PLC via the serial ports, to the Data Communications Unit (DCU) in the CPU.

COMMUNICATING WITH THE SERIES ONE (MODEL E) OR SERIES ONE PLUS PLC

Logicmaster 1F software communicates with the Series One (Model E) or Series One Plus PLC over a serial communications channel to a Data Communications Unit (DCU). Communication is possible over long distances, using a wide range of baud rates, with or without modems. The system can communicate with a single DCU and CPU, or be used in a multidrop configuration having up to eight DCUs and CPUs.

You must use the correct version of the Data Communications Unit to communicate with the CPU.

CPU	DCU
IC610CPU104 (for Series One Model E)	IC610CCM105B or IC610CCM105C
IC610CPU105 (for Series One Plus)	IC610CCM105B or later
IC610CPU106 (for Series One Plus)	IC610CCM105C or later

For point-to-point M-232 communications over distances less than 50 feet, connection is made to the serial port on the Combination Adapter card in the Workmaster computer. This card can also be used for communications using modems. With RS-232 communications, an RS-232/RS-422 Adapter Unit, IC630CCM390B or later, is required.

For RS-422 multidrop communications or point-to-point communications over distances greater than 50 feet, connection must be made to the serial port on the optional Asynchronous Joystick card, IC640BGB311.

Refer to chapter 2 and appendix A for the hardware requirements for serial communications.

SECTION 2
OPERATING MODES

The Logicmaster IF system has three operating modes:

OFF-LINE	Off-Line mode is used for program development. Power flow display or register contents are not updated from the CPU when the system is in Off-Line mode.
ON-LINE	On-Line mode provides real-time displays, data table changes, and. program constant changes.
MONITOR	Monitor mode allows programs to be examined and real-time status displayed, but no changes of program constants, register content, or I/O forcing are allowed.

MODE SELECTION

Both the Workmaster and Cimstar I industrial computers have a keyswitch, which is used to select the operating mode.

The Workmaster II, IBM PC-XT, PC-AT, and PS/2 computers do not have a keyswitch. For these computers, pressing the ALT and 1 keys simultaneously toggles the operating mode from off-line to monitor to on-line.

Mode selection may also be made in the software. In a computer without a keyswitch, the software package starts up in Off-Line mode. The operating mode may be changed by first accessing the Scratch Pad display, typing in the mode desired, and then pressing a function key. For instructions, refer to chapter 3, Scratch Pad.

ON-LINE MODE

In On-Line mode with the CPU unlocked, the CPU periodically sends an updated input and output status table, register memory, and Scratch Pad to the Logicmaster 1F system. On-line changes can be made to register data values and program constants, and to toggle inputs or outputs that are currently in the CPU. For more information, refer to chapter 4, Display Program, and chapter 5, Edit Program.

MONITOR MODE

In Monitor mode with the CPU unlocked, the system can read data from the CPU, but may not transfer data to the CPU. All registers and tables are updated automatically to reflect the current operating state of the CPU. For Workmaster and Cimstar I computers, this is the only operating mode that allows removal of the key from the unit's keysw i tch.

OFF-LINE MODE

In Off-Line mode, tables and registers are updated in the programmer memory (not the CPU) only upon command from the keyboard. Programs may conveniently be developed in Off-Line mode, without being connected to a CPU.

SUMMARY OF OPERATING MODES

The following chart summarizes data transfer capabilities of the three operating modes:

MODE	I/O TABLE MEMORIES REGISTER MEMORY		LADDER PROGRAM (LOGIC MEMORY)	
	TO CPU	FROM CPU	TO CPU	FROM CPU
On-Line	L/S/V Function	Automatically	L/S/V Function	L/S/V Function
Monitor	Not Available	Automatically	Not Available	L/S/V Function
Off-Line	L/S/V Function	L/S/V Function	L/S/V Function	L/S/V Function

SECTION 3
GUIDE TO USING LOGICMASTER 1 F SOFTWARE

This section introduces many of the features of Logicmaster 1 F software. Individual topics include references to guide you to other chapters in the book, where more detailed information is located.

Section 3 introduces these subjects:

- How to duplicate the master software, set up serial ports, and handle files.
- How to use the Scratch Pad function to set up programming parameters, or to turn the CPU on and off.
- The types of program annotation you can include in a program.
- How to edit, copy, and combine ladder logic programs.
- How to display tables of register and I/O values.
- How the software is set up to communicate with the Series One (Model E) CPU or the Series One Plus CPU.
- How to transfer programs between the computer and the CPU, and between the computer and disks.
- The format of ladder logic, and how to display a program.
- How to enter a password.

USING THE HELP SCREENS

Logicmaster 1 F software includes detailed Help screens. For more information about the feature you are using, just press the Help key on your keyboard. The Help screens are easy to get into of out of. Program data will not be lost if you press the Help key. You will find the Help screens to be a very useful feature of Logicmaster 1F software.

The Help screens are always available when the diskette containing them is present in the computer. For a system with hard disk memory storage, the Help files can be loaded onto the hard disk.

UTILITIES

The Utilities functions are probably the first functions you will use.

Duplicating the Master Software

When you start up the system for the first time, you will use the original diskettes shipped from the factory. You should make copies of these diskettes. If you have a floppy diskette system, copying the master diskettes will give you a set of diskettes for everyday use. If you have a hard disk system, copying the master diskettes will place Logicmaster 1 F software on the hard disk. Chapter 11, *Utilities,* explains how to copy your master diskettes.

Setting up the Serial Ports

The Serial Port Setup utility is used to select the characteristics for serial ports. You must do this for the system to be able to communicate with the CPU. If you have a serial printer or other device, you will use the Serial Port Setup utility before using the printer. Refer to chapter 11 for instructions.

Using the File Utilities

You will use the File Utilities often. These are a group of DOS file-handling programs built into the Logicmaster software. They are easier to use than conventional DOS programs, because they are "menu-driven". That means you do not have to remember and type DOS commands. Instead, you select the file utilities from a menu, and complete fully-prompted screens. For example, to copy a file you would select COPY FILE from the Utilities menu, then complete this screen:

```
COPY FROM : SERIAL PORT/DRIVE ID      (1/A,B)
            FILE NAME

COPY TO   : SERIAL PORT/DRIVE ID      (1/A,B)
            FILE NAME
```

Information on copying, deleting, and renaming files is found in chapter 11.

SCRATCH PAD

The Logicmaster 1F system can easily be used to create programs off-line, perhaps in a location far from the programmable logic controller (PLC). With Logicmaster 1F software, one computer can be used to create programs for many Series One (Model E) or Series One Plus PLCs. These programs can be stored on diskettes or a hard disk, and used whenever and wherever they are needed.

Logicmaster 1F software can be used to create programs with the features described in this book. Your PLC may not be able to use all of these features. For instance, you may be creating programs for several PLCs that have CPUs with different capabilities.

A function called "Scratch Pad" is used to match the programming features of Logicmaster 1F software to the CPU. When you select Scratch Pad function from the Supervisor menu, the Scratch Pad screen is displayed. Here, you can select the features you want to include in the program for a specific CPU. For example:

```
MEMORY SIZE:          700        WORDS USED:          1
FUNCTION SET: ONE PLUS           WORDS AVAILABLE:   699
                                 REGISTERS:         128
```

In this example, the CPU has 700 words of programmer memory available. It has the ONE PLUS function set.

The Scratch Pad display also shows the number of words of memory that have been used by the program, and the number of words still available. In this example, only one word has been used so the number of remaining words available is 699.

The register size depends upon the function. For function set ONE (for the Series One Model E CPU), the data register memory size is 000. For function set ONE PLUS (for the Series One Plus CPU), the data register memory size is 128. In this example, the register size is 128 because the function set selected is ONE PLUS.

Changing the Scratch Pad

If you are going to create a program for a CPU with less memory or with a different CPU function set, first type in the information here. During programming, the Logicmaster 1F software will display only the features selected in the Scratch Pad.

Using the Scratch Pad to Control the CPU

You can also use the Scratch Pad when the Logicmastet 1F system is on-line to the CPU, or in Monitor mode. Then, the information you see on the Scratch Pad screen comes from the CPU itself.

When the Logicmaster 1 F system is on-line to a CPU, you can turn the CPU scan on or off by simply pressing one key on your computer keyboard.

Chapter 3, Scratch Pad, explains how to use the Scratch Pad features.

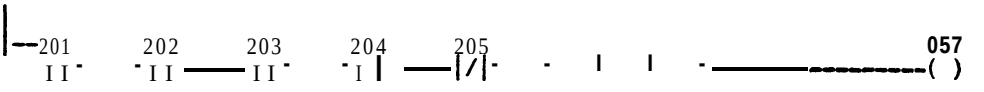
ANNOTATION

Annotation is explanatory text in a program. This text makes a program easier to read and understand.

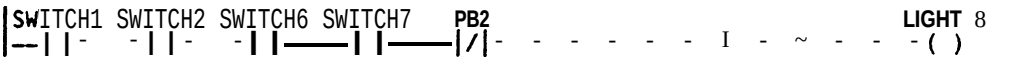
There are four basic types of annotation:

A "*nickname*" is another name for an input, an output, or a register. A nickname can have up to 7 characters. Examples of nicknames that might be used in a program are: LS035, PB11A, and SOL129C. When you display or print a program, you can see the nicknames above the program line.

This is an example of a program line without nicknames:



With nicknames for the inputs and outputs, the same line can be more meaningful when read:

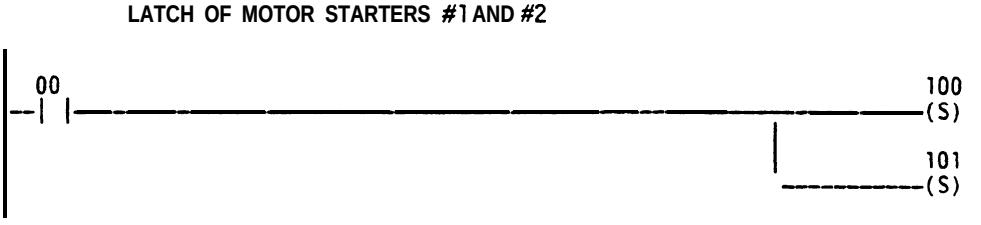


"*Names*" **are another kind of program annotation. Like nicknames, they can be placed above I/O and register references. A name for a program reference can consist of up to 21 characters. Examples of names are: HIGH LEVEL ALARM, and ERROR CONDITN DETECTD. You can also print or display names.**

This example uses names (but not nicknames):

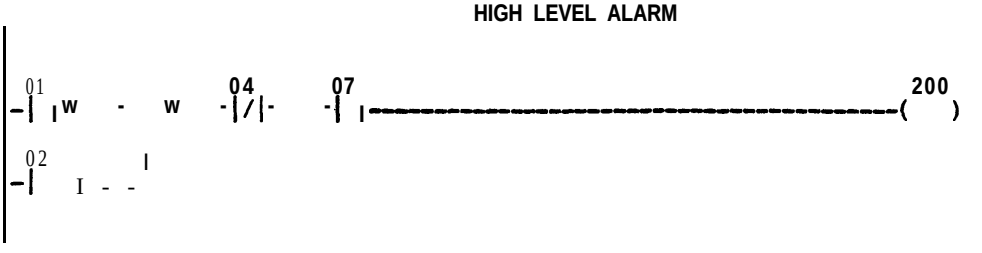
" *Rung Explanations"* **between rungs explain the logic. Rung explanations are easy to create or edit. They can contain any text you enter.**

Example rung with a rung explanation:



The fourth kind of annotation is "*coil labels*". A coil label may appear either above or to the right of a coil. Like a rung explanation, a coil label is easy to create. It can contain any text you enter. One coil label per rung is permitted.

Example rung with a coil label:



Annotation can be displayed either, on-line or off-line, or printed. Special formats can be used to print borders around rung explanations and coil labels. Each page of the print-out can be given a special title.

Refer to chapter 6, *Annotation*, for more information. For information about printing annotation see chapter 8, *Print*.

EDIT PROGRAM

When you create a new program or edit an existing program, you will select Edit Program from the Supervisor menu.

Edit Program mode provides a broad range of functions for editing ladder logic. Edit Program also includes text editing functions for editing annotation. For information on editing annotation, refer to chapter 6.

In Edit Program mode, the program is displayed graphically on the screen. To add a rung to a program, you select Insert Rung. This allows you to add elements to build the rung. The Insert Rung function provides access to the programming instructions. All of the program elements may be reached by selecting either Insert Rung or Edit Rung. You can limit the functions that can be used for a program. To do this, set up the Scratch Pad as described in chapter 3.

Each time you select a rung element, it appears on the screen at the current location of the cursor. For example, if you added a normally-closed contact to a rung, a graphic representation of a normally-closed contact would appear:

```
---|/|--
```

Elements are added, with the appropriate values and references, to complete the rung. All of the Logicmaster 1F program instructions are explained in chapter 12.

Copying and Combining Programs

Similar logic may be needed in more than one program. With Logicmaster 1F software, it is simple to copy part or all or one program into another program. This is done by combining program files, as explained in section 5 of chapter 5. Naturally, you must check to be sure the new program you have created makes sense.

It is also easy to create an editable copy of a program, leaving the original version unchanged. All you have to do is load the program you want to copy, and give it a new name. Refer to chapter 5 for information.

DISPLAY REFERENCE TABLES

The Logicmaster 1F system maintains a set of tables showing the values of the inputs, outputs, and registers available in the CPU. The reference table you wish to display is selected from the Supervisor menu.

If you make no entry in the work area of the screen, the last table displayed is automatically selected. If no table has been displayed, then the discrete table is selected and the cursor will be on I/O point number 0.

You may also enter a reference, reference type, or nickname in the work area. If only the type of reference is shown in the work area, the first reference of that type will appear.

Then, select Display Reference Tables from the Supervisor menu. The reference title and associated table will appear. An example of a discrete reference table is shown below:

```
 POINT#      I/O   137    (NICKNAME)

                      I N P U T / O U T P U T   T A B L E
077 00000000  00000000 00000000 00000000 00000000 00000000 00000000 00000000
177                   00000000 00000000 00000000 00000000 00000000 00000000
```

If the Logicmaster 1F system is connected to a CPU and in On-Line mode, the values shown are from the CPU. Otherwise, they are from the programmer memory.

In addition to being able to display values for I/O references, their status can be toggled on/off from the reference tables displays when the Logicmaster 1F system is in the On-Line mode and the CPU is unlocked and running.

Chapter 7, *Display Reference Tables,* **explains the types of reference tables and tells how to display them.**

COMMUNICATING WITH THE CPU

The Logicmaster 1F system can transfer programs to and from the CPU, monitor program operation, and display tables of program data. To do this, it must be set up properly to communicate with the CPU. Appendix A, *Setup Information,* **describes how to connect the computer to the CPU.**

The Logicmaster 1F system communicates with the CPU through a Data Communications Unit (DCU). Logicmaster 1F software includes a screen called the Communications Setup menu. On this screen, you enter the port number, the type of protocol, and the identifying number of the DCU.

COMMUNICATION **PORT NUMBER:** (1,2)

SELECTED DCU ID NUMBER: (1-90)

After this screen is completed, the Logicmaster 1F system can communicate with the selected CPU. For information on the Communication Setup screen, refer to chapter 10, *Configuration Setup.*

LOAD/STORE/VERIFY

While programs are being worked on, they are contained in the programmer (RAM) memory of the computer. Programmer memory can contain only one ladder logic program at a time. To be saved, a program must be "stored" on diskettes or a hard disk.

You will use the Load/Store/Verify functions to store programs. After selecting the Store Program screen from a menu, all you have to do is specify where the program is to go, and type in its name. For example:

```
DRIVE  ID  /  CPU  B   (A,B/P)  P  =  CPU

PROGRAM NAME     program1
```

Then, press the Enter key (CTRL-E). In this example, the program named PROGRAM1 will be stored on drive B. Drive B is the second diskette drive. It is often used for program diskettes.

If you look again at the example, you'll see that the Store Program screen is also used to send a program to the programmable controller CPU.

Loading a Program

"Loading" a program is the opposite of storing it. When you load a program, you transfer it into programmer memory, where the program can be viewed or changed.

In the example above, the program named PROGRAM1 was stored on a diskette in drive B. After that, the computer was turned off. To work on PROGRAM1 again, you would start up the computer, and load the program files that had been stored on the diskette.

After selecting the Load Program screen from a menu, you would specify where the program was stored, and type in its name. For example:

```
DRIVE  ID  /  CPU  B   (A,B/P)  P  =  C P U

PROGRAM NAME     program1
```

This time, when you press the Enter key (CTRL-E), the computer reads the files for PROGRAM1 from the diskette into programmer memory.

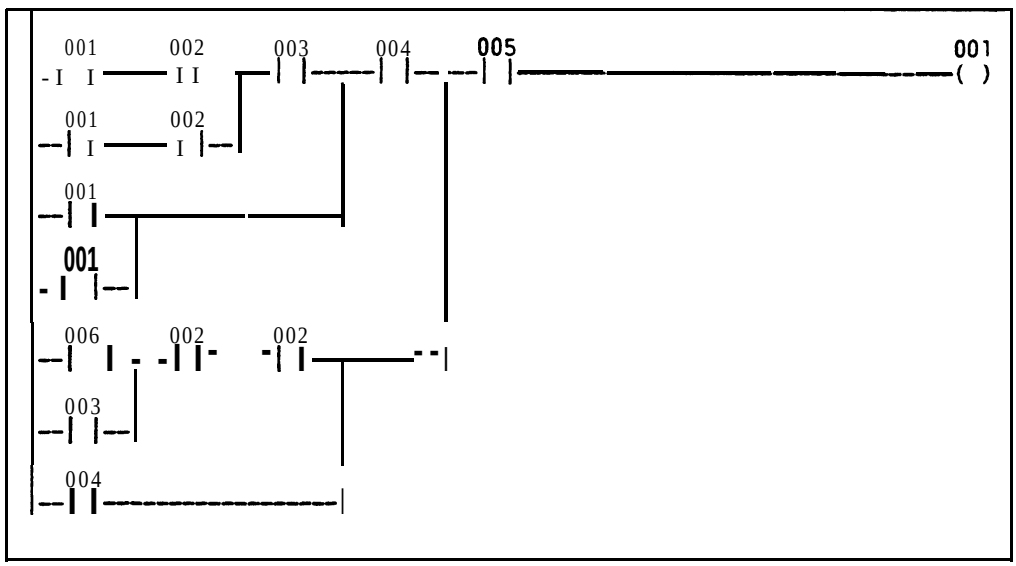
To be sure that a program has been either loaded or stored accurately, another function can be used to "verify" its content.

Chapter 9, *Load/Store/Verify,* explains how to use these functions.

DISPLAY PROGRAM

You can "display" a program in programmer (RAM) memory. It can be a new program, or one you have placed in programmer memory using the Load function.

After entering the name of the program, all you have to do is select Display Program from the Supervisor menu. The program will be displayed on the screen.



The display shows up to seven lines of logic at a time. You can quickly display any portion of the program using the cursor keys, or by "searching" for it.

On the display, you can see the symbolic flow of power through the rungs of the ladder logic.

With the computer in On-Line or Monitor mode, you can display the same program that is currently running in the CPU. The current values of the program elements will be displayed. The program display will include I/O states and register contents. The Logicmaster 1F system allows certain changes to the program currently in the CPU. Chapter 4, Display Program, describes the types of changes that can be made.

Chapter 5, Edit Program, explains how to make more extensive changes to a program.

CPU PASSWORD PROTECTION

To enter a password, you must first access the CPU Password Protection menu by pressing the CPU Protect (F2) key from the Communications Setup menu. Then press the Change Password (F3) key.

If a password already exists, you must type the current password and press the Enter key (CTRL-E). Your keystrokes are not displayed while entering passwords. After entering the current password, you must enter the new password twice to insure accurate entry. Then, the system will try to change the password. If the current password entry is an invalid number, a message will be displayed and the password change will not occur.

If you press the wrong key while entering the password, you cannot use the Backspace or Delete keys to correct your error. You must continue with this attempt, which will be unsuccessful, and then try again.

Refer to section 3 in chapter 10 for more information on CPU password protection.

PROGRAM INSTRUCTION SETS

The basic ladder diagram functions available with Logicmaster 1F software can be considered the basic building blocks for a relay ladder diagram. These instructions reference discrete bits that are to be part of an operation. Logicmaster 1 F software can be used to create programs for a Series One (Model E) or Series One Plus PLC with any of these instruction sets. In addition, there are data operation functions, for use with the Series One Plus PLC, that greatly extend the number and complexity of applications possible with the Series One family. These instructions operate on multiple bits rather than one bit at a time. The instructions used in your program should match the function level of the CPU for which the program is intended.

The instructions listed below are presented in groups that correspond to their functionality. For more information about these functions, refer to chapters 12 and 13.

GROUP	FUNCTION
BASIC INSTRUCTIONS FOR SERIES ONE (MODEL E) AND SERIES ONE PLUS PLC	
	Normally Open Contact, Normally Closed Contact, Shunt/Open, Vertical /Open, Normally Open Sequencer, Normally Closed Sequencer, Master Control Start, Master Control Reset, Out, Set, Reset, Set Out, Set Out Reset, Timer, Thumbwheel Timer, Counter, Thumbwheel Counter, High Speed Counter, Shift Register
DATA OPERATIONS FOR SERIES ONE PLUS PLC	
MOVE	DSTR0 (F50), DSTR1(F51), DSTR2(F52), DSTR3 (F53), DSTR5(F55), DOUT0 (F60), DOUT1(F61), DOUT2(F62), DOUT3 (F63), DOUT5(D65), External Fault Diagnosis (FZ0)
ARITHMETIC	Compare (F70), Add (F71), Subtract (F72), Multiply (F73), Divide (F74)
LOGIC	Data And (F75), Data Or (F76), Shift Right (F80), Shift Left (F81), Decode (F82), Encode(F83), Invert (F84), BCD to Binary (F85), Binary to BCD (F86)

CHAPTER 2
OPERATION

This chapter explains what you will need to know to start up the Logicmaster 1 Family software package, and to use the features described in this book.

There are 7 sections in this chapter. If you are already familiar with MS-DOS, you may wish to quickly peruse section 1 and go directly to section 2 to install the software, or section 3 to start up the software.

Section 1. Using DOS: Section 1 describes DOS versions, and explains how to start up DOS, use DOS commands, format diskettes, and exit from Logicmaster 1F software to DOS.

Section 2. Installing Logicmaster 1 F Software: Before you use Logicmaster 1 F software for the first time, follow the installation instructions in section 2.

Section 3. Starting Up Logicmaster 1 F Software: Refer to section 3 for instructions to start up Logicmaster 1 F software using diskettes or a hard disk.

Section 4. Using Features of the Supervisor Menu: Section 4 describes the entries on the Supervisor menu. This section also explains how to specify a file name from the Supervisor Menu screen.

Section 5. Using Your Keyboard: Section 5 explains the types of keyboards that may be used with Logicmaster 1 F software. This section also explains how to define special key assignments to make programming easier.

Section 6. Entering Data: Section 6 explains the types of information you will see on the screen. This section also explains how you will enter data, such as file names and numerical values.

Section 7. Working with Numbers: Refer to section 7 for information about number types: binary, decimal, BCD, hex, and octal.

SECTION 1
USING DOS

Before you can use Logicmaster 1F software, your computer must first be started up with DOS. DOS is not contained on the Logicmaster disks so it must be supplied separately.

This section provides a basic introduction to DOS.

- Versions of DOS
- Starting up DOS
- Entering or changing the drive ID
- Using DOS commands
- Formatting diskettes
- Finding a file
- Exiting to DOS

The acronym DOS stands for Disk Operating astern. DOS is a software program that interfaces other programs (like Logicmaster 1F) with the computer hardware. *DOS must be used to start up Logicmaster 1F software.*

VERSIONS OF DOS

As with other types of software, there are different versions of DOS. To run Logicmaster 1 F software, you must use a compatible version of DOS.

- For a Workmaster or Cimstar I industrial computer, you should use MS-DOS® version 3.2. If you have a copy of the earlier GE version 3.14 of MS-DOS, it can be used for a Workmaster computer with diskette drives or a 10 mbyte hard disk.
- For a Workmaster II industrial computer, you must use MS-DOS version 3.3.
- For an IBM PC or PC-XT computer, you must use PC-DOS version 2.10, or later. An IBM PC-AT requires PC-DOS version 3.0, or later. (The term PC-DOS refers to the software supplied by IBM as "DOS Disk Operating System for IBM personal computers".)
- For an IBM PS/2 computer, you must use PC-DOS version 3.3 or 4.0.

Determining the DOS Version Number

If you are not sure what version DOS you have, start up the computer in DOS, as described on the following page. The copyright screen will display the DOS version number.

If you are already in DOS, you can display the DOS version by entering the following command:

```
A> VER
```

and pressing the Return key.

STARTING UP DOS

DOS can be run from the diskette or from a hard disk. To start up DOS, follow these instructions:

1. The DOS software must be in the computer. If DOS is not installed on a hard disk, place your DOS diskette in drive A.

2. Start up the computer. If the computer was already running, you can restart by pressing CTRL-ALT-DEL, or a Reset button. Otherwise, turn on power to the computer.

3. The copyright screen is displayed while the DOS software is loaded into programmer memory. When the date and time prompts are displayed, you can enter the requested information, or press the Return key to continue.

4. The DOS command prompt appears.

```
A>
```

   This prompt shows the letter ID of the drive. If you used a diskette in drive A to start up DOS, then the prompt will indicate drive A. This is the "current" drive.

   The cursor appears at the prompt. If you wanted to use one of the DOS commands, you would type it here, and press the Return key. If you wanted to run a software program from a diskette or hard disk, you would enter its command line.

ENTERING OR CHANGING THE DRIVE ID

DOS assigns an identifying letter to each drive in the computer. The letter assignments depend on the type of computer you are using, and how its hardware is set up.

When you start up or reset the computer, it will check drive A for a diskette with certain system files. If these files are present, the contents of the diskette in drive A will be loaded into the programmer memory of the computer. This is what happens when you load DOS from a diskette. After the software is loaded, the drive A command prompt is displayed. Drive A is now the current drive.

If the computer does not find the system files in drive A, it will look for a hard disk. (If a non-system disk is in drive A, an error message is displayed.) If the system files are on a hard disk, it will load those files into programmer memory and the hard disk drive prompt will be displayed. In this case, the hard disk becomes the current drive.

Changing the Current Drive

To change the current drive, enter the new drive ID followed by a colon and press the Return key. The following example changes the current drive from C to A.

```
C>
C>A:            (and press the Return key.)
A>
```

Now, the computer will go to drive A to execute commands, rather than to drive C.

USING DOS COMMANDS

Your DOS manual explains how to use DOS, and provides complete definitions of all DOS commands. Each time you enter a command, DOS will perform some function for you. You will use the following commands to install and start up Logicmaster 1F software:

COPY To copy one or more files, either on the same disk or from one disk to another, use the Copy command. For example, to copy a file named CONFIG.WM to the same disk, and call the copy CONFIG.SYS, you would enter:

```
COPY CONFIG.WM CONFIGSYS
```

REN To rename a file, use the Rename command. For example, to rename a file named CONFIG.WM as CONFIGSYS (on the same drive) you would enter:

```
REN CONFIG.WM CONFIGSYS
```

TYPE Use the Type command when you want to display a file on the computer screen. For example:

```
TYPE CONFIG.SYS
```

Any kind of file can be displayed with the Type command. If the file is not an ASCII (readable) file, it will appear as an assortment of characters and beeps. One kind of file displayed in that way is a ladder logic file. You cannot use DOS to display a ladder logic file in recognizable form. To see the ladder logic, you must enter Logicmaster 1F, load the file into programmer memory, and then use Edit Program or Display Program.

FORMATTING DISKETTES

Before you can use a new diskette, it must be initialized. The Format command prepares a diskette to receive data. You should remember that formatting erases any data previously placed on the diskette. Don't format a diskette that contains data you want to save. To format a diskette, follow these steps:

1. Start up the computer in DOS. At the DOS prompt, type:

   ```
   FORMAT (drive:)
   ```

2. Insert a write-enabled diskette into the specified drive. Press the Return key. Follow the prompts to format the diskette.

FINDING A FILE

DOS will display a listing of all of the files on a drive. This listing is called a "*directory". The directory shows the name of each file, its extension, its size, and the date and time it was last edited.

If you want to display a directory, enter the Directory command. For example:

A> DIR	displays the directory of the disk in drive A, when drive A is the current drive.
A> DIR B:	displays the directory of the disk in drive B, when drive A is the current drive.
B> DIR	displays the directory of the disk in drive B, when drive B is the current drive.

The Directory command causes the file listing to scroll rapidly upward on the screen. If the listing is too long to fit on one screen, you can display just one screen at a time by entering the characters /P after the command. For example:

A> DIR B:/P

This command would cause DOS to display a directory of the files on the disk in drive B. After the first screen of the listing is displayed, pressing any key displays the next screen.

Wildcard characters can be used to display a directory of related files on a disk. For example:

A> DIR B:*.LAD

This command would display a directory of all .LAD files on the disk in drive B.

EXITING TO DOS FROM LOGICMASTER 1F SOFTWARE

When Logicmaster 1F software is running in the computer, you can exit directly to DOS from the Supervisor menu. You may want to do this, for example, if you need to format a diskette using DOS. Be careful exiting to DOS if there is a ladder logic program in programmer memory that you want to keep. Exiting to DOS is just like restarting the computer; the contents of programmer memory will be lost.

If you have been editing a program that has an active file name, it has automatically been saved to disk each time you press CTRL-A or the Accept key. If the program does not have an active file name, before exiting to DOS you should store the program using the Load/Store/Verify function of Logicmaster 1 F. If necessary, you can use any formatted diskette to store the program.

To exit to DOS from the Supervisor menu, follow these steps:

1. Press the ALT and Z keys. If your computer has a hard disk, it. will return to DOS. If you are using DOS diskettes to start up the computer, your screen may display the following prompt:

   ```
   Insert disk with \COMMAND.COM in drive A
   and strike any key when ready
   ```

   Place a diskette with a COMMAND.COM file in drive A. This should be your DOS diskette. Press any key to continue. If you do not have a diskette with a COMMAND.COM file, you will not be able to continue this procedure. You should refer to your DOS manual for more information about the COMMAND.COM file.

   If you are running Logicmaster 1F software from diskettes, the screen may now prompt:

   ```
   Insert disk with batch file
   and press any key when ready
   ```

   If that prompt is displayed, place a diskette with a batch file in drive A. Diskette 1 of the Logicmaster 1 F diskettes contains a batch file. Press any key to continue.

2. The DOS command prompt will be displayed. If you have been using diskettes, it will be the drive A prompt:

   ```
   A>
   ```

3. To return to the Logicmaster 1F software, enter L1FWM or L1FPC on the command line. (Refer to page 2-8 for an explanation of which command to enter.)

   If you are using diskettes, the Logicmaster 1F diskette 1 must be in the default drive. Press the Return key.

SECTION 2
INSTALLING LOGICMASTER 1 F SOFTWARE

Ordinarily, you will use the information in this section once, to prepare Logicmaster 1 F software for regular use. This section describes:

- **The diskettes supplied with Logicmaster 1 F software.**
- **The types of System Configuration f iles that are supplied with Logicmaster 1F software.**
- **The correct content of the CONFIG.SYS file for the type of computer you are using.**
- **Editing the System Configuration file, if necessary.**
- **Instal ling Logicmaster 1 F software on a hard disk.**
- **For the Workmaster or Cimstar I computer, 3½-inch diskette only: customizing Logicmaster 1F system diskettes so that they can be started up without DOS.**

BEFORE USING LOGICMASTER 1 F SOFTWARE

Before you use Logicmaster 1F software regularly, you should follow the instructions in this section.

1. **Check the content of your System Configuration CONFIG.SYS file. This file must agree with your hardware setup. If necessary, edit or create this file on your start-up disk.**
2. **If your computer has a hard disk, install Logicmaster 1F software on the hard disk.**
3. **If you are using either a Workmaster or Cimstar I computer with 3½-inch diskettes, you can create a start-up diskette. This will eliminate the need for using a DOS diskette to start up the Logicmaster 1F software.**

LOGICMASTER 1 F SYSTEM DISKETTES

Logicmaster 1 F software is supplied on diskettes as described below:

1. For computers with 3½-inch drives with 80 track format, such as that provided with the Workmaster or Cimstar I computer, the software is provided on one 3½-inch diskette. Starting up the software will take you to the Supervisor menu, with all software functions loaded into programmer memory.

2. For IBM PC-XT, PC-AT, and most IBM-compatible computers with 5¼-inch disk drives with 40 track format, such as that provided with the IBM personal computer, the software is provided on two 5¼-inch diskettes. Starting up the software with disk 1 in the drive will proceed to the Clock Setup menu. Then you will be prompted to insert the second disk. When the second disk finishes loading, the Supervisor menu will be displayed, with all software functions loaded into programmer memory.

Once installed and/or set up properly, either configuration of the Logicmaster 1 Family (L1F) programmer (described above) will operate in one of two ways:

1. Enter **L1FWM** to start the software for operation on the Workmaster or Cimstar I computer. The Logicmaster 1F software will recognize the Workmaster keyswitch.

2. Enter **L1FPC** to start the software for operation on the Wotkmaster II computer, an IBM-PC, PC-XT, or PC-AT computer, and most IBM compatible computers. Refer to section 6 of this chapter for alternate key sequences required for non-Workmaster, IBM-compatible keyboards.

CHANGING THE ORIGINAL LOGICMASTER 1F FILES

All files provided with Logicmaster 1 F software are read-only files. They can be renamed, but they cannot be copied over, deleted, or edited. Unused files can be left on the disk; they will not interfere with operation of the Logicmaster 1F software. If you want to edit one of these original files (including any of the System Configuration files), you must copy and rename the file first; then edit the copy.

BEFORE STARTING UP LOGICMASTER IF SOFTWARE THE FIRST TIME

Use the original diskettes to start up the system the first time. Then, use the Duplicate Master utility of Logicmaster 1F software to make copies of the diskettes. Use the copies for everyday diskette operations; keep the originals in a protected location. Complete instructions for using Duplicate Master are given in chapter 11.

Before using the Duplicate Master utility, prepare the diskettes for the working copy by using the DOS Format command.

SYSTEM CONFIGURATION FILE

To run Logicmaster 1 F software, the disk you use to start up the computer must contain a System Configuration file with the name CONFIG.SYS. When a hard disk is used as the start-up disk, the CONFIG.SYS file must be in the root directory of the hard disk. The required content of the file is discussed below.

The CONFIG.SYS file is a short, readable file that describes the system requirements for the software package. Different software packages use different system configuration files, depending on the software requirements and the existing hardware configuration. Your DOS diskette should already contain a CONFIG.SYS file. The computer uses this file at boot-up time to establish the system configuration. If the content of the CONFIG.SYS file is changed *after* boot-up, the computer must be re-booted *before* the changes will take effect.

Sample system configuration files are provided with Logicmaster 1 F software for reference. One of these two files will probably meet most application requirements without change. The content of these files is discussed below:

1. The CONFIG.PC file (for Workmaster II computers, Cimstar I computers, IBM personal computers, and most IBM-compatible computers) contains three lines which must be in the CONFIG.SYS for all computers running Logicmaster 1F software. These lines are:

   ```
   buffers = 5
   files = 20
   device = ansi.sys
   ```

   The entry for buffers must be 5, and the entry for files must be 20. The device driver calls for a file named ANSI.SYS. The ANSI.SYS file must be present on the DOS disk for Logicmaster 1F software to run.

2. The CONFIG.WM file (for Workmaster computers) contains the same three lines, as provided in the CONFIG.PC file. It also contains one additional line specifically required for the Workmaster computer. This additional line enables the device driver for the Workmaster clock. The CONFIG.WM file contains:

   ```
   buffers = 5
   files = 20
   device = ansi.sys
   device = wmclock.sys
   ```

If the CONFIG.SYS file on your DOS disk does not contain the above information, you must create a file that does. You can copy one of the above files or modify your existing file. It is wise to save your existing CONFIG.SYS file in case you need to refer back to it. Then, you can copy one of the above files to make the CONFIG.SYS file.

If changes ate still required to the CONFIG.SYS file, you will need to know how to use a text editor. A brief discussion of EDLIN (Line Editor supplied with DOS) can be found on the following page (see "WORKING WITH THE CONFIG.SYS FILE").

For a Workmaster Computer with a 5¼-Inch Disk Drive

If you are using MS-DOS version 3.2 and your Workmaster or Cimstar I computer has a 5¼-inch disk drive, you should place a DRIVPARM command in the CONFIG.SYS file. This line tells DOS the capacity of diskettes placed in the drive, which is important when formatting disks.

For example, if you have a Workmaster computer with two 3½-inch drives (A and B) and an external 5¼-inch floppy drive (C), the following line will specify that drive C has the standard 40-track, 360K byte form factor:

```
DRIVPARM-/D:2 /F:0
```

In this example, the 2 refers to drive C (O=A, I=B, and 2=C), and 0 refers to form factor 0 (360K). If you do not use this line, DOS assumes form factor 2 (760K), which is only correct for 3½-inch drives. Refer to your DOS manual for more information on the DRIVPARM command.

Running Other Software with the CONFIG.SYS File for Logicmaster 1 F

Other types of software may require different entries in the CONFIG.SYS file. It is not always possible to combine the requirements for multiple software packages into one CONFIG.SYS file. In that case, you must maintain multiple versions of the CONFIG.SYS file. That can be done by using multiple DOS diskettes, or by renaming versions of the CONFIGSYS file and using the one required for a specific application. *Remember to re-boot your system if the CONFIGSYS is changed.* Your DOS manual contains more information about the CONFIG.SYS file.

WORKING WITH THE CONFIG.SYS FILE

Follow the instructions below if you need to display, create, or edit a CONFIG.SYS file.

Displaying the CONFIG.SYS File

Use the DOS Directory command, as explained previously, to display the contents of your DOS disk. If there is a CONFIGSYS file on the disk, you can display its contents by entering:

```
TYPE CONFIGSYS      (press Return)
```

Creating a CONFIG.SYS File

If you do not have a CONFIG.SYS file, create one as described below. Note that this procedure will write over any existing version of the CONFIG.SYS file. If such a version exists, rename it CONFIG.BAK before following these steps.

1. At the DOS prompt, type:

```
COPY CON CONFIGSYS
```

2. Press CTRL-E or the Enter key.

3. Type in the configuration commands needed, pressing the Return key after each command. When you have finished typing the commands, press the F6 key, then the Return key. This saves the new CONFIG.SYS file.

Editing an Existing CONFIG.SYS File

If you have a CONFIG.SYS file, but it does not include all the parameters needed to run Logicmaster 1F software, edit the file using a line editor such as EDLIN.

NOTE

if you are already familiar with EDLIN, go to page 2-14.

A simple procedure to edit the CONFIG.SYS FILE using EDLIN follows. (Refer to your DOS manual for complete instructions on using the EDLIN commands and features.) In the procedure below, the example entries assume the DOS diskette being edited is in drive A. *If you should need to end the use of EDLIN without saving the file, type the Quit command to return to the command prompt:*

```
*Q
```

and press the Return key.

Instructions to edit the CONFIG.SYS file:

1. Enter the EDLIN command and the name of the file. For example:

```
A>EDLIN CONFIGSYS
```

and press the Return key.

2. EDLIN will prompt:

```
End of input file
*
```

3. The asterisk (*) is the EDLIN prompt. The first step in editing the file is to display the file contents. Enter the List command.

```
*L
```

and press the Return key.

The CONFIG.SYS file will be listed as individual numbered lines. For example:

```
*L
1: break=on
2: buffers=5
3: files=20
4: device=ansi.sys
```

4. **Compare the contents of your file with the entries required to run Logicmaster 1F** software. You **can insert, delete, or edit lines as described** below. *EDLIN commands can only be executed at the EDLIN asterisk prompt at the left side of the screen (not from a numbered line).* **To execute an EDLIN** command, **return to the asterisk prompt by pressing the CTRL-C keys like this:**

```
    2: buffers=5
    3: files=20
    4: device=ansi.sys
    5: *^C
*
```

A. **Adding a Line: If you** want to **insert a line in the file,** enter **the Insert command at the** EDLIN **asterisk prompt:**

```
*I
```

and press the Return key. The sequence of items in the CONFIG.SYS file is not important. However, if you want to insert the line in a particular order, you can specify a line number before entering the Insert command (above). For example, to have the inserted line as line 5 in the file, you would enter:

```
*51
```

and press the Return key. This line number is displayed beside the asterisk prompt. Now, type in the content for the line. For example:

```
5:*drivparm=/d:0 /f:2
```

Press the Return key at the end of the line.

Continue until all the necessary lines have been added to the file. After entering the last new line, press the Return key again. The next line number is displayed:

```
5:*drivparm=/d:0 /f:2
6:*device=wmclock.sys
7:*
```

Press the CTRL-C keys to return to the EDLIN asterisk prompt:

```
5:*drivparm=/d:0 /f:2
6:*device=wmclock.sys
7:*^C
*
```

B. **Removing a Line: If you want to delete a line from the file, enter the Delete command at the asterisk prompt (at the left side of the screen). Include the number of the line to delete. The next example removes the Workmaster clock device driver from the file:**

```
5:*drivparm=/d:0 /f:2
6:*device=wmclock.sys
*6D
*
```

You should use the List command to verify the deletion.

C. **Editing a Line: If you want to change part of an existing line, enter its line number at the asterisk prompt. In the next example, line 2 is selected for editing:**

```
1: break=on
2: buffers=20
3: files=20
4: device=ansi.sys
5:*drivparm=/d:0 /f:2
6:*device=wmclock.sys
*2
```

The line is displayed again on the screen:

```
2: buffers=20
2:*
```

Enter the correct line and press the Return key.

```
2: buffers=20
2* buffers=5
```

Press the CTRL-C keys to return to the EDLIN asterisk prompt.

```
7:*^C
*
```

5. To finish using EDLIN, enter the End command:

```
*E
```

and press the Return key. The End command saves the new version of the file under the original file name (here, CONFIG.SYS). Also, it automatically creates a backup version of the file named CONFIG.BAK.

After you enter the End command and press the Return key, the DOS command prompt is displayed. Check the contents of the file by entering:

TYPE CONFIGSYS

and pressing the Return key.

After Editing the CONFIG.SYS File

After you create or edit a CONFIG.SYS file, restart the computer. This must be done to use the entries in the new file.

If the computer is not restarted, any previous version of the CONFIG.SYS file that was present the last time the computer was started up will continue to be used.

INSTALLATION: COMPUTER WITHOUT A HARD DISK

With the correct CONFIG.SYS file on the DOS disk, boot up the computer in DOS. Insert the Logicmaster 1F system disk #1 in drive A: and start it up by entering either L1FWM for Workmaster and Cimstar I computers or L1FPC for Workmaster II computers, IBM personal computers, and most IBM-compatible computers.

Preparing Bootable Logicmaster 1F System Diskettes

Copies of the 3½-inch version of Logicmaster 1F can be made "bootable" by preparing a system disk containing DOS system files, and then transferring a copy of Logicmaster 1F to the disk. *The master diskette shipped from GE Fanuc cannot be made bootable.* **To prepare a Logicmaster 1 F bootable 3½-inch system diskette, it is best to use a computer with two disk drives.**

1. **First, start up the computer with the DOS disk in drive A.**

2. **Insert a new disk into drive B so the disk can be formatted as a system disk.** All data **on the disk will be erased as it is formatted. A copy of DOS system files will** be **transferred to the new disk by entering the following command:**

   ```
   FORMAT B: /S
   ```

3. **Enter the following commands** to **copy additional system files from the DOS disk to the newly formatted disk:**

   ```
   COPY A:ANSI.SYS B:
   ```

   If the disk is being made to **run on the Workmaster computer, you must also** copy **the following file from the DOS diskette. (This does not apply to the Workmaster II computer .)**

   ```
   COPY A:WMCLOCK.SYS B:
   ```

4. **Insert the Logicmaster 1F master disk in drive A and copy the proper system configuration file to the newly formatted disk as follows:**

   A. **If the disk is being made to run on the Workmaster computer, copy the following file from the Logicmaster 1 F diskette:**

      ```
      COPY A:CONFIG.WM B:CONFIG.SYS
      ```

   B. **If the disk is being made to run on the Workmaster II, Cimstar I, IBM-PC computer, or IBM-compatible computer, copy the following file from the Logicmaster 1 F diskette:**

      ```
      COPY A:CONFIG.PC B:CONFIG.SYS
      ```

5. Start up the Logicmaster 1 F software and go to the Duplicate Master utility. Proceed to duplicate the master disk (in drive A) to the newly formatted disk (in drive B). Refer to chapter 11 for more information on Duplicate Master.

This completes the making of a bootable disk. You may insert the new disk into drive A and restart the computer. After DOS starts up, you will be prompted to enter either L1FWM or L1FPC to start up the Logicmaster 1F software.

NOTE

The AUTOEXEC.BAT file can be modified to automatically start up the Logicmaster 1F software after DOS boots up. Simply add the L1FWM command as the last line in the AUTOEXEC.BAT file.

INSTALLATION: COMPUTER WITH A HARD DISK

These instructions describe steps to install Logicmaster 1F files on a computer with a hard disk. (If you prefer to run the software using diskettes, refer to the instructions for a computer without a hard disk.)

1. The hard disk should already be formatted, and DOS should be installed. For more information about DOS, refer to your DOS manual. The following files should be in the root directory of your hard disk:

ANSI .SYS	provided with your DOS.
CONFIG.SYS	system configuration requirements for Logicmaster 1F software.
WMCLOCK.SYS	only required for the Workmaster computer. (This does not apply to the Workmaster II computer.)

NOTE

The System Configuration file used by your computer at start-up should contain the appropriate information prior to starting up Logicmaster 1 F software. Refer to page 2-10 for additional information regarding the CONFIG.SYS file. If the CONFIG.SYS file used by DOS during start-up is revised, you must restart the computer before the new file becomes active.

2. Start up the computer in DOS. When the DOS command prompt is displayed, place the Logicmaster 1F disk 1 in drive A and enter one of the following commands to start up Logicmaster 1 F software:

L1FWM	(if using a Workmaster or Cimstar I computer)
LI FPC	(if using a Workmaster II, IBM-PC, or IBM-compatible computer)

Press the Return key. The Logicmaster system will prompt you to enter the time and date. (If using 5¼-inch disks, you will be prompted to insert system disk 2.)

3. **Follow these steps to duplicate the** software:

   A. Select **Utility functions by pressing F8 at the Supervisor level.**

   B. **Select Duplicate Master function by** pressing **F1 in the Utility function.**

   C. **Enter A** as **the drive to duplicate from and your hard** disk as **the drive to duplicate** to.

   D. Press **CTRL-E or the Enter key to begin the duplication of the** software.

   If **using** *5¼-inch disks, repeat the duplication process so both disks will be duplicated to the hard disk.*

4. **Once the duplication process is complete, you may return to the Supervisor** menu, **and then exit to DOS by pressing the ALT-Z keys. The master disks should be removed and placed in a protected location.**

5. **A new L1F directory was created on the hard disk containing a copy of the Logicmaster 1 F system files. Change to the LI F directory, and start up the software from the hard disk using either the L1FWM or L1FPC command.**

Specifying the Path for a Hard Disk

Since the Duplicate Master **automatically creates a subdirectory called L1F on the hard disk, you may wish to add this directory to a path statement. This will supply DOS with a path to \L1 F subdirectory from other directories or disk drives. This is normally done by placing a path statement in the AUTOEXEC.BAT start-up file. For example:**

```
PATH \L1F
```

This statement will define the path each time the system **is booted. If you already have a path statement, you can add the \L1F path to the** end **of that statement. For example:**

```
PATH D:\;D:\DOS;D:\L1F
```

will tell DOS to first look for the command in the root directory of drive D, then look in a DOS subdirectory on drive D and finally look in the L1 F subdirectory on drive D. Of course, DOS always looks in the current directory of the current drive before using the path.

SECTION 3
STARTING UP LOGICMASTER 1 F SOFTWARE

After the installation procedures described in the preceding section have been completed, you can start up Logicmaster 1 F software normally.

This section describes the following procedures for regular start-up of Logicmaster 1F software.

- Entering the Logicmaster 1F command line.
- Displaying the Logicmaster 1 F title screen.
- Changing the time and date.
- Displaying the Supervisor menu.

USING OTHER TYPES OF SOFTWARE: RAM REQUIREMENTS

Logicmaster 1 F software requires that 640K of programmer memory (RAM) be available in your computer. The Logicmaster 1F software will fail to start up if you attempt to run it simultaneously with other software packages (i.e., VTERM of Sidekick).

Communications Setup File

At start-up the system looks for a file named COMSETSET. This file describes the serial communications configuration of the system. If the system is started up in Monitor mode or On-Line mode (implying communications with the CPU), the serial version attempts to establish communications with the CPU, and read in the scratch pad settings if the COMSET.SET file is present and specifies a valid port. If an invalid port is specified, the screen displays the message:

INVALID PORT SPECIFIED IN COMSETSET

If communications cannot be established, the system supplies default settings for the items in the scratch pad.

ENTERING THE LOGICMASTER 1F COMMAND LINE

Follow these steps to start up the Logicmaster 1F software.

NOTE

If you are using a computer with **a hard disk, the Logicmaster** 1F software **should be installed on the hard disk as described in the** preceding sect ion. **With the software installed on the hard** disk, begin **at** step 3 below.

1. **Start up the system using the appropriate DOS (as explained in the preceding section). If the computer is turned off, apply power. If the computer is already turned on when you insert the diskette, you can perform a software start by pressing the CTRL-ALT-DEL keys at the same time. After the DOS software is loaded, the DOS command prompt is displayed:**

   A>

2. **Insert Logicmaster 1F diskette 1 in drive** A.

3. **At the DOS command (drive) prompt, type one of the following:**

   L1FWM — to **start Logicmaster 1F software on either the Workmaster or Cimstar I computer.**

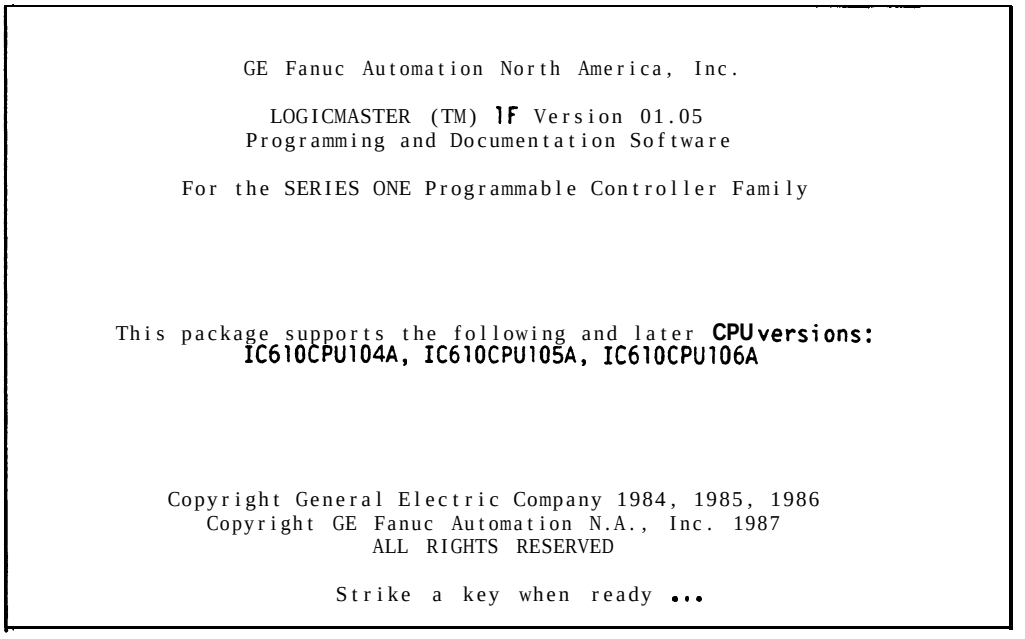
   Of

   L1FPC — to **start Logicmaster 1F software on a Workmaster II, IBM personal computer, or IBM-compatible computer.**

4. **After entering the Logicmaster 1F command, press the Return key. Follow the prompts that are displayed to display the Supervisor menu.**

DISPLAYING THE TITLE SCREEN

At power-up, the title screen is displayed:



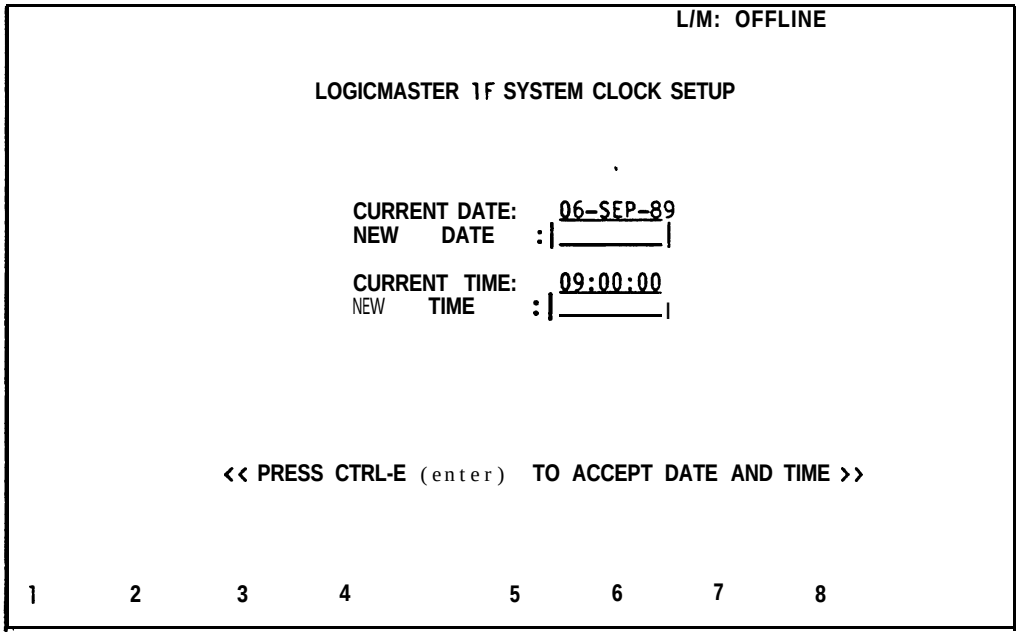
This screen identifies the version of software being used.

From the title screen, pressing any key starts the Logicmaster software loading from disk into programmer memory until the System Clock Setup menu is displayed.

CHANGING THE TIME AND DATE

The System Clock Setup menu allows you to set the system's internal calendar and clock. To set the time and date, type in entries using either the keyboard or the numeric keypad. The standard date format is DD-MMM-YY; the standard time format is HH:MM:SS.

Use the Return key or cursor keys to move between fields on the screen. To accept the new values, press CTRL-E or the Enter key. Pressing CTRL-E or the Enter key with no changes in the two fields accepts the current date and time as shown on the menu.



The time and date screen can be accessed only from the title display.

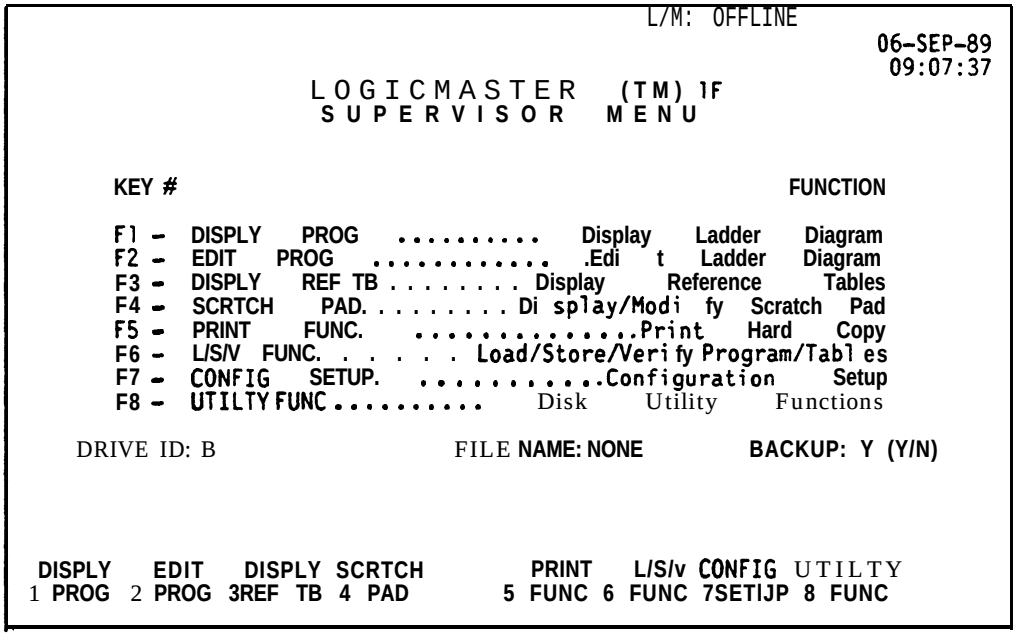
DISPLAYING THE SUPERVISOR MENU

When the time and date shown are correct, press CTRL-E or the Enter key to complete the software loading process until the Supervisor menu is displayed. (If loading Logicmaster 1 F from 5¼-inch disks, you will be prompted to insert the second disk after the time and date screen.)

When the main Supervisor menu is displayed, all software functions are resident in programmer memory, except the Help text. The Help text will always be accessed f rom disk when the Help key is pushed.

SECTION 4
USING FEATURES OF THE SUPERVISOR MENU

The Supervisor Menu, which represents the top level of control, provides access to the primary functions of the Logicmaster 1F system. The Supervisor menu can be reached at any point by pressing the SUPRV hard key. The menu lists the name and function of each function key.



SUPERVISOR MENU FUNCTION SUMMARY

Use the function keys to select system functions, as explained below:

DISPLAY PROGRAM (Fl) Select Display Program to display a ladder diagram program stored in programmer memory. If connected to an operating CPU, power flow and register content can be shown in On-Line or Monitor mode. Refer to chapter 4 for information about this function.

EDIT PROGRAM (F2) Select Edit Program to develop a program, or to modify a program stored in the system. This function is performed within the Logicmaster system. It does not require connection to a CPU, and is available in Off-Line, On-Line, and Monitor mode. Refer to chapter 5 for information about this function.

SUPERVISOR MENU FUNCTION SUMMARY (Continued)

DISPLAY REFERENCE TABLES (F3) — Select Display Reference Tables to display I/O status or register contents. If connected to an operating CPU, real-time data can be displayed in On-Line or Monitor mode. In Off-Line mode, data is from the programmer memory status image. Refer to chapter 7 for information about this function.

SCRATCH PAD DISPLAY (F4) — Select Scratch Pad Display to display information about memory size, function level, register capacity, CPU ID, and other status information. Use the Scratch Pad function to establish parameters before programming. Refer to chapter 3 for information about this function.

PRINT FUNCTION (F5) — Select Print Functions to print out program and other information in either foreground or background mode. Refer to chapter 8 for information about this function.

L/S/V/FUNCTION (F6) — Select this function to transfer programs between the Logicmaster 1F system, the CPU, and disks. Refer to chapter 9 for information about this function.

CONFIGURATION SETUP (F7) — Select Configuration Setup to display and modify serial CPU communications setup and monitor color select ion.

UTILITY FUNCTION (F8) — Select these functions to copy diskettes, and to perform other file-handling operations. Refer to chapter 11 for information about this function.

The bottom of the Supervisor screen displays the following information:

DRIVE ID — The program drive ID. This is the drive you are using for your program files. To change it, enter the new drive ID followed by a file name or the word NONE. Press CTRL-E or the Enter key on the numeric keypad (not the Return key). For example:

A:program1 (and press CTRL-E or the Enter key)

FILE NAME — The program name.

BACKUP — Shows whether backup files (copies) will be made before program files are edited. Fife backup is selected by entering Y for the prompt that is displayed at the beginning of an editing session.

LOADING PROGRAM FILES FROM THE SUPERVISOR MENU

Program files can be loaded into Logicmaster 1F programmer memory using the Load/Store/Verify function, or directly from the Supervisor menu. To load program files from the Supervisor menu, follow these steps:

1. Be sure that the file is present on the default drive (hard disk or diskette).

2. If the drive ID does not show the drive where the program files are located, change it. To enter a drive ID, type it into the work area and press CTRL-E or the Enter key.

3. Enter the program file name. Type the basic program file name, not including a file name extension, into the work area. For example:

   PROGRAM 1

   Then press CTRL-E or the Enter key.

4. Press and hold the ALT key; then press the L key. All files with the file name entered will be loaded into programmer memory. The message BUSY is displayed on the screen until the files are loaded. If an error occurs, a message is displayed and the loading is aborted.

Refer to chapter 9 for information on using the Load/Store/Verify function to load files.

NAMING THE PROGRAM

You should enter a program name before leaving Supervisor level to edit, display, or print a program. The name is retained until a new program is loaded, until the name is canceled by entering the word "NONE", or until power is removed from the system.

If no name is entered, the system can develop programs or monitor the CPU, but annotation cannot be used or displayed. In addition, without a program name, display formats will not be saved because there will be no files to place them in. Finally, if no program name has been specified before editing a program, the system is unable to save the edits automatically. Edits will be saved in programmer memory only. If power goes off during editing, the work you have done will be lost. Therefore, you should always enter the program name before leaving the Supervisor level.

A program name may have up to 8 characters. Do not use the following reserved words in program names: NONE, CON, NUL, PRN, AUX, COM1, COM2, LPT1, LPT2, LPT3.

SECTION 5
USING YOUR KEYBOARD

This section explains:

- How to select a keyboard for use with Logicmaster 1 F programming and documentation software.
- How to use a personal computer keyboard for programming. The *91-key keyboard described here was developed for use in ladder diagram programming. It has several keys that are not on standard personal computer keyboards.* While a personal computer keyboard can be used for programming as described in this book, the 91 -key keyboard is recommended.

  If you must use a personal computer keyboard for programming, refer to the list of equivalent key functions included in this section.
- ALT and CTRL key functions.
- How to define sequences of frequently-used keystrokes for easier programming.

THE 91-KEY KEYBOARD

The 91-key keyboard from GE Fanuc - NA was designed to satisfy the special requirements of PLC programming and monitoring. It has two modes of operation:

- In its default mode, it operates as described on the following pages. It is compatible with Logicmaster programming software. Its extra keys perform special programming functions.
- In its alternate mode, it emulates the functions of a standard 83-key IBM PC-XT keyboard.

TPK.A.41680

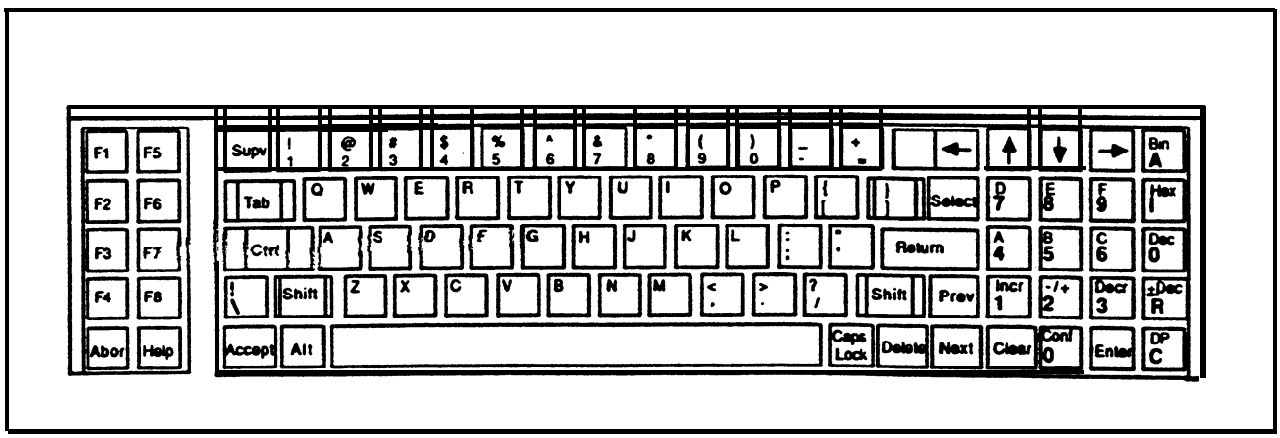


Figure 2.1 91-KEY KEYBOARD LAYOUT

FUNCTIONS OF THE 91-KEY KEYBOARD

Typewriter Keys

The central area of the keyboard includes the typewriter keys, in standard QWERTY layout. All of these keys will repeat their functions when held down.

The central area of the keyboard also includes these keys:

SUPRV	The Supervisor key returns the display to the Supervisor menu.
TAB	The Tab key works like a standard typewriter Tab key. Tab stops are set every 8 characters.
CTRL	The Control key, when pressed at the same time as another key, controls the execution of a function or command. The function performed depends on the software.
| / \	The Backslash key types a backslash character, or a split vertical bar when shifted.
ACCEPT	The Accept key (or CTRL-A) is used to verify and accept an operation, such as a ladder diagram run entry in the Edit Program function.
ALT	The Alternate key, when pressed at the same time as another key, controls the execution of a function or command. Refer to the heading "ALT Key Functions" in this section for more information.
CAPS LOCK	The Caps Lock key locks the characters A through Z into uppercase letters. It does not lock in the shifted functions of other keys.

Left Keypad

The keypad on the left includes keys labelled F1 through F8. The functions of these keys are controlled by Logicmaster 1F software. The currently-active functions are always displayed at the bottom of the screen. The left keypad also includes these keys:

ABORT	The Abort key (or F9) is. used to end the current operation.
HELP	The Help key (or F10) is used to display the Help screen associated with the current operation taking place in the software.

FUNCTIONS **OF THE 91-KEY** KEYBOARD **(Continued)**

Right Keypad

The right keypad contains many **of the keys you will use most frequently during programming with the Logicmaster 1 F system.**

ARROW KEYS — **The arrow keys move the cursor.**

BACKSPACE — **The Backspace key backs up the cursor** and deletes any characters the cursor moves over.

DEL — **The Delete key erases the previous/last character.**

NEXT — **The Next key scrolls the program display upward to the next rung.**

ENTER — **The Enter key (or CTRL-E) places the** value **currently in the work area into the program.**

PREV — **The Previous key scrolls the program display downward to the previous rung.**

SELECT — **The Select key moves the reverse-video banner in the work area of the screen. This allows** data to **be entered in the text line, the reference** line, or **the value line of the work area. For more information, refer to the explanation on screen format.**

DATA ENTRY KEYS — **The gray keys in the right keypad have dual functions. Unshifted, they are used to enter values into the work area during programming. Shifted, they change the number base of the work area, or of a selected item in one of the display tables.**

KEY	SHIFTED	UNSHIFTED
Bin/A	Inactive	AR (accumulate register
Hex/I	Register value	T (timer)
Dec/0	Unsigned decimal	C (counter
±Dec/R	Signed decimal	R (register)
DP/C	Double-precision	K (constant)
Conf/0	Confirm action	Zero
Incr/1	Increment by one	1
+/-/2	Toggle sign	2
Decr/3	Decrement by one	3

Alternate Mode of the 91-Key Keyboard

In default mode, the keys of the 91-key keyboard execute their normal functions. The 91-key keyboard can also emulate the functions of an 83-key keyboard, as described below:

Pressing the CTRL and Select keys at the same time toggles the keyboard between 91-key and 83-key mode. Note that these functions are *not* used with the Logicmaster 1F software. *This information is included here for reference only.*

91-KEY MODE	83-KEY MODE
Accept	Alternate
Cef t Cursor	Backspace (erases)
Right Cursor	Scroll Loc k
Up Cursor	Num Lock
Down Cursor	Num Lock
Decimal/O	Plus bar
Dec/R	Plus
Cl ear	O/Ins
Conf/O	O/Ins
Return	New Line
Enter	Delete/.
Incr/1	1/End
+/-/2	Z/Down Cursor
Decrement/3	3/Page Down
A/4	4/Left Cursor
B/5	5
C/6	6/Right Cursor
D/7	7/Home
E/8	8/Up Cursor
F/9	9/Page Up
Suprv	Escape
Tab	Tab
Sel ect	Ti 1 de/Accent Grave
Abort	F9
Help	F10
DP/C	Plus
Prev	Print Screen/*
Next	Minus
Binary/A	Scroll Lock
Hexadecimal /I	Minus
Delete	Delete/.

PERSONAL COMPUTER KEYBOARD

The following information describes the use of a standard IBM personal computer-type keyboard with Logicmaster 1 F software. Note that such a keyboard lacks the additional programming keys of the 91-key keyboard. Therefore, the 91-keyboard is recommended.

The illustration below shows the layout of the IBM PC-XT keyboard. This is the same layout as the 83-key keyboard from GE Fanuc - NA.

The Workmaster II and IBM PC-AT keyboards have a different layout, but are functionally similar.

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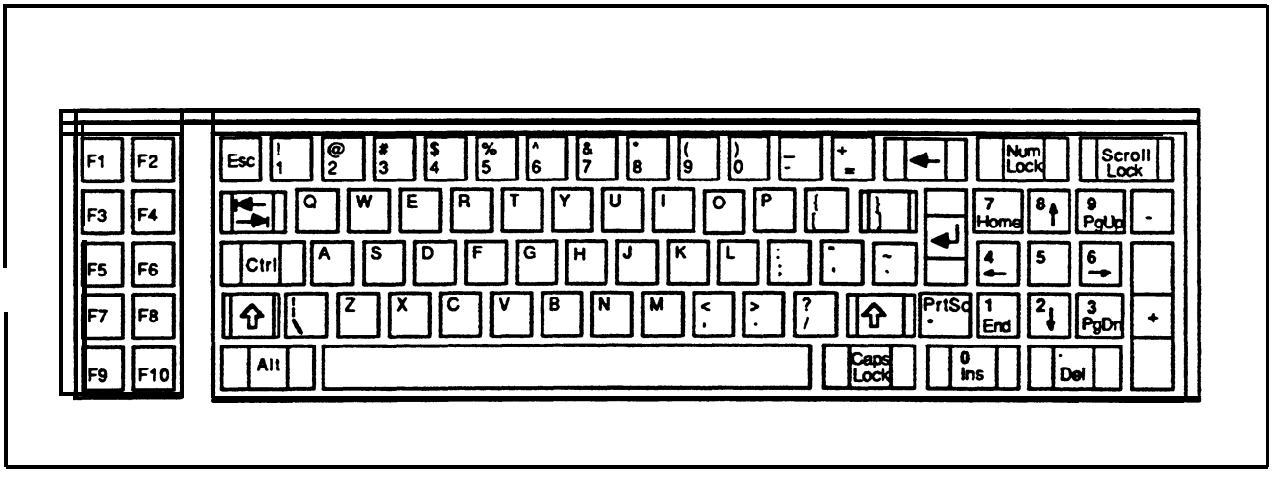


Figure 2.2 PERSONAL COMPUTER KEYBOARD LAYOUT

TPK.A.43110

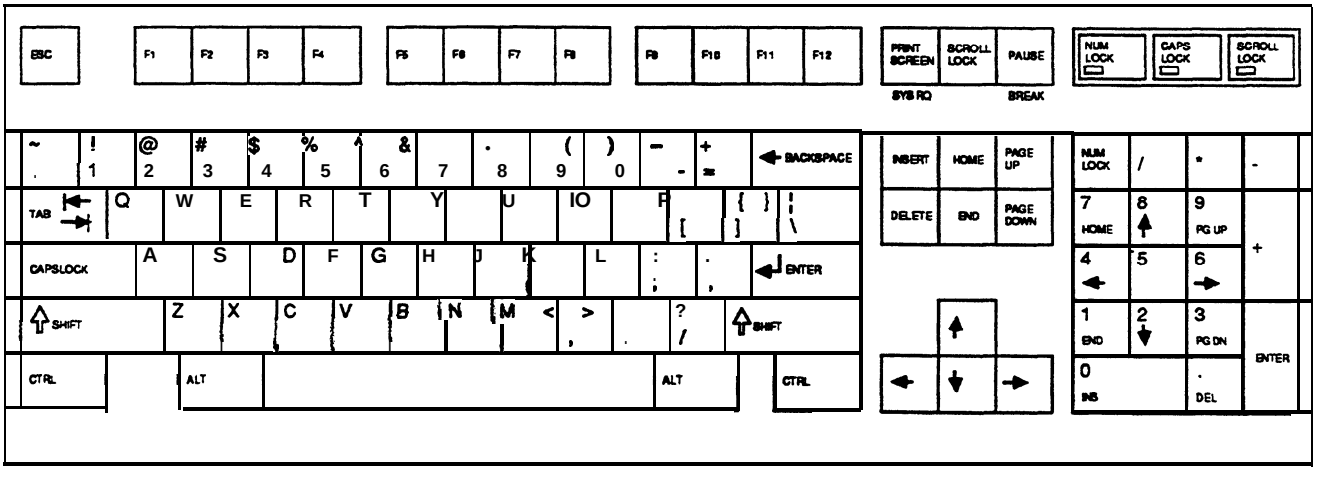


Figure 2.3 WORKMASTER II COMPUTER KEYBOARD LAYOUT

FUNCTIONS OF THE PERSONAL COMPUTER KEYBOARD

Typewriter Keys

The central area of the keyboard includes the typewriter keys, in standard QWERTY layout. All of these keys will repeat their functions when held down.

The central area of the keyboard also includes these keys:

ESC	The **Escape key emulates the function of the Supervisor key. It returns the display to the Supervisor menu.**
CTRL	**The Control key, when pressed at the same time as another key, controls the execution of a function or command. The function performed depends on the software.**
| / \	**The Backslash key types a backslash character, or a split vertical bar when shifted.**
ALT	**The Alternate key, when pressed at the same time as another key, controls the execution of a function or command. Refer to the heading "ALT KEY FUNCTIONS" in this section.**
* / PRT SC	**The Print Screen key can be used to print out a copy of what is currently displayed on the screen. The printing parameters must previously have been established, as described in this manual. Print Screen is a shifted function.**
CAPS LOCK ·	**The Caps Lock key locks the characters A through Z into uppercase letters. It does not lock in the shifted functions of other keys.**

Left Keypad

The keypad on the left includes keys labelled F1 through F10. The functions of these keys are controlled by Logicmaster 1F software. Keys F1 through F8 function as shown by the labels that are displayed on the bottom of the screen.

F9	**functions as the Abort key. It is used to end the current operation.**
F10	**functions as the Help key. It is used to display the Help screen associated with the current operation taking** place in **the software.**

FUNCTIONS OF THE PERSONAL COMPUTER KEYBOARD (Continued)

Right Keypad

The right keypad contains many of the keys you will use most frequently during programming with the Logicmaster 1 F system.

NUM LOCK	The Num Lock key locks the keys in the numeric keypad into their "upper" functions. For example, with the Num Lock key on, the cursor keys can be used to enter the numbers printed on the keys.
ARROW KEYS	With Num Lock off, the arrow keys move the cursor.
BACKSPACE	When used with Logicmaster 1F software, the Backspace key emulates the 0/Dec key on the 91-key keyboard. This key is used to enter a letter 0 (for output) in the center line of the work area, or to change the bottom line of the work area to decimal format.
DEL	The Delete key erases the last character entered.
INS/O (Num Lock Off)	With Num Lock off, the Ins/O key functions as the Next key. It scrolls the program display upward to the next rung. With Num Lock on, this key enters a zero.
PGDN/3 (Num Lock Off)	With Num Lock off, this key functions as the Enter key (or CTRL-E). It places the value currently in the work area into the program. With Num Lock on, this key enters a number 3 in the work area.
PRT SC / *	Unshifted, the Print Screen/* key functions as the Previous key. It scrolls the program display downward to the previous rung .
~ / `	Unshifted, the Tilde key functions as the Select key. It moves the reverse-video banner in the work area of the screen. This allows data to be entered in the text line, the reference line, or the value line of the work area. For more information, refer to section 4, SCREEN FORMAT.

For more information, refer to the list of key functions on the next page.

USING A PERSONAL COMPUTER KEYBOARD WITH LOGICMASTER 1F SOFTWARE

The table below summarizes the key functions of a personal computer keyboard when used with the Logicmaster 1F software. In the rest of this manual, the instructions refer to the 91-key keyboard. *If you are using a personal computer keyboard, use the following keys instead of those indicated in the text.* **Remember that the Num Lock key controls the functions of many of the keys in the numeric keypad. Assume that Num Lock and Shift should both be off unless the list says otherwise.**

91-KEY KEYBOARD	PC-TYPE KEYBOARD	ALT- AND CTRL- KEY SEQUENCES	FUNCTION DESCRIPTION
Suprv	Esc		Return to Supervisor menu.
Abort	F9		Cancel the current function.
Help	F10		Display the Help screens.
Clear	Home/7	CTRL-Z	Clear the work area line.
Delete	Del/.	CTRL-D	Delete the last character.
Select/*	' / ~	CTRL-S	Move the work area cursor.
Enter	PgDn/3	CTRL-E	"Enter" the current function.
Accept	End/1	CTRL-A	"Accept" the rung.
Shift-O/Conf	Shift-Num Lock-Ins/0	ALT-X	"Confirm" the prompt.
up cursor	Up Cursor/8		Move program cursor up.
Left Cursor	Left Cursor/4		Move program cursor left.
Right Cursor	Right Cursor/6		Move program cursor right.
Down Cursor	Down Cursor/2		Move program cursor down.
Prev	*/PrtSc	CTRL-P	Display previous rung.
Next	Ins/0	CTRL-N	Display the next rung.
A/BIN	Scroll Lock-PgUp/9	ALT-A	Enter accumulate register in work area.
O/DEC	Backspace	ALT-C	Enter counter in work area.
I/HEX	- (minus)	ALT-T	Enter timer in work area.
R/±DEC	PgUp/9	ALT-R	Enter register in work area.
C/DP	+ bar	ALT-H	Enter constant in work area.
Shift-A/Bin	Shift-Scroll Lock		Change work area to binary.
Shift-O/Dec	Shift-Backspace	CTRL-, or ALT-U	Change work area to decimal.
Shift-I/Hex	Shift-Minus (-)	CTRL-H or ALT-Y	Change work area to register value.
Shift-R/±Dec	Shift-PgUp/g	CTRL-/ or ALT-I	Change work area to ±decimal.
Shift-C/DP	Shift- + bar	CTRL-. or ALT-O	Change to octal.
	Shift-Num Lock- Down Cursor/2		Toggle ± sign or channel.

ALT KEY FUNCTIONS

The following special functions are produced by pressing the ALT key at the same time as another key. Key functions are listed below according to the modes in which they are active.

In All Modes

ALT-P	Print screen. (The printer must already be set up, and Background Printing must be enabled. See chapter 8.)

Supervisor Menu

ALT-L	Load user program and related tables, without entering L/S/V functions.
ALT-Z	Exit to DOS. (Type either L1FWM or L1FPC to return.)

Display Program Mode

ALT-E	If annotation is available, display the rung explanation for the current rung. (Invalid only when the Logicmaster system is set to Page display.)
ALT-L	If annotation is available, display the coil label for the current rung. '(Invalid only when the Logicmaster system is set to Page display.)

Edit Program Mode

ALT-D	Delete the number of rungs specified in the data line of the work area.
ALT-E	Select Relay/Sequencer menu.
ALT-G	Read the .LAD or .SDE file specified in the work area from disk storage. ALT-G only functions when there is no file name active.
ALT-W	Write the .SDE file to the file name specified in the work area.
ALT-S	Initiate a global substitution of all occurrences of the old reference with the new reference.

Teach Mode

ALT-J	Start a teach session.	
ALT-K	End a teach session.	
ALT-V	View a stored key sequence.	
ALT-F1 thru ALT-F8	Teach Mode:	Select soft key to be taught.
	View Mode:	Select soft key sequence to be viewed.
	Normal Mode:	Select soft key sequence to be played back:

Alternate Keys

Because some keyboards do not have key mappings for all of the keys on a standard Workmaster keyboard, the following alternate keys are defined:

ALT-A	Accumulate register address type key.
ALT-T	Timer address type key.
ALT-C	Counter address type key.
ALT-R	Register address type key.
ALT-H	Constant address type key.
ALT-Y	BCD HEX data type key.
ALT-U	Decimal data type key.
ALT- I	Signed decimal data type key.
ALT-0	Octal data type key.
ALT-X	Confirm key.

DEFINING SEQUENCES OF FREQUENTLY-USED KEYSTROKES (TEACH MODE)

Logicmaster 1 F software allows you to program the soft keys (F1 through F8) to reproduce sequences of key strokes. These "mini-programs" al low frequently used key strokes to be duplicated with only two key presses. For example, an edit session may be stored and then reproduced by pressing only two keys.

The key strokes are stored on any diskette in the default drive specified on the Supervisor menu.

CAUTION

Do not include keystrokes representing Pause, Resume, or Abort functions. Use of these keys may lead to unpredictable results when using the customized function.

The keystrokes that make up the customized function will be stored in the file Fx.DEF, where x is the number of the function key. A diskette can store up to eight of these customized key functions – one for each key F1 through F8. Additional key functions can be stored on other diskettes.

CREATING A CUSTOMIZED KEY FUNCTION

Follow the steps below to create a customized key function.

1. Confirm that a diskette is in the default drive.

2. Place the system in the exact mode and condition for the function to begin. The system will remember this configuration, and will not allow the function to be used later unless the configuration matches.

3. It is best to begin the function at a basic level, such as Supervisor Menu, Print Main Menu, or Edit Program. When you are at the exact point for the function to begin, press and hold the ALT key and press the J key. This places the system in Teach mode.

4. Press and hold the ALT key and press the function key (F1 – F8) that will control the function. The new function will replace the original function of the key in that location, so choose either an unused key or one you will not need.

5. To create the function, you can use any succession of keystrokes. Do not include keystrokes for Pause, Resume, or Abort. The system records every keystroke until the ALT and K keys are pressed.

6. While the system is in Teach mode, it records all keystrokes except those that can be used to end the function. To end the function normally and store it in the Fx.DEF file, press the ALT and K keys.

   If an error condition is encountered during the playback of the stored sequence, the sequence is halted. Pressing any key causes an error message to be displayed. Respond to the prompt to either resume or terminate the key sequence.

USING A DEFINED KEY FUNCTION

After a key function is defined and stored in the Fx.DEF file, it can be recalled by pressing the ALT key together with the Fl – F8 key assigned to the function.

For the function to be correct, the screen display and function key assignments must be the same as when the function was created. Cursor position, work area content, and data on the screen may not be the same. Be sure to check these before using the function.

When the function is selected, using the ALT key and the assigned function key, the system repeats the keystrokes very rapidly.

During this "playback" of the function, the only keyboard input recognized is the Abort key. Press F9 or the Abort key to stop the function. Pressing F9 or Abort does not remove the part of the function that has already been performed.

If an error condition is encountered during the execution of the function, a message is displayed and the system automatically aborts the function.

DISPLAYING AND PRINTING A DEFINED KEY FUNCTION (VIEW MODE)

The system stores the defined function in the .DEF file as a list of the keystrokes that were executed for the function. This list can be displayed on the screen, and printed using the Print Screen command (ALT-P).

One page of the View Mode screen can list approximately 500 to 600 keystrokes, separated by commas. If the entire function list does not fit on one screen in View mode, press the NEXT key to view additional screens.

The first key listed is the function key which has been redefined. In this example, it is F6. The next two numbers represent the display 'level where the function was defined. The displays represented by these numbers are listed on the following pages.

On the next line, the listing of keystrokes begins.

- Capital letters indicate that the shifted and unshifted values of the key are essentially equal.
- The caret (^) character indicates a press of the CTRL key.
- An exclamation point (!) indicates a press of the ALT key.
- A quotation mark (") character indicates a press of the shift key.
- The number symbol (#) is displayed before numbers input from the numeral keypad. No number symbol is displayed before numbers input from the ASCII keyboard.

KEYNAME ABBREVIATIONS IN VIEW MODE	
ABBREVIATION	STANDS FOR
F1 - F8	Function key F1- F8
ABORT	Abort key
ACCEPT	Accept key
AUX	Auxiliary Reference key
CLEAR	Clear key
CONF	Confirm Upper Case Zero
CONST	Constant Reference key
DELETE	Delete key
DOWN	Cursor Down key
ENTER	Enter key
HELP	Help key
INPUT	Input Reference key
LEFT	Cursor Left key
NEXT	Next key
OUTPUT	Output Reference key
PREV	Previous key
REG	Register Reference key
RETURN	Return key
RIGHT	Cursor Right key
SELECT	Select key
SUPRV	Supervisor key
UP	Cursor Up key

Ending the View Mode Display

To end the View Mode display, press the ALT-V keys, F9 or the Abort key, or the Supervisor key.

SECTION 6
ENTERING DATA

This section explains:

- The format of the display screen.
- How function key assignments are displayed.
- The format of the screen's status line.

FORMAT OF THE DIS'PLAY

The screen uses the following basic format:

TPK.A.42180

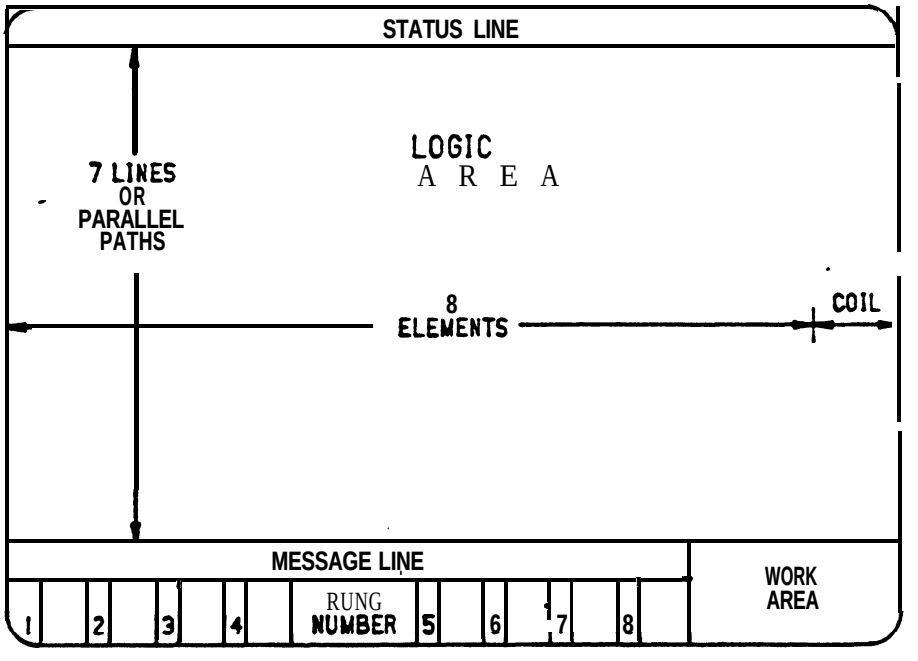


Figure 2.4 SCREEN DISPLAY FORMAT

The screen format consists of 25 lines of 80 columns. Line 1, the status line, displays the CPU status, keyswitch status, and equality of the CPU and user program, when applicable. If either the Display or Edit function is active, the memory address of the first word of the selected element is shown.

Lines 2 through 22 are used to display the ladder diagram, text annotation, function menus, and various other displays.

Line 23 displays error codes and messages, when appropriate. The last twelve characters of this line comprise the text field of the work area, where special text (nicknames or disk file names) is entered.

Lines 24 and 25 contain the legends for the soft keys, in two groups of four. These soft keys are are specific to the function displayed. The two groups of soft keys are separated by an area displaying the rung number selected by the cursor. The last twelve characters of lines 24 and 25 are reserved for the reference and value fields of the work area. Line 24 contains machine reference entries; line 25 contains numerical entries.

FUNCTION KEY ASSIGNMENTS

The bottom of the screen shows messages, and the current assignments of the function keys. Function key assignments vary with the function being used, and sometimes with the position of the cursor on the screen. These assignments are accessed with the keys labelled F1 through F8.

STATUS LINE

The status line for Logicmaster 1F software has the following format:

```
CPU: RUN/LOCK      CPU ID: 2 L/M EQUAL CPU L/M: MONITOR CURSOR: 0000
```

The status line for the IBM personal computer version has the following format:

```
CPU: RUN/ENABLE CPU ID:  2  L/M EQUAL CPU NUM L/M: MONITOR CURSOR: 0139
```

Status Line: Definitions

Definitions for the items on the Status Line are:

CPU STATUS	The first item shows the current status of the CPU. It may be: RUN/LOCK, RUN, STOP/LOCK, or STOP.
CPU ID	The second item shows the ID number of the CPU. Range = 1 to 90 for master/slave or 1 to 254 for peer-to-peer communications.
L/M-CPU PROGRAM	The third item shows whether the program in programmer memory and the program in the CPU are EQUAL or NOT EQual.
NUM	This optional field, for the IBM personal computer only, is displayed when the Num Lock key is active.
MODE	This item shows the current mode of the system with respect to the CPU. It may be: ON-LINE, OFF-LINE, or MONITOR. (For the IBM PC version, you can set the mode in the Scratch Pad display, or by pressing the ALT and 1 keys.)
CURSOR ADDRESS	The last item shows the cursor address in decimal in the ladder diagram.

Work Area

The bottom right corner of the screen is referred to as the "work area". It shows data that is typed in.

TPK.A.40046

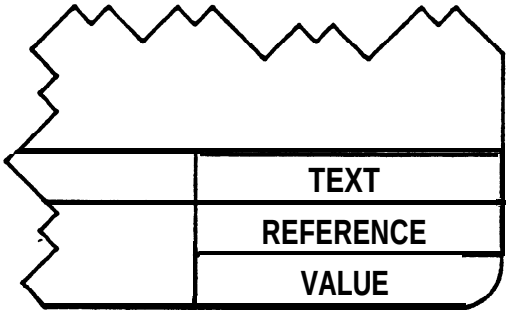


Figure 2.5 SCREEN DISPLAY WORK AREA

The *top line* of the work area is called the text line. File names and annotation nicknames are entered from the keyboard into the ASCII text line.

The *second line* of the work area is called the reference line. Machine references are entered from the decimal keypad area. The T, C, R, and K keys (I, 0, R, and C keys on the Workmaster computer) in the keypad area specify the reference type. The R, T, and C keys specify register, timer, and counter references, respectively. A number entered without one of these prefixes signifies an I/O reference.

The *bottom line* of the work area is called the data line. The base of the entry (Reg Val, Decimal, Signed Decimal, and Octal) can be changed by pressing the Shift/Reference Type keys.

The INCR and DECR keys can be used to increment or decrement the value of the number in the field currently selected.

Only one line of the work area is active at a time, as shown by the reverse-video block. To move between lines, press the Select key. On a personal computer keyboard, use the (~ tilde) key.

The Delete key removes one character from the selected line; the Clear key removes all characters. The Enter key (or CTRL-E) and the Shift/Enter key combination are used to transfer values from the work area to the screen display.

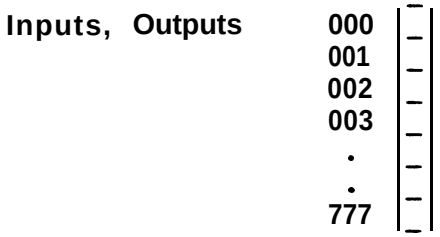
SECTION 7
WORKING WITH NUMBERS

To use the Logicmaster 1F system, you will need to understand the different number types and how these numbers are handled. This section describes the types of numbers you will be using with Logicmaster 1F software.

BINARY DATA

In binary, data can be either a 0 or a 1. These two choices conveniently represent on/off conditions. All of the I/O data used in the system are in binary.

A Binary digiT is referred to as a BIT. It represents the smallest unit of data storage within memory. Inputs and outputs are stored in memory in adjacent bits. Each bit is numbered, beginning at 000.



BYTES

A group of 8 consecutive bits is referred to as a BYTE. A byte boundary marks the beginning of a new byte. The first byte boundary is reference 0, the second is 10, and so on to the last at 770.

REGISTERS AND WORDS

A group of 8 and 16 consecutive bits are referred to as a byte and a word, respectively. The term "register" refers to a byte or word located in register memory. Three classes of registers exist in Logicmaster 1 F software:

1. I/O registers O-77 are byte registers and are mapped onto I/O points O-777. The location of an I/O point in the register map can be determined by dividing the I/O address by 8. For example, I/O point 656 is located in R65 (octal addressing). I/O registers are represented in BCD decimal.

2. Data registers 400–577 are byte registers used primarily for data operations. Data registers ate represented in BCD decimal.

3. Accumulate registers 600–677 are word registers that indicate the status of the corresponding timer or counter reference. For example, R601 is automatically assigned as the counting register for a counter instruction referenced with I/O point C601. Accumulate registers are internally represented as hex values in the CPU and are displayed by Logicmaster 1F software as decimal numbers.

These **three classes of registers can be used interchangeably on instructions that take register operands. The rules for register addressing are as follows:**

1. **Accumulate registers can be used as references only on instructions that take 16-bit operands. The other two classes of registers can be used on instructions that take either 8-bit or 16-bit operands.**

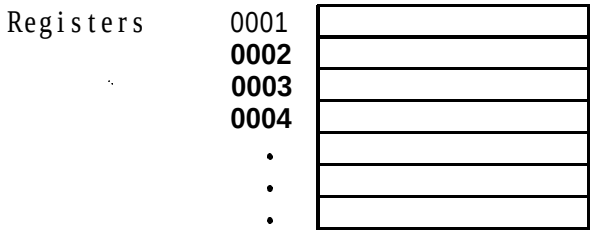
2. **When a byte register is used as a** reference **on a** word **operand, the** next **higher** register **number is implicitly addressed. For example, if R400 is the operand for an ADD FUN70 instruction, the combined 16 bits from R400 and R401 are added to the contents of the CPU's accumulator. The DSTR5 FUN55 and DOUT5 FUN65 instructions are special exceptions, which are discussed in chapter 5.**

3. **Because RO-77 is mapped onto the I/O memory, the contents of these registers are reset to zero whenever the CPU is stopped. The other two register classes retain their values, regardless of the run/stop status of the CPU. This behavior should be taken into consideration when using RO-77 in a program.**

4. **Even though data registers are byte addressable, the contents** of **these registers are communicated between the Logicmaster system and the CPU as words** (register pairs). **On-line changes of data registers used as 16-bit operands will affect the contents of both registers. When using data registers as word operands, it is recommended that an even address be** used. **On-line changes of values of data registers used as word operands that are not evenly addressed are not** permitted.

DECIMAL

Decimal numbers use 10 digits, 0 through 9. The system stores decimal numbers in binary format, in 16-bit registers or words.



The range of decimal numbers that can be stored in a byte register is O-99; in a word **register or constant, it is 0-9999.**

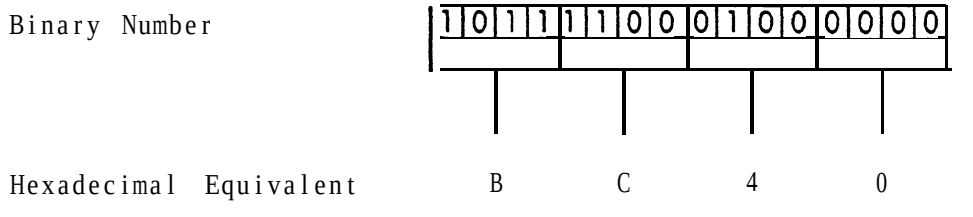
HEXADECIMAL

Hexadecimal uses 16 digits, 0 through F. The **digits** 0 **through 9 represent their exact** binary **equivalent. The digits 10 through 16 are represented by the letters A through F.**

Hexadecimal allows eight binary digits to be represented by two hexadecimal symbols. The table below shows the binary equivalents of the 16 hexadecimal digits.

HEXADECIMAL	BINARY
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1
A	1 0 1 0
B	1 0 1 1
C	1 1 0 0
D	1 1 0 1
E	1 1 1 0
F	1 1 1 1

Therefore, the binary value contained in a 16-bit register or word can be represented (and displayed or printed) as 4 hexadecimal digits. For example:



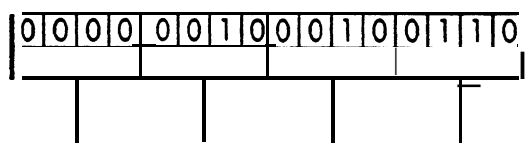
BINARY CODED DECIMAL

Binary coded decimal (BCD) represents the decimal digits 0 through 9 as their binary equivalents. In BCD, one decimal digit is represented by 4 bits. Because this equivalence is on a single-decimal digit basis, the resulting number is not a true binary number (unless it is less than 9). Equivalent decimal and binary values are shown below.

DECIMAL	BINARY
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1
(none)	1 0 1 0
(none)	1 0 1 1
(none)	1 1 0 0
(none)	1 1 0 1
(none)	1 1 1 0
(none)	1 1 1 1

Because the decimal numbers from 10 to 15 would require two decimal digits, the last six bit patterns shown above are not available in BCD.

As an example, the number 226 is represented in BCD format as shown below. This binary value is actually equal to the decimal number 550.

550 (decimal) = 

(binary)

The BCD equivalent is: 0 2 2 6

CHAPTER 3
SCRATCH PAD

The Scratch Pad function is used to store and display information about the current program in programmer memory, or about the CPU capabilities. Select the Scratch Pad function in order to:

- Change the ID number of the CPU.
- Display the current CPU capabilities in On-Line or Monitor mode.
- Compare the current CPU parameters with those stored for a program.
- Select the functions to be used when programming in Off-Line mode.

  When you are developing a program in Off-Line mode, establish the parameters in the Scratch Pad before beginning. This will determine which functions are available during programming.

- Set up the current mode of the system (Off-Line, On-Line, or Monitor) for an IBM-compatible personal computer.
- Start or stop the Data Communications Unit (DCU).

This chapter contains the following sections:

Section 1. Scratch Pad Display: Section 1 defines the entries on the Scratch Pad display.

Section 2. Editing the Scratch Pad Display: Section 2 explains how to change the Scratch Pad entries for CPU ID, CPU memory size, number or registers available, CPU status, and function set.

SECTION 1
SCRATCH PAD DISPLAY

This section explains:

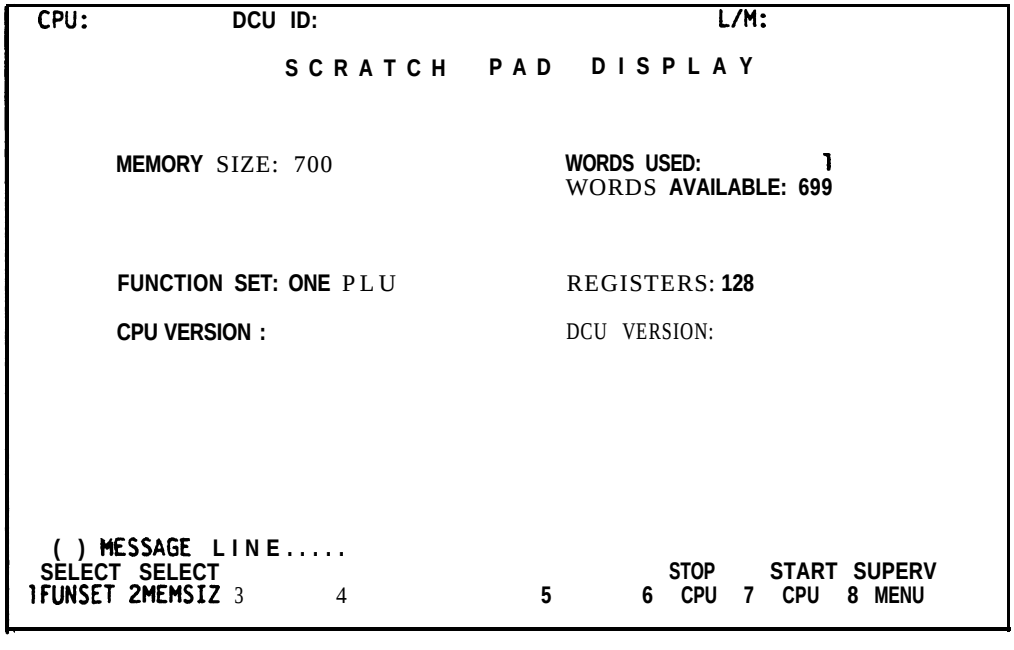
- **How to access the Scratch Pad Display screen.**
- **The definitions of the items on the display.**
- **How differences between the Scratch Pad values in programmer memory and the connected CPU are displayed.**
- **How to set up the current mode of the system (Off-Line, On-Line, or Monitor) for an IBM-compatible personal computer.**

ACCESSING THE SCRATCH PAD DISPLAY SCREEN

The CPU must be unlocked in order to access the Scratch Pad Display screen. Press F4 (SCRTCH PAD) from the Supervisor menu to access the Scratch Pad Display screen.

On-Line or Monitor Mode

Workmaster and Cimstar I computers have a mode keyswitch to select either On-Line, Of f-Line, or Monitor mode of operation. When the keyswitch is in the ON-LINE or MONITOR position, the Scratch Pad is displayed as shown below:



For IBM-compatible personal computers without the mode keyswitch, the Scratch Pad Display includes an additional function key: L/M Mode (F5) key. The function keys for these computers are displayed as shown below:

```
 SELECT SELECT                  RUNG    LM      STOP      START SUPERV
1FUNSET 2MEMSIZ 3       4        # 5 MODE  6  CPU   7  CPU  8 MENU
```

Figure 3.1 shows the Scratch Pad Display in On-Line mode or Monitor mode with the CPU connected. When the Logicmaster 1 F software package is in the Scratch Pad function and the keyswitch is in the ON-LINE or MONITOR position, the CPU status, CPU version, and DCU version is updated continuously.

In Monitor mode, the Stop CPU (F6) and Start CPU (F7) function keys are inactive. **If a CPU is connected (scanning or not scanning) and the system is in On-Line or Monitor mode, the initial information on this screen comes from the CPU. Otherwise, it comes from the programmer memory and the CPU-related entries are blank.**

In On-Line and Monitor mode, when a connected CPU has capabilities that are different than the settings in the system, the values of the CPU are shown beside the values stored by the system. They are shown in reverse-video blocks.

If the keyswitch is in the ON-LINE or MONITOR position and the CPU is either locked or not connected when you press the F4 key in Supervisor mode, the Scratch Pad screen will bedisplayed with one of these messages:

CPU IS LOCKED or NO COMMUNICATIONS PORT SPECIFIED

No default values will be shown for the DCU version and CPU version.

Off-Line Mode

When the keyswitch on the Workmaster or Cimstar I computer is in the Off-Line mode, the Scratch Pad is displayed as shown below:

```
                                                    L/M:  OFFLINE

                    S C R A T C H   P A D   D I S P L A Y


      MEMORY SIZE:  700                    WORDS USED :          1
                                           WORDS AVAILABLE:  699


      FUNCTION SET:  ONE PLU               REGISTERS:  128




  (    ) MESSAGE LINE.....
  SELECT SELECT                  RUNG                          SUPERV
 1FUNSET 2MEMSIZ 3       4        # 5       6       7        8 MENU
```

For IBM-compatible personal computers without the mode keyswitch, the function keys are displayed as shown below:

```
 SELECT SELECT                  RUNG   LM      STOP     START  SUPERV
1FUNSET 2MEMSIZ 3       4        # 5 MODE  6  CPU  7  CPU  8 MENU
```

In Off-Line mode, information from the CPU Scratch Pad is inactive and does not appear on the screen. The Stop CPU (F6) and Start CPU (F7) keys are not active and will not be displayed.

To return to the Supervisor menu, press F8 (SUPERV MENU).

SETTING SYSTEM MODE WITHOUT THE KEYSWITCH

The Workmaster II, IBM PC-XT, PC-AT, and PS/2 computers do not have a keyswitch. For these computers, pressing the ALT and 1 keys simultaneously toggles the operating mode from off-line to monitor to on-line.

Mode selection may also be made in the software. In a computer without a keyswitch, the software package starts up in Off-Line mode. The operating mode may be changed by first accessing the Scratch Pad display and then following these steps:

1. On the Scratch Pad Display screen, enter (in the work area) the abbreviation of the mode you want to establish:

   ON = On-Line mode
   OFF = Off-Line mode
   MON = Monitor mode

2. Press the L/M Mode (F5) function key.

SCRATCH PAD DISPLAY: DEFINITIONS

CPU STATUS

In the Off-Line mode, this field is blank. In On-Line or Monitor mode with a CPU connected, it shows the state of the CPU. The status may be:

CPU: RUN
CPU: RUN/LOCKED
CPU: STOP
CPU: STOP/LOCKED

where:

RUN = scanning logic.
STOP = halted.
Refer to chapter 10 for information on locking and unlocking the CPU.

MEMORY SIZE

This is the number of 16-bit words of total programmer memory available. This value is fixed by the hardware if the system is in On-Line or Monitor mode with a connected CPU. You may change this value by pressing F2 (SELECT MEMSIZ). An error message will be displayed if you attempt to change the memory size to a value smaller than that required by a program currently in programmer memory.

The possible memory sizes for Series One (Model E) programmable logic controllers (PLCs) are 700 and 1724 words. For Series One Plus PLCs, the possible memory sizes are 700, 1724, and 3700 words.

SCRATCH PAD DISPLAY: DEFINITIONS (Continued)

WORDS USED	This entry shows the exact length of the current program, in 16-bit words. (You can verify the words used for a particular program with the Logicmaster 1F programmer.)
WORDS AVAILABLE	This entry shows the exact number of 16-bit words remaining for program storage. WORDS AVAILABLE equals MEMORY SIZE minus WORDS USED.
FUNCTION SET	This entry shows the level of features available in the CPU. The possible function sets are ONE (for Series One Model E) and ONE PLUS (for Series One Plus). Press F1 (SELECT FUNSET) to toggle between ONE and ONE PLUS. If the ladder diagram program in memory contains logic using functions not available with the function set selected, your selection will not be accepted.
REGISTERS	This entry shows the number of 8-bit storage locations (registers). In On-Line or Monitor mode, when connected to a CPU, this is the total number of registers available. You can change this entry by changing the function set.
CPU VERSION	This entry is only displayed in On-Line or Monitor mode, with a CPU connected. It shows the revision level of the CPU software.
DCU VERS I ON	This entry is also displayed only in On-Line or Monitor mode, with a CPU connected. It shows the revision level of the Data Communications Unit (DCU).

SECTION 2
EDITING THE SCRATCH PAD DISPLAY

This section explains:

- **How to change the entry for memory size.**
- **How to change the entry for function set.**
- **How to change the entry for registers.**

When attempting to store a program into the CPU, the system compares the values that are stored in its Scratch Pad memory with those in the CPU. It uses these values to ensure that the CPU has the capacity to run the program.

First, the system compares the CPU logic memory size to the Scratch Pad entry for MEMORY SIZE.

The system compares the Scratch Pad entry for FUNCTION SET with the available CPU function set. If the CPU function set is lower than the Scratch Pad entry, the system checks the program to see if the functions it uses are within the level of the CPU.

The program cannot be stored if any of these comparisons show that it is not suitable for use in the CPU.

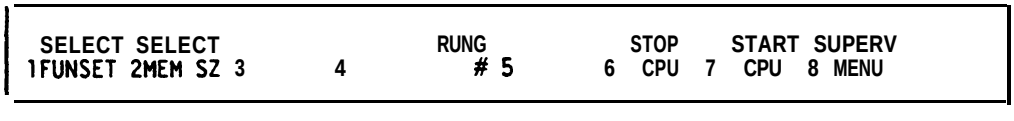
WHEN THE SCRATCH PAD CAN BE CHANGED

The Scratch Pad contents can be changed at any time, with the following restrictions:

1. **In On-Line or Monitor mode, the CPU controls the values for CPU memory size, run status, CPU functions, CPU registers, and version.**
2. **In Off-Line mode, if there is a program loaded into programmer memory, changes are limited to those compatible with the program.**

FUNCTION KEY ASSIGNMENTS

The function keys shown below are used to change the Scratch Pad. *They are displayed only when their functions can be used.*



CHANGING THE ENTRY FOR CPU STATUS

The CPU status can only be changed in On-Line mode, with a CPU connected. The On-Line/Off-Line switch on the Data Communications Unit (DCU) must be in the ON-LINE position. If a handheld programmer is attached, the keyswitch on the programmer must be in the RUN position.

1. Press F6 (STOP CPU) to change the CPU status to STOP from RUN (scanning logic).

2. Press F7 (START CPU) to change the CPU status from STOP to RUN. This key is only functional when the CPU is stopped.

CHANGING THE ENTRY FOR MEMORY SIZE

You may select a new value for memory size by pressing F@ (SELECT MEMSIZ). The value entered can be either 700, 1724, or 3700 words. Possible memory sizes for Series One (Model E) PLCs are 700 and 1724 words. For Series One Plus PLCs, the possible memory sizes are 700, 1724, and 3700 words.

An error message will be displayed if you attempt to change the memory size to a value smaller than that required by the program currently in memory.

CHANGING THE ENTRY FOR FUNCTION SET

You can change the function set of the CPU to one that is compatible with the functions used by the program currently in programmer memory. Select the appropriate function set by pressing F1 (SELECT FUNSET) to toggle between ONE and ONE PLUS.

If the ladder diagram program currently in memory contains logic using functions not available with the function level you selected, the system will not allow your selection.

If the function level of the CPU is not the same as the new level you selected, both levels are displayed on the Scratch Pad Display screen. The CPU value is shown in a reverse video block.

CHANGING THE ENTRY FOR REGISTERS

The register size depends upon the function set. This entry reflects the total number available and does not change as registers are used. This parameter can be changed by pressing the F1 key to select a different function set.

- For function set ONE, the data register memory size is 000.

- For function set ONE PLUS, the data register memory size is 128. (A register = 8 bits.)

CHAPTER 4
DISPLAY PROGRAM

The Display Program function is used to display ladder logic, showing power flow through the rungs. If the program is annotated, names and nicknames can be shown in the program. Rung explanations and coil labels can be shown in Window or in full-screen Page mode.

Display Program includes full search capabilities, allowing you to quickly locate any rung, reference, nickname, or element in the program.

In addition, the Display Program function allows data values and constants to be changed when the system is on-line with an operating CPU.

This chapter explains how to use the features of Display Program. Refer to the appropriate sections:

Section 1. Displaying a Program: Section 1 explains how to display a program. This section also shows program display format, and summarizes the instructions for annotation display.

Section 2. Searching for a Program Element: Section 2 gives basic instructions for locating an element of the program currently being displayed.

Section 3. Making On-Line Changes: Section 3 explains how to make data value and constant changes to the program and the effect of on-line changes.

SECTION 1
DISPLAYING A PROGRAM

This section explains:

- **How** to display **a program.**
- **Program display** format.
- **Display Program function key assignments.**
- How **to go from program display to the reference tables** display.
- **How to display a specified rung of the program.**
- **How to scroll the ladder logic display.**
- **How to display annotation.**

HOW TO DISPLAY A PROGRAM

To display a program, follow the steps below:

1. **Display Program displays the program currently in programmer** memory. If the **program you want to display is the one now in programmer memory, go to step 5.**

2. **If the program is not currently in programmer memory, you can load it using the Load/Store/Verify functions, or the quick-load feature from the Supervisor menu.** *For On-Line display, the program in the CPU and the program in programmer memory must be equal. If the program is loaded from the CPU, they are equal. Otherwise, the program in programmer memory must be stored to the CPU.*

3. **If you want to load a program from the CPU, or if you want to check the accuracy** of **the transferred program with the Verify function, go to step 4 for instructions on using Load/Store/Verify. Otherwise, you can quickly load the program directly from the Supervisor menu.**

   A. **If the file name is not the active file name, type it in. A drive ID followed by a colon can be used before the program name if the program is not on the default** disk. **Press the** Enter key **(CTRL-E).**

   B. **When the file name is active, press the** ALT **and** L **keys simultaneously to load the file. The screen will display the following message after the program is successfully loaded:**

      LOAD COMPLETE

   C. **Go to step 5.**

4. If you want to load a program from the CPU, or use the Verify function, select Load/Store/Verify (F6) from the Supervisor menu.

   A. In the Load/Store/Verify menu, press F1 (LOAD).

   B. On the Load Program/Tables screen, enter the drive ID for the program file. This may be P for the CPU, or it may be the diskette or hard disk ID. After entering the drive ID, move the cursor to PROGRAM NAME. Enter the name of the program to be displayed. Press the Enter key (CTRL-E).

   C. When the load is complete, you can use the Verify function to check program content. For more information, refer to chapter 9.

      Return to the Supervisor menu through the L/S/V menu, or by pressing the Supervisor key.

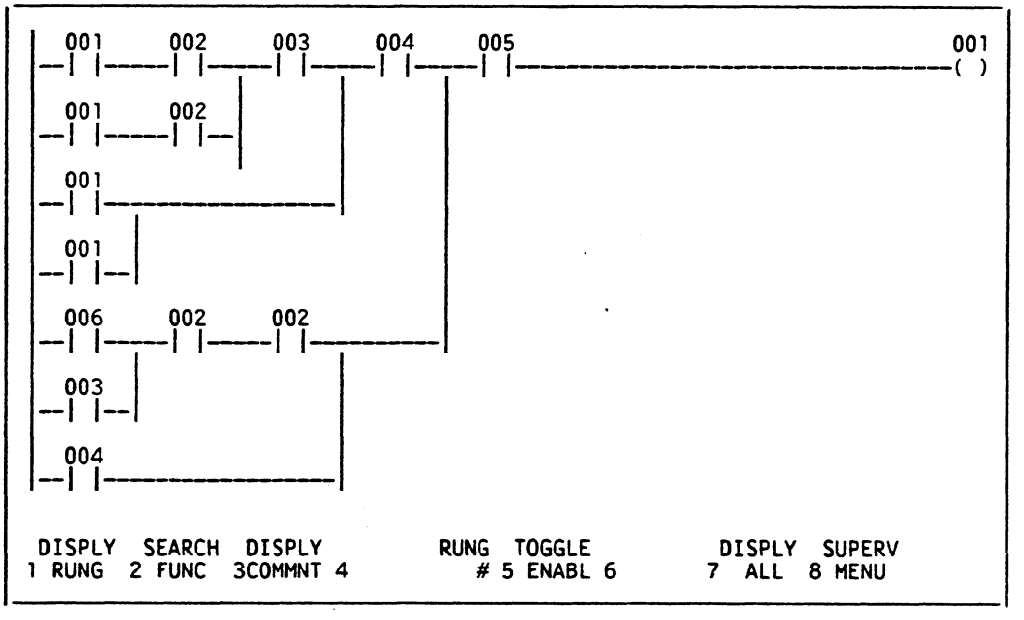
5. In the Supervisor menu, type in the name of the program to be displayed. Then, select Display Program (F1).

NOTE

If there is no name in the text area, the last program name used in either Display Program or Edit Program is used. If no program name is either entered or retained from the Display or Edit Program functions, the system displays the last program that was used. You can delete this name by typing in NONE.

PROGRAM DISPLAY FORMAT

When the program first appears, it is either at the area last displayed in the Edit or Display Program mode, or at the beginning of the program if it is a new program or if memory was reloaded.



The program is displayed as lines of relay logic, including power flow of relay contacts. Reverse video appears at those relay contacts that transmit power flow from the left to the right. If the system is on-line to an operating CPU, the current values of references are displayed.

Up to eight lines can be connected to a coil to form a rung of logic. The screen displays seven lines at one time. The reference, element type, and value can be shown. If nicknames have been used in the program, they are displayed over the appropriate elements, in place of the reference addresses.

The bottom of the Display Program screen shows the key functions that are currently available. For example, if the cursor is at:

```
-|  Start of Program  |-
```

the functions of Toggle Enable/Disable and Toggle Status cannot be used. Therefore, the F5 and F6 function keys display no assignments. The functions appropriate to the current cursor location are the ones which are displayed. Key functions are summarized on the next page.

DISPLAY PROGRAM FUNCTION KEY ASSIGNMENTS

At the initial Display Program menu, function keys F1 through F8 have the assignments defined below. These assignments are only available where they can be used.

```
 DISPLY  SEARCH  DISPLY          RUNG  TOGGLE          DISPLY  SUPERV
 1 RUNG  2 FUNC  3COMMNT 4          # 5 ENABL 6       7 ALL   8 MENU
```

DISPLAY RUNG (F1) Press F1 to select another rung for display. Refer to "Selecting a Rung for Display" in this section.

SEARCH FUNCTION (F2) Press F2 to search for a program element. Refer to section 2 of this chapter for instructions.

DISPLAY COMMENT (F3) The F3 key is available only if a file name was specified upon entry to the Display function. When activated, rung explanations, coil labels, and reference names can be displayed. Refer to chapter 6 for more information.

TOGGLE ENABLE/ DISABLE (F5) Use this key to provide a safety interlock for toggling discrete I/O while on-line. Pressing F5 will activate the Toggle (F6) key and remove all other display soft keys. To disable the Toggle mode and return to the normal menu, press F5 again. Press F6 (TOGGLE) for warnings and additional information.

DISPLAY ALL (F7) Press F7 to toggle the format of the ladder logic display between references/nicknames display and annotated display. In Display All mode, reference addresses, nicknames, and names are displayed over each element. In Display Nickname mode, only the nicknames are displayed. *Note that the file containing the .NAM file for the program must be present in the default drive for proper annotated display.* Refer to chapter 6 for more information.

RETURNING TO THE SUPERVISOR MENU

Press F8 (SUPERV MENU) when you want to return to the Supervisor Menu screen from the ladder diagram display.

GOING TO THE REFERENCE TABLES DISPLAY

To display the reference tables:

1. Press the Supervisor key to access the Supervisor menu.
2. Then, select Display Reference Tables by pressing F3. The last table displayed reappears.

SELECTING A RUNG FOR DISPLAY

To display another rung at the top of the screen:

1. Enter one of the following parameters:
   A. A **rung number**: Enter an unsigned decimal value in the numeric line of the screen's work area.
   B. A **memory address**: Enter a constant (K) decimal value in the reference line of the screen's work area.
   C. A **coil reference**: Enter an appropriate output value in the reference address field of the work area.
2. Press F1 (DISPLY RUNG). The rung will be displayed at the top of the screen.

The cursor will be positioned at either the first element, memory address, or coil, depending on which was selected in step 1.

MOVING THE CURSOR

Use the cursor keys to move the cursor on the ladder diagram.

MOVING THE DISPLAY UP OR DOWN

The cursor can be moved up or down one line at a time, one rung at a time, or seven lines at a time.

1. Use the Up and Down cursor keys to scroll the screen up or down one line at a time.
   A. Scroll the display upward by pressing the Down cursor key with the cursor at the bottom of the screen.
   B. Scroll the display downward by pressing the Up cursor key with the cursor at the top of the screen.
2. Press CTRL-N (NEXT or Return) to display the next rung (up to seven lines) of the program. Press Shift-NEXT at the same time to display the next seven lines of the program.
3. Press CTRL-P (PREV) to display the previous rung (up to seven lines) of the program. Press Shift-PREV at the same time to display the previous seven lines of the program.

SECTION 2
SEARCHING FOR A PROGRAM ELEMENT

This section explains how to search for a program element while in Display Program mode.

To search for an element of a program being displayed on the screen, press F2 (SEARCH FUNC) from the Display Program function. The screen displays these function key assignments:

```
 BEGIN          FROM    RELAY RUNG   COILS   ARITH  MOVE /  PROGRM
1SEARCH 2ADVNCE 3 TOP  4 T/C    # 5       6 METIC 7 LOGIC 8 MENU
```

EXECUTING A SEARCH

1. To search for a reference only, regardless of how that reference is used, type the entry into the reference line of the work area. Continue at step 4 below.

2. To search for a nickname, type it into the text line of the work area. To search for a specific use of a nickname, then select the type of element using the function keys, as shown in the listing that follows in this section. Continue at step 4 below.

3. After entering a reference or nickname, if desired, press the appropriate search function key(s), as explained on the following pages. This will enter the name of the function into the work area.

4. Use Advance/Backup (F2) to select whether the search will be made forward or backward in the program. The key function displayed reflects the current search direction.

5. Use From Top/From Current (F3) to select whether the search will begin at the start of the program, or at the current rung. The key function displayed reflects the current starting point.

6. Use Begin Search (F1) to start the search for the program element indicated in the work area. When the element is located, that element will be displayed at the top of the screen. To repeat the search, adjust the parameters as needed, and press F1 again.

8. Use Program Menu (F8) to exit from the Search function. The system returns to the Display Program function.

"Wildcard" Nickname Search

An asterisk (*) can be used to search for similar nicknames. It must be used at the end of the nickname. For example, entering PB* would search for PB1, PB2, or PB3.

1. Enter the nickname in the work area, using the * to replace the variable characters at the end.
2. Use From Top/From Current (F3) to select the starting point.
3. Use Advance/Backup (F2) to select the direction of the search.
4. Use Begin Search (F1) to start the search.

SEARCH KEYS: DEFINITIONS

The Search Function keys are summarized below:

BEGIN SEARCH (F1) — Use F1 to start the search for the element defined in the work area. Selections relating to the search operation must be made prior to pressing this key.

ADVANCE/BACKUP (F2) — F2 toggles the search direction between forward and reverse.

FROM TOP/ FROM CURRENT (F3) — F3 toggles the starting point for the search between the top of the program and the current cursor location.

Each of the following four function keys activates a menu of instructions. Selecting one of the instruction keys within each menu will place the instruction in the work area and specify a search for that instruction. The instructions accessed from each menu are listed below:

RELAYS, TIMERS/COUNTERS (F4) — Use F4 to access Relays, Drum Sequencers, Timers, and Counters.

COILS (F5) — Use F5 to access Out, Set, Reset, Set Out, and Set Out Reset Coils, Shift Registers, and High Speed Counters.

ARITHMETIC INSTRUCTIONS (F6) — Use F6 to access Addition, Subtraction, Multiplication, Division, Compare, BCD to Binary, and Binary to BCD instructions.

DATA MOVE, LOGIC, and SPECIAL INSTRUCTIONS (F7) — Use F7 to access DSTR0, DSTR1, DSTR2, DOUT0, DOUT1, DOUT2, DAND, DOR, Invert, Shift Right, Shift Left, DSTR3, MCS, MCR, External Fault Diagnosis, Decode, Encode, DSTR5, DOUT5, and Bad Opcode instructions.

RETURNING TO THE DISPLAY FUNCTION MENU

Press F8 (PROGRM MENU) to return to the Display Program menu.

SEARCHING FOR THE CAUSE OF A DOUBLE LEFT RAIL

A double left rail in the ladder logic means a Master Control Relay (MCR) is controlling execution of the rungs. To locate the cause of a double left rail, search backward from the current rung. Search for an MSC to find the beginning of controlled logic and an MCR to find the end. Do not include references.

SECTION 3
MAKING ON-LINE CHANGES IN THE PROGRAM

Data values and program constant (K) changes can be made to the program in Display Program mode. This section explains:

- The effect of on-line changes in the program.
- Under what conditions on-line changes may be made.
- How to change a constant.

EFFECT OF ON-LINE CHANGES

The effect of on-line changes made in Display Program mode depends upon the current mode (On-Line, Off-Line, or Monitor), whether the program in the CPU is equal or not equal to the program in programmer memory, and whether on-line changes are enabled.

When the system is in On-Line or Monitor mode, status information can be obtained from a connected CPU. This information includes I/O state and register content. To ensure an accurate display, the Logicmaster 1F system requires that the CPU and system programs are equal. If they are not equal, or the CPU is locked, data will not be displayed and on-line changes are not permitted.

When the system is connected to a scanning CPU, with the program in memory equal to the program in the CPU, in the On-Line or Monitor mode, power flow to the rungs of the ladder diagram is shown in reverse video. As the CPU status changes, displays are updated. *Note that if rungs are added or deleted while in the Editor mode, the program in memory and the CPU become "Not Equal".*

When the system is in the On-Line mode and the CPU is unlocked, on-line changes are permitted. The values of data registers 400-577 and timer/counter accumulate registers 600-677 can be changed when the CPU is in either run or stopped mode. Discrete I/O and references 000-157 and 700-767 can be changed only when the CPU is in run mode.

On-line changes to preset constants are permitted when the CPU is in either run or stop mode. On-line changes to all other constants are only permitted when the CPU is stopped.

When the system is in Off-Line mode, the status is always obtained from programmer memory. In the Off-Line mode, power flow is shown with numerical values from programmer memory. Registers 400-677 can be changed off-line, although new values are not transferred to the CPU. Discrete I/O and registers 0-77 cannot be changed off-line.

SYSTEM STATUS REQUIREMENT FOR ON-LINE CHANGES

To make on-line changes, the status line at the top of the screen must show that the Logicmaster 1F system is on-line to the CPU, and that the active program is exactly the same ("equal"). For example:

```
CPU: RUN        DCU ID:   2  L/M EQUAL CPU      L/M: ONLINE   CURSOR:    0
```

MAKING ON-LINE CHANGES

WARNING

Exclusive single bit on-line changes of discrete I/O are not supported in either the Series One (Model E) Data Communications Unit or the Series One Plus Data Communications Unit. The toggling function in these versions is accomplished by (1) reading a byte wide I/O group from the CPU containing the I/O point to be toggled, (2) setting the I/O point to be toggled, and (3) writing the entire byte wide I/O group back to the CPU memory.

If the CPU changed the status of any I/O points in that group during the read-set-write cycle for I/O toggling, the new status may be overwritten. Because this could produce unexpected and potentially hazardous results, caution is necessary when toggling discrete I/O. Toggling I/O must be performed when programmer memory is cleared to avoid any unexpected or hazardous results.

On-line changes must be enabled in the Communications Setup menu, as explained in a later section.

Occasionally, with all types of on-line changes (bit, byte, or word), errors may occur because the system does not verify the change until a later sweep. If an error has occurred, the system cannot try the change again.

To make on-line changes, other than toggling individual bits:

1. Following the steps outlined in this chapter, display the rung that contains the element to be changed.

2. Place the cursor on the element to change. Continue as described below.

Changing a Constant

To change a constant, type the new constant into the work area and press the Enter key (CTRL-E).

Changing the Content of a Numeric Field

To change the content of a register, or 8 or 16 bits of I/O:

1. Place the cursor on the item to be changed.
2. Type the new value into the work area. Press the Enter key.

CHAPTER 5
EDIT PROGRAM

The Edit Program function, which is available in all modes, is used to create or modify a ladder logic program in programmer memory.

If the Edit function is entered with an active file name, annotation can be edited. In addition, disk memory will be updated whenever a rung is accepted. A file name is activated from the Supervisor menu, by entering a valid file name and pressing CTRL-E or the Enter key, or the Edit Program function key.

If a file name is not active, the program must be stored to disk using the L/S/V functions. That means if power goes off while editing, changes will be lost.

Like Display Program, the Edit Program function contains full search capabilities. You can quickly locate any rung, reference, nickname, or other element in a program.

This chapter explains how to use the Logicmaster 1 Family Software package to enter or modify a ladder logic program. Refer to the following sections:

Section 1. Entering Edit Program Mode: Section 1 explains how to begin the Edit Program function.

Section 2. Editing the Program: For instructions on editing a program, refer to section 2.

Section 3. Editing a Rung: Section 3 explains how to create or edit a rung.

Section 4. Searching for a Program Element: Section 4 explains how to search for a particular element of a program, such as a reference or a program instruction.

Section 5. Ladder Diagram File Editing: Section 5 explains how to copy part of a program into another file. It also explains how to merge program files.

SECTION 1
ENTERING EDIT PROGRAM MODE

This section explains:

- How to start a new program.
- How to display an existing program for editing.
- How to create a backup program, if you are editing an existing program.

STARTING A NEW PROGRAM

To start a new program, follow these steps:

1. Edit Program edits the program in programmer memory. If there is another program already in memory, you must either store it or clear memory using the Load/Store/Verify functions. If necessary, refer to chapter 8 for instructions.

2. When memory is clear, you can begin the new program. In the work area, type either:

   A. The program name, if you want to automatically update the program on disk after each rung is accepted. This is recommended. Entering the program name is also necessary for annotation.

      The name can have up to 8 characters. It should be different from any other program name on the disk. Uppercase and lowercase characters are displayed, but are considered to be the same by the system. Do not use the following reserved words as program names: NONE, CON, PRN, AUX, COM1, COM2, LPT1, LPT2, LPT3, NUL.

      Press CTRL-E or the Enter key to enter the name.

   B. If you do not want to enter a name, type the word NONE. To save the program later, you will have to store it to disk using the Load/Store/Verify functions.

3. Select Edit Program by pressing F2. The beginning of a new program appears. Now go to section 2, EDITING THE PROGRAM.

DISPLAYING AN EXISTING PROGRAM FOR EDITING

1. Edit Program edits the program currently in programmer memory. If the program you want to edit is the one now in memory, go to step 5.

2. If the program is not currently in programmer memory, you can load it using the Load/Store/Verify functions, or the quick-load feature from the Supervisor menu.

3. If you want to load a program from the CPU, or if you want to check the accuracy of the transferred program with the Verify function, go to step 4 for instructions on using the Load/Store/Verify function. Otherwise, you can quickly load the program directly from the Supervisor menu.

   A. If the file name is not the active file name, type it in and press CTRL-E or the Enter key.

   B. When the file name is active, press the ALT-L keys to load the file.

   C. Go to step 5.

4. If you want to load a program from the CPU, or use the Verify function, select Load/Store/Verify (F6) from the Supervisor menu.

   A. In the Load/Store/Verify menu, press F1 (LOAD).

   B. On the Load Program/Tables screen, enter the drive ID for the program file. This may be P for the CPU, or it may be the diskette or hard disk ID. After entering the drive ID, move the cursor to PROGRAM NAME. Enter the name of the program to be displayed, and press CTRL-E or the Enter key.

   C. When the load is complete, you can use the Verify function to check program content. For more information, refer to chapter 9.

      Return to the Supervisor menu through the L/S/V menu, or by pressing the Supervisor key.

   D. In the Supervisor menu, type in either:

      - The program name, if you want to automatically save the program to disk after each rung is accepted. This is recommended. entering the program name is also necessary for annotation.

      - If you do not want to enter a name, type the word NONE. To save the program later, you will have to store it to disk using the Load/Store/Verify functions.

5. Select Edit Program (F2). If a program with the name entered is located on the disk, the system checks the contents of its programmer memory against the contents of the disk. Any differences are noted. However, the programmer memory is not loaded from the disk at this time.

   If no program is found with the name that you entered, no comparison is performed. A new editable copy of the program is stored to the active disk under the specified file name.

If you load an existing program but give it a new name in the work area, an editable copy of the program will be stored to disk under the new name. The new name must not be the same as the name of any other program on the disk.

CREATING A BACKUP PROGRAM

If there is a program already in memory with the same name when you enter Edit Program mode, the screen prompts:

```
DO YOU WISH TO BACKUP PROGRAM? (Y/N)
```

A backup program is a copy of the program before any new editing changes are made. Only one backup version of a program is permitted. A new backup destroys any old backup versions of the same program.

To make a backup program, type **Y**. A copy of the current version will be stored on the disk. The existing .LAD, .NAM, .RDF, and .EXP files will be duplicated with extensions of .LBU, .NBU, .RBU, and .EBU. If you do not want to back up the program, type **N**.

In addition to making a backup copy of the file on disk, you should also keep a library of backup diskettes.

ABORTING AN EDIT SESSION

Any edit session may be aborted by pressing F9 or the Abort key. If any text was changed during the edit session, you must confirm the abort by pressing ALT-X (Confirm or Shift-0). By confirming the abort, no text is stored to disk and the text will be redisplayed as it appeared before you began the edit session.

If the F9 or Abort key was accidentally pressed, pressing any key other than ALT-X (Confirm or Shift-0) will continue the edit session.

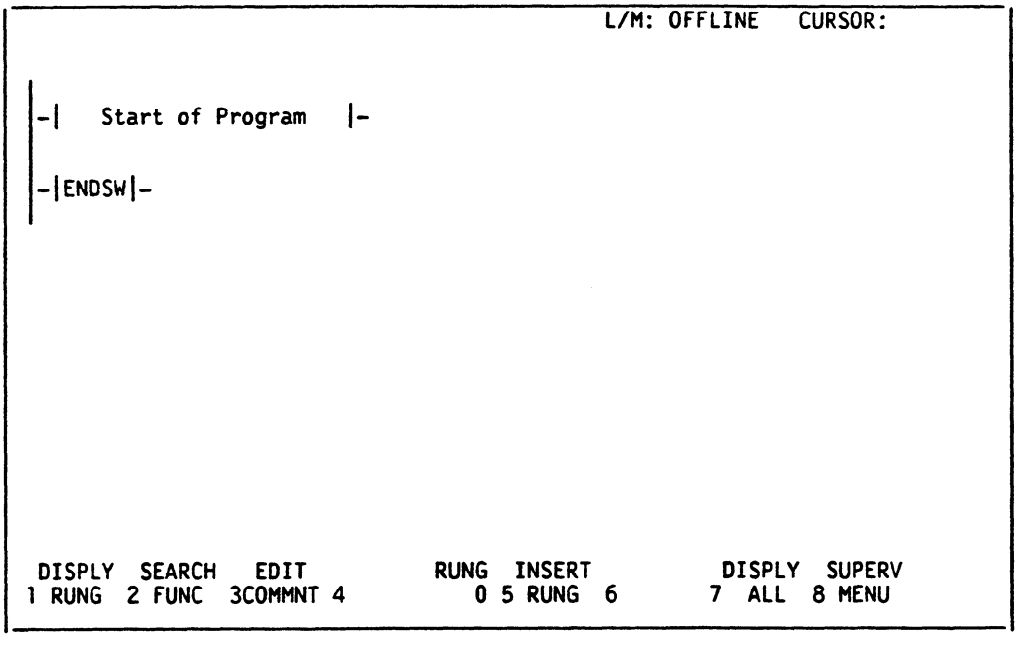
SECTION 2
EDITING THE PROGRAM

This section explains:

- Edit program display format.
- Edit Program function key assignments.
- How to display a specified rung of the program.
- How to insert a rung.
- How to delete a rung.
- How to replace references in a program.

DISPLAYING A PROGRAM IN EDIT MODE

When the Edit Program function is selected from the Supervisor menu, the program is displayed on the screen.



If it is a new program, as shown above, it has a Start of Program rung (rung 0), and one End of Sweep element. These are the minimum program contents; they cannot be deleted.

EDIT PROGRAM FUNCTION KEY ASSIGNMENTS

The bottom of the Edit Program screen shows the function key assignments and the current rung location of the cursor. *Key assignments are only available where they are permissible.* For example, if you did not enter a program name the Display All (F7) function key is not displayed.

```
 DISPLY  SEARCH   EDIT   DELETE RUNG  INSERT   EDIT   DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4 RUNG     # 5 RUNG  6 RUNG  7  ALL  8 MENU
```

DISPLAY RUNG (F1) Use F1 to display the rung number or output coil entered in the work area.

SEARCH FUNCTION (F2) Use F2 to search for a program element. Refer to section 3 of this chapter for instructions.

EDIT COMMENT (F3) Use F3 to select Window Mode or in Page Mode for editing annotation. This key is used in conjunction with F7 (DISPLY ALL) to select the format for annotation display. (Refer to chapter 6 for information on editing annotation.)

DELETE RUNG (F4) Use F4 to delete the rung at the cursor position. Rung explanations in the annotation file will be renumbered automatically if a file name is active.

INSERT RUNG (F5) Use F5 for each rung that you add to the program. This function displays the Edit Rung keys, which are used to select the program elements. Rung explanations in the annotation file will be renumbered automatically, if a file name is active.

EDIT RUNG (F6) Use F6 to edit the rung at the cursor location. This function displays the Edit Rung keys, which are used to select the program elements.

DISPLAY ALL (F7) Use F7 to toggle the format of the ladder logic display between reference and nickname display, or annotated display. Note that the file containing the .NAM file for the program must be present in the default drive for proper annotated display. (Refer to chapter 6 for more information.)

RETURNING TO THE SUPERVISOR MENU

Press F8 (SUPERV MENU) to return to the Supervisor menu from the ladder diagram display.

DISPLAYING A SPECIFIED RUNG

1. Type one of the following into the work area:

   A. Enter the number of the rung in the data line, in decimal format.
   B. Enter a coil reference in the reference line.
   C. Enter the memory address in the reference line, as a decimal constant (K).
   D. Enter the nickname in the text line.

2. Press F1 (DISPLY RUNG). The selected rung is displayed at the top of the screen, followed by up to six lines of the program. The cursor indicates the rung, coil, or memory address that was specified.

INSERTING A RUNG

1. If the new location for the rung is not shown, display it using the Search or Display Rung function.

2. Place the cursor on an element in the rung BEFORE the location where you want the new rung.

3. Press F5 (INSERT RUNG).

EDITING A RUNG

1. If the rung is not shown, display it using the Search or Display Rung function.

2. Place the cursor on the rung to be edited.

3. Press F6 (EDIT RUNG).

4. Continue at section 3, EDITING A RUNG.

DELETING ONE OR MORE PROGRAM RUNGS

1. Decide how many rungs will be deleted.

2. Place the cursor on the first rung to be deleted. If the rung is not shown on the screen, display it using the Search or Display Rung function.

3. If you are deleting just one rung, press F4 (DELETE RUNG). Go immediately to step 5. The following message will be displayed:

   ```
   PRESS ALT-X (confirm) TO DELETE RUNG x
   ```

4. If you are deleting multiple rungs, use the Select key to move the cursor to the data line (bottom line) of the work area. Then type in the number of rungs to be deleted. Press ALT-D to delete the rungs. The following message will be displayed:

   ```
   PRESS ALT-X (confirm) TO DELETE RUNG x - x
   ```

5. To confirm the deletion, press ALT-X (Confirm or Shift-0). To cancel the deletion, press any other key.

6. Repeat this procedure for the next rung to be deleted.

REFERENCE SUBSTITUTION IN A PROGRAM

The Reference Substitition function allows you to globally replace all occurrences of a reference within a program. This allows you to randomly select references during program development. After the real hardware points are established, the Reference Substitution function can replace these randomly-selected points with correct reference addresses. The reference can be replaced in two ways; both are described below.

If the program is not currently in memory, load it in, as previously described. *The program name must be the active file name.* If the file name is not currently active, the following error message will be displayed:

```
FUNCTION ONLY VALID WITH FILE NAME ACTIVE
```

Replacing the Same Reference Type in a Program

Follow the steps below to replace a reference:

1. With the Edit Program main menu keys displayed, enter the new reference address into the reference (center) line of the work area.

2. Enter the old reference into the data (bottom) line of the work area by pressing the Octal key (Shift/C), to change the base to OCTAL. Enter only the reference number, not the reference type. The following entries would replace the reference 100 with 102:

Text Line		(no entry)
Reference Line	102	NEW Reference
Data Line	100	OLD Reference

3. Press ALT-S to begin the replacement. The following mesage will be displayed:

```
PRESS ALT-X (confirm) TO REPLACE ALL OCCURRENCES OF _____ BY _____
```

4. Press ALT-X (Confirm or Shift-0) to confirm the global substitution.

5. If during the global substitution, the new reference cannot replace the old reference, the screen will display the rung where the substitution was unsuccessful and you will be allowed to abort or continue. If you choose to abort the substitution at any time during the process, the .LAD file will be automatically reloaded from disk to restore it to its previous state before this last global substitution.

6. If the substitution is successful, the following message will be displayed:

   REPLACED _____ OCCURRENCES WHILE ATTEMPTING _____

Replacing a Reference Type with Another Reference Type

Follow the steps below to replace a reference of one type with a reference of another:

1. With the Edit Program main menu keys displayed, enter the new reference address into the reference (center) line of the work area.

2. Enter the old reference as a nickname into the text (top) line of the work area. The reference must not already be assigned to another nickname. The following entries would replace the current reference assigned to nickname data* (for example, 500) with reference 200:

Text Line	data*	Nickname
Reference Line	200	NEW Reference
Data Line		(no entry)

   If the nickname entered in the text line of the work area is not associated with a reference address, the following error message will be displayed:

   NICKNAME NOT DEFINED

   If the new reference address is already associated with another nickname, the following error message will be displayed:

   THE SPECIFIED REFERENCE IS ALREADY ASSIGNED TO A NICKNAME

3. Press ALT-S to begin the replacement. The following mesage will be displayed:

   PRESS ALT-X (confirm) TO REPLACE ALL OCCURRENCES OF _____ BY _____

4. Press ALT-X (Confirm or Shift-0) to confirm the global substitution.

5. If during the global substitution, the new reference cannot replace the old reference, the screen will display the rung where the substitution was unsuccessful and you will be allowed to abort or continue. If you choose to abort the substitution at any time during the process, the .LAD file will be automatically reloaded from disk to restore it to its previous state before this last global substitution.

6. If the substitution is successful, the following message will be displayed:

   REPLACED _____ OCCURRENCES WHILE ATTEMPTING _____

With this method of substitution, the nickname and name are de-associated from the old reference and re-associated with the new reference. Coil labels retain their old association.

SECTION 3
EDITING A RUNG

This section explains:

- How to access the edit functions.
- How to add an element to a rung.
- How to enter or change a reference.
- How to add an open space to a rung.
- How to accept or cancel a rung.

ACCESSING THE EDIT FUNCTIONS

Using either the Insert Rung or Edit Rung function key provides access to these function key assignments:

```
  RELAY   COILS   ARITH   DATA  RUNG   TM/CT   LOGIC   SPEC    EDIT
1  SEQ  2       3 METIC 4 MOVE     # 5INSERT 6       7 INSTR 8 MENU
```

Use these keys to add elements to a rung. The functions of each are explained later in this section. To edit a rung:

1. Place the cursor on the rung to be edited, and press F6 (EDIT RUNG).

2. For a simple function such as a relay, you can enter the reference and then select the element. The element is displayed with the reference above it.

   For a function requiring more than one reference, select the function first. Then, enter the references as indicated by the display. For example, select a drum sequencer:

```
     *** * ****
---| |---STEP---
```

   Here, the display shows you to enter a contact referencing a counter address R (600-677) and the step operand which can be a constant or register address.

   As another example, if you are entering a timer with a constant preset, the screen displays:

```
     * ****   T ***
---|PRESC|---(TMR)
```

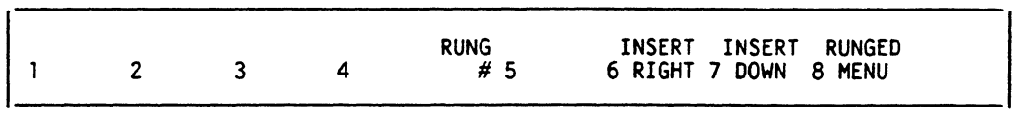
   You would enter a constant value or register and a timer address. Refer to chapter 2 for more information on entering values in the work area.

ENTERING A REFERENCE

To enter a reference, type in the reference type and address using the numeric keypad. When the correct value has been entered, press CTRL-E or the Enter key.

ADDING AN OPEN SPACE TO A RUNG

Use the Timer/Counter Insert (F5) key in Edit mode to open element spaces in a rung. Use the function keys to select the direction, as described below:



Use these functions as follows:

INSERT RIGHT (F6) All elements to the right of the cursor and the element at the cursor position move one position to the right in that line only. A new element can now be inserted at the cursor position.

INSERT DOWN (F7) Use F7 to open a new rung line. For example, by using this key, space for a new parallel contact can be inserted between two parallel contacts. Unused spaces will be deleted when the rung is accepted. This key assignment is only displayed when the cursor is not on the top line of a rung.

RUNGED MENU (F8) Use F8 to return to the Runged Menu key assignments.

EXITING A RUNG

While you are editing a rung, the cursor remains in that rung. There are two ways to leave the rung:

1. Complete the rung, and enter it into the program by pressing CTRL-A or the Accept key. At this time, the system checks the construction of the rung. If the rung is accepted, the edit functions are displayed at the bottom of the screen. The cursor can now be moved to another rung.

2. If you want to terminate editing the rung without placing any changes in the program, press F9 or the Abort key. Respond to the prompt by pressing ALT-X (Confirm or Shift-0). If any other key is pressed, that rung remains open for further editing, and is not aborted.

ADDING A RELAY TO THE PROGRAM

When the Relay Sequence (F1) key is selected in Edit mode, the screen displays the following function key assignments:

```
  -] [-   -]/[-  +-----+ |VERT  RUNG    SEQ     SEQ    (   )  RUNGED
1  NO   2  NC   3 SHUNT 4|CONN     0 5  NO   6  NC   7  OUT  8 MENU
```

Use these keys as defined below:

NORMALLY-OPEN (F1)/ NORMALLY-CLOSED (F2) CONTACTS

Use F1 and F2 to select a normally-open or normally-closed relay contact. Contacts can be referenced with I/O points 000-157 or 700-777 (000-157 in the Series One Model E CPU). References in the range 600-677 require a "T" or "C" prefix, identifying them as counters or timers.

HORIZONTAL SHUNT/ OPEN SPACE (F3)

Use F3 to select a horizontal shunt or open space if an element is present. A shunt is a connector with no contact function or reference.

If there is an element at the cursor location, the function of F3 changes to Open Space. It will replace the element with an open space.

VERTICAL CONNECTION/ VERTICAL OPEN (F4)

This function is not valid in the first or last column of the ladder. It creates a vertical connection from the left of a relay element to the next lower line of logic.

If there is a vertical connection at the cursor location, the function of F4 changes to Vertical Open Space. It will replace the vertical connection with an open space.

NORMALLY-OPEN (F5)/ NORMALLY-CLOSED (F6) DRUM SEQUENCERS

Sequencers are special relays associated with counters. They consist of a contact referencing a counter address (600-677) and a STEP operand that specifies the counter accumulate value on which the power flow is to be propagated. The STEP operand can be either a constant (K) in the range 0-9999 or a register address that contains the step number.

OUT (F7)

Use F7 to define a coil for a rung of logic. OUT stays on as long as power is received. Valid references are 0-373, 376, and 700-770.

RUNGED MENU (F8)

Use F8 to return to the Runged Menu function key assignments.

ADDING A COIL TO THE PROGRAM

When the Coil (F2) key is selected in Edit mode, the screen displays the following function key assignments:

```
  (SET)   (RST)   (SO )   (SOR) RUNG   SHIFT  HI SPD   (   )  RUNGED
1       2 RESET 3SETOUT 4SO RST    0 5  REG  6COUNTR 7  OUT  8 MENU
```

Use these keys as defined below:

SET (F1) F1 is a latch coil instruction, which sets the addressed reference on until turned off by the Reset instruction. Valid references are 0-373, 400-577, 700-770, and the Output Disabler Coil (376).

RESET (F2) F2 is the unlatch coil instruction, which turns off I/O points. Valid references are 0-373, 400-577, 700-770, and the Output Disabler Coil (376).

SET OUT (F3) F3 is an output coil that is not affected by the Output Disabler Coil (376). Valid references are 0-157, 700-767.

SET OUT RESET (F4) F4 is a one-shot coil. The coil is on for one scan of user logic. Valid references are 0-373, 376, and 700-770.

SHIFT REGISTER (F5) F5 is a series of storage locations in which values (ON or OFF) enter at one end and are shifted with each clock cycle. Valid references are 0-377, 400-577, 600-677, and 700-777. In Logicmaster 1F, this operation is implemented as a single instruction with 5 operands.

The fourth and fifth operands specify START and end (STOP) references. Valid references for START and STOP are 400-577 and can span the entire range of 128 I/O points.

The first operand is the DATA input, which feeds values into the shift register at the START reference. When the CLOCK operand turns from OFF to ON, the value of each position in the shift register will shift one position towards the STOP reference. When the RESET operand turns from OFF to ON, all references in the shift register are set to OFF.

Series One (Model E) and Series One Plus CPUs allow each input (DATA, CLOCK, RESET) to be a multiple contact network. Logicmaster 1F requires that each input block of logic be programmed as a separate rung which turns ON a discrete coil (any reference address if valid). That coil is then used as one of the 3 input operands of the shift register function.

HIGH SPEED COUNTER (F6)

The High Speed Counter is implemented in hardware and can achieve much higher update frequencies than the CPU counter functions which increment once per scan. Valid references are 100-107.

OUT (F7)

Use F7 to define a coil for a rung of logic. Stays ON as long as power is received. Valid references are 0-373, 376, and 700-770.

RUNGED MENU (F8)

Use F8 to return to the Runged Menu function key assignments.

ADDING ARITHMETIC FUNCTIONS TO THE PROGRAM

All arithmetic is performed in a 16-bit register called the accumulator. The data is processed as 4-digit BCD numbers (0000-9999). For each instruction, the contents of the accumulator is processed by the specified operation and operand, and then returned to the accumulator.

Constant values, or values contained in a specified register, can be used as operands. When registers other than the timer/counter accumulate registers are used as operands, both the register address specified and the next higher register address are combined to make 16 bits. All math operations occur only on power flow. if the result of any math operation is 0, the zero flag (internal coil 776) is set.

When the Arithmetic (F3) key is selected in Edit mode, the screen displays the following function key assignments:

```
  ADD     SUB     MPY     DVD  RUNG   CMPR   BCDBIN  BINBCD  RUNGED
1 FUN71 2 FUN72 3 FUN73 4 FUN74    0 5 FUN70 6 FUN85 7 FUN86 8 MENU
```

Use these keys as defined below:

ADDITION
FUNCTION 71 (F1)

The contents of a 4-digit constant or a specified 2-group reference are added to the contents of the accumulator. The result of the addition is stored in the accumulator as a 4-digit BCD number. If the answer is greater than 9999, a carry flag (internal coil, 775) will turn on. If the answer is zero, the zero flag (776) will turn on. The flag coils can be used in a program as references for contacts to turn on an output connected to a light or other device to provide an indicator of the flag conditions.

SUBTRACTION
FUNCTION 72 (F2)

The contents of a specified 2-group reference or a 4-digit BCD constant value are subtracted from the contents (BCD) of the accumulator. If the answer after the subtraction is positive, it is written directly to the accumulator. If the answer is negative, the borrow flag (775) turns on, the absolute value is subtracted from 10000, and the resulting value is written to the accumulator. If the answer after subtraction is zero, the zero flag (776) turns on.

MULTIPLICATION
FUNCTION 73 (F3)

The contents of the accumulator are multiplied by the contents of a specified 2-group reference or a 4-digit BCD constant. The answer can be from 1 to 8 digits. The lower 4 digits of the answer are stored in the accumulator and digits 5-8 are stored in data registers 576 and 577, which are the auxiliary accumulator. If the answer is zero, the zero flag (776) will turn on.

DIVISION
FUNCTION 74 (F4)

The contents of the accumulator are divided by the contents of a specified 2-group reference or a 4-digit BCD constant. The 4 digits of the quotient are stored in the accumulator, and the 4 digits of the remainder are stored in the auxiliary accumulator (data registers 576 and 577). If either the dividend or the divisor is zero, the zero flag (776) will turn on. If the divisor is zero, the overflow flag (777) will also turn on.

COMPARE
FUNCTION 70 (F5)

The contents of a specified 2-group reference or a 4-digit BCD constant are compared to the contents of the accumulator. The result of the comparison will cause one of three special purpose internal coils (772, 773, or 774) to turn on, depending on whether the accumulator value is greater than (>), equal to (=), or less than (<) the value specified by the reference or constant, respectively.

BCD TO BINARY
FUNCTION 85 (F6)

The BCD value stored in the accumulator is converted to a binary code corresponding to that value. If any nibble (4-bit segment) of the value in the accumulator is greater than 9, the overflow flag (777) will turn on; and the BCD to Binary instruction is not executed.

BINARY TO BCD
FUNCTION 86 (F7)

A binary code stored in the accumulator is converted to a 4-digit BCD value. If the binary value in the accumulator is greater than 9999, the value is converted to BCD, and the least significant 4 digits of the result are placed in the accumulator. The overflow flag (777) will turn on. The flag coil can be used to turn on an output device as an indication of the overflow.

RUNGED MENU (F8)

Use F8 to return to the Runged Menu function key assignments.

ADDING DATA MOVE INSTRUCTIONS TO THE PROGRAM

Data move instructions copy the contents of registers or constant values into the accumulator, or from the contents of the accumulator to registers. Two byte references can exist either as a single accumulator register or as two other adjacent registers.

When the Data Move (F4) key is selected in Edit mode, the screen displays the following function key assignments:

```
 D STR0  D OUT0  D STR1  D OUT1 RUNG  D STR2  D OUT2          RUNGED
1 FUN50 2 FUN60 3 FUN51 4 FUN61    0 5 FUN52 6 FUN62 7       8 MENU
```

Use these keys as defined below:

D STR0
FUNCTION 50 (F1) — DATA STORE 0 is a 2-word instruction which loads the accumulator with a 4-digit BCD constant or the contents of a specified 2-byte reference.

D OUT0
FUNCTION 60 (F2) — DATA OUT 0 is a 2-word instruction which transfers the contents of the accumulator (16 bits) to a specified 2-byte (group) reference (output, internal relay, shift register coils, data registers or timer/counter accumulate value register).

D STR1
FUNCTION 51 (F3) — DATA STORE 1 is a 2-word instruction which loads the lower 8 bits of the accumulator with the contents of a specified 1-byte reference. The upper 8 bits in the accumulator (8-15) will be zeros.

D OUT1
FUNCTION 61 (F4) — DATA OUT 1 is a 2-word instruction which writes the contents of the first 8 bits (0-7) of the accumulator to a specified reference.

D STR2
FUNCTION 52 (F5) — DATA STORE 2 is a 2-word instruction which loads the lower 4 bits of the accumulator with the upper 4 bits of a specified 1-byte reference. The upper 12 bits in the accumulator will be zeros.

D OUT2
FUNCTION 62 (F6) — DATA OUT 2 is a 2-word instruction which writes the contents of the lower (first) 4 bits of the accumulator to the upper 4 bits of a specified reference.

RUNGED MENU (F8) — Use F8 to return to the Runged Menu function key assignments.

ADDING A TIMER OR COUNTER TO THE PROGRAM

When the Timer/Counter Insert (F5) key is selected in Edit mode, the screen displays the following function key assignments:

```
  (TMR)   (CNT)   TH/WH   TH/WH RUNG          INSERT  INSERT  RUNGED
1 TIMER 2COUNTR 3 TIMER 4COUNTR    0 5       6 RIGHT 7 DOWN  8 MENU
```

Use these keys as defined below:

TIMER (F1) Timers turn on the specified output (T600-T673) when the value of the associated accumulator register is greater than or equal to the value of the preset operand (constant or register contents). As long of the instruction receives power, the accumulate value register increments every 0.1 seconds. The accumulate value register is reset to 0.0 seconds when the flow of power is interrupted.

COUNTER (F2) Counters turn on the specified output (C600-C673) when the value of the associated accumulate value register is greater than or equal to the value of the preset operand (constant or register contents). The accumulate value register increments every time the top element in the counter rung goes from no power flow to power flow (off to on). In addition to a primary control line, counters have a reset line that upon power flow resets the accumulate value register to 0.

THUMB WHEEL TIMER (F3)/ COUNTER (F4) Thumbwheels allow you to control the preset on a timer or counter through the use of the Thumbwheel Interface module, or the timer/counter setpoint unit. Valid references are T674-T677 or C674-C677, respectively.

INSERT RIGHT (F6) Use F6 to move all logic, from the cursor position to column 7, one column to the right provided that column 8 is empty.

INSERT DOWN (F7) Use F7 to move all logic, from the cursor row down to row 7, down one row provided row 8 is empty.

RUNGED MENU (F8) User F8 to return to the Runged Menu function key assignments.

ADDING LOGIC FUNCTIONS TO THE PROGRAM

All logic functions are performed on a 16-bit accumulator. The data is interpreted as 16-bit binary numbers. For each instruction, the contents of the accumulator is processed by the specified operation and operand, and then returned to the accumulator. Constant values or values contained in a specified register can be used as operands. When registers other than the accumulator register are used as operands, both the register address specified and the next higher address are combined to make 16 bits. All logic operations occur only on power flow. If the result of a logic operation is 0, the zero flag (internal coil 776) is set.

When the Logic Functions (F6) key is selected in Edit mode, the screen displays the following function key assignments:

```
  D AND   D OR   INVERS  SFH RT RUNG   SHF LF D STR3  D OUT3  RUNGED
1 FUN75 2 FUN76 3 FUN84 4 FUN80    0 5 FUN81 6 FUN53 7 FUN63 8 MENU
```

Use these keys as defined below:

AND
FUNCTION 75 (F1)

The contents of the accumulator are logically bit AND-ed with the contents of a specified 2-group reference or a 4-digit BCD constant. The result is stored in the accumulator. If the answer is 0000, the zero flag (776) will turn on.

OR
FUNCTION 76 (F2)

The contents of the accumulator are logically bit OR-ed with the contents of a specified 2-group reference or a 4-digit BCD constant. The result is stored in the accumulator. If the answer is 0000, the zero flag (776) will turn on.

INVERSE
FUNCTION 84 (F3)

The 16 bits stored in the accumulator are logically inverted. (All bits ON are turned off, and all bits OFF are turned on.) INVERSE is a NOT operation that is performed on the accumulator.

SHIFT RIGHT
FUNCTION 80 (F4)

The contents of the accumulator are shifted to the right by the number of shifts (bits) specified by the instruction. The number of bits shifted can be from 1 to 15. The bit positions shifted from the left are filled with zeros. If a 1 is shifted out of the accumulator as a result of the shift, the carry flag (775) is set. If, after the shift, the accumulator contains only zeros, the zero flag (776) will turn on.

SHIFT LEFT
FUNCTION 81 (F5)

The contents of the accumulator are shifted to the left by the number of shifts (bits) specified by the instruction. The number of bits shifted can be from 1 to 15. The bit positions shifted from the right are filled with zeros. If a 1 is shifted out of the accumulator as a result of the shift, the carry flag (775) will turn on. If, after the shift, the accumulator contains only zeros, the zero flag (776) will turn on.

D STR3
FUNCTION 53 (F6)

DATA STORE 3 is a 2-word instruction which loads the lower 4 bits of the accumulator with the lower 4 bits of a specified 1-byte reference. The upper 12 bits in the accumulator will be zeros.

D OUT3
FUNCTION 63 (F7)

DATA OUT 3 is a 2-word instruction which writes the contents of the lower 4 bits of the accumulator to the lower 4 bits of a specified 1-byte reference.

RUNGED MENU (F8)

Use F8 to return to the Runged Menu function key assignments.

ADDING SPECIAL INSTRUCTIONS TO THE PROGRAM

When the Special Instructions (F7) key is selected in Edit mode, the screen displays the following function key assignments:

```
  (MCS)   (MCR)  EX FLT  DECODE RUNG  ENCODE  D STR5  D OUT5  RUNGED
1       2       3 FUN20 4 FUN82    0 5 FUN83 6 FUN55 7 FUN65 8 MENU
```

Use these keys as defined below:

MASTER CONTROL START (MCS) (F1)/ RESET (MCR) (F2)

The Master Control Relay function consists of two parts: Master Control Start (MCS) and Master Control Reset (MCR). The MCS tells the CPU when one or more input elements should be made common to rungs that follow. The MCR tells the CPU when the input elements in front of the MCS should stop being common to rungs that follow.

MCS instructions are controlled by a block of permissive logic. An MCR instruction is not controlled and must be programmed in a rung by itself. MCS/MCR pairs can be nested up to 8 levels.

EXTERNAL FAULT DIAGNOSIS FUNCTION 20 (F3)

This instruction provides a method of monitoring external devices for unwanted conditions, such as switches that should not be on at the same time. When the instruction is programmed, a 4-digit BCD number is specified as a fault indication number. If the unwanted condition occurs, the 4-digit number will be displayed on the programmer data display. The 4-digit number can be a constant value or read from a group reference.

DECODE FUNCTION 82 (F4)

The lower 4 bits (least significant) of the accumulator are decoded to a decimal number from 0 to 15. A 1 is placed in the bit position in the accumulator that corresponds to the decoded decimal number. The upper 12 bits of the accumulator are disregarded for this operation.

ENCODE FUNCTION 83 (F5)

The least significant logic 1 in the accumulator is encoded to a 4-bit code representing the position number (0-15) in the accumulator. The resulting 4-bit code is placed in the lower four bits of the accumulator.

D STR5
FUNCTION 55 (F6)

DATA STORE 5 is a 2-word instruction which loads the accumulator with a BCD value from the 2-byte contents of a 16-circuit input or output module.

The contents of the specified I/O reference is stored in the lower 8 bits of the accumulator. The contents of the specified I/O reference +100 is placed in the higher 8 bits of the accumulator.

Valid references are R0-R5. For example, if the operand is R2, then R2 (I/O points 20-27) are placed in the lower 8 bits of the accumulator. R12 (I/O points 120-127) are placed in the upper 8 bits.

D OUT5
FUNCTION 65 (F7)

DATA OUT 5 is a 2-word instruction which writes the contents of the accumulator to a 2-byte reference which must be a 16-circuit input or output module.

The lower 8 bits of the accumulator are stored in the specified register reference. The upper 8 bits are stored in the specified reference +100. Valid references are R0-R5.

RUNGED MENU (F8)

Use F8 to return to the Runged Menu function key assignments.

SECTION 4
SEARCHING FOR A PROGRAM ELEMENT

This section explains how to search for a program element while in Edit Program mode.

To search for an element of a program being displayed on the screen, press the Search Function (F2) key from the Edit Program function. The screen displays these function key assignments:

```
  BEGIN           FROM    RELAY RUNG   COILS   ARITH  MOVE /  PROGRM
 1SEARCH 2ADVNCE 3  TOP  4  T/C     # 5       6 METIC 7 LOGIC 8 MENU
```

EXECUTING A SEARCH

1. To search for a reference only, regardless of how that reference is used, type the entry into the reference line of the work area. Continue at step 4 below.

2. To search for a nickname, type it into the text line of the work area. To search for a specific use of a nickname, then select the type of element using the function keys, as shown in the listing that follows in this section. Continue at step 4 below.

3. After entering a reference or nickname, if desired, press the appropriate search function key(s), as explained on the following pages. This will enter the name of the function into the work area.

4. Use Advance/Backup (F2) to select whether the search will be made forward or backward in the program. The key function displayed reflects the current search direction.

5. Use From Top/From Current (F3) to select whether the search will begin at the start of the program, or at the current rung. The key function displayed reflects the current starting point.

6. Use Begin Search (F1) to start the search for the program element indicated in the work area. When the element is located, that element will be displayed at the top of the screen. To repeat the search, adjust the parameters as needed, and press the Begin Search (F1) key again.

8. To exit from the Search function, press F8 (PROGRM MENU). The system returns to the Edit Program function.

"Wildcard" Nickname Search

An asterisk (*) can be used to search for similar nicknames. It must be used at the end of the nickname. For example, entering PB* would search for PB1, PB2, or PB3.

1. Enter the nickname in the work area, using the * to replace the variable characters at the end.
2. Use From Top/From Current (F3) to select the starting point.
3. Use Advance/Backup (F2) to select the direction of the search.
4. Use Begin Search (F1) to start the search.

SEARCH KEYS: DEFINITIONS

The Search Function keys are summarized below.

BEGIN SEARCH (F1) Use F1 to start the search for the element defined in the work area. Selections relating to the search operation must be made prior to pressing this key.

ADVANCE/BACKUP (F2) F2 toggles the search direction between forward and reverse.

FROM TOP/CURRENT (F3) F3 toggles the starting point for the search between the top of the program and the current cursor location.

Each of the following four function keys activates a menu of instructions. Selecting one of the instruction soft keys within each menu will place the instruction in the work area and specify a search for that instruction. The instructions accessed from each menu are listed below:

RELAYS, TIMERS/COUNTERS (F4) Use F4 to access Relays, Drum Sequencers, Timers, and Counters.

COILS (F5) Use F5 to access Out, Set, Reset, Set Out, and Set Out Reset Coils, Shift Registers, and High Speed Counters.

ARITHMETIC INSTRUCTIONS (F6) Use F6 to access Addition, Subtraction, Multiplication, Division, Compare, BCD to Binary, and Binary to BCD instructions.

DATA MOVE, LOGIC, and SPECIAL INSTRUCTIONS (F7) Use F7 to access DSTR0, DSTR1, DSTR2, DOUT0, DOUT1, DOUT2, AND, OR, Invert, Shift Right, Shift Left, DSTR3, MCS, MCR, External Fault Diagnosis, Decode, Encode, DSTR5, DOUT5, and Bad Opcode instructions.

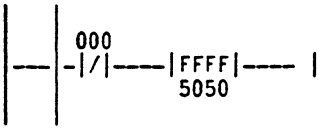
RETURNING TO THE DISPLAY FUNCTION MENU

Press F8 (PROGRM MENU) to return to the Edit Program menu.

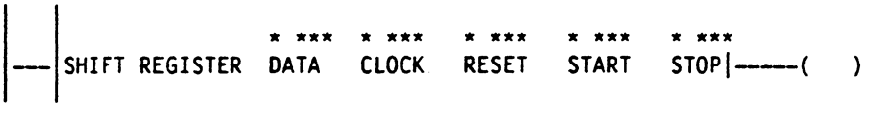
SEARCHING FOR A "BAD OPCODE"

Opcodes can be selected through the Bad Opcode (F7) search key. Use this search function to locate incorrect program mnemonics. For example, certain commands in a program may be incompatible with the Logicmaster 1F software. The system will search for the first occurrence of the opcode. If an address is specified as well as an opcode, the system will search for the first occurrence of the opcode with the specified address. The numeric field of the work area is used to display the specified opcode.

For example:



This is an opcode from a program not compatible with Logicmaster 1F software. For this rung, you would delete the rung and re-enter the shift register. The same rung might then look like this:



This situation may occur if an incompatible program was created with the LCD Programmer or a previous Logicmaster 1 software package (IC640CPP539, IC640CPP541, IC640CPP543, or IC641PFE626). If a program, which does not conform to the programming instructions in chapters 12 and 13, is uploaded, it must be corrected before proceeding.

SECTION 5
LADDER DIAGRAM FILE EDITING

This section explains:

- How to save part of a program in a separate file. This file has the extension .SDE and is called a Side File.
- How to copy all of an .SDE file into another program.
- How to copy all of the ladder logic contained in a .LAD file into another program.

COPYING RUNGS TO A SIDE (.SDE) FILE

Follow the steps below to copy rungs from a program into a separate file called a Side file.

1. With the program displayed in Edit mode, determine the exact number of rungs you want to copy into the Side file.
2. Place the cursor at the first rung to be copied.
3. Use the Select key to move the cursor in the work area to the top line, and enter a name for the file. The system will automatically add the extension .SDE to this file name when the file is created.
4. Use the Select key to move the cursor in the work area to the bottom line, and enter the number of rungs to be copied to the file.
5. Press ALT-W. The system creates a new file, consisting of the specified rungs.

ADDING THE .SDE OR .LAD FILE TO A PROGRAM

The entire content of the .SDE or .LAD file can be added to the ladder diagram program if no file name is active.

Follow the steps below:

1. With the program to receive the added rungs displayed in Edit mode, place the cursor on the rung prior to which the extra rungs should be added.

2. Use the Select key to move the cursor in the work area to the top line, and enter the name of the .LAD or .SDE file. For the .LAD file, you must enter the extension .LAD after the file name.

3. Press ALT-G. The extra rungs appear in the display.

WARNING

Using these functions can create an incorrect program. For example, it is possible to insert an extra MCS instruction that is not matched with a corresponding MCR. This situation may also occur if an incompatible program was created with the LCD Programmer or a previous Logicmaster 1 software package (IC640CPP539, IC640CPP541, IC640CPP543, or IC641PFE626). If a program, which does not conform to the programming instructions in chapters 12 and 13, is uploaded, it must be corrected before proceeding.

CHAPTER 6
ANNOTATION

Annotation is an important feature of the Logicmaster 1 Family (L1F) software package. It can be used to add explanatory text to a ladder logic program. The annotation can be names and nicknames for individual references, and longer blocks of text used for rung explanations and coil labels within the program.

This chapter explains how to create, how to display, and how to print annotation. Refer to the appropriate sections:

Section 1. Types of Annotation: This section introduces the four types of annotation. Read this section before going to sections 2 through 4.

Section 2. Entering and Editing Annotation: Section 2 explains how to create annotation, as part of a ladder logic program, or separately. It also explains how to adjust the annotation when rungs are added or deleted in a program. Finally, this section gives instructions for creating a separate file to contain additional annotation text for printing.

Section 3. Viewing Annotation in Display Program Mode: Section 3 summarizes the ways in which annotation can be displayed.

Section 4. Printing Annotation: This section supplements the information on printing (refer to chapter 8) with specific instructions for printing annotation.

SECTION 1
TYPES OF ANNOTATION

The Logicmaster 1F software package features four types of program annotation:

NICKNAMES

A program reference can be assigned a "nickname" of up to 7 ASCII-keyboard characters. *Each nickname must be unique within a program.* Examples of nicknames are LS035, PB11A@, SOL129C. Every discrete reference and all registers, including R0-R77, can be assigned a nickname.

NAMES

Every program reference can also be assigned a "name" of up to 21 ASCII-keyboard characters. Names are formatted as three lines of 7 characters each. *Reference names do not have to be unique within a program.* Examples of names are: HIGH LEVEL ALARM,.ERROR CONDITN DETECTD. Every discrete reference and all registers, including R0-R77, can be assigned a name.

The total number of names and nicknames permitted in a program is limited only by the amount of space available on the disk.

INTER-RUNG EXPLANATIONS

For each rung, an explanation can be entered. The explanation might describe the logic function, or provide diagnostic information for maintenance personnel. A rung explanation can have up to 4000 ASCII-keyboard characters, entered up to 255 characters per line. The display will show only the first 74 characters, with a diamond symbol indicating the presence of additional characters.

COIL LABELS

Each discrete reference used as a coil can be assigned a label to represent its function, or its output device. Coil labels can contain up to 4000 ASCII-keyboard characters, entered up to 255 characters per line. The display will show only the first 46 characters, with a diamond symbol indicating the presence of additional characters. Coil labels are displayed above the coil on the screen, and in 80-column printouts. They appear to the right of the coil on 132-column printouts.

SECTION 2
ENTERING AND EDITING ANNOTATION

This section explains the annotation editing features of the Logicmaster 1F system. Included are:

- How to toggle the display between ladder-logic and annotation display.
- How to create and edit names, nicknames, rung explanations, and coil labels.
- How to use the editing functions.
- How to create additional text files for printing.
- How to re-number rung explanations, if rungs have been added or deleted in the ladder logic.

ACCESSING THE ANNOTATION EDITING FUNCTIONS

Annotation editing functions are accessed through the Edit menu.

```
 DISPLY  SEARCH  EDIT    DELETE RUNG  INSERT   EDIT   DISPLY  SUPERV
1 RUNG   2 FUNC  3COMMNT 4 RUNG      # 5 RUNG  6 RUNG  7 ALL   8 MENU
```

Two of these Edit Mode function keys are used with annotation:

DISPLAY ALL (F7) In the Edit menu, F7 toggles the format of the program display between reference (or nickname-only) display, and annotated (reference, nickname, name) display. The .NAM file for the program must be present in the default drive for proper annotation display.

EDIT COMMENT (F3) F3 allows access to the annotation entry and editing functions. When this key is pressed, the following functions become available:

```
  EDIT     EDIT     EDIT          RUNG  RENUM   PAGE/           EDIT
1EXPLAN 2 LABEL 3 NAME  4          # 5EXPLAN 6WINDOW 7        8 MENU
```

EDIT COMMENT FUNCTION KEYS

The Edit Comment function keys are defined below. They are described more fully on the pages that follow.

EDIT EXPLANATION (F1)	Use F1 to enter or edit rung explanations.
EDIT LABEL (F2)	Use F2 to enter or edit coil labels.
EDIT NAME (F3)	Use F3 to enter or edit names and nicknames.
RENUMBER EXPLANATIONS (F5)	Use this function if rungs have been added or deleted in the program at a time when the file containing the annotation was not present.
PAGE/WINDOW DISPLAY (F6)	Use F6 to toggle the display between Page Display mode and Window Display mode.

USING ANNOTATION IN A PROGRAM

To use annotation in a program, a file name must be specified. To do this, enter a program name of up to 8 characters in the text line of the work area prior to selecting Display Program, Edit Program, or Print from the Supervisor menu.

LOADING THE PROGRAM

Follow the steps below if the program to be annotated is not already displayed on your screen.

1. If the program is stored on disk, type in the name of the program and press CTRL-E (Enter). Then, press ALT-L to load the program from the Supervisor menu. Continue at "Creating an Annotation File" below.

2. If the program is the one now in the CPU, use the Load/Store/Verify functions to load it into programmer memory.

   A. From the Supervisor menu, select Load/Store/Verify (F6).

   B. In the Load/Store/Verify menu, press F1 (LOAD).

   C. Enter the disk *drive* ID (P = CPU), and press CTRL-E (Enter). Continue on the next page.

CREATING AN ANNOTATION FILE

The program name must be entered from the Supervisor menu to use annotation. If you have not entered the file name, follow the steps below:

1. From the Supervisor menu, type in the file name for the program.

2. To create the file without entering Edit Program mode, press CTRL-E (Enter). The file name will be displayed below the menu selections.

   Or, select Edit Program by pressing F2. When the backup prompt is displayed, enter N if no annotation file with the same name already exists, or Y if you want to save a previous version of the file before editing the annotation.

ENTERING NICKNAMES WHEN CREATING A RUNG

Nicknames can be entered when a rung is created, or entered separately. Follow the instructions below to enter a nickname while creating a rung.

1. Be sure that the program name has been specified from the Supervisor menu.

2. While entering a program element, the reference is entered in the center line of the work area. To assign a nickname for that reference, enter up to 7 ASCII-keyboard characters in the top line of the work area. For example: LS035, PB11A@, SOL129C.

3. Press the Shift key and the Enter key at the same time, or press an instruction function key. The system checks whether the reference has been used before in the program, and whether the reference has already been assigned a nickname. If not, that nickname will be assigned to the reference throughout the program. The nickname will be stored on the program disk when the rung is accepted.

   If the nickname has already been used, a message is displayed and the nickname is not stored.

   If the reference has a prior nickname, a message is displayed requesting confirmation to delete the prior nickname. If confirmed, the new nickname will replace the former one throughout the program. It will be stored on the program diskette.

DELETING A NICKNAME

To delete a nickname, enter the reserved name "none" as the nickname in the top line of the work area. Enter the reference from which the nickname is to be deleted in the center line of the work area. Press the Shift and Enter keys at the same time, or select an instruction function key. A message will be displayed, confirming the nickname deletion.

ENTERING ANNOTATION IN WINDOW MODE OR PAGE MODE

In addition to entering nicknames when creating a rung, annotation can be entered in either Window mode or Page mode.

- In Window mode, a window is created in the ladder logic. In this way, the annotation can be edited while the logic is displayed on the screen.
- In Page mode, the entire screen is used for annotation. *Note that Page mode can be used to enter annotation prior to actually creating the ladder logic.* The annotation will be saved in a file, for future use.

When entering rung explanations or coil labels, which can contain many lines of text, a beep occurs near the end of a display line. This is similar to the end-of-line bell on a typewriter.

EDITING ANNOTATION IN WINDOW MODE

Window mode allows annotation to be entered while the ladder logic is displayed. Follow the steps below to edit annotation in Window mode:

1. From the Edit menu, select Edit Comment (F3) to display these function keys:

```
 EDIT    EDIT    EDIT          RUNG  RENUM   PAGE/          EDIT
1EXPLAN 2 LABEL 3 NAME  4        # 5EXPLAN 6WINDOW 7      8 MENU
```

   The Edit Name (F3) key is available only when Edit Comment is pressed from Display All mode and the cursor is at a rung element with a register or discrete I/O reference. The Edit Label (F2) key is available only when the cursor is on a rung with a coil.

2. If F6 is labeled Window Display, press F6 to enter Window mode.

Entering a Rung Explanation in Window Mode

To enter a rung explanation in Window mode, follow the steps below:

1. With the cursor at the rung where the explanation will appear, press F1 (EDIT EXPLAN). A reverse-video window appears above the rung. The window is seven lines deep and 74 characters wide.
2. Enter text for the rung explanation into the window. If necessary, refer to the editing instructions given later in this section. The edit window will scroll upward when the bottom is reached, allowing entry of up to 4000 characters.
3. When the rung explanation is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. Saved text will be stored in the program's annotation file.

Entering a Coil Label in Window Mode

To enter a coil label in Window mode, follow the steps below:

1. With the cursor at the rung where the label will appear, press F2 (EDIT LABEL). A reverse-video window appears on the right side of the screen, above the rung. The window is seven lines deep and 46 characters wide.

2. Enter text for the label into the window. If necessary, refer to the editing instructions given later in this section. The edit window will scroll upward when the bottom is reached, allowing entry of up to 4000 characters.

3. When the coil label is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. Saved text will be stored in the program's annotation file.

Editing Names in Window Mode

To enter a name for a reference in Window mode, follow the steps below:

1. With the cursor at the rung element where the name will appear, press F3 (EDIT NAME). A window appears above the reference.

2. Enter text for the name into the window. If necessary, refer to the editing isntructions given later in this section.

3. When the name is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. If saved, the name will be stored in the program's annotation file.

EDITING ANNOTATION IN PAGE MODE

Page mode permits full-screen display of annotation. It is useful for entering annotation before creating the ladder logic for the program. Follow the steps for loading the program and creating the annotation file given earlier in this chapter.

Follow the steps below to edit annotation in Page mode:

1. From the Edit menu, select Edit Comment (F3) to display these function keys:

```
 EDIT    EDIT    EDIT          RUNG  RENUM   PAGE/          EDIT
1EXPLAN 2 LABEL 3 NAME  4         # 5EXPLAN 6WINDOW 7      8 MENU
```

2. If F6 is labeled Page Display, press the F6 key. The ladder logic disappears from the screen.

Entering a Rung Explanation in Page Mode

To enter a rung explanation in Page mode, follow the steps below:

1. Use the Select key to move the work area cursor to the bottom line. Enter the rung number above which the rung explanation is to appear. The decimal mode of data entry must be selected by pressing the Shift-Dec keys on the keypad area (ALT-U on some IBM-compatible computers).

   Note that the Increment and Decrement keys (these are shifted key functions) can be used when entering rung explanations in sequential order.

2. Press F1 (EDIT EXPLAN). A reverse-video window appears for entering the text of the rung explanation. The window is 21 lines deep and 74 characters wide.

3. Enter text for the rung explanation into the edit window. If necessary, refer to the editing instructions given later in this section. The edit window will scroll upward when the bottom is reached, allowing up to 4000 characters to be entered.

4. When the rung explanation is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. The text will be stored in the program's annotation file.

Entering a Coil Label in Page Mode

To enter a coil label in Page mode, follow the steps below:

1. Enter either the coil nickname in the top line of the work area, or the coil reference in the center line of the work area.

   Note that the Increment and Decrement keys (these are shifted key functions) can be used when entering coil labels in sequential order.

2. Press F2 (EDIT LABEL). A reverse-video window appears for entering the text of the coil label. The window is 21 lines deep and 46 characters wide.

3. Enter text for the label into the window. If necessary, refer to the editing instructions given later in this section. The edit window will scroll upward when the bottom is reached, allowing up to 4000 characters to be entered.

4. When the coil label is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. The text will be stored in the program's annotation file.

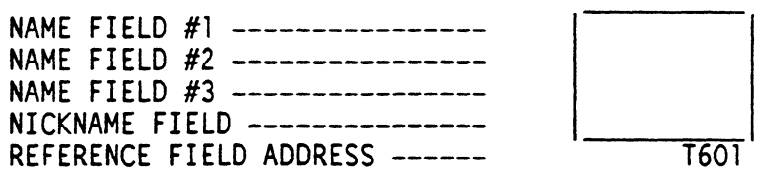
Editing a Name or Nickname in Page Mode

To enter a name or nickname for a reference in Page mode, follow the steps below:

1. Enter either the nickname in the top line of the work area, or the reference in the center line of the work area.

   Note that the Increment and Decrement keys (these are shifted key functions) can be used when entering references in sequential order.

2. Press F3 (EDIT NAME). The following display appears. Here, the illustration assumes that T601 was entered in the second line of the work area.



3. Enter the desired text into the window. If necessary, refer to the editing instructions given later in this section.

4. When the text is complete, press CTRL-A (Accept) to save it or F9 (Abort) to delete it. The text will be stored in the program's annotation file.

ANNOTATION TEXT EDITING

In an edit window, the end of the explanation or label is marked EOB (End of Block). If there is no text in the window, the EOB appears in the upper left corner of the window. Enter new text by typing it in. When the text is complete, press CTRL-A (Accept) to save it in an annotation file with the same name as the program file name.

Text Editing Instructions

The bottom of the screen shows the function key assignments. Edit text using these keys, as described below:

```
  UPPER   UND C   UND W   UND L RUNG  DELEOL  RESET    PASTE   TOP
1       2 DEL C 3 DEL W 4 DEL L    # 5 EOL   6SELECT 7  CUT  8BOTTOM
```

The upper and lower functions of the keys toggle when the keys are pressed. Text editing must be ended either by pressing CTRL-A (Accept), F9 (Abort), or the Supervisor key.

UPPER/LOWER (F1) Use F1 to toggle the active functions of the other keys. Press F1 to select UPPER (as shown above) or LOWER functions.

INSERT/DELETE CHARACTER (F2)

Use Delete Character (F2) to delete the character at the cursor position, and move the following text one character to the left.

Use Insert Character (F2) to insert the most recently-deleted character immediately before the cursor position, and move the cursor one character left, to the new character's position. This can be done repeatedly, to insert the most-recently deleted character at several positions in the text.

INSERT/DELETE WORD (F3)

Use Delete Word (F3) to delete all the characters (255 maximum) from the cursor position to the next word or the next carriage return.

Use Insert Word (F3) to insert the most recently deleted character string (word segment) immediately before the cursor position.

INSERT/DELETE LINE (F4)

Use Delete Line (F4) to delete all characters from the cursor position to the end of the line, including the carriage return.

Use Insert Line (F4) to insert the most recently deleted line of text immediately before the cursor position. If the line length exceeds 255 characters, no insertion will occur.

DELETE END OF LINE/ END OF LINE (F5)

Use End of Line (F5) to move the cursor to the end of the line.

Use Delete End of Line (F5) to delete all characters from the cursor to the end of the line, but not the carriage return at the end of the line.

RESET/SELECT (F6)

Use Select (F6) to mark a location in the window from which text will be removed using the F7 (CUT) key. After pressing the Select key, move the cursor to indicate the area from which text will be removed.

Use Reset (F6) to reset (or deselect) the selection made with the Select key.

PASTE/CUT (F7)

Use Cut (F7) to remove the characters selected with the F6 (SELECT) key. These characters are placed in a buffer; they can be placed elsewhere in the text window using the Paste key.

Use Paste (F7) to insert the contents of the buffer immediately before the cursor location. This can be done more than once, to make multiple copies of the same text. Text can be restored to its original location using the Paste key.

TOP/BOTTOM (F8)

Use Top (F8) to move the cursor to the first character of the text block.

Use Bottom (F8) to move the cursor to the last character of the text block.

CREATING ADDITIONAL TEXT FILES FOR ANNOTATION PRINTOUT

The maximum number of characters that can be included in a rung explanation or coil label is 4000. However, longer text can be incorporated in a program printout by creating an annotation text file. Such text files can only be printed, not displayed on the screen.

To include a text file in a printout, follow the steps below:

1. Create the file, using one of the many DOS-compatible word-processing software packages.

2. Store the text file on a drive that is accessible to the system during the printout.

3. Create the coil label or rung explanation, as described earlier in this section. At the place in the label or explanation where the text file is to be included in the printout, move the cursor to the beginning of a new line, and enter \I followed by the drive designation (if necessary), and the name of the file. There must be no other text on the same line. For example:

```
\I B:LABEL:MEM
```

RENUMBERING RUNG EXPLANATIONS

Rung explanations are stored in a different file from the ladder logic for the program. If rungs are added or deleted in the program, the system will automatically re-structure the text in the annotation file so that the explanations will appear in the correct locations in the program.

However, if the annotation file is not present when the program is changed (i.e., the diskette containing the annotation file is not in the drive) or during file merge operations (i.e., including rungs from an .SDE file), the system will not be able to perform this automatic re-structuring on the annotation file. In that case, the annotation must be changed to agree with the new program content. If rungs were added or deleted when the annotation file was not available, follow these steps:

1. Window Mode: If rungs were added, move the cursor to the first new rung of logic. If rungs were deleted, move the cursor to the first rung after the deletion.

   Page Mode: If rungs were added, type the rung number of the first new rung of logic, on the center line of the work area. If rungs were deleted, type the rung number of the first rung after the deletion, on the center line of the work area.

2. In the bottom line of the work area, using decimal mode, enter a + sign to indicate added rungs, or a - sign to indicate deleted rungs. Follow that with the number of rungs added or deleted.

NOTE

The use of incorrect values may result in a loss of more explanations than intended.

3. Select the Renumber Explanations (F5) key from the Comment Editing display. The screen displays the following message:

   PRESS ALT-X (confirm) TO MOVE REST OF EXPLANATIONS - SOME MAY BE LOST

4. Press ALT-X (Confirm or Shift-0) to execute the re-numbering. The rung explanations will be re-numbered in the direction, and by the quantity entered.

SECTION 3
VIEWING ANNOTATION IN DISPLAY PROGRAM MODE

This section explains the annotation display features of the Logicmaster 1F system. Included are:

- How to toggle the display between ladder-logic and annotated display.
- How to display annotation in Page mode or Window mode.

ACCESSING THE ANNOTATION DISPLAY FUNCTIONS

Annotation display functions are accessed through the Display Program menu.

```
DISPLY  SEARCH  DISPLY          RUNG          TOGGLE  DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4         # 5       6       7 ALL   8 MENU
```

The Display Program menu provides two function keys for annotation display:

DISPLAY ALL (F7) Use F7 to toggle the format of the program display between reference (or nickname-only) display, and annotated (references, names, nicknames) display. The .NAM file for the program must be present in the default drive for proper annotation display.

DISPLAY COMMENT (F3) F3 allows access to the annotation display functions. When this key is pressed, the following functions become available:

```
DISPLY  DISPLY                  RUNG          PAGE          DISPLY
1EXPLAN 2 LABEL 3       4         # 5       6DISPLY 7       8 MENU
```

Note that the Display Label function is available only when the cursor is on a rung within a coil. The Display Label (F2) key is always available in Page mode. Also, in Window mode the Page Display (F6) key is available. In Page mode, the Window Display (F6) key is available instead.

DISPLAY COMMENT FUNCTIONS

DISPLAY EXPLANATION (F1)

Use F1 to view rung explanations.

If the Window Display function has been selected and the Window mode is active, then F1 will display the rung explanation of the rung where the cursor is located. The rung explanation appears in a reverse-video window that is seven lines deep and 74 characters wide. If there is additional text, use the cursor to scroll the text in the window.

If the Page Display function has been selected and Page mode is active, then F1 will display the rung explanation of the rung number entered in the bottom line of the work area. The rung explanation appears in a reverse-video window that is 21 lines deep and 74 characters wide. If there is additional text, move the cursor to scroll the text in the window.

DISPLAY LABEL (F2)

Use F2 to display coil labels.

If the Window Display function has been selected and Window mode is active, then F2 will display the coil label of the coil on the rung where the cursor is located. The coil label appears in a reverse-video window that is seven lines deep and 46 characters wide. If there is additional text, use the cursor to scroll the text in the window.

If the Page Display function has been selected and Page mode is active, then F2 will display the coil label of the coil reference entered in the center line of the work area, or the nickname of the coil reference entered on the top line of the work area. The coil label appears in a reverse-video window that is 21 lines deep and 46 characters wide. If there is additional text, use the cursor to scroll the text in the window.

PAGE/WINDOW DISPLAY (F6)

Use F6 to toggle the display between Page Display and Window Display mode.

SECTION 4
PRINTING ANNOTATION

Annotation can be printed with the ladder program, or separately. Information on printing is provided in chapter 8.

This section describes:

- The basic steps followed to print annotation.
- The printout formats.
- How to print annotation in foreground mode, or from a print file.
- How to change the title on a printout.
- How to place borders around comments in printouts.

SETTING UP THE PRINTER

1. If the printer has already been set up and the printout parameters specified, go directly to step 2. Otherwise, set up the printer (this is only required when using a printer for the first time).

   A. If it is a parallel printer, attach it to port 3. Turn the printer on, and place it in On-Line mode. Continue at step 1c.

   B. If it is a serial printer, set the DIP switches and jumpers on the printer, as instructed in the manual for the printer. Attach the printer to serial port 1.

   C. From the Supervisor menu, select Utility Functions (F8). Enter parameters for port A which correspond to those set up for the printer. Press F1 (SET UP PORT) to implement the printer parameters at the port.

   D. Return to the Supervisor menu, and select Print Functions (F5). If no file name is active, enter the file name of the annotation to be printed, on the top line of the work area.

   E. Define the printer parameters. In the Print menu, press F5 (DEFINE PRINTR). The default printer parameters can be changed, as described in chapter 8.

2. In the Print menu, press F6 (DEFINE OUTPUT) to determine the content of the printout. Here, you can select the program and annotation feature to be printed.

3. To print the annotation in foreground mode, press F1 (PRINT OUT) from the Print menu. This command can either send the output to a printer directly, or store it as a print *file for printing later in* background mode. Specify the port to receive the printout or file. If the file is being saved for later printing, give it a file name. Press CTRL-E (Enter) to start the printout.

   To print the annotation in background mode, press F2 (PRINT PROG). Specify the printer port and the source drive for the file. Enter the program name. Press CTRL-E (Enter) to start the printout.

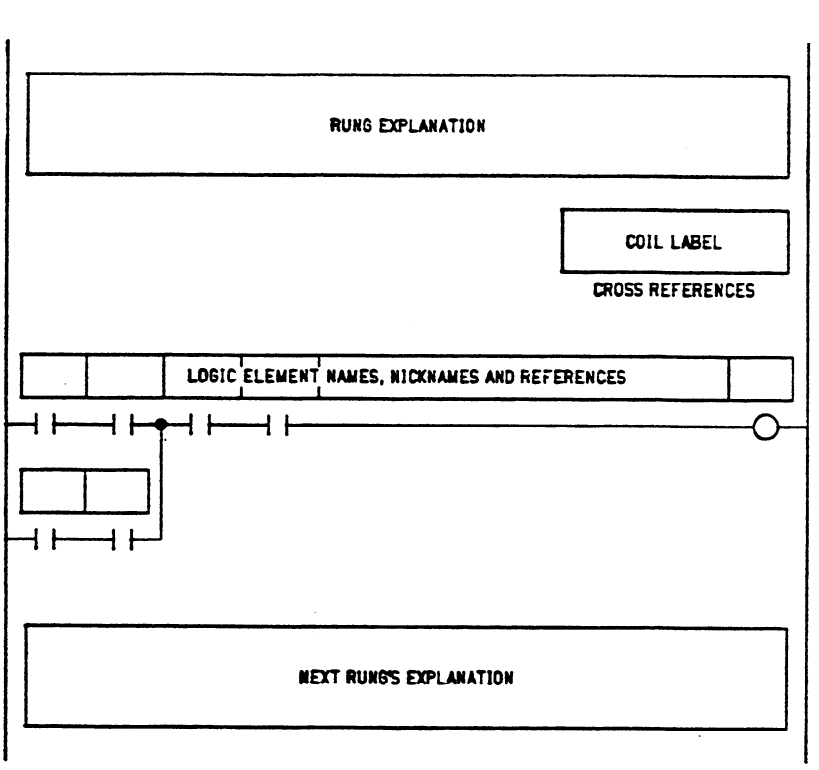


Figure 6.1 80-COLUMN FORMAT OF PRINTOUT WITH ANNOTATION

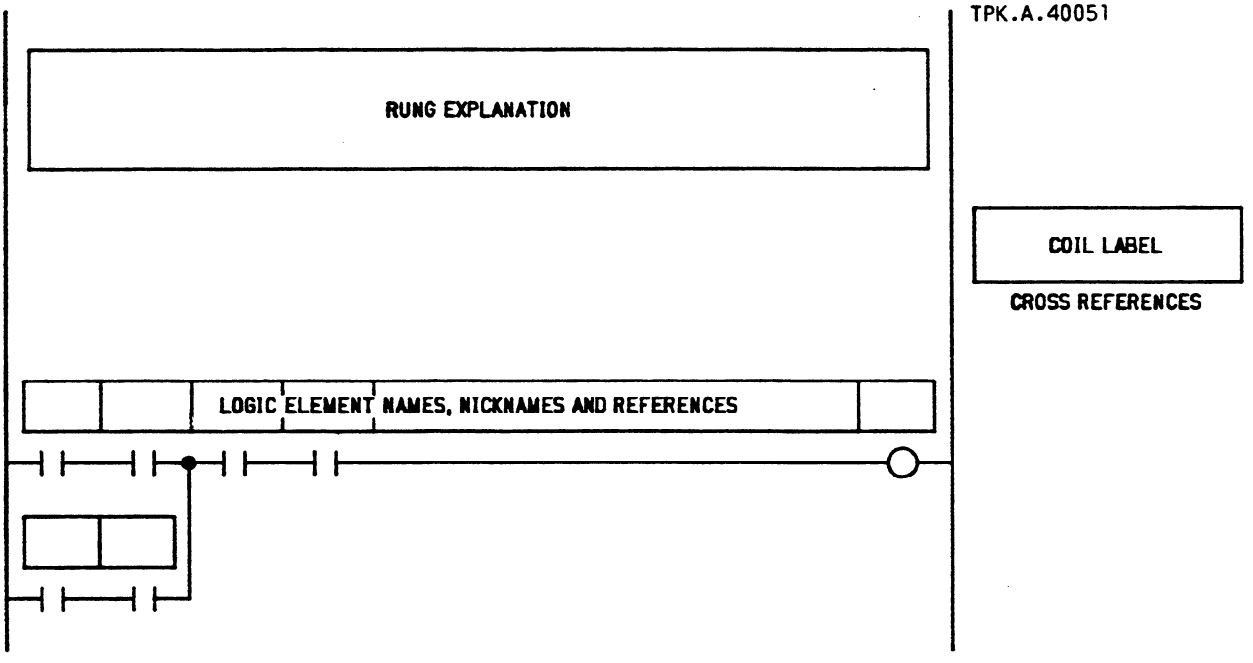


Figure 6.2 132-COLUMN FORMAT OF PRINTOUT WITH ANNOTATION

CHANGING THE TITLE ON THE PRINTOUT

When the printer output is defined, a title and subtitle for the printout are created. This title and subtitle can be changed before any rung explanation in the program. Each time a new title and subtitle are encountered during a printout of the program, the printer begins a new page. The new title/subtitle are displayed at the top of the page, before the Rung Explanation, and will continue to be displayed until changed by another rung explanation.

Follow the steps below to change the title and/or subtitle for the printout pages.

1. At the beginning of the rung explanation, enter the characters **\T** for a new title or **\S** for a new subtitle.

2. Type up to 60 characters for the title or subtitle, on the same line as the \T or \S.

3. Continue the text of the rung explanation on the next line.

PLACING BORDERS AROUND COMMENTS IN PRINTOUTS

To make coil labels and rung explanations stand out in program printouts, borders can be printed around them. The system will automatically create a border of the correct size. To place a border around a label or explanation, follow the instructions below:

1. Create the coil label or rung explanation, as described in this section.

2. At the beginning of a line by itself, enter **\B** followed by two ASCII characters to make up an outer and inner border. The two ASCII characters must be the next two characters after the B. Any spaces in these two positions will become part of the border. For example,

   \B* (space)

   This would create a border of asterisks around the outside of the comment. A blank is usually specified as the inner (second) character, to provide space between the text and the border.

   The **\T**, **\S**, and **\B** can be entered on any of the first three lines of the rung explanation, in any order. For example:

\S	New subtitle
\B*	Border
\T*	New title

   For coil labels, the **\B** can be any of the first three lines of the text.

Borders are used only in printouts; they are not displayed on the screen.

CHAPTER 7
DISPLAY REFERENCE TABLES

The Display Reference Tables function is used to display the status of any group of references. These may be discrete references or registers.

The Display Reference Tables function can be selected from the Supervisor menu or another screen on which it is active. If a CPU is connected and the current system status is on-line, the information shown comes from the CPU. Otherwise, it comes from the programming system's memory.

This chapter explains how to enter, use, and exit the Display Reference Tables function. Refer to the appropriate sections.

Section 1. Using the Display Reference Tables Function: Read section 1 for general information about the Display Reference Tables function.

Section 2. Displaying Discrete References: To display the I/O reference table, internal coils table, shift registers table, and timer/counters status table, refer to the instructions in section 2.

Section 3. Displaying Data Register Contents: To display the Data Register table, refer to the instructions in section 3.

Section 4. Displaying Accumulate Register Contents: To display the Timer/Counter Accumulate table, refer to the instructions in section 4.

Section 5. Making On-Line Changes: Section 5 explains how to make on-line changes to discrete and register values.

SECTION 1
USING THE DISPLAY REFERENCE TABLES FUNCTION

This section consists of general instructions for using the Display Reference Tables function. It explains:

- How to enter and exit the function.
- How to display the reference table you want, from the Supervisor menu.
- How to move within a table, and from one reference table to another.
- How to return to the ladder logic display from the reference tables.

HOW TO DISPLAY THE REFERENCE TABLES

To display the reference tables values for a program, follow the steps below:

1. In the Supervisor menu, select the reference table to be displayed. Do that in one of the following ways:

   A. If you make no entry in the work area, the last table displayed is automatically selected. If no table has been displayed, then the discrete table is selected and the cursor will be on I/O point number 0.

   B. Enter a reference, reference type, or nickname in the work area. If only the type of reference is shown in the work area, the first reference of that type is displayed.

2. Select Display Reference Tables (F3) from the Supervisor menu. The reference title and associated table are displayed.

MOVING WITHIN A REFERENCE TABLE

If there is a reference table on the display and you want to move to another reference address within the same table:

1. Enter the nickname or reference address into the work area.
2. Press CTRL-E or the Enter key. The cursor will move on the current screen to the reference. If that reference *is not* on the current table, then an error message will be displayed.

MOVING FROM ONE REFERENCE TABLE TO ANOTHER

If there is a reference table on the display and you want to go directly to a different table:

1. Press the appropriate hard key and enter the reference address or nickname into the work area.
2. Press F8 (DISPLY REF TB).

RETURNING TO THE SUPERVISOR MENU

Press the Supervisor key when you want to return to the Supervisor menu from one of the reference tables displays.

You can re-enter the tables without specifying a table. The Logicmaster 1F system will return to the last table that was displayed.

RETURNING TO THE LADDER DIAGRAM DISPLAY

To return to the ladder diagram display from one of the reference tables displays:

1. Press the Supervisor key to display the Supervisor menu.
2. Select Display Program (F1).

The ladder diagram is displayed, at its last viewing position.

OFF-LINE DISPLAY OF REFERENCE TABLES

When the Logicmaster 1F system is in the Off-Line mode, the reference table values displayed are retrieved from the programmer (RAM) memory. In this mode, data register values and timer/counter accumulate register values can be entered. Entering discrete table values or toggling of I/O is not permitted in the Off-Line mode.

ON-LINE DISPLAY OF REFERENCE TABLES

When the Logicmaster 1F system is in the On-Line or Monitor mode, the reference tables displayed are retrieved from the CPU.

CPU STOPPED The discrete tables display will be blank.

CPU RUN All tables are retrieved from the CPU and displayed.

NOTE

The programs in the Logicmaster 1F system and the CPU do not need to be equal to display reference tables.

SECTION 2
DISPLAYING DISCRETE REFERENCES

This section explains how to display one of the discrete reference tables.

DISPLAYING A TABLE OF DISCRETE REFERENCES

The discrete display screens show status tables of each of the discrete reference types (I/O, internal coils, shift registers, timers and counters). To display the discrete reference table, follow the instructions below:

1. From the Supervisor menu, or from within the Display Reference Tables function, enter a reference address from 000 to 777 in the reference field of the work area.

   The four categories of discrete references are:

Input/Output	000-077, 077-157, 700-777
Internal Coils	160-377
Shift Registers	400-577
Timer/Counters Up Status	600-677

   You can also display each table by entering a nickname instead of a reference address. When the table is displayed, the cursor will fall on the address in the table for the nickname entered in the work area.

2. Select Display Reference Table (F3) from the Supervisor menu.

   If you press F3 in the Supervisor menu, or press F8 (DISPLY REF TB) from within the Reference Tables function, and the work area is either blank or contains an invalid reference, the reference display that was last shown before exiting the Display References function will be shown. If this function has not been accessed since the Logicmaster 1F system was powered up or reset, the Display References function will default to the display containing discrete status.

I/O, INTERNAL COIL, SHIFT REGISTER, T/C UP STATUS TABLE

```
                                                    L/M: OFFLINE
POINT#            I/O 137 (NICKNAME)

   77      70        60        50        40        30        20        10        00

                  I N P U T / O U T P U T   T A B L E
777 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
077 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
177                   00000000 00000000 00000000 00000000 00000000 00000000

                  I N T E R N A L   C O I L S   T A B L E
177 00000000 00000000
277 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
377 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

                  S H I F T   R E G I S T E R S   T A B L E
477 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
577 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

        T I M E R / C O U N T E R S   U P   S T A T U S   T A B L E
677 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000


          BYTE    WORD   BINARY       TOGGLE          CHANGE  DISPLY
1       2DISPLY 3DISPLY 4DISPLY      5ENABL  6TOGGLE 7 ALL   8REF TB
```

FORMAT OF THE DISCRETE REFERENCE DISPLAY

References are displayed with addresses increasing from right to left. The reference where the cursor is positioned is also displayed in binary format, along with its corresponding reference and nickname, in the header line of the display.

NOTE

When the Logicmaster 1F system is on-line and the CPU is stopped, this display will be blank.

DISCRETE REFERENCE TABLES FUNCTION KEYS

The bottom of the screen displays the function key assignments:

BYTE DISPLAY (F2)	Press F2 to display the value(s) in byte bcdhex format.
WORD DISPLAY (F3)	Press F3 to display the value(s) in word bcdhex format.
BINARY DISPLAY (F4)	Press F4 to display discrete value(s) in binary code.
TOGGLE ENABLE (F5)	Press F5 to enable the Toggle function. This function is *only* available in On-Line mode.
TOGGLE (F6)	Press F6 to change the state (on/off) of the reference point that is currently highlighted by the cursor. This function key is *only* displayed when toggling is enabled.
CHANGE ALL (F7)	Press F7 to change the entire display to the specified format.
DISPLAY REFERENCE TABLE (F8)	Press F8 to change displays within the Display References function.

RETURNING TO THE SUPERVISOR MENU

Press the Supervisor key when you want to return to the Supervisor menu from one of the reference tables displays.

RETURNING TO THE LADDER DIAGRAM DISPLAY

To return to the ladder diagram display from one of the reference table displays:

1. Press the Supervisor key to display the Supervisor menu.
2. Select Display Program (F1).

The ladder diagram is displayed, at its last viewing position.

SECTION 3
DISPLAYING DATA REGISTER CONTENTS

This section explains how to display the register reference table.

DISPLAYING A TABLE OF REGISTER REFERENCES

To display one of the Data Register tables:

1. Press the R hard key and then type the number from 400 to 577 (optional) in the reference field of the work area.

2. Select Display Reference Table (F3) from the Supervisor menu, or press F8 (DISPLY REF TB) from a screen within the Display Reference Tables function.

DATA REGISTER TABLE

L/M: OFFLINE
REGISTER 500 (NICKNAME) EQUALS 1001010101010100
D A T A R E G I S T E R S

REG	7	6	5	4	3	2	1	0
R 407	11	23	34	45	56	67	78	89
R 417	00	00	00	00	77	53	00	99
R 427	11	23	34	45	56	67	78	89
R 437	00	00	00	00	77	53	00	99
R 447	11	23	34	45	56	67	78	89
R 457	11	23	34	45	56	67	78	89
R 467	00	00	00	00	77	53	00	99
R 477	11	23	34	45	56	67	78	89
R 507	00	00	00	00	00	00		1234
R 517	00	00	00	00	77	53	00	99
R 527	00	00	00	00	00	00		1234
R 537	00	00	00	00	77	53	00	99
R 547	11	23	34	45	56	67	78	89
R 557	00	00	00	00	77	53	00	99
R 567	00	00	00	00	77	53	00	99
R 577	00	00	00	00	77	53	00	99

BYTE WORD CHANGE DISPLY
1 2DISPLY 3DISPLY 4 5 6 7 ALL 8REF TB

FORMAT OF THE DATA REGISTER REFERENCE DISPLAY

The top line of the register reference display shows the register number at the cursor location (register 500 in the example above). The top line also displays the binary equivalent of the number at the cursor location and the associated nickname.

The left column on the screen indicates the register numbers of the left column of values. The highest number register is on the bottom left.

The default display consists of 16 rows of 8 references each in the byte bcdhex format. The references are displayed with addresses increasing from right to left. The reference where the cursor is positioned is also displayed in binary format, along with its corresponding reference and nickname, in the header line of the display.

The data entered in the work area is moved to the Data Register table memory without any conversion. When the cursor is in the Work Display mode, the valid range is 0000H to 9999H. When the cursor is in the Byte Display mode, the valid range is 00H to 99H.

REGISTER REFERENCE TABLES FUNCTION KEYS

The bottom of the screen displays the function key assignments:

BYTE DISPLAY (F2)	Press F2 to display the value(s) in byte bcdhex format.
WORD DISPLAY (F3)	Press F3 to display the value(s) in word bcdhex format.
CHANGE ALL (F7)	Press F7 to change the entire display to the specified format.
DISPLAY REFERENCE TABLE (F8)	Press F8 to change displays within the Display References function.

SECTION 4
DISPLAYING ACCUMULATE REGISTER CONTENTS

This section explains how to display the Accumulate Register reference table.

DISPLAYING A TABLE OF REGISTER REFERENCES

To display one of the Timer/Counter Accumulate Register tables:

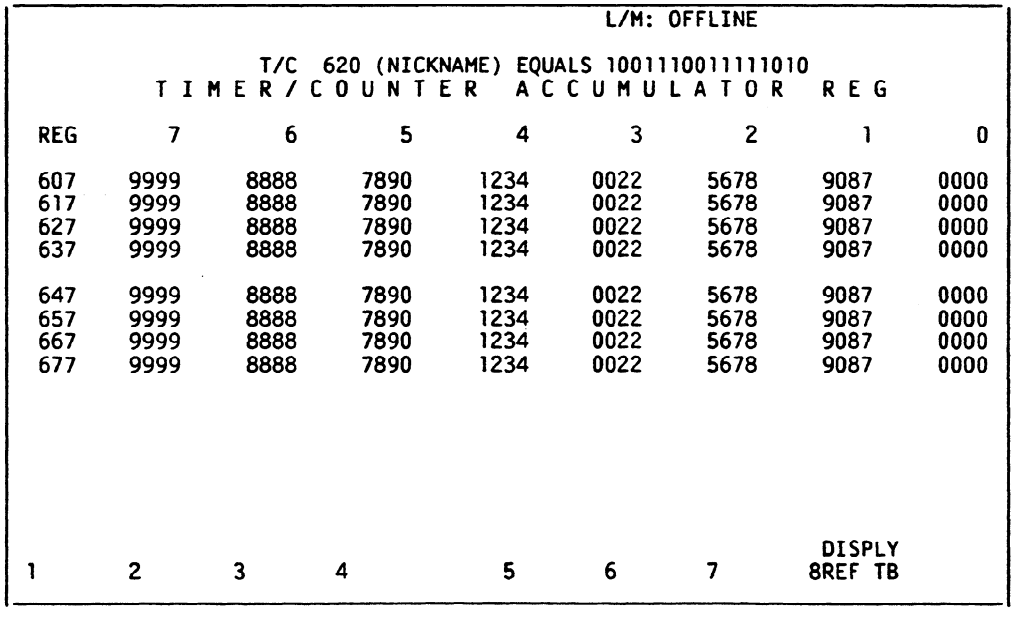
1. Press the R hard key, or the A and R hard keys (AR = Accumulate Register) and then type the number from 600 to 677 (optional) in the reference field of the work area.

NOTE

Either the "R" or "AR" prefix is acceptable when requesting one of these references.

2. Select Display Reference Table (F3) from the Supervisor menu, or press F8 (DISPLY REF TB) from a screen within the Display Reference Tables function.

TIMER/COUNTER ACCUMULATE TABLE



L/M: OFFLINE

T/C 620 (NICKNAME) EQUALS 1001110011111010

TIMER/COUNTER ACCUMULATOR REG

REG	7	6	5	4	3	2	1	0
607	9999	8888	7890	1234	0022	5678	9087	0000
617	9999	8888	7890	1234	0022	5678	9087	0000
627	9999	8888	7890	1234	0022	5678	9087	0000
637	9999	8888	7890	1234	0022	5678	9087	0000
647	9999	8888	7890	1234	0022	5678	9087	0000
657	9999	8888	7890	1234	0022	5678	9087	0000
667	9999	8888	7890	1234	0022	5678	9087	0000
677	9999	8888	7890	1234	0022	5678	9087	0000

1 2 3 4 5 6 7 8 DISPLY REF TB

FORMAT OF THE ACCUMULATE REGISTER REFERENCE DISPLAY

The top line of the Timer/Counter Accumulate Register table shows the register number at the cursor location (timer/counter 620 in the example above). The top line also displays the binary equivalent of the number at the cursor location and the associated nickname.

The table display consists of 8 rows of 8 references, each in the word bcdhex format. The references are displayed with addresses increasing from right to left. The reference where the cursor is positioned is also displayed in binary format, along with its corresponding reference and nickname, in the header line of the display.

The data entered in the work area, and on the display, is in decimal format. The valid range is 0000 to 9999. To perform on-line changes, enter the data in the data line of the work area and press CTRL-E or the Enter key.

REGISTER REFERENCE TABLES FUNCTION KEYS

The bottom of the screen displays the function key assignments:

DISPLAY REFERENCE TABLE (F8) Press F8 to change displays within the Display References function.

SECTION 5
MAKING ON-LINE CHANGES

Single word changes can be made in Display Reference Tables mode. This section explains:

- The effect of on-line changes.
- Under what conditions on-line changes may be made.
- How to toggle the status of an contact or coil.
- How to change register and I/O values.

EFFECT OF ON-LINE CHANGES

As in the Display Program mode, the effect of on-line changes depends upon the current mode (On-Line, Off-Line, or Monitor), whether the program in the CPU is equal or not equal to the program in programmer memory, and whether on-line changes are enabled.

When the system is in On-Line or Monitor mode, status information can be obtained from a connected CPU. This information includes I/O state and register content. To ensure an accurate display, be sure that the Logicmaster 1F system and the CPU programs are equal. If the CPU is locked, data will not be displayed and on-line changes are not permitted.

When the system is connected to a scanning CPU in the On-Line or Monitor mode, displays are updated as the CPU status changes.

When the system is in Off-Line mode, status is always obtained from internal memory. In the Off-Line mode, power flow is shown with numerical values from internal memory.

MAKING ON-LINE CHANGES

WARNING

Exclusive single bit on-line changes of discrete I/O are not supported in either the Series One (Model E) Data Communications Unit or the Series One Plus Data Communications Unit. The toggling function is accomplished by (1) reading a byte wide I/O group from the CPU containing the I/O point to be toggled, (2) setting the I/O point to be toggled, and (3) writing the entire byte wide I/O group back to the CPU memory.

If the CPU changed the status of any I/O points in that group during the read-set-write cycle for I/O toggling, the new status may be overwritten. Because this could produce unexpected and potentially hazardous results, caution is necessary when toggling discrete I/O. Toggling I/O must be performed when programmer memory is cleared to avoid any unexpected or hazardous results.

On-line changes must be enabled in the Communications Setup menu. If they are not enabled, the On-Line Change function key assignment will not be available.

Occasionally, with all types of on-line changes (bit, byte, or word), errors may occur because the system does not verify the change until a later sweep. If an error has occurred, the system cannot try the change again.

Forcing the Status of a Reference

When toggling is enabled in the Display Discrete References function, the Toggle Reference (F6) function key is used to toggle the status of a reference between on and off. The new status is retained until changed by some other function, such as rung solution or I/O servicing. This usually occurs within one scan.

To toggle a reference:

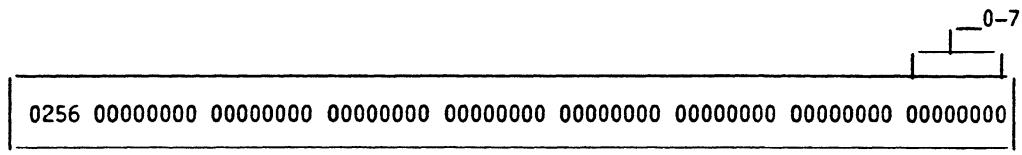
1. With the table displayed on the screen, enable toggling by pressing the Toggle Enable (F5) key.

2. Place the cursor on the reference to be forced.

3. Press F6 to change that reference to its opposite state. All logic elements in the program that use the reference will reflect the new status.

Changing the Value of a Register of Discrete References

The Toggle Reference key can only be used to change the status of one discrete reference at a time. You can also change the value of the entire byte or word where the cursor is located. To do that, first you must change the base to a byte or word. For example, suppose you want to convert discrete references 0 to 7 to 01110111.



Follow the steps below to change a byte of discrete references.

1. Be sure the cursor is in the rightmost (lower numbered) byte of the register to be converted. Use the function keys to change the base to one of the following: byte (by pressing F2), or word (by pressing F3).

2. If the work area cursor is not on the bottom line, press the Select key to move it there.

3. Type in the equivalent of the binary value you want to enter. In the example above, you would enter 77.

4. Press CTRL-E or the Enter key to change the reference table value at the cursor position to the new value.

5. Press F4 (BINARY DISPLY) to convert the base back to binary values.

CHANGING REGISTER VALUES

Register contents can be changed from the keyboard. If the Logicmaster 1F system is on-line to the CPU, such changes are placed in CPU memory. If the system is in Off-Line mode, changes are loaded into the programmer memory.

When the CPU is on-line and running, on-line changes are allowed for any register 0-77 or 600-677, and for any evenly addressed word change for registers 400-577.

If the CPU is on-line and stopped, or if the Logicmaster 1F system is operating off-line, changes to registers 400-577 and 600-677 are allowed. Changes to registers 0-77 are prohibited.

To change a register:

1. With the register table displayed on the screen, place the cursor on the register to be changed. The register will be updated by the value in the work area's numeric line.

2. Type in the value for the register using the numeric keypad. The entry is displayed in the work area.

3. When the entry is correct, press CTRL-E or the Enter key to load the value into the register.

CHAPTER 8
PRINT

The Print function can be used to print copies of ladder logic and annotation. You can print all of a program, or just a part of it. The program currently in programmer memory or the content of the screen can be printed in foreground mode. During a foreground mode print, the system is dedicated to printing and cannot be used for anything else. A program stored as a print file can be printed in background mode, allowing the system to be used for other functions at the same time.

This chapter explains how to use the Print functions. It tells how to enter the characteristics of a new printer, select the content of a print-out, or create or print out a print file. This chapter contains the following sections:

Section 1. The Print Menu: Section 1 explains the Print menu and summarizes the Print function keys.

Section 2. Setting Up the Printer: Section 2 explains how to set up a printer for use with your system.

Section 3. Defining Print-out Content: Section 3 explains how to select the content of a print-out. You can print part or all of the ladder logic, annotation, or cross-reference tables.

Section 4. Printing in Foreground Mode: Section 4 explains how to send a print-out to either a printer or a file.

Section 5. Printing a File in Background Mode: Section 5 explains how to print out a file.

PRINTING A COPY OF THE SCREEN

For quick reference, the Print Screen function can be used to print a copy of the current screen display. Print Screen will print 25 lines of 80 characters.

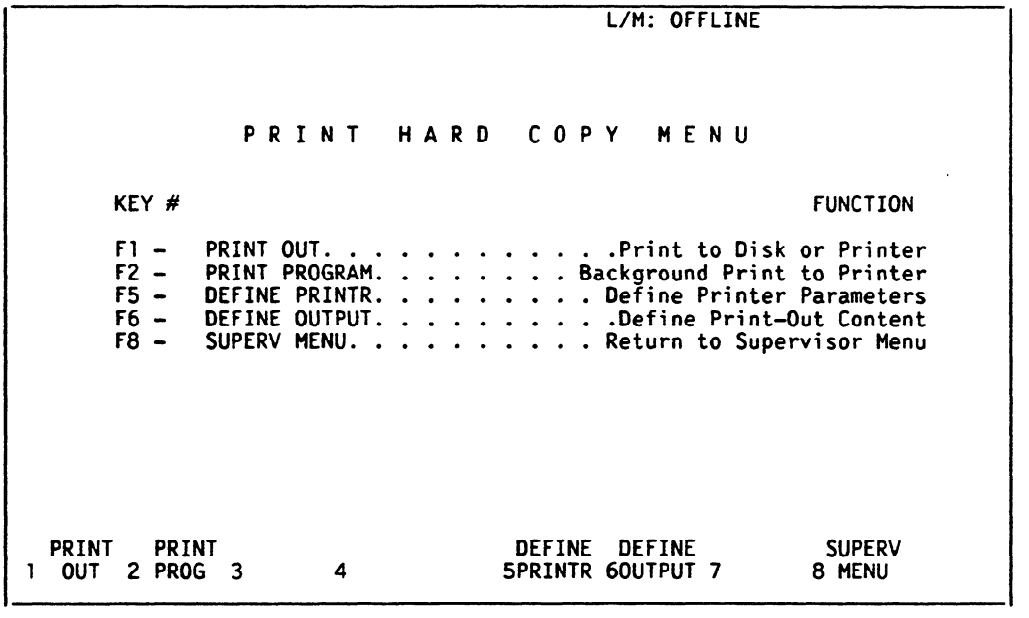
Before this function can be used, the printer must be set up for printing in background mode, as described in section 2. After this is done, the contents of any screen can be printed out. To execute a screen print, with the screen displayed, press the ALT-P keys at the same time. The print-out stops when the screen has been printed. To stop the print-out sooner, press any other key.

SECTION 1
THE PRINT MENU

This section describes the use of the Print menu.

DISPLAYING THE PRINT MENU

Select Print Function (F5) from the Supervisor menu to display the Print Hard Copy menu.



PRINT MENU FUNCTION KEY SUMMARY

This menu lists the Print mode function keys, which are summarized below:

PRINT OUT (F1) Use F1 to send the program to either a printer or a diskette. The Print Out function is done in foreground mode. F1 is also used to store a program on a diskette for printing with the Print Background function.

PRINT PROGRAM (F2) Use F2 to print a program from a print file on a diskette. The printing is done in background mode, so the system can be used for other activities while the program is printing.

DEFINE PRINTER (F5) Use F5 to specify the print format to be used with the printer.

DEFINE OUTPUT (F6) Use F6 to specify the content of print-outs. For example, with annotation, or with cross-references.

SECTION 2
SETTING UP THE PRINTER

Follow the instructions in this section before doing any printing. This section explains:

- How to attach your printer to the system.
- How to define the printer parameters.

ATTACHING YOUR PRINTER TO THE SYSTEM

Follow the instructions for the type of printer you are using.

Parallel Printer

1. Attach the printer to a parallel printer port. With a Workmaster computer, use the lower port on the Combination Adapter card.
2. When you are ready to use the printer, turn it on and place it in the On-line mode.
3. To use the Print Menu functions, you must define the printer parameters as explained in this section.
4. If you expect to use the Print Screen command, set up the printer for printing in background mode:

   A. From the Supervisor menu, select Print Functions (F5). Press F2 (PRINT PROG) to set up background printing.

   B. Enter the number of the destination port. For the Workmaster computer, this is port 3.

The printer may now be used with the Print Screen command.

Serial Printer

1. Set the DIP switches and jumpers on the printer as instructed in the manual for the printer.

2. Attach the printer to serial port 1 or 2. With a Workmaster computer, the upper port on the Combination Adapter card is port 1.

3. From the Supervisor menu, select Utility Functions (F8).

   A. In the Utilities menu, press F6 (PORT SET UP). Enter parameters for the port (1 or 2) which correspond to those set up for the printer.

   B. Press F1 (SET UP PORT) to store the printer parameters.

4. When you are ready to use the printer, turn it on and place it in the On-Line mode.

5. To use the Print Menu functions, you must define the printer parameters, as explained in this section.

6. If you expect to use the Print Screen command, set up the printer for printing in background mode:

   A. From the Supervisor menu, select Print Functions (F5). Press F2 (PRINT PROG) to set up background printing.

   B. Enter the number of the destination port. For the Workmaster computer, this is port 1 or 2.

NOTE

Do not disconnect the printer cable while printing. When the cable is reconnected, the print-out will be incorrect.

DEFINING THE PRINTER PARAMETERS

The first time a printer is used with the system, its print output format must be defined so the system can format the data properly.

To define the printer parameters, press F5 (DEFINE PRINTR) in the Print menu. The Define Printer Parameters screen is displayed.

```
                                        L/M: OFFLINE


             D E F I N E   P R I N T E R   P A R A M E T E R S


        PAPER WIDTH     80  (80/132)          EXPLICIT LF      Y  (Y/N)

        LINES/PAGE      60  (50..80)          NULLS WITH LF    0  (0..30)

        FORM FEED        Y  (Y/N)

                     << PRESS F5 TO SAVE PARAMETERS TO DISK >>




      PRINT   PRINT                                 DEFINE         PRINT
    1  OUT  2 PROG  3       4          5 SAVE  6OUTPUT 7       8 MENU
```

Your screen shows the current value and possible selections for each parameter.

Changing the Entries on the Printer Parameters Screen

To change entries on the Printer Parameters screen:

1. Move the cursor to the item you want to change.

2. Enter new values as appropriate. If you need more information, refer to the definitions that follow in this section.

3. When you are finished, decide whether your entries or the default values shown above should be used when the system is started up.

   A. To save the printer parameters only until the next power up (then return the default parameters), press F8 (PRINT MENU) to exit.

   B. To save the printer parameters until this screen is changed again, press F5 (SAVE) to exit. This causes the printer parameters to be written to the PRINTER.SET file. For a floppy diskette system, this file will be written to drive A. A write-enabled Master or copy diskette must be present in that drive. When the Logicmaster 1F system is powered up, these parameters replace the standard default values.

PRINTER PARAMETERS: DEFINITIONS

Refer to the following definitions when changing the entries on the Printer Parameters screen.

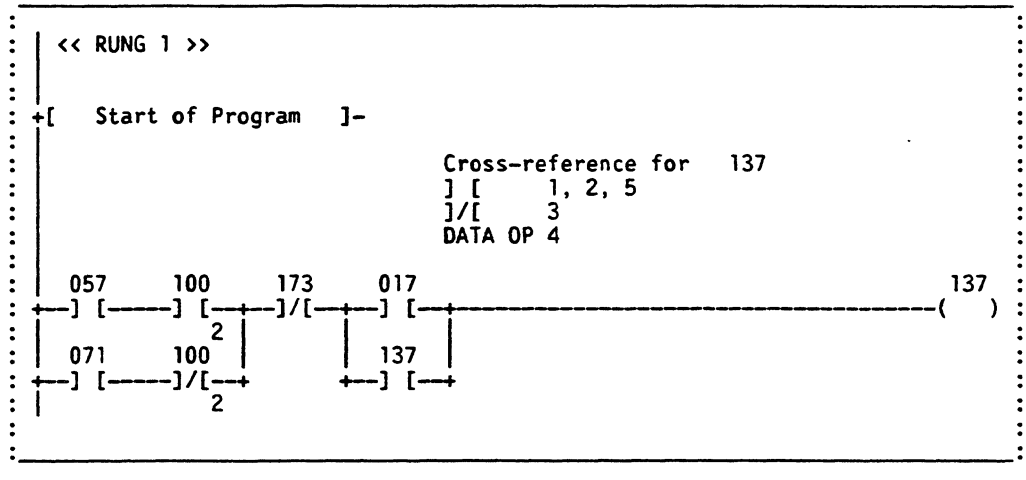
Paper Width: (80/132)

The entry for paper width determines the number of characters that will be printed on a line. If the printer is set up for standard 8½-inch wide paper, select 80 characters for the paper width. If the printer uses 11-inch (or wider) paper, you may select 132 characters. The default is 80 characters per line.

Changing the value of paper width will only affect the format of:

1. The page header containing the date, time, page number, and title.
2. The ladder diagram with coil labels or cross-references.
3. The cross-reference tables.

In 80-character mode, the cross-references for a rung are printed above that rung. For example:



In both 80-character and 132-character mode, the ladder diagram itself is printed in the same way. However, in 132-character mode, coil labels are printed at the right side of the rungs, and cross-reference information in the tables are spread over 132 characters instead of 80.

Setting the paper width to 132 for print-outs of cross-reference tables, for example, will usually result in fewer pages needed since more cross-reference rung numbers can be placed on one line. This also applies to a ladder diagram with labels or cross-reference.

Number of Lines per Page: (50..80)

This entry determines the maximum number of lines that will be printed before the system automatically starts a new page. The range of possible values is from 50 through 80 lines per page. The default value is 60 lines per page.

If an associated group of lines will not fit on one page, the system will command the printer to advance to the next page after the number of lines specified by this entry. Note that some printers automatically insert a form feed after printing a certain number of lines (typically, 66). If the printer has this feature, specify a shorter page length to prevent an automatic page eject.

Form Feed: (Y/N)

This item determines whether the system automatically inserts an ASCII form feed character at the end of a page.

1. This item should be set to **Y** (yes) if the printer recognizes a form feed.

2. Set this item to **N** if the printer does not recognize the form feed character. That will cause the system to insert a sequence of carriage returns to advance from the last line printed on one page to the top of the next page. The number of carriage returns output will depend upon the previous parameter, LINES PER PAGE.

Explicit Line Feed: (Y/N)

The line feed character advances the paper to the next line for printing. This item determines whether the system automatically inserts a line feed character each time the printer head returns to the left page margin.

1. This item should be set to **Y** (yes) to have the system insert a line feed character after each carriage return character.

2. Set this item to **N** (no) if the printer automatically advances the paper each time it encounters a carriage return character.

The default for this parameter is **Y** (yes).

Nulls with Line Feed: (0..30)

This parameter defines the number of null characters (characters that have no effect on the printer) that must be sent to the printer after a carriage return character. Some printers require these null characters to allow the print head sufficient time to return to the left margin after the carriage return. The quantity of null characters the system will automatically output may vary from 0 to 30, with the default value being 0. Most printers now have internal controls for this function.

SECTION 3
DEFINING THE PRINT-OUT CONTENT

When a print-out is done through the Print menu, you can select which parts of the program, tables, or annotation to print. Otherwise, the print-out will have the default content (shown below). This section explains:

- How to change the print-out content.
- How to select annotation for printing.
- How to print part or all of the program, annotation, and reference tables.
- How to create a title and subtitle for the print-out.
- How long it may take to complete various types of print-outs.

DISPLAYING THE DEFINE PRINT-OUT CONTENT SCREEN

The first step in defining the content of the print-out is to display the Define Print-Out Content screen.

1. If you want to print annotation, enter the program name from the Supervisor menu before displaying the Print menu.
2. In the Print menu, press F6 (DEFINE OUTPUT). The Define Print-Out Content screen is displayed. If a program name was not entered, the annotation choices default to **N** and you will not be allowed to change this to **Y**.

The illustration below shows the Define Print-Out Content screen.

```
                                          L/M: OFFLINE

              D E F I N E   P R I N T - O U T   C O N T E N T

 TITLE       |________________________________________________|
 SUBTITLE
                        (Y/N)
 LADDER DIAGRAM           Y      PRINT LIMITS:  FROM RUNG 0000 TO RUNG 1999
 TEXT ANNOTATION:                STARTING PAGE NUMBER:    0001
    RUNG EXPLANATIONS     N
    COIL NAMES            N      ADDRESS RANGE:   FROM          TO
    NAMES                 N                        000          777
    NICKNAMES             N                      R 000        R 677
    SORTED NICKNAMES      N
 CROSS-REFERENCE:
    IN LADDER             N
    XREF TABLE            Y
    VALUE TABLE           N
    USE TABLE             N
 HEADER PAGE              Y


 PRINT   PRINT                      DEFINE                  PRINT
1 OUT  2 PROG  3        4          5PRINTR 6        7     8 MENU
```

CHANGING THE ENTRIES ON THE PRINT-OUT CONTENT SCREEN

To change entries on the Print-Out Contents screen:

1. Move the cursor to the items you want to change.

2. Type in new entries. If you need more information, refer to the definitions that follow in this section.

   To reduce the time needed for a cross-reference print-out, select only the address range actually needed. Setting the system mode to Off-Line (using the mode-select keyswitch, or on the Scratch Pad screen), should also reduce cross-reference print-out time.

3. When the entries are complete, press F8 (PRINT MENU) to return to the Print menu. If the printer parameters have been established, the content can be printed using the Print Out function.

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS

Refer to the following definitions when making entries on the Print-Out Contents screen.

TITLE

To print a main title at the beginning of each page, enter the title here. This title can be changed within a print-out, as explained in chapter 6, by specifying a "\Tnew title" at the beginning of a rung explanation text block. To enter a title:

1. If the reverse-video banner is not displayed at the top of your screen, press the Up cursor key as needed.

2. Type in a title of up to 60 characters. To make changes, you can use the Delete key to delete the last character, or the Clear key to delete all the characters at once.

SUBTITLE

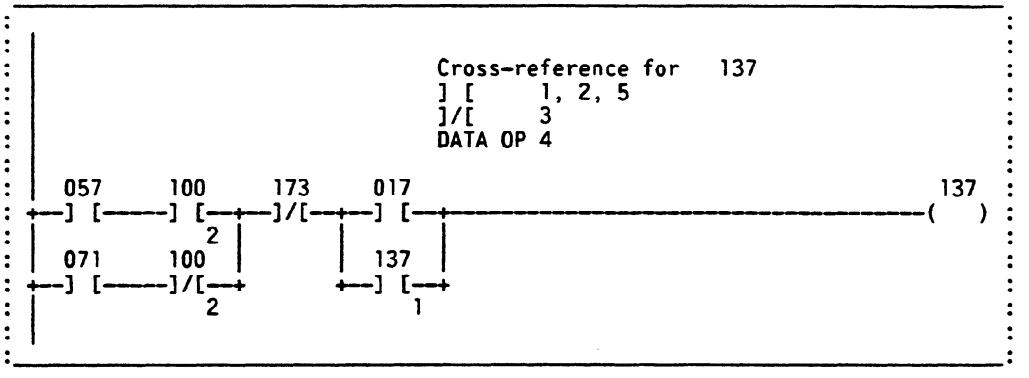
To print a subtitle below the title on each page, enter it here. This is entered like a title, as explained above, except that you must use "\S" to change the subtitle within an explanation.

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

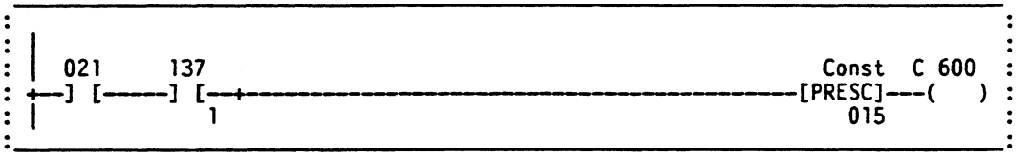
LADDER DIAGRAM: (Y/N) Select whether or not the print-out will include any of the ladder logic.

Ladders are printed by rung numbers. Page breaks occur between rungs, or between the cross-reference list and the rung in 80-character mode. Ladder logic is printed as up to nine horizontal elements, up to eight parallel lines of logic. The coil is printed to the right, in the tenth column.

If In-Ladder Cross-Reference is selected, under each relay contact that is referenced to a coil, the print-out shows the number of the last rung where the scan encountered that reference as a coil.



In the ladder, constants are printed with their decimal values.



After the ladder diagram is printed, if explanations or labels have been requested, additional explanations and coil labels for which there are no program rungs will be printed. This will show whether the program has additional unnecessary annotation.

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

PRINT LIMITS

Enter the rung in the program where you want the ladder diagram print-out to begin, and to end.

If no ladder diagram is requested, this FROM/TO range will be used when printing out the rung explanations, if requested.

STARTING PAGE NUMBER

To begin numbering the print-out with a page number other than 1, enter the number here.

ADDRESS RANGE

The FROM/TO addresses will define the range over which the sorted nicknames, cross-reference tables, use tables, and coil labels without the ladder diagram will be printed.

If no print-out is required for a particular reference type, the FROM and TO address selection fields should be made blank using the Clear key.

TEXT ANNOTATION

Select whether to print any annotation. There are four types of annotation that may be created for your program: rung explanations, coil labels, nicknames, and names. Any or all of these may be included in the print-out. To change the default selections, enter **Y** or **N**.

The illustration below shows the basic format for an 80-column print-out with annotation. A 132-column print-out is the same, except that the coil label and in-ladder cross-references, if printed, appear to the right of the ladder diagram.

TPK.A.42184

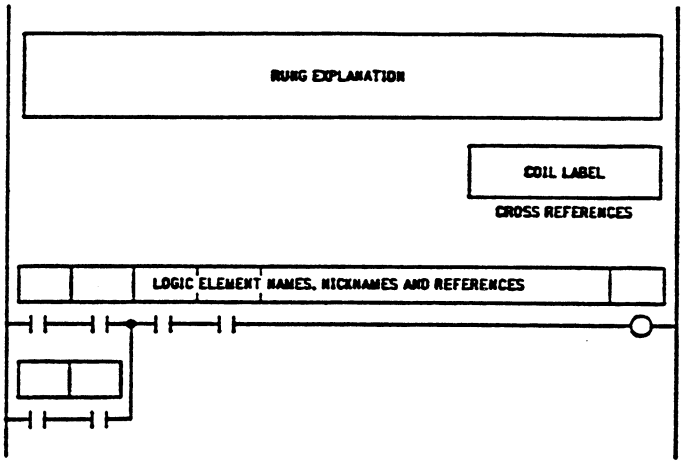


Figure 8.1 80-COLUMN PRINT-OUT WITH ANNOTATION

If either rung explanations or coil labels are requested without the ladder diagram, then just the annotation is printed. In that case, any control characters for titles, subtitles, borders, or side files are printed out (instead of executed as they would be in a ladder diagram print-out).

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

SORTED NICKNAMES

Select whether to print a list of all the nicknames used in the program, sorted alphabetically. The address associated with each nickname will also be printed. If the selection for NAMES is **Y**, then the names will also be printed.

Note that this is an alphabetized listing of all the nicknames. If a reference address has a name associated with it but no nickname, that address and name are displayed in this listing.

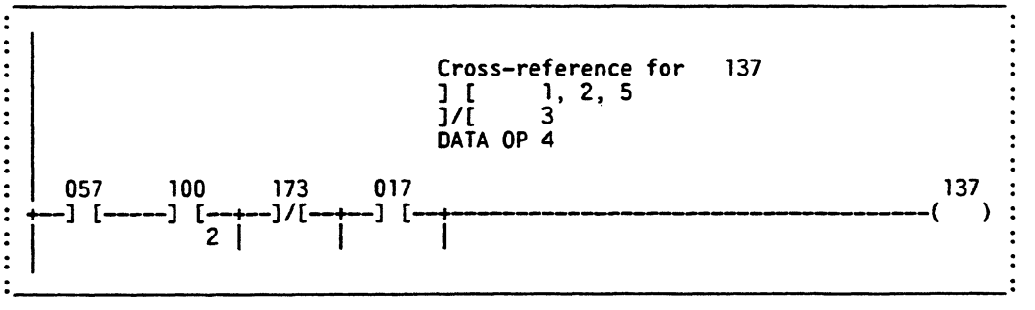
CROSS-REFERENCE

Print cross-references with or without printing the ladder diagram. To change the default selections, enter **Y** or **N**.

Before the cross-references can be printed out, the system must first create temporary files containing the selected cross-references. These files are placed on the diskette containing the active file. If no active file name has been specified at the Supervisor menu, the files will be placed on the disk in the default drive.

IN LADDER

Select whether or not the ladder diagram print-out will include cross-references for coils. These are placed above the rung in 80-character mode, and beside the coil in 132-character mode. For example, the 80-character mode has this format:



A second function of in-ladder cross referencing is to print a rung number below every contact in each rung. This rung number is the rung containing the coil that controls the contact's state. If there is no coil for that contact, nothing will be printed.

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

XREF TABLE

Select whether to print at the end of the ladder diagram a listing of all the references that appeared in the print-out. Note that printing cross-reference tables takes a considerable amount of time.

Discrete References Cross-Reference Print-Outs: This listing groups discrete references into normally-open contacts, normally-closed contacts, drum sequencers, various types of coils, shift registers, and data operations. The left column of the discrete references print-out lists the references in ascending numerical order. To the right, all occurrences of that reference in the program are listed by rung number. For example:

```
      *****  I O  P O I N T S  S T A T U S  T A B L E  *****

IO POINT   NAME /     CROSS-REFERENCE
VALUE      NICKNAME

  000              : ] [     1, 55, 57, 59, 61, 62, 63, 64, 65, 66, 67

  001              : ] [     2, 61, 62, 63, 64, 65, 66, 67
                     SHF REG 21

  002              : ] [     3, 61, 62, 63, 64, 65, 66, 67

  003              : ] [     4, 61, 62, 63, 64, 65, 66, 67

  004              : ] [     5, 61, 62, 63, 64, 65, 66, 67

  005              : ] [     6, 61, 62, 63, 64, 65, 66, 67

  006              : ] [     7, 61, 62, 63, 64, 65, 66, 67

  007              : ] [     8, 61, 62, 63, 64, 65, 66, 67

  010              : ] [     16
                     DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
                             36, 37, 44, 47, 51, 52, 53

  011              : ] [     16
                     DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
                             36, 37, 44, 47, 51, 52, 53

  012              : ]/[     16
                     DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
                             36, 37, 44, 47, 51, 52, 53

  013              : ]/[     16
                     DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
                             36, 37, 44, 47, 51, 52, 53

  014              : DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
                             36, 37, 44, 47, 51, 52, 53
```

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

Register Cross-Reference Print-Outs: Register cross-reference print-outs list the references on the left side. Under each reference, its value is displayed in the format that was selected with the Display Reference Tables function. To the right, all occurrences of that reference in the program are listed by rung number. For example:

```
        *****  R E G I S T E R   S T A T U S   T A B L E  *****

REGISTER   NAME /     CROSS-REFERENCE
VALUE      NICKNAME

R 001              :  DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
[   FF ]                      36, 37, 44, 47, 51, 52, 53

R 004              :  DATA OP 47, 51
[   00 ]

R 005              :  DATA OP 44
[   24 ]

R 006              :  DATA OP 44
[   00 ]

R 011              :  DATA OP 14, 15, 15, 17, 19, 20, 28, 29, 30, 31, 32,
[   00 ]                      36, 37, 44, 47, 51, 52, 53

R 400              :  DATA OP 44, 44
[   00 ]

R 401              :  DATA OP 44, 44
[   00 ]

R 402              :  DATA OP 16, 16
[   55 ]

R 403              :  DATA OP 16, 16
[   55 ]

R 477              :  DATA OP 57
[   00 ]

R 500              :  DATA OP 55, 55, 55, 57, 59, 59
[   00 ]

R 501              :  DATA OP 55, 55, 57, 57, 59, 59
[   00 ]

R 502              :  DATA OP 52, 52, 53
[   00 ]

R 503              :  DATA OP 52, 52, 53
[   00 ]
```

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

VALUE TABLE

Select whether to print the values of all references at the end of the ladder diagram. Reference print-outs have the format set up with the Display Reference Tables function. The example below shows discrete references printed out in binary format.

```
          *****  I O  P O I N T  V A L U E  T A B L E  *****
          *****      ( R E G I S T E R S  0 - 7 7 )     *****

POINT    |77      |67      |57      |47      |37      |27      |17      |7
ADDRESS  +------- +------- +------- +------- +------- +------- +------- +-------
  077    00000100 00000000 00100100 00000000 00000000 00000000 11111111 11111111
  177    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000101
  277    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
  377    00100000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

  477    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
  577    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
  677    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
  777    00100100 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

The next print-out includes registers that have been reformatted using the Display Reference Tables function.

```
          *****  R E G I S T E R  V A L U E  T A B L E  *****

REGISTER  |7    |6    |5    |4    |3    |2    |1    |0
ADDRESS   +---- +---- +---- +---- +---- +---- +---- +----
R 407       00    00    00    00    55    55    00    00
R 417       00    00    00    00    00    00    00    00
R 427       00    00    00    00    00    00    00    00
R 437       00    00    00    00    00    00    00    00

R 447       00    00    00    00    00    00    00    00
R 457       00    00    00    00    00    00    00    00
R 467       00    00    00    00    00    00    00    00
R 477       00    00    00    00    00    00    00    00

R 507       00    00    00    00    00    00    00    00
R 517       00    00    00    00    00    00    00    00
R 527       00    00    00    00    00    00    00    00
R 537       00    00    00    00    00    00    00    00

R 547       00    00    00    00    00    00    00    00
R 557       00    00    00    00    00    00    00    00
R 567       00    00    00    00    00    00    00    00
R 577       00    00    55    55    00    00    00    00

R 607     0000  0000  0003  0000  0000  0000  0000  0020
R 617     0000  0000  0000  0000  0005  0004  0000  0000
R 627     0000  0000  0000  0000  0000  0000  0000  0000
R 637     0000  0000  0000  0000  0000  0000  0000  0000

R 647     0000  0000  0000  0000  0000  0000  0000  0000
R 657     0000  0000  0000  0000  0000  0000  0000  0000
R 667     0000  0000  0000  0000  0000  0000  0000  0000
R 677     0000  0000  0000  0000  0000  0000  0000  0000
```

DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

USED TABLES

The References Used Tables show how references are used in a program. This is a partial example:

```
          *****  I O  P O I N T S  U S E D  T A B L E  *****

POINT    |77      |67      |57      |47      |37      |27      |17      |7
ADDRESS  +------- +------- +------- +------- +------- +------- +------- +-------

  077    -----*** RRRRRRRR CCCCCCRR CCCCCCCC ******** ******** RRRRCCCC ********
  177    -------- -------- -------- -------- ---***** ******** RRRRRRRR ********
  277    -------- -------- -------- -------- -------- -------- ---*---- --------
  377    -*------ -------- -------- -------- -------- -------- -------- --------

  477    -------- -------- -------- -------- -------- -------- -------* **------
  577    -------- -------- -------- -------- -------- -------- -------- --------
  677    -------- -------- -------- -------* -------- -------- --****** ********
  777    ******-- -------- -------- -------- -------- -------- -------- --------


              - = Not used
              * = Used
              R = Register references
              C = Conflict in reference usage
```

The following symbols may appear in the Reference Used Tables:

C There are many ways to reference the same physical point. For example, I/O point 032 and R003 used as a byte operand or R002 used as a word operand all reference the same point. It is important not to use the same point for multiple references. The letter C in the Use Tables means that the reference is used by another reference type in the program.

R An I/O reference's storage is used as part of a register reference.

I A register reference's storage is used as an I/O point in at least one of its 8 bits.

***** The reference is used as an explicit reference.

- Not used; the reference is available for future use.

This list is in order of priority. The highest priority symbol is printed. Appendix D shows the possible types of physical point usage, and the character for each.

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DEFINE PRINT-OUT CONTENT SCREEN: DEFINITIONS (Continued)

ADDRESS RANGE

Print-outs of discrete and register references default to the entire table of values. To print a smaller range of values, move the cursor to the type of reference and enter the address range. The value entered for FROM must be lower than the value entered for TO.

HEADER PAGE

Select whether to include a header page at the beginning of the print-out.

The header page has the title and subtitle entered on the Define Print-Out Contents page. It displays information about the program. For example:

```
LAST REFERENCE USED:

INSTRUCTION SET:   ONE +          REGISTER:   R 503
        DCU ID:      003    INPUT/OUTPUT:     777
CPU MEMORY SIZE:     700
PROGRAM MEMORY SIZE: 700
REGISTER MEMORY SIZE: 128
```

If any type of cross-reference is selected, In-Ladder, Xref Table, or Use Table, then at the right side of the box a list shows the highest reference used in each type.

Each subsequent page starts with a line showing the current date and time. Under that, the title and subtitle are displayed.

SECTION 4
PRINTING IN FOREGROUND MODE

Use the Print function to print out or store as a print file, the program currently in programmer memory. The printer characteristics must already be defined.

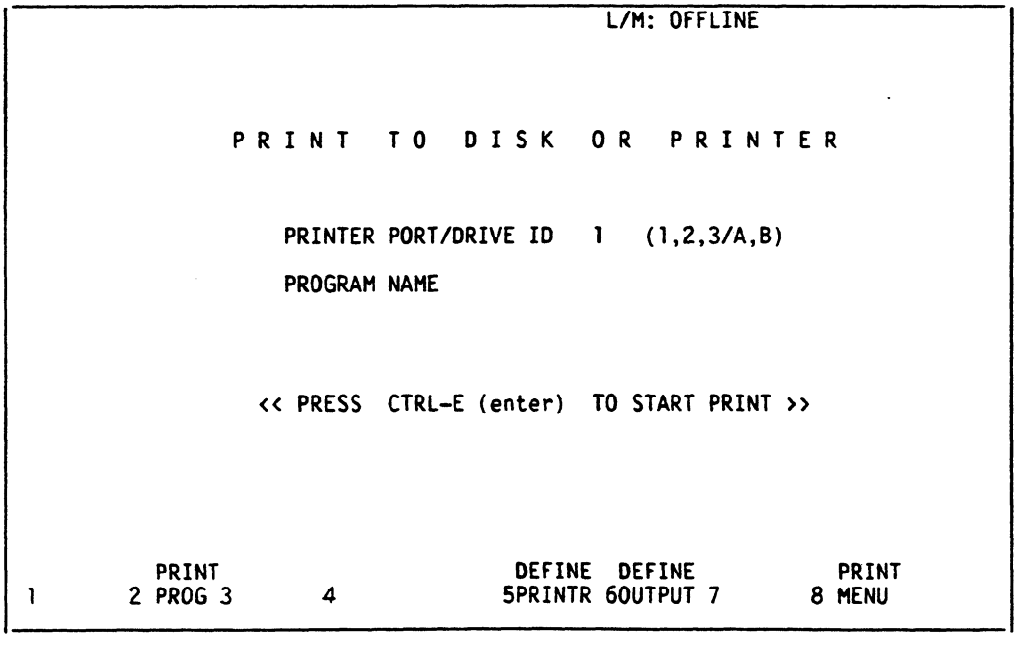
The Print function executes in foreground mode; the system cannot be used for anything else while the print-out is in progress. To print a hard copy in background mode instead, first use this function to create the print file.

This section explains:

- How to select a foreground print.
- How to create a print file in foreground mode.
- How to stop a foreground print temporarily.
- How to cancel a foreground print.

DISPLAYING THE PRINT TO DISK OR PRINTER MENU

To print or create a print file in foreground mode, press F1 (PRINT OUT) from the Print menu. The Print to Disk or Printer screen is displayed.



PRINTING IN FOREGROUND MODE

To send the print output directly to printer for immediate printing in foreground mode:

1. If you are sending the output to a printer, be sure the printer is set up as described in section 2.

2. With the cursor at PRINTER PORT/DRIVE ID, enter the destination for the print-out:

   A. Enter the number 3 if the printer is connected to the parallel port.

   B. Enter the number 1 or 2 if the printer is connected to a serial port, depending on the number of the serial port.

3. Press CTRL-E or the Enter key to start the print-out. The screen continues to display the Print to Disk or Printer screen until the print-out is complete.

CREATING A PRINT FILE

Printing out a complete program can take a considerable amount of time. It is often preferable to first store the information in the form of a print file. A print file can be printed out later in the background mode.

To send the program to a disk drive for later printing in background mode:

1. For a floppy-diskette system, be sure a write-enabled diskette is in the drive.

2. With the cursor at PRINTER PORT/DRIVE ID, type in the letter destination of the drive to receive the file.

3. Move the cursor to PROGRAM NAME and enter the name for the print-out.

   The first text file created has the file name extension .TXT. If the diskette runs out of space while the file is being stored, the screen prompts for another diskette to be inserted. This second part of the print file has the extension .TX1. For example, PROGRAM1.TX1. Subsequent portions of the same file will have the file name extension .TX2, and so on.

   If the text file is being created on the same disk containing the annotation or temporary cross-reference files, the text file may not be continued beyond one disk. Therefore, if you have a dual-drive system it is recommended that you always print to a drive that does not contain the annotation files or temporary cross-reference files.

4. Press CTRL-E or the Enter key to begin creating the file. The screen continues to display the Print to Disk or Printer screen until the file is complete.

STOPPING A PRINT-OUT TEMPORARILY

To stop a print-out temporarily (for example, to change the printer ribbon), press F4 (PAUSE PRINT). To resume the print-out at the place it was stopped, press F4 again.

CANCELING A PRINT-OUT

To end a print-out in progress, press F3 (ABORT PRINT). This requires a confirmation by pressing ALT-X (Confirm or Shift-0). When confirmed, it cancels the print-out completely. Aborting a print-out stops the printing only. It does *not* delete the print files that were created. Print files must be deleted using the Utilities functions.

While waiting for confirmation, the print-out continues. Pressing any key except ALT-X (Confirm or Shift-0) cancels the abort.

SECTION 5
PRINTING A FILE IN BACKGROUND MODE

Use the Print function to print out a file from disk. The printer characteristics must already be defined. Any file may be printed, not just the .TXT files that were created with Foreground print.

The Print function executes in background mode; the system can be used for other activities while the print-out is in progress.

This section explains:

- When background printing may be used.
- How to do a background print.
- How to stop a background print temporarily.
- How to cancel a background print.

BACKGROUND PRINTING

Background printing is only permitted in Off-Line mode. If a background print is started in Off-Line mode and the mode is changed during printing, the print-out is suspended until the mode is again changed to Off-Line. If a screen is being printed in Off-Line mode, using the Print Screen command ALT-P, the printing is aborted if the mode is changed.

DISPLAYING THE PRINT PROGRAM MENU

To print out a print file, press F2 (PRINT PROG) in the Print Hard Copy menu. The Print Program screen is displayed.

```
                                           L/M: OFFLINE


                         P R I N T   P R O G R A M

                     DESTINATION :
                           PRINTER PORT 1    (1,2,3)

                     SOURCE :
                           DRIVE ID       B    (A,B)
                           PROGRAM NAME


                 << PRESS CTRL-E (enter) TO START BACKGROUND PRINT >>



 PRINT                                     DEFINE  DEFINE          SUPERV
1 OUT   2      3      4                   5PRINTR 6OUTPUT 7       8 MENU
```

ENTER THE DESTINATION AND PROGRAM NAME

To send the print file to a printer port for printing in background mode:

1. Be sure that the printer is properly connected, and that it is turned on.

2. With the cursor at DESTINATION: PRINTER PORT, enter the destination for the print-out:

   A. Enter the number 3 if the printer is connected to the parallel port.

   B. Enter the number 1 or 2 if the printer is connected to a serial port, depending on the serial port.

3. Move the cursor to DRIVE ID and enter the letter designation of the drive where the print file is stored.

4. Move the cursor to PROGRAM NAME and enter the file name and extension. This is usually a .TXT file created with Foreground print. However, any text file may be printed.

5. Press CTRL-E or the Enter key to start the print-out. The screen displays the message:

   ```
   BACKGROUND PRINT IN PROGRESS
   ```

6. Press F8 (PRINT MENU) to return to the Print menu.

STOPPING A PRINT-OUT

To end a print-out in progress, press the Abort Print (F3) function key. This requires a confirmation by pressing ALT-X (Confirm or Shift-O). When confirmed, it terminates the print-out completely.

While waiting for confirmation, the print-out continues. If ALT-X (Confirm or Shift-O) is not pressed, the print-out will continue.

CHAPTER 9
LOAD/STORE/VERIFY

The Load/Store/Verify functions are used to transfer programs and tables between the programmer and the CPU. They are also used to compare the data in the programmer with that in the CPU.

For information about using the Load/Store/Verify functions, turn to the following sections:

Section 1. The Load/Store/Verify Menu: Section 1 summarizes the Load/Store/Verify Menu function keys.

Section 2. Loading a Program into Programmer Memory: Section 2 explains how to load programmer memory with a program and its associated tables. The program may be loaded from the CPU, or from a disk.

Section 3. Storing Data from Programmer Memory: Section 3 explains how to transfer a program and its associated tables from the programmer memory to the CPU, or to a disk.

Section 4. Verifying the Content of Program Data: Section 4 explains how to use the Verify function to compare program data after a Load or Store operation.

Section 5. Clearing Programmer Memory: Section 5 explains how to delete any program and tables currently present in programmer memory.

NOTE

Be sure that you are using the correct version of the Data Communications Unit to communicate with the CPU.

CPU	DCU
IC610CPU104	IC610CCM105B or IC610CCM105C
IC610CPU105	IC610CCM105B or later
IC610CPU106	IC610CCM105C or later

SECTION 1
THE LOAD/STORE/VERIFY MENU

This section describes the use of the Load/Store/Verify menu.

DISPLAYING THE LOAD/STORE/VERIFY MENU

Select Load/Store/Verify (F6) from the Supervisor menu to display the Load/Store/Verify menu.

```
CPU:                 DCU ID:                          L/M: ONLINE



L O A D / S T O R E / V E R I F Y   P R O G R A M / T A B L E S   M E N U

     KEY #                                                      FUNCTION

     F1 -    LOAD . . . . . .Load Program/Tables into the L/M Memory
     F2 -    STORE. . . . . Store Program/Tables from the L/M Memory
     F3 -    VERIFY  . . . .Verify Program/Tables with the L/M Memory
     F5 -    CLEAR.  . . . . . . . . . . . . . . Clear the L/M Memory
     F6 -    STOP   CPU . . . . . . . . . . . . . . . . . . stop   CPU
     F7 -    START   CPU.  . . . . . . . . . . . . . . . . .Start  CPU
     F8 -    SUPERV MENU. . . . . . . . . .Return to Supervisor Menu




  LOAD     STORE  VERIFY                 CLEAR   STOP              SUPERV
1 FUNC   2 FUNC  3 FUNC  4             5 FUNC  6  CPU  7          8 MENU
```

This menu lists the Load/Store/Verify function keys, which are summarized on the following page.

NOTE

> For all Load/Store/Verify operations with the CPU, the Data Communications Unit (DCU) On-Line/Off-Line switch must be in the ON-LINE position. The CPU must be unlocked, or the password must not be in effect. The On-Line/Off-Line switch must remain in the ON-LINE position during the entire Load/Store/Verify operation.

LOAD/STORE/VERIFY MENU FUNCTION KEY SUMMARY

LOAD FUNCTION (F1)	Use F1 to copy the program and table data into programmer memory. This writes over any program or data already in the programmer.
STORE FUNCTION (F2)	Use F2 to copy program and table data from programmer memory to a disk, or to the CPU.
VERIFY FUNCTION (F3)	Use F3 to compare data in programmer memory with data in the CPU or on a disk. A listing of differences can be optionally printed out.
CLEAR FUNCTION (F5)	Use F5 to remove the program, register, and I/O tables from programmer memory.
STOP CPU (F6)	Press F6 to stop the CPU. Communications must have previously been established with the DCU to issue the Stop command to the CPU, and the Logicmaster system must be in the On-Line mode.
START CPU (F7)	Press F7 to start the CPU. Communications must have previously been established with the DCU to issue the Start command to the CPU, and the Logicmaster system must be in the On-Line mode.

SECTION 2
LOADING A PROGRAM INTO PROGRAMMER MEMORY

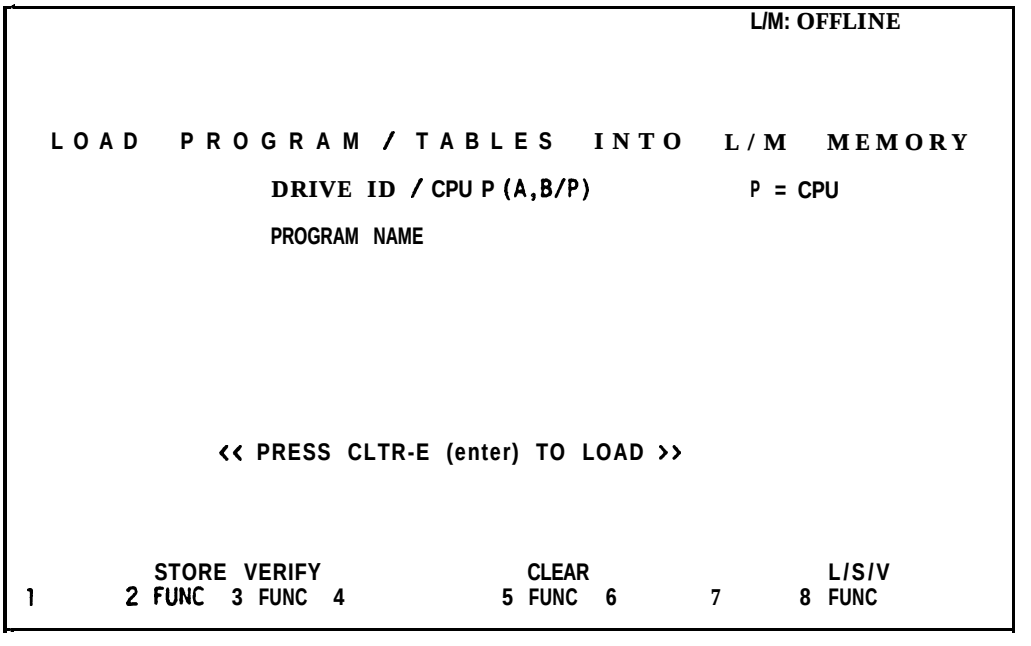
Use the Load function to transfer a program and its associated tables into programmer memory from external storage, or from the CPU. The Load function copies the program, which remains unaltered in its original location.

This sect ion explains:

- **How to display the Load Program screen.**
- **How to load a program into programmer memory from a disk.**
- **How to load a program into programmer memory from the CPU.**

DISPLAYING THE LOAD PROGRAM SCREEN

Press F1 (LOAD) to display the Load Program screen.



CAUTION

Copying a program into programmer memory will overwrite a program already stored there. You may wish to save the program already stored in memory to disk or CPU before loading in new data.

LOADING A PROGRAM INTO THE SYSTEM FROM A DISK

To copy the program into the memory of the programmer from a disk:

1. With the cursor at DRIVE ID/CPU, enter the character that represents the drive where the program is stored. Enter the drive or port designation.

2. Move the cursor to PROGRAM NAME and enter the name of the program.

3. Press CTRL-E or the Enter key to copy the program into programmer memory. The screen displays the word BUSY during the transfer. If the system finds any fault or inconsistency in the data, the Load operation is completed and an error message is displayed. After a successful load, the screen displays the message:

   LOAD COMPLETE

LOADING A PROGRAM INTO THE SYSTEM FROM A CPU

Use the Load function to copy a program from the CPU into programmer memory.

If the Logicmaster 1F system is in the Off-Line mode, the entire program including the ladder logic and tables, is copied into programmer memory. In On-Line mode or Monitor mode, only the ladder logic is copied.

1. With the cursor at DRIVE ID/CPU, enter the letter P, which represents the CPU.

2. Press CTRL-E or the Enter key to copy the program into memory. The screen displays the word BUSY during the Load operation. If the system'finds any fault or inconsistency in the data, the Load operation is terminated and an error message is displayed. After a successful load, the screen displays the message:

   LOAD COMPLETE

   If the CPU is in Stop mode prior to loading the user logic from the CPU, a grammar check is performed on the CPU user logic. Any errors will be displayed on the screen.

NOTE

Loading a program from the CPU into programmer memory with the Logicmaster 1 software package may take up to 14 minutes. With the Logicmaster 1 Junior software package, it may take up to 19 minutes.

CANCELING THE LOAD FUNCTION

To stop a program transfer in progress, press F4 (ABORT).

SECTION 3
STORING DATA FROM PROGRAMMER MEMORY

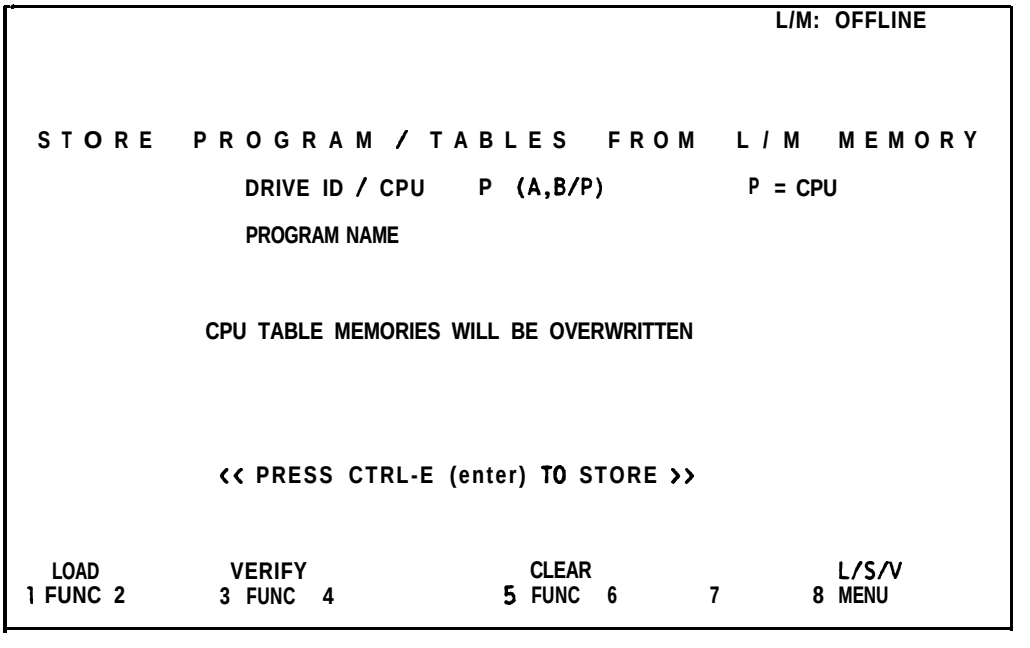
Use the Store function to copy a program and its associated tables currently in programmer memory. The transfer may be to a CPU, or to file storage on a hard disk, or diskettes.

This section explains:

- **How to display the Store Program menu.**
- **How to store a program to a storage device.**
- **How to store a program into the CPU.**

DISPLAYING THE STORE PROGRAM SCREEN

Press F2 (STORE) to display the Store Program/Tables screen.



STORING A PROGRAM TO A DISK

To store the program in programmer memory to a storage device:

1. With the cursor at DRIVE ID/CPU, enter the character from the displayed list that represents the drive where the program will be stored.

2. Move the cursor to PROGRAM NAME and enter the name of the program.

CAUTION

If a program with the same name is already stored on the disk, the new data will be written over it.

3. Press CTRL-E or the Enter key to copy the program.

STORING A PROGRAM TO THE CPU

To copy the program in programmer memory to a CPU, the On/Off-Line switch on the Data Communications Unit (DCU) must be in the ON-LINE position and the CPU must be unlocked. *The DCU must remain in the ON-LINE position and the CPU must remain unlocked until the Store function is finished.* In addition, the CPU must be stopped (see the note below).

If the Logicmaster system is 'in the Off-Line mode the entire program, including the ladder logic and tables, is copied to the CPU. In the On-Line mode, only the ladder logic is copied. If the system is in Monitor mode, the program cannot be copied into the CPU.

1. With the cursor at DRIVE ID/CPU, enter the letter P, which represents the CPU.

CAUTION

The CPU can only contain one program at a time. If a program is already stored in the CPU, the new data will be written over it, and the original program in the CPU will be lost.

2. Press **CTRL-E or the Enter key to copy the program. The system checks the size and functions used by the program. If the program is compatible with the CPU, it will be copied to the CPU.**

   The attached CPU must be stopped before the program can be transferred from the programmer memory to the CPU. If the CPU is not stopped, the screen will display the message:

   CPU MUST BE STOPPED - LOGICMASTER MUST BE ON-LINE OR OFF-LINE

   If the CPU is locked, **the screen will display the message:**

   CPU IS LOCKED

   While a program is being transferred to the CPU, the screen displays the message:

   PROGRAM BEING TRANSFERRED **TO** THE CPU
   DO NOT LOCK CPU OR PLACE DCU IN OFF-LINE MODE

NOTE

Storing a program to the CPU from programmer memory with the Logicmaster 1 software package may take up to 17 minutes. With the Logicmaster 1 Junior software package, it may take up to 8 minutes.

CANCELING THE STORE FUNCTION

To stop a program transfer in progress, press F4 **(ABORT). Aborting the Store function will result in the CPU containing an invalid program.**

SECTION 4
VERIFYING THE CONTENT OF PROGRAM DATA

Use the Verify function to compare versions of a program after a Load or Store **operation. The system compares the program in programmer memory with the program in the** CPU, or **on disk. Differences, called "miscompares", are displayed and** can be **printed out. If the verification is with a scanning CPU, dynamic** register **data can** be omitted f **rom the** comparison.

This sect ion explains:

- **How to display the Verify Program screen.**
- **How to select register data to be compared.**
- **What the results of the comparison mean.**

DISPLAYING THE VERIFY PROGRAM MENU

Press F3 (VERIFY) to display the Verify Program screen.

```
                                                L/M: OFFLINE
VERIFY  PROGRAM  /TABLES  WITH  L / M  MEMORY

              DRIVE ID/CPU    P  (A,B/P)          P = CPU

              PROGRAM NAME

              PRINTER PORT          (1,2,3)
                        - MEMORY SELECTION -
                        REGISTERS




                  << PRESS CTRL-E (enter) TO VERIFY >>

  LOAD     STORE          XCLUDE                              L/S/V
1 FUNC  2 FUNC  3       4REGSTR      5       6       7       8 FUNC
```

NOTE

The Verify function compares relative memory locations. If one program has an additional element, all the memory locations f rom that point on *may miscompare.*

VERIFYING PROGRAM DATA

To compare the program in programmer memory with the version in the CPU, or on disk:

1. With the cursor at DRIVE ID/CPU, enter the character that represents the drive where the program to be compared is located. Enter the drive location of the program file, or the letter P for the CPU.

2. If the comparison is to a file on disk, move the cursor to PROGRAM NAME and enter the name of the program.

3. To print a copy of the differences, move the cursor to PRINTER PORT and enter the number of the port to which the printer is connected. Be sure that the printer is on-line and connected to the system.

4. To exclude register data from the comparison, press the Exclude Registers (F4) key to exclude the contents of the registers. The function of the key then becomes Verify Registers.

5. Press CTRL-E or the Enter key to begin the Verify operation. While the comparison is underway, the screen displays the BUSY message. Also, two key functions, Abort (F6) and Pause (F7), are displayed.

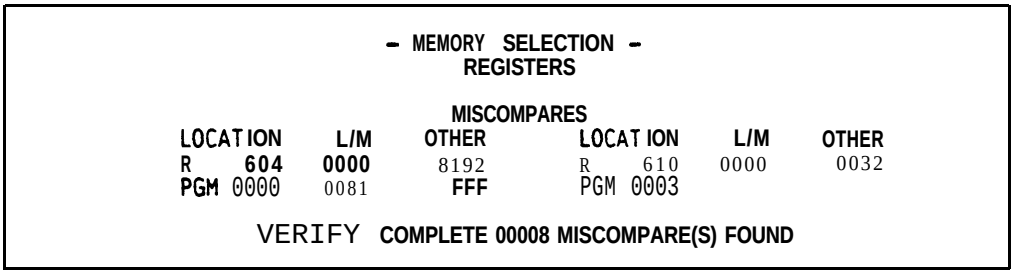
6. To temporarily halt the Verify operation, press F7 (PAUSE). To resume the Verification, press F7 again.

7. To end a verification before it is finished, press F6 (ABORT). Respond to the prompt to confirm the abort. This ends the function completely.

NOTE

The CPU must be unlocked to compare the program in programmer memory with the program in the CPU.

8. Any miscompares encountered are listed on the screen.



This screen shows two columns of miscompares. Up to 10 miscompares can be displayed at once. if more than 10 miscompares are located, the 10 most recent are displayed. A printout has the same format as the screen display. Miscompares are listed from left to right by row:

(first)	**(second)**
(third)	**(fourth)**
(fifth)	**etc.**

Verify Miscompare Screen

The Miscompare list displays any miscompares found during verification. This list will be displayed on the screen, and optionally sent to a printer, with two miscompares per line, up to five lines (10 miscompares) on the screen at one time. Each item indicates the location, programmmer memory value, and other memory value of that miscompatison.

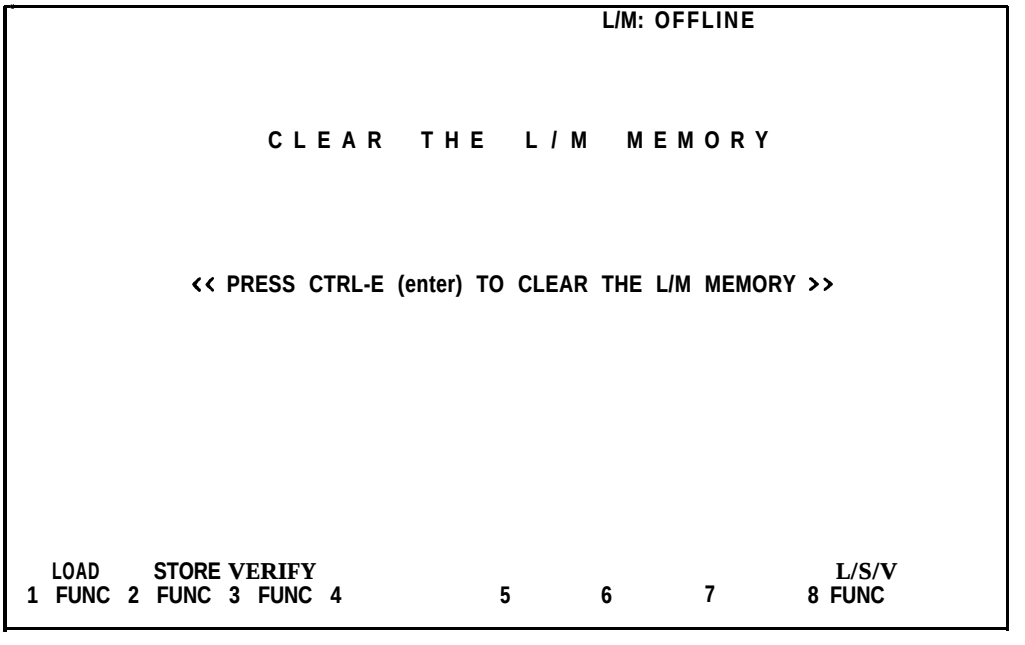
The following table shows how the various memory types will be indicated in the Miscompare List:

Memory Type	Abbreviation	Location (Address)	Content
Scratchpad Table	SP	Function Set	One, One Plus
Data Registers	R	3-digit Octal	2-digit BCD/Hex
T/C ACC Registers	R	3-digit Octal	&digit Decimal
Ladder Logic	PRG	4-digit Dec	4 digit Hex

SECTION 5
CLEARING PROGRAMMER MEMORY

Use **the Clear** function to delete a program **and its associated tables from the** programmer memory. **This is usually** done after storing the program to a disk, or to the CPU.

Press F5 (CLEAR) in the Load/Store/Verify menu to display the Clear Memory screen.



Press CTRL-E or **the** Enter **key to** delete **the entire program and tables from** programmer **memory. The screen will display the message:**

CLEAR COMPLETE

at the bottom **of the screen when the Clear operation** is **completed.**

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CHAPTER 10
CONFIGURATION SETUP

The Configuration Setup menu provides entry to the Communications Setup and Machine Setup functions.

This chapter contains the following sections:

Section 1. The Configuration Setup Menu: Section 1 explains the Configutation Setup menu, and summarizes the function keys.

Section 2. Setting Up Communications with the CPU: Section 2 provides instructions to set up parameters for communicating with the CPU.

Section 3. CPU Password Protection: Section 3 provides instructions to lock or unlock the CPU and to change the password.

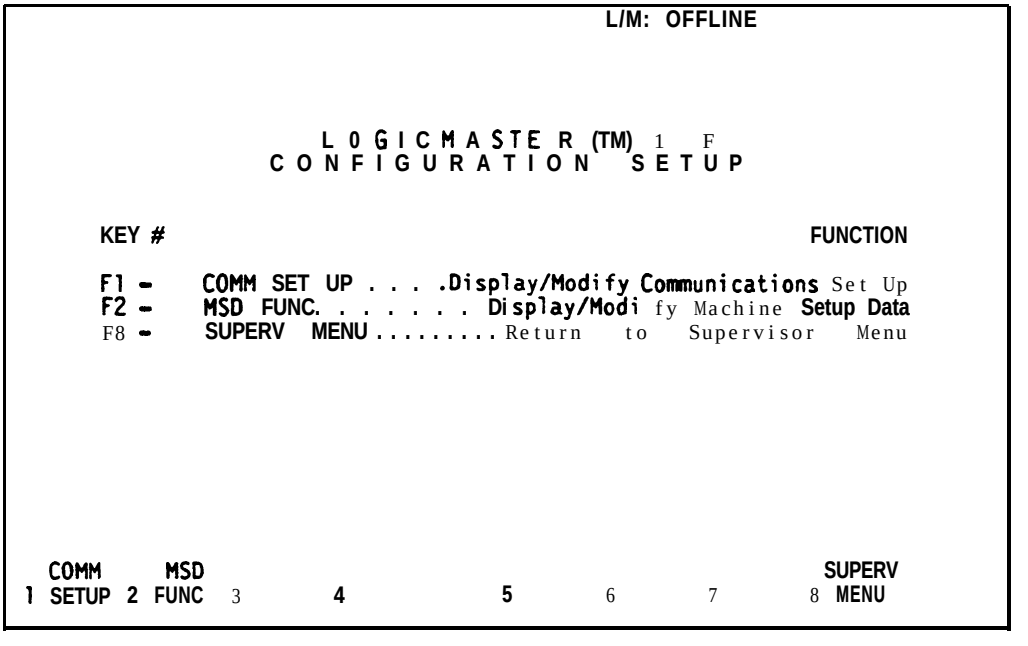
Section 4. The Machine Setup Menu: Section 4 provides instructions to select display colors if you are programming on a computer with a color monitor.

SECTION 1
THE CONFIGURATION SETUP MENU

This section explains the Configuration Setup menu.

DISPLAYING THE CONFIGURATION SETUP MENU

Select Configuration Setup (F7) from the Supervisor menu to display the Configuration Setup screen.



CONFIGURATION SETUP MENU

Use the function keys to select the functions, as explained in this section.

COMM SETUP (F1)

Use F1 to set up the system parameters for communicating with the Data Communications Unit (DCU).

Listed below is the correct version of the DCU to be used for communicating with the CPU:

CPU	DCU
IC610CPU104	IC610CCM105B or IC610CCM105C
IC610CPU105	IC610CCM105B or later
IC610CPU106	IC610CCM105C or later

MSD FUNCTIONS (F2)

Use F2 to change display colors when a color monitor is used.

SECTION 2
SETTING UP COMMUNICATIONS WITH THE CPU

The Communications Setup menu is used to specify parameters for serial communications with the CPU. This section explains:

- How to display the Communications Setup menu.
- How to set up the parameters for communication between the Logicmaster 1F system and the DCU attached to the CPU.
- How to enable on-line changes.
- How to recover from an error in the CPU.

DISPLAYING THE COMMUNICATIONS SETUP MENU

Press F1(COMM SETUP) in the Configuration Setup menu to display the Communications Setup menu.

```
                                                    L/M: OFFLINE

              C O M M U N I C A T I O N S    S E T    U P    M E N U

                  COMMUNICATION PORT NUMBER:          (1,2)

                  SELECTED DCU ID NUMBER:    3   (1 - 90)



                  ON-LINE CHANGES: DISABLED

 WARNING:   ONLINE CHANGES SHOULD BE PERFORMED ONLY BY PERSONS
            KNOWLEDGEABLE OF THE USER APPLICATION. IN PARTICULAR,
            TOGGLING I/O POINTS MAY RESULT IN UNEXPECTED RESULTS
            ON ADJACENT I/O POINTS. SEE HELP.

              CPU    SELECT    SHOW          SELECT          ONLINE CONFIG
 1SAVE 2PROTEC  3PORT #4 ID #5        5DCU ID 6        7CHANGE 8SETUP
```

At startup, the system uses data from the COMSET.SET file for this display. If this file is not present, default values are provided.

The COMSET.SET file can be changed by making new entries on this screen and pressing F1(SAVE). If you always communicate through the same port and DCU, you should save these entries. This time-saving feature will enable the system to be automatically set up at power-up.

CHANGING THE COMMUNICATIONS SETUP SCREEN

Change the entries on the Communications Setup screen to describe your system. **Changes are made in two ways:**

A. Port Number and DCU ID fields: Type the entry into the work area and press the appropriate function key.

B. On-Line Changes fields: Press the appropriate function key to toggle the selections.

Cancelinca Entries on the Communications Setup Screen

To exit this screen and return to the values that were displayed when the screen was entered, press F9 or the Abort key. The screen displays:

```
PRESS CONFIRM TO ABORT, ANY OTHER KEY TO PROCEED
```

Press ALT-X (Confirm or Shift-O) to exit, or press any other key to cancel the abort.

COMMUNICATIONS SETUP SCREEN: DEFINITIONS

Refer **to the following definitions** when **making changes to the Communications Setup screen,**

COMMUNICATION PORT NO.

This entry is the number of the DCU communication port. The menu displays the numbers of the ports that were operable when the system was started up. To select the port, enter the desired port number into any field of the work area and press F3 (SELECT PORT #). To deselect a port, leave the work area blank and press F3. *A port currently selected for communications must be deselected if it is to be used for other Logicmaster 1F functions.*

The port selected must be configured to match the DCU to which the system is connected. If the port is on the Combination Adapter card of the Workmaster computer, it can only be RS-232. Therefore, it can only be connected to a DCU card through the RS-232/RS-422 Adapter Unit, IC630CCM390.

If the port is on the Asynchronous/Joystick card, it may be configured for either RS-232 or RS-422. If it is set up for RS-232, it can only be connected to a DCU card through the RS-232/RS-422 Adapter Unit, IC630CCM390. If it is set up for N-422, it may be used directly with a DCU through a Workmaster-to-DCU cable, IC630CBL391.

Multidrop configurations (one Logicmaster 1 F system connected to more than one DCU) must be done with RS-422. Refer to GEK-90477 for more information.

COMMUNICATIONS SETUP SCREEN: DEFINITIONS (Continued)

SELECTED DCU ID

Enter the ID number of the DCU (from 1 to 90) that will be communicating with the system. After entering the number, press F5 (SELECT DCU ID). The number will be entered into the field, and the system will immediately begin communicating with that DCU.

To display the IDs of the currently-available DCUs within the parentheses to the right, press F4 (SHOW ID #S). The screen will display:

POLLING DCU ID NUMBER:

plus the number of each currently-available DCU. For a network interface with more than eight DCUs, press F6 again, as needed, to display additional DCU IDs.

To cancel the polling of DCU IDs, press F9 or the Abort key. The screen prompts:

PRESS CONFIRM TO ABORT, ANY KEY TO CONTINUE

Press ALT-X (Confirm or Shift-O) to confirm the abort, or any other key to continue polling the DCU IDs.

ON-LINE CHANGES

Press F7 (ONLINE CHANGE) to select the ability to use the system's on-line change features. This allows you to change registers, I/O points, or constants while the programmer is switched on-line.

WARNING

Exclusive single bit on-line changes of discrete I/O are not supported in either the Series One (Model E) Data Communications Unit or the Series One Plus Data Communications Unit. The toggling function is accomplished by (1) reading a byte wide I/O group from the CPU containing the I/O point to be toggled, (2) setting the I/O point to be toggled, and (3) writing the entire byte wide I/O group back to the CPU memory.

If the CPU changed the status of any I/O points in that group during the read-set-write cycle for I/O toggling, the new status may be overwritten. Because this could produce unexpected and potentially hazardous results, caution is necessary when toggling discrete I/O. Toggling I/O must be performed when user logic memory is cleared to avoid any unexpected or hazardous results.

COMMUNICATIONS SETUP SCREEN: DEFINITIONS (Continued)

SAVE

Press F1 to create a file named COMSET.SET on the system start-up diskette. The system diskette must be write-enabled to receive the file. (The tab in the window on the diskette must be closed.) The system diskette must also be in the default drive. This file will store the current settings for the Communications Setup screen, except the listing of available DCU IDs. The system will read the contents of this file at start up.

If the COMSET.SET file is present when the Logicmaster 1F software is loaded, the saved values will be used to set the communications parameters automatically. If COMSET.SET is not present at load time, the communications parameters are set to default values. (These default values include: No port selected, and DCU ID 3.)

CONFIGURATION SETUP

Press F8 (CONFIG SETUP) to return to the Configuration Setup menu.

RECOVERING FROM AN ERROR IN THE CPU

If the CPU contains a program with a fatal error in it and the DCU is power cycled, the Logicmaster system may not be able to communicate with the DCU/CPU even after power is restored. On power-up, the CPU performs a grammar check and the result is passed to the DCU. The DCU then inhibits communications until the error is cleared.

This situation is more likely to occur if the program was created or modified using either the handheld programmer or the LCD portable programmer. Creating or modifying a program directly on the Logicmaster system will usually prevent this situation.

If the Logicmaster system will not communicate with your CPU through the Data Communications Unit, even though the system was working previously, you should follow this procedure:

1. Take the DCU off-line, and attach a handheld programmer.
2. Press CLR CLR SCH to perform a manual grammar check. The error type (if any) will be displayed in the window.
4. Press CLR NXT to obtain the error address.
5. Correct the error using the appropriate edit keys. You may also clear the program by pressing CLR CLR SHF 3 4 8 DEL NXT.
6. Remove the handheld programmer, and place the DCU back on-line. The Logicmaster system should now be able to communicate properly with the CPU through the Data Communications Unit.

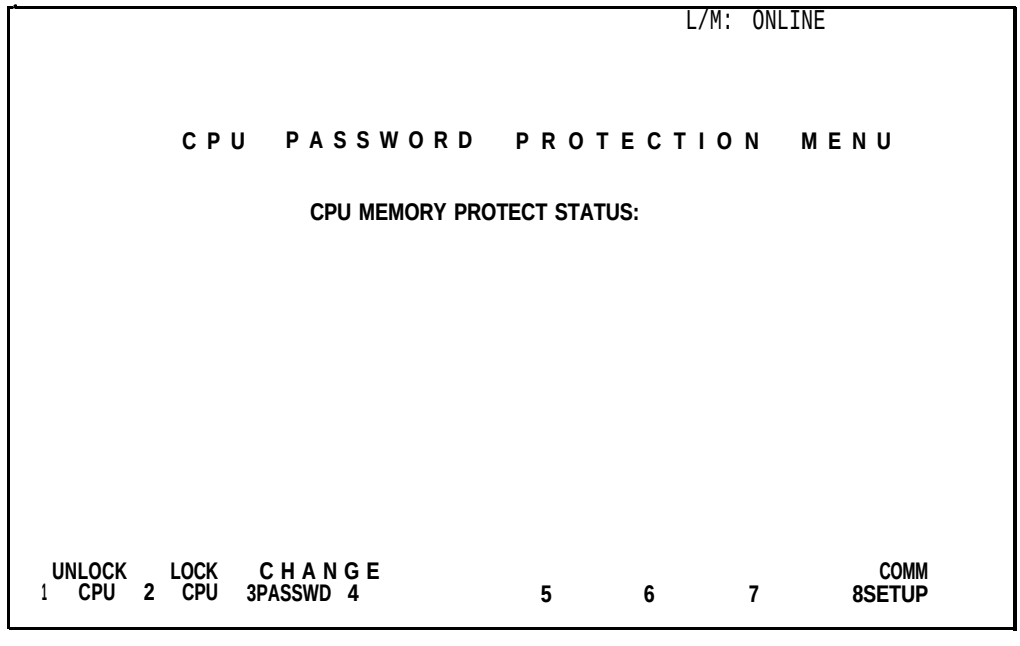
SECTION 3
CPU PASSWORD PROTECTION

The CPU Password Protection menu allows you to lock or unlock the CPU and to change the password. This section explains:

- **How to lock/unlock the CPU.**
- **How to change/enter the CPU password.**

DISPLAYING THE CPU PASSWORD PROTECTION MENU

Press F2 (CPU PROTEC) in the Communications Setup menu to display the CPU Password Protection menu.



CPU PASSWORD PROTECTION KEY SUMMARY

Refer to the following definitions when locking or unlocking the CPU and changing the password.

UNLOCK CPU (F1) — **Press F1 and enter the current password. For security, your keystrokes are not displayed while typing passwords.**

When you press CTRL-E or the Enter key, the system will attempt to unlock the CPU using your password. If the password is an invalid number, the CPU will remain locked.

CPU PASSWORD PROTECTION SCREEN: DEFINITIONS (Continued)

	if you press the wrong key while entering the password, you cannot use the Backspace or Delete keys to correct your error. You must continue with this attempt to unlock the CPU, which will be unsuccessful, and then try again.
LOCK CPU (F2)	Press F2. The system will attempt to lock the CPU. Note *that the CPU will remain unlocked if the current password is zero.* In that case, the password must be changed before locking the CPU.
CHANGE PASSWORD (F3)	Press F3 and enter the current password. Your keystrokes are not displayed while typing in passwords. After entering the current password, you must enter the new password twice to insure accurate entry. Then the system will try to change the password. if the current password entry is an invalid number, a message will be displayed and the password change will not occur. If you press the wrong key while entering the password, you cannot use the Backspace or Delete keys to correct your error. You must continue with this attempt to unlock the CPU, which will be unsuccessful, and then try again.

UNLOCKING THE CPU

To unlock the CPU, follow these steps:

1. With the Logicmaster system in the On-Line mode only, press F1 (UNLOCK CPU) in the CPU Password Protection menu. The following message is displayed:

   TYPE CPU PASSWORD (UP TO 4 DECIMAL DIGITS)
   THEN PRESS << ENTER >>

2. Type the current password, and press CTRL-E or the Enter key. If the correct password is entered, the system- will unlock the CPU. The CPU memory protect status will be displayed as UNLOCKED:

   CPU MEMORY PROTECT STATUS: UNLOCKED

   However, if the password entered is incorrect, the CPU will remain locked.

LOCKING THE CPU

To **lock the CPU, follow these steps:**

1. **With the Logicmaster system in the On-Line mode only, press F2 (LOCK CPU) in the CPU Password Protection menu. The system will lock the CPU, as indicated by the status of the CPU displayed on the screen:**

```
CPU MEMORY PROTECT STATUS: LOCKED
```

2. if **the current password, however, is zero, the system will remain unlocked and the following message will be displayed:**

```
PASSWORD = 0000; CPU CANNOT BE LOCKED
```

The system will remain unlocked until you change the password.

CHANGING THE PASSWORD

To change the password, follow this procedure:

1. **Press F3 (CHANGE PASSWD) in the CPU Password Protection menu. The following message is displayed:**

```
TYPE CURRENT PASSWORD (UP TO 4 DECIMAL DIGITS)
            THEN PRESS << ENTER >>
```

2. **Type the current password, and press CTRL-E or the Enter key. The following message is displayed:**

```
TYPE NEW CPU PASSWORD
THEN PRESS << ENTER >>
```

3. **Type the new password, and press CTRL-E or the Enter key. The following message is displayed:**

```
RETYPE CPU PASSWORD FOR VERIFICATION
       THEN PRESS << ENTER >>
```

4. **Retype your new password and press CTRL-E or the Enter key. The system will verify this password with the new password you entered in step 3. If the two passwords agree, the status of the CPU will be changed to LOCKED.**

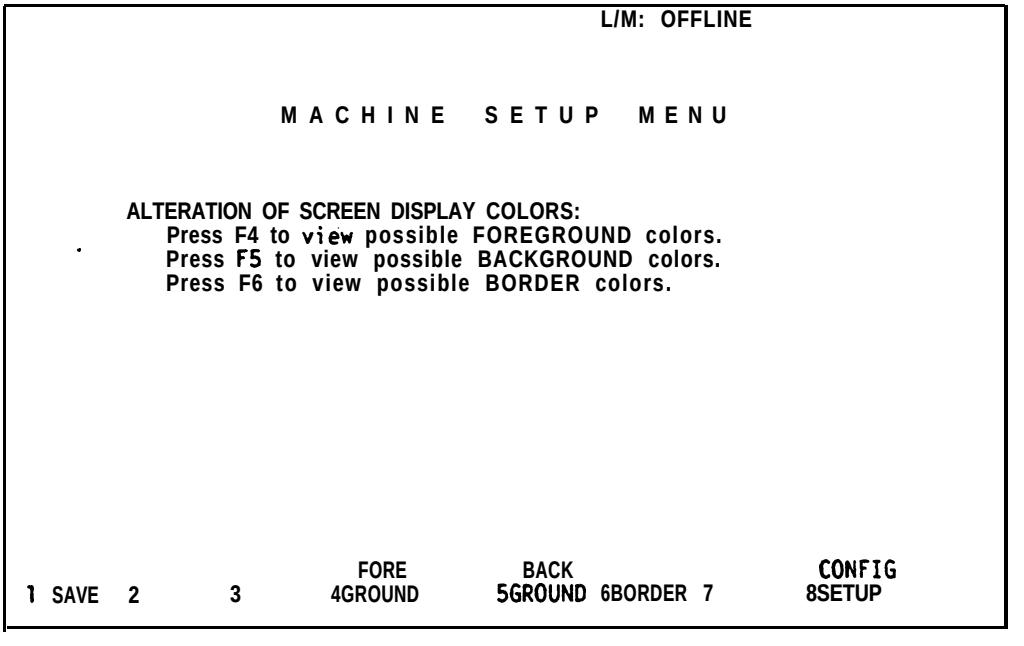
SECTION 4
THE MACHINE SETUP MENU

The Machine Setup functions allow you to select the display colors for a color monitor and to save these selections in the MACHINE.SET file This sect ion explains:

- How to display the Machine Setup menu.
- Machine Setup screen definitions.
- How to change display colors if the computer you are using for programming has a color monitor.

DISPLAYING THE MACHINE SETUP MENU

Press F2 (MSD FUNC) in the Configuration Setup menu to display the Machine Setup menu.



MACHINE SETUP KEY SUMMARY

Refer to the following definitions when making changes to the Machine Setup screen.

FOREGROUND (F4) Use F4 to select the color of the foreground (text). Each time you press F4, a new foreground color is displayed.

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MACHINE SETUP KEY SUMMARY (Continued)

BACKGROUND (F5)	Use F5 to select the color of the background. Each time you press F5, a new background color is displayed. The system will prevent you from selecting matching foreground and background colors.
BORDER (F6)	If your system uses a Color Graphics Adapter (CGA), you can change the border color by pressing F6. The Enhanced Graphics Adapter (EGA) will always display a black border.
SAVE (F1)	Color selections take effect immediately and remain active while the system is running. Press F1 to save the selections in the MACHINE.SET file on the startup disk. These selections will then be used automatically whenever the system is started.
CONFIGURATION SETUP (F8)	Press F8 key to return to the Configuration Setup menu.

CHANGING SCREEN COLORS

If you are using a color monitor, you can change the color of the text, background, and/or screen border. To change colors, follow these steps:

1. Select MSD functions from the Configuration Setup menu.
2. Use the function keys F4-F6 to toggle through the 16 different color selections for each item.

CHAPTER 11
UTILITIES

The Utilities functions are used for disk and file management, and for configuring the serial port(s).

This chapter explains how to use the Utilities functions. Refer to **the appropriate sect ions.**

Section 1. The Utilities Menu: Section 1 explains how to access the Utilities menu, and defines the Utilities function keys.

Section 2. Duplicating the Master Software: Refer to section 2 for instruct ions to duplicate the original Logicmaster 1 F software diskettes.

Section 3. Using the File Utilities: Section 3 explains how to copy and delete files. It also explains how to display or print a directory of files.

Section 4. Setting Up the Serial Ports: Section 4 explains how to examine and modify the serial port parameters.

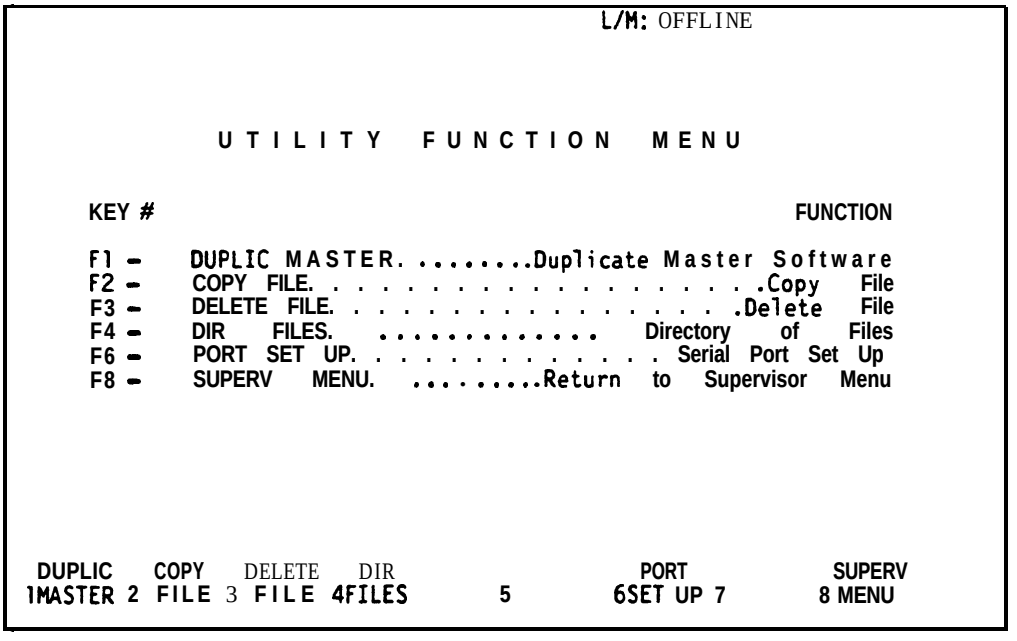
SECTION 1
THE UTILITIES MENU

This sect ion explains:

- How to display the Utilities menu.
- The definitions of the Utilities function keys.

DISPLAYING THE UTILITIES MENU

Select Utility Function (F8) from the Supervisor menu to display the Utility Function menu.



UTILITIES FUNCTION KEY SUMMARY

DUPLICATE MASTER (F1) — Use F1 to make copies of the master diskette.

COPY FILE (F2) — Use F2 to copy one of mote files.

DELETE FILE (F3) — Use F3 to delete one or more files.

DIRECTORY OF FILES (F4) — Use F4 to display a listing of the files on a diskette. This command will also print out the file listing if a printer is set up, and is on-line to the system.

PORT SETUP (F6) — Use F6 to specify the parameters of the serial port(s).

SECTION 2
DUPLICATING THE MASTER SOFTWARE

Use the Duplicate Master Software utility to copy the Logicmaster 1F master diskettes.

This section explains:

- **How to duplicate master software using a single floppy-drive or dual floppy-drive system.**
- **How to duplicate the master software using a hard disk system. This utility installs the software on the hard disk.**

USING THE DUPLICATE MASTER SOFTWARE UTILITY: DISKETTE SYSTEM

Make a copy of each master software diskette using the Duplicate Master Software utility. Follow the steps below:

1. **Format the diskette using DOS. For instructions on formatting diskettes and making bootable disks, refer to chapter 2.**
2. **Use the Duplicate Master utility to copy the Logicmaster 1F system files onto the formatted diskette. Note** *that copies can only be made from the master diskette. Copy diskettes themselves cannot be copied.*
3. **instructions are provided below for using the Duplicate Master Software utility with single and multiple floppy-diskette drives. Continue at the appropriate heading.**

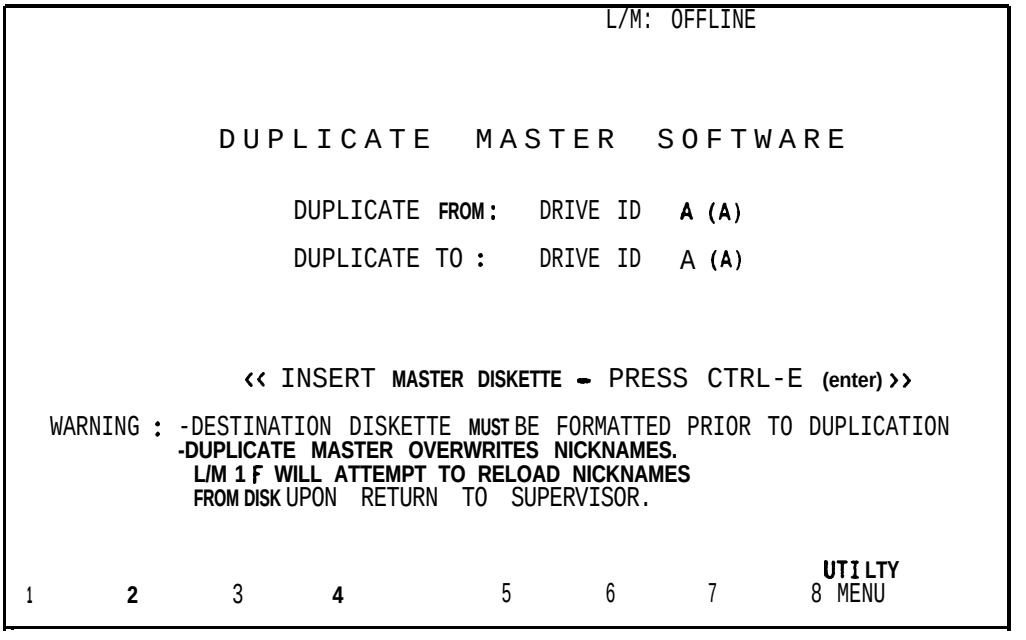
NOTE

If there is currently a .NAM file for names and nicknames stored in the programmer memory, the Duplicate Master Software utility will overwrite it. Be sure that you copy this .NAM file with your program before using the Duplicate Master Software utility. The system will attempt to reload the .NAM file from disk when you return to the Supervisor menu.

Duplicate Master Software: Single Diskette Drive System

Follow these **instructions for a single-drive system:**

1. **Press F1** (DUPLIC MASTER) **in the Utilities menu to display the Duplicate** Master Software **screen.**



2. **If the master software diskette (not a copy) is not presently installed, place it into the disk drive.**

3. **Press** CTRL-E or **the Enter key. When prompted, remove the master diskette.**

4. **Insert a formatted diskette in the disk drive. Press** CTRL-E or **the Enter key.** *To stop the Duplication process, press F4 (ABORT).*

5. **After some of the program has been placed on the diskette, a prompt will ask you to** remove **the copy (destination disk) and reinsert the master diskette.**

6. **Continue exchanging diskettes until the entire program has been copied.** When the **copying is complete, the following message is displayed:**

   DUPLICATION **COMPLETED**

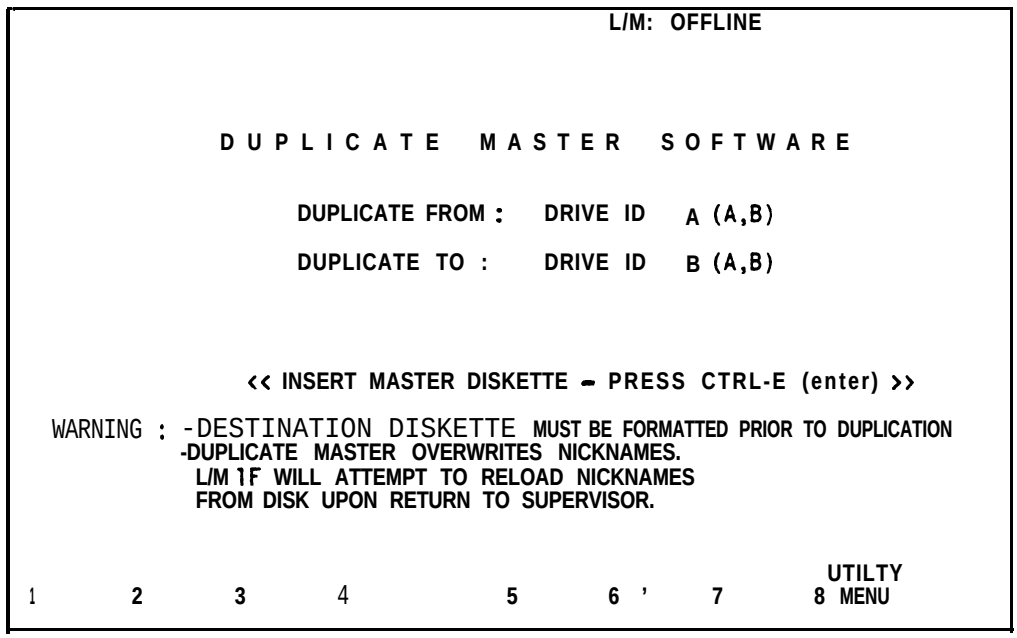
7. **Repeat the process to copy the other master diskette(s). You should refer to chapter 2 for further instructions before attempting to run the Logicmaster 1F software.**

The next return to the Supervisor level causes the system to search for the nickname file that was used last, and **to try to reload it if there is an active .NAM file name.**

Duplicate Master Software: Multiple Diskette Drive System

Follow these instructions for a multiple-drive system:

1. **Press F1 (DUPLIC MASTER) in the Utilities menu to display the Duplicate Master Software screen.**



2. **If the master software diskette (not a copy) is not presently installed, place it into a disk drive. Insert a formatted diskette in another disk drive (usually drive B).**

3. **At DUPLICATE FROM, enter the designation of the drive containing the master diskette. Available letters are displayed beside the prompt.**

4. **Move the cursor to DUPLICATE TO and enter the designation of the drive to receive the copy. Available letters ate displayed beside the prompt.**

5. **Press CTRL-E or the Enter key.** *To stop the Duplication process, press F4 (ABORT).*

6. **The system begins copying the software onto the diskette. When the copying is complete, the screen displays:**

   DUPLICATION **COMPLETED**

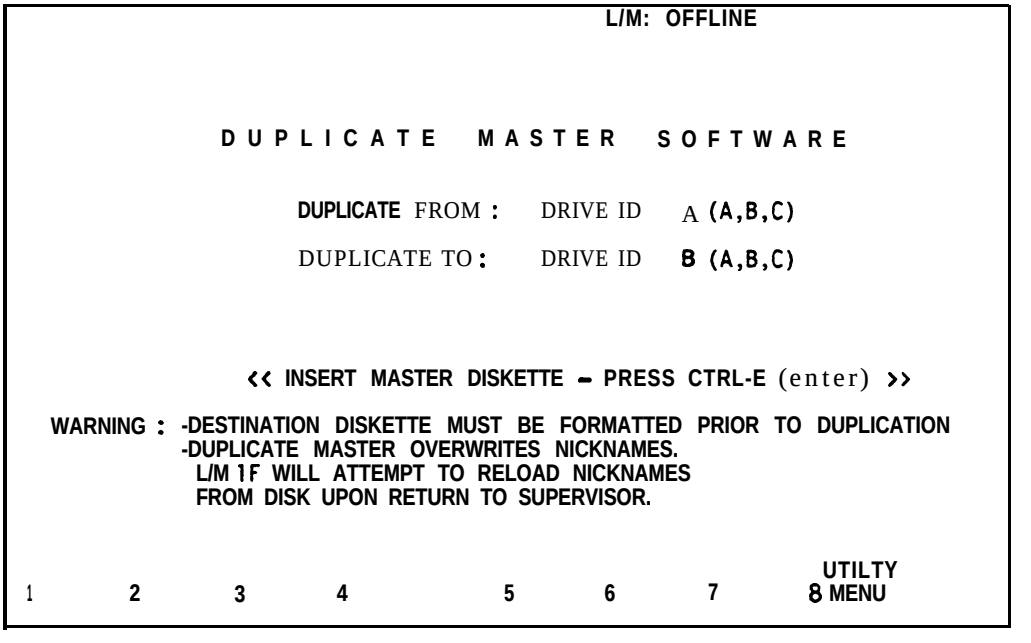
7. **Repeat the process to copy the other master diskette(s). You should refer to chapter 2 for further instructions before attempting to ton the Logicmaster 1F software.**

The next return to the Supervisor level causes the system to search for the nickname file that was used last, and to try to reload it if there is an active .NAM file name.

Duplicate Master Software: Hard Disk System

Follow the instructions below for a hard disk system. The Duplicate Master Software utility does not format a hard disk. If you have a new hard disk, it must be appropriately formatted before it can be used with this utility. For instructions on formatting a hard disk, refer to the instructions provided with the hard disk.

1. **Press F1(DUPLIC MASTER) in the Utilities menu to display the Duplicate Master Software screen.**



2. **If the master software diskette (not a copy) is not presently installed, place it in a disk drive.**

3. **At DUPLICATE FROM, enter the designation of the drive containing the master diskette. Available letters are displayed-beside the prompt.**

4. **Move the cursor to DUPLICATE TO and enter the designation of the hard** disk drive **to receive the copy. Available letters are displayed beside the prompt.**

5. **Press CTRL-E or the Enter key. To** *stop the Duplication process, press F4 (ABORT).*

6. **If not already present, the utility creates the directory /L1F on the hard disk. System files are then copied into the L1F subdirectory. When the copying is complete, the screen displays:**

   DUPLICATION COMPLETED

7. **Repeat the process to copy the other master diskette(s). You should refer to chapter 2 for further instructions before attempting to run the Logicmaster 1F software.**

The next return to the Supervisor level causes the system to search for the nickname file that was used last, and to try to reload it if there is an active .NAM file name.

SECTION 3
USING THE FILE UTILITIES

The system stores all program data as files. This section explains:

- How to use file names and "wildcards".
- How to copy files.
- How to use the Copy utility to rename backup files.
- How to delete files.
- How to display or print a directory of files.

FILE NAMES

Each file has a unique name by which the system identifies it. The name you give a program becomes the basic file name for that program, and for other files associated with it.

Reserved File names

Do not begin a file name with any of the following reserved system names: CON, AUX, COM1, COM2, PRN, LPT1, LPT2, LPT3, or NUL.

Do not use the wildcard characters * or ? as part of a file name.

Using "Wildcards" to Represent Parts of File names

When using the File Utilities (Directory, Copy File, and Delete File), "wildcard" characters can be used to represent parts of existing file names. The two wildcard characters are:

*	Asterisk, which can be used to represent one or more characters in a file name. For example, an asterisk may represent all files with the same extension (*.LAD) or all extensions to the same file name (PROGRAM1.*).
?	Question mark, which can be used to represent one character in a file name For example, PROGRAM?.LAD and PROGRAM1 .L??.

Both wildcatd characters can be used together. For example, PROGRAM?.* means all files beginning with PROGRAM.

NOTE

When using w ildcard characters in a file name, you must also use the period character between the main part of the file name and the extension (for example, PROG*.*).

PROGRAM FILES

A program is stored as more than one type of file. The system automatically gives each type of file a three-character file name extension. The extension is part of the file name, and differentiates one program file from another. When entering a file name and an extension, be sure to include the period between the file name and the extension.

The following list defines the file name extensions used by the Logicmaster 1F system.

name.LAD The .LAD file contains the ladder diagram, properly formatted for transfer to the CPU. This file uses two bytes of storage for each word of logic. The .LAD file includes the registers, I/O status, and user logic associated with the ladder diagram. The .LAD file is created in the Edit Program function if there is an active file name when you enter user logic.

name.LBU This file contains the backup copy of an .LAD file that is created if a program backup is selected at the beginning of the Edit Program function. You must specify Y for YES in response to the following prompt:

DO YOU WISH TO BACKUP PROGRAM? (Y/N)

If program backup is not selected, an .LBU file is not created.

name.RDF The .RDF file contains the formats that will be used for reference displays and printouts. The .RDF file is created when a file name is active. Initially, the file contains default formats supplied by the system. The Display References utility changes this file.

name.RBU The .RBU file is the backup file for the .RDF file. This file is created at the beginning of the Edit Program function when you specify Y for YES in response to the backup prompt.

name.TXT The .TXT file is the text output file that is created when the program is stored for later printing (in Background mode), using the Print Program function.

name.NAM The .NAM file contains program names and nicknames. The .NAM file is created if there is an active file name when you enter names or nicknames.

name.NBU The .NBU file is the backup file for the .NAM file. This file is created at the beginning of the Edit Program function when you specify Y for YES in response to the backup prompt.

name.EXP The .EXP file contains the program rung explanations and coil labels. The .EXP file is created if there is an active file name when you enter a rung explanation or coil label.

name.EBU The .EBU file is the backup file for the .EXP file. This file is created at the beginning of the Edit Program function when you specify Y for YES in response to the backup prompt.

If you had a program named PROGRAM1, the ladder diagram would be stored as the file named PROGRAM1.LAD. Other files for that program would be named as described above. For example, the format for the reference displays would be named PROGRAM1.RDF.

OTHER FILES OF INTEREST

In addition to the program files, other files of interest are:

Fx.DEF	where x = l-8. The Fx.DEF file contains the user-defined keys created in Teach mode.
COMSET.SET	The Communications Setup file contains the communications setup data. The system creates or updates this file when the Save (F1) key is pressed from the Communications Set Up'menu.
PRINTER.SET	The Printer Setup file contains the printer data. The system creates or updates this file when the Save (F5) key is pressed from the Define Printer screen.
PORTn.PSU	The PORT1 .PSU or PORT2.PSU file contains the serial port setup information entered with the Setup Serial Port utility.
MACHINE.SET	The Machine Setup file contains the color monitor default colors.

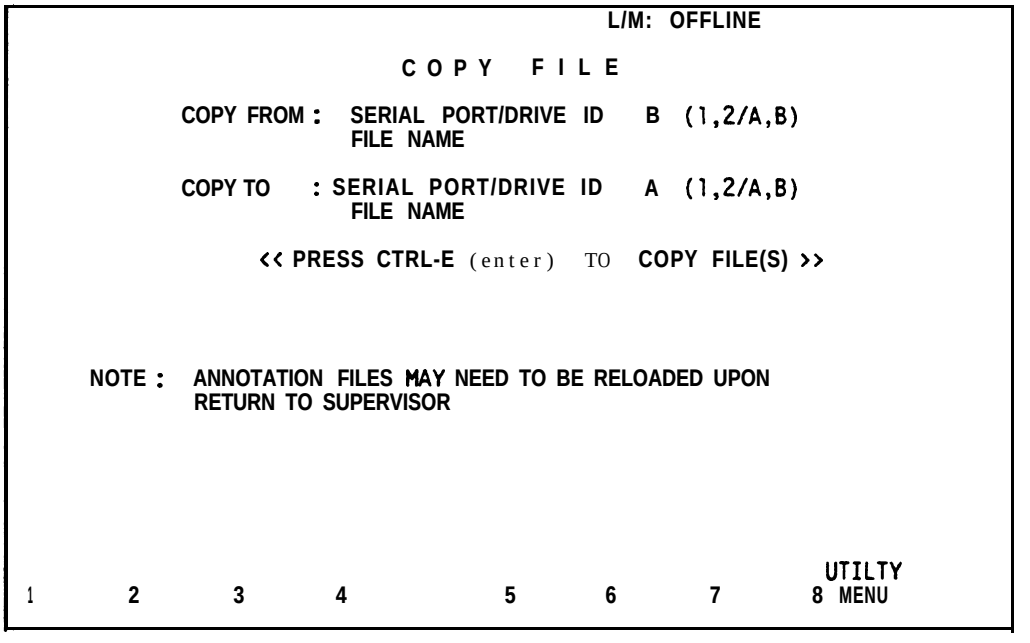
COPYING FILES

The Copy File utility is used to copy one or more files. Copying may be done between serial ports or disks.

NOTE

If there is currently a .NAM file for names and nicknames stored in the programmer memory, the Copy File utility will overwrite it. Be sure that you copy this .NAM file with your program before using the Copy File utility. The system will attempt to reload the .NAM file from disk when you return to the Supervisor menu.

To copy files, press F2 (COPY FILE) in the Utilities menu to display the Copy File screen.



1. Enter the designation of the serial port or disk drive from which the file(s) will be copied.

2. Enter the name of one or more files to be copied. Use wildcatd characters as needed in the file name. For example, enter *.LAD to copy all ladder diagram files on the source drive, or (name).* to copy all files with the same program name. For more informat ion on w ildcards, refer to **Using Wildcards to Represent Parts of a File names".

   To copy the primary program files (the .LAD, .RDF,.NAM, and .EXP files), enter just the file name without an extension.

3. Enter the designation of the serial port or disk drive to receive the file(s).

4. If the copies are to have the same name as the original versions of the files, no entry is needed for the COPY TO file name.

   Enter a new name if you want to rename the copies. To name multiple file copies, use wildcard characters as needed. For example, you could enter the file name PROGRAM1 .* to copy all the PROGRAM1 files, and enter PROGRAM2.* as the file name for the copies.

NOTE

When entering the name for the copy, be sure not to use the name (including the file name extension) of a file already stored on the destination device. The new file will replace any old file with the same name, and the old file will be lost.

5. **Press CTRL-E or the Enter key. If the entries for source and destination are correct, the copy begins.** *To stop the Copy File procedure in progress, press* **F4** *(ABORT).*

6. **Respond to any prompts to insert and remove diskettes. When the following message is displayed, the copy is finished:**

   FILE COPY COMPLETED

   If multiple files were copied using wildcard characters, the names of the files are displayed on the screen.

RENAMING BACKUP FILES

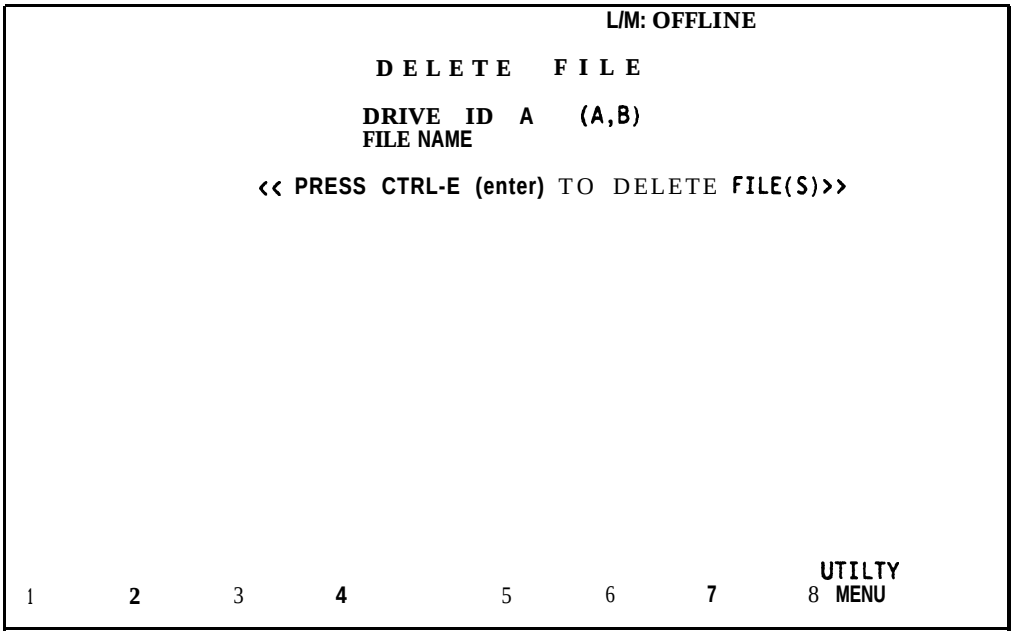
Backup files must be renamed to be accessed and used as program files.

TYPE OF FILE	PROGRAM FILE NAME	BACKUP FILE NAME
Ladder 1 ogi c	program. LAD	program. LBU
Rung expl an. & coil labels	program. EXP	program. EBU
Names & nicknames	program. NAM	program.NBU
Reference display formats	program. RDF	program.RBU

Use the Copy utility to copy a backup file, giving the copy a new name and the **appropriate extension, as listed above. For example, "program1.LBU" could be renamed "program2.LAD. This new file could be edited (and backed-up) like any other program file.**

DELETING PROGRAM FILES

The Delete File utility is used to delete one or more files from a disk. Press F3 (DELETE FILE) in the Utilities menu to display the Delete File screen.



1. **Enter the designation of the disk drive from which the file(s) will be deleted.**

2. **Enter the name of one or more files to be deleted. Use wildcard characters as needed to specify multiple files. For example, enter *.TXT to delete all printer text files on the disk.**

CAUTION

When using wildcard characters within the main part of a file name, be sure to use a period after the wildcard character. Failure to use the period (for example, PROG* without a period) will cause all files to be deleted.

For more information on wildcards, refer to "Using Wildcards to Represent Parts of a File names".

To delete the primary program files (the LAD, .RDF, .NAM, and .EXP files), enter just the file name without an extension.

3. **Press CTRL-E or the Enter key. If one file name with extension (for example, PROGRAM1 .TXT) was** entered, **the file is deleted immediately.**

   If wildcards were used to **specify multiple files for deletion, the screen prompts:**

   CONFIRM BEFORE DELETE (Y/N>? Y

   To check each file name before the system deletes the file, press the Return key.

   To have the system **automatically delete all files, without checking them first, enter N. Use this option with care. After the last file is found and deleted, the screen displays the message:**

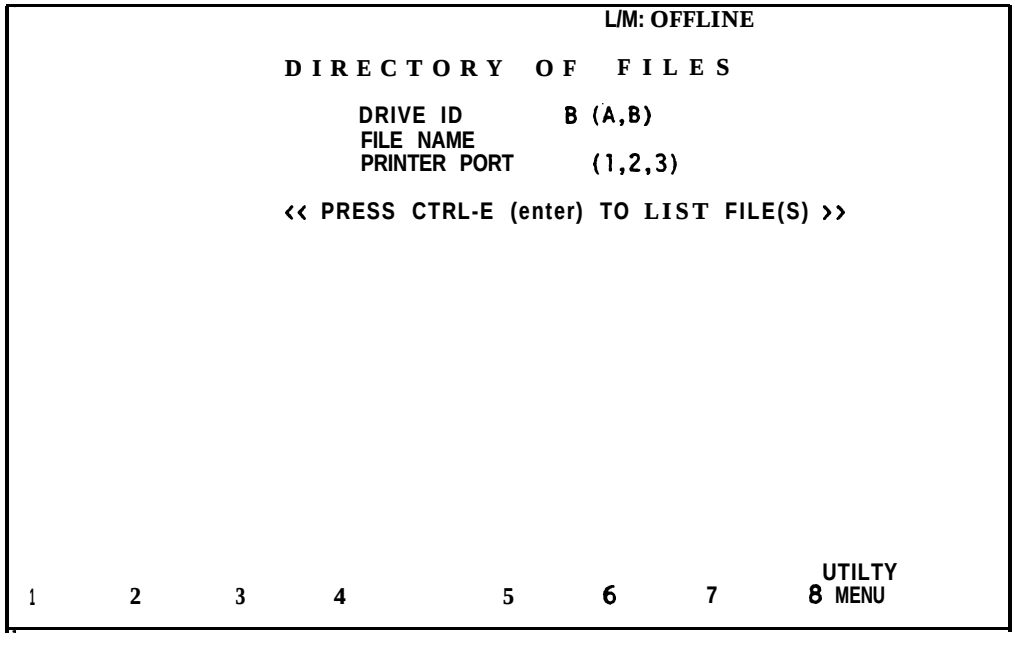
   DELETION COMPLETED

   To stop the Delete File procedure in progress, press F4 (ABORT).

DISPLAYING AND PRINTING A DIRECTORY OF FILES

The Directory utility is used to display a list of the files on a disk. The file listing can also be printed out if a printer has been set up **and is on-line to the system. The directory lists all files on the disk. For each file, the listing shows its size in** bytes, and **the time and date it was last stored on the disk.**

Press F4 (DIR FILES) in the Utilities menu to display the following screen.



1. Identify the disk drive from which to read the files. If the directory source is a disk, insert the diskette into the drive.

2. For a listing of all the files on the source drive, make no entry for file name.

   For a listing of selected files on the source drive, enter a file name. Use wildcard characters as needed in the file name. For example, enter *.LAD for a listing of all ladder diagram files on the source drive, or (name).* for a listing of all files with the same program name. For more information on wildcards, refer to "Using Wildcards to Represent Parts of a File name".

3. To print a copy of the listing, enter the number of the printer port.

4. Press CTRL-E or the Enter key. A listing of files is displayed on the directory screen. The listing has the following format:

```
FILE NAME          NUMBER OF BYTES    LAST MODIFIED DATE    TIME

PROGRAM1.LAD       3078               02-18-86              13:19:29
PROGRAM1.LBU       3016               02-06-86              10:46:08

. . . . . .

FREE SPACE REMAINING: 336896
```

The directory listing shows the name of each file and its size in bytes. The time and date shown are those recorded by the system when the file was last updated.

The bottom of the screen shows the amount of free space remaining on the source drive.

Controlling the Scroll of File names

If the directory includes more files than can be displayed on the screen, the list scrolls upward. To temporarily stop the scroll (and printout), press the Pause/Resume (F2) key. To resume the scroll (and printout), press the (F2) key again.

Ending the Directory Utility

To end a Directory listing before it is finished, press F4 (ABORT). Press CTRL-E or the Enter key to start the directory from the beginning.

To return to the Utilities menu, press F8 (UTILTY MENU).

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SECTION 4
SETTING UP THE SERIAL PORTS

The serial ports in the system (designated 1 and 2) can be used for serial printers or DCU communications. The characteristics of the serial ports must be established before the system can use them to communicate data. Use the Port Setup utility to assign or display the characteristics of the serial ports in the system.

This section explains:

- **How to display the Port Setup screen.**
- **How to display the current port setup characteristics.**
- **How to display port characteristics from a Port Setup (.PSU) file.**
- **How to modify the parameters of a port.**
- **How to save port parameters in a file, for use at a later time.**

DISPLAYING THE PORT SETUP SCREEN

Press F6 (PORT SET UP) in the Utilities menu to display the Serial Port Setup screen,

```
                                                    L/M: OFFLINE


                        S E R I A L   P O R T   S E T   U P

        PORT  NUMBER   1    (1,2) -- PORT TO BE SET UP OR SHOWN
        DRIVE ID       A    (A,B)
        FILE NAME


        BAUD RATE          19200  (110, 300, 1200, 2400, 4800, 9600, 19200)
        STOP BITS              1  (1,2)
        PARITY              NONE (ODD, EVEN, NONE)
        DATA BITS/WORD         8  (7,8)
        X-ON/X-OFF             N  (Y/N)


 SET UP    SAVE     SHOW     SHOW                                    UTILTY
1 PORT  2 FILE   3 POUT   4 FILE      5        6        7        8 MENU
```

PORT SETUP SCREEN KEY SUMMARY

The screen shows the characteristics for a port. The bottom of the screen shows these function key assignments:

SET UP PORT (FI)	Use F1 to implement the parameters.
SAVE FILE (F2)	Use F2 to create a Port Set Up file.
SHOW PORT (F3)	Use F3 to display present port parameters.
SHOW FILE (F4)	Use F4 to display port parameters from a file.

DISPLAYING THE CURRENT PARAMETERS FOR A PORT

To determine the current settings for one of the serial ports, enter the number of the port (1 or 2) for PORT NUMBER and press F3 (SHOW PORT).

DISPLAYING PARAMETERS IN A PORT SETUP FILE

Port Set Up values may be stored in a program file with the file name extension .PSU. To determine the current values stored in a Port Set Up file:

1. Enter the drive where the file is stored for DRIVE ID.
2. Enter the name of the file for FILE NAME.
3. Press F4 (SHOW FILE). The current set up characteristics of the file are displayed.

SETTING UP PORT PARAMETERS

Serial port characteristics can be set up for current use only, or they can be stored in a file and loaded into the system each time it is powered up. Follow the steps below to set up the software to communicate over a serial port. If the port is being used for communication with the Data Communications (DCU), the parameters set up must match those of the DCU. It is also necessary to configure the hardware, as described in appendix A.

1. Enter the following information about the device that will be using the serial port:

Baud Rate	The communications rate, in bits per second.
Stop Bits	All communications use one start bit. Slower devices may use two stop bits.
Par i ty	An ASCII character may consist of either seven or eight data bits. Specify whether parity is indicated by an odd or even number of bits, or whether no parity bit is added to the word.

Data Bits — Specify whether the device recognizes 7 or 8 bit words.

X-On/X-Off — Change this entry to Y if you want to select Level 2 protocol. Level 2 protocol allows the device connected to the serial port to suspend or restart transmission of characters using the X-ON and X-OFF characters. When the system receives an X-OFF character (DC3-13H) from the device, it stops transmitting characters. When the system then receives an X-ON (DC1-11H) character, transmission resumes.

The X-OFF character must be sent by the device before the reception of the last data bit of the current character being sent to the system, or the next character will also be sent.

If X-ON/X-OFF protocol is used with a device that does not support hardware handshaking, the hardware lines DTR-DSR and RTS-CTS must be tied together (pins 4-5 and 6-9 on the 9-pin port).

2. Enter the number of the serial port being set up.

3. If this setup will be stored in a file for use in future start up, proceed with steps 4-6.

   If this setup is intended only until power is removed from the system, or until new setup information is entered, press F1 (SET UP PORT) to execute the setup.

4. If this setup will be stored in a file, place the Logicmaster 1 F system diskette in a disk drive, and enter the letter designation of the drive. The set up file will be written to the diskette, so remove any write-protection from the diskette temporarily. If storing to a hard disk, the file will be stored in the \L1F subdirectory.

5. Enter the file name PORT1 .PSU or PORT2.PSU, depending on whether you are setting up port 1 or 2. Note: the file may be stored as any file name.PSU, but must be renamed to either PORT1.PSU or PORT 2.PSU, depending on whether you want to set up port 1 or port 2 automatically at power-up.

6. Press F2 (SAVE FILE). The setup file will be placed on the Logicmaster 1 F system diskette. However, the setup information in the file will not be used until the file is loaded into programmer memory during the next power up. To activate the set up during the current session, press the Set Up Port (F1) key to execute the setup.

CHAPTER 12
PROGRAMMING

The first eleven **chapters of this manual describe the features and use of Logicmaster 1 F software.**

Chapters 12 and 13 are about programming the Series One (Model E) and Series One Pius PLC. **Chapter 12 presents general programming concepts and describes basic programming instructions. Chapter 13 describes data operation instructions, which are available only with the Series One Plus PLC.**

This chapter consists of the following sections:

Section I. Ladder Logic Programs: Section 1 describes the CPU scan, the format of a program, elements of a program, and program references.

Section 2. Programming Instructions: Section 2 describes basic programming instructions available for the Series One **(Model E) and** Series **One Plus PLC. (Refer to Chapter 13 for Data Operation instructions for the Series One Plus PLC.)**

SECTION 1
LADDER LOGIC PROGRAMS

This section is an introduction to ladder logic programs. It explains:

- How the CPU executes a program.
- Basic ladder diagram format.
- The elements of a ladder diagram.
- How a program can be edited.
- The general format of a program function.
- References.

HOW THE CPU EXECUTES A PROGRAM

A ladder logic program is a continuous sequence of logic and instructions. The Series One (Model E) and Series One Plus CPU executes the ladder program as part of its regular scanning cycle.

PC-S1-83-0004

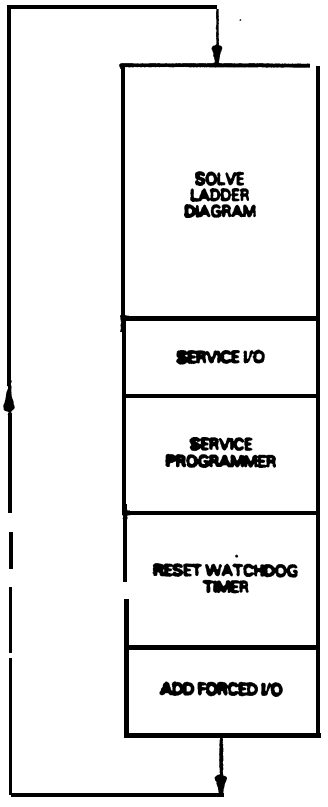


Figure 12.1 CPU SCANNING SEQUENCE

The CPU begins executing the logic at the first function entered into the beginning of memory (address 0000). It proceeds sequentially through all the memory addresses until it reaches either the end of memory or the end of the program.

During the scan, the logic sets or resets coils according to the instructions entered into the logic program. The status of these coils is immediately available to the next logic function. At the end of the logic scan, the CPU gets input data from the input modules and provides new data to output modules.

Next, the programmer, if connected, is serviced by making logic changes and/or updating its display. After servicing the programmer, the CPU performs a check of its internal hardware and resets the watchdog timer. The watchdog timer is a hardware timer set at a maximum of 180 msec to ensure that memory or internal circuit faults do not cause the CPU to enter an endless loop because of hardware failure. If a scan is not completed at least once every 150 to 180 msec, the hardware will shut the CPU down, turning outputs off. Finally, any forced I/O will be entered. After successfully completing the internal checks, the CPU begins the next scan. This repetitive scanning operation is performed from the time power% applied to the CPU until it is removed.

'BASIC LADDER DIAGRAM FORMAT

The program logic that is executed by the CPU during its regular scan can be represented graphically as a ladder diagram.

PC-S1-83-0005

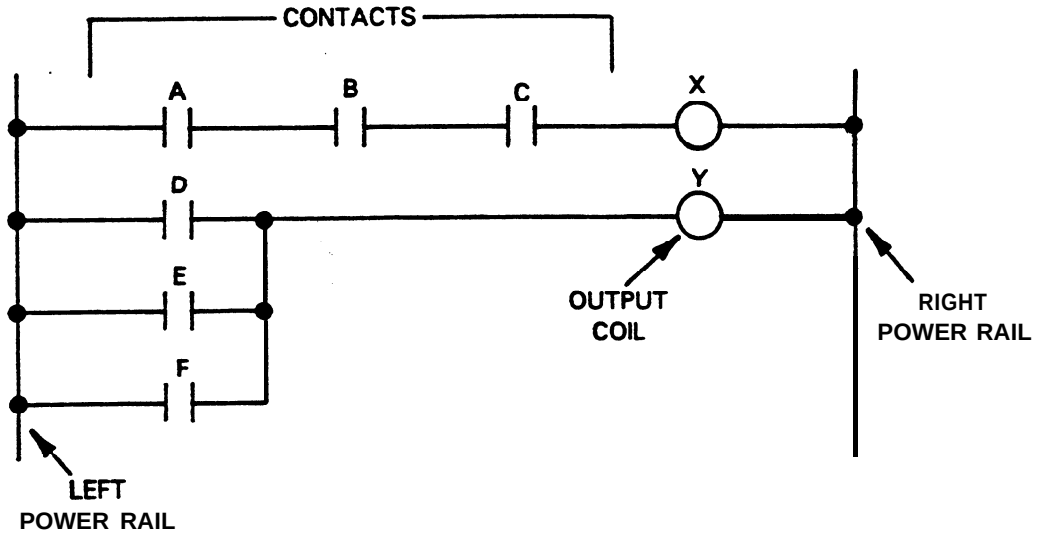


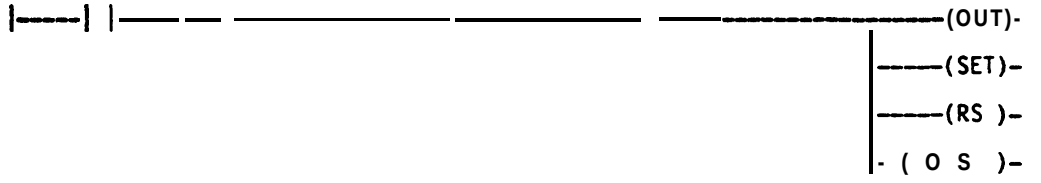
Figure 12.2 LADDER DIAGRAM FORMAT

Contacts are placed in horizontal strings or lines between two vertical power rails on the extreme left and right. Adjacent lines can be connected between contacts by a vertical line to allow logic to be solved in parallel. The horizontal strings of contacts are in series and are equivalent to ANDs. For example, line 1 in figure 12.2 can be described as: A and B and C must occur before coil X is energized; any one reference can prevent the coil from energizing. Similarly, vertical contacts are in parallel and programmed as ORs. Thus, line 2 is described as: D or E or F will energize coil Y. Any one reference can, by itself, energize coil Y.

There is no internal limit on how many contacts can be placed in series, or in parallel. However, for simple programming and system documentation, a horizontal string should be limited to eight contacts and one coil; and a vertical array to seven parallel lines.

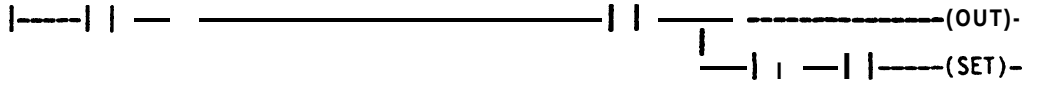
ELEMENTS OF A LADDER DIAGRAM

A ladder program consists of a sequence of linked "rungs". Each rung may begin at the left side, which is called a rail. Each rung can include up to 8 parallel lines of logic. A rung may end with multiple coils or other termination instructions (up to a maximum of 8), as shown in the following example:

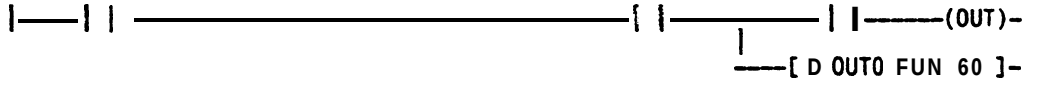


Each line of a rung may consist of up to eight program elements (contacts or drum sequencers) entered in series and a rung terminator, if programmed. Vertical connections can be made between two parallel lines of logic in positions (columns) 1 through 8. All rungs end in a terminator that starts in either column 9 or 10. If a terminator occupies only a single column, it will be placed in the tenth column, preceeded by a horizontal shunt. The terminator represents an output of the rung.

The vertical branch connecting parallel outputs must be between the eighth and ninth columns. For example, the following rung would be illegal:



No instructions other than termination instructions can follow vertical branches connecting parallel outputs. For example, the following rung would be illegal:



The following instructions are valid termination instructions for the multiple output feature:

OUT	SET
RESET	SET OUT
SET OUT RST	TIMER
MCS	HIGH SPEED COUNTER
FUN 50	FUN 20'
FUN 52	FUN 51
FUN 55	FUN 53
FUN 61	FUN 60
FUN 63	FUN 62
FUN 70	FUN 65
FUN 72	FUN 71
FUN 74	FUN 73
FUN 76	FUN 75
FUN 81	FUN 80
FUN 83	FUN 82
FUN 85	FUN 86
FUN 84	

A ladder diagram has a symbolic "power source". Power flows from the left rail (+) to the coil connected to the right rail (–). The phantom diodes are implied but not shown. They illustrate that power can flow only from left to right, or up or down.

TPK.A.42178

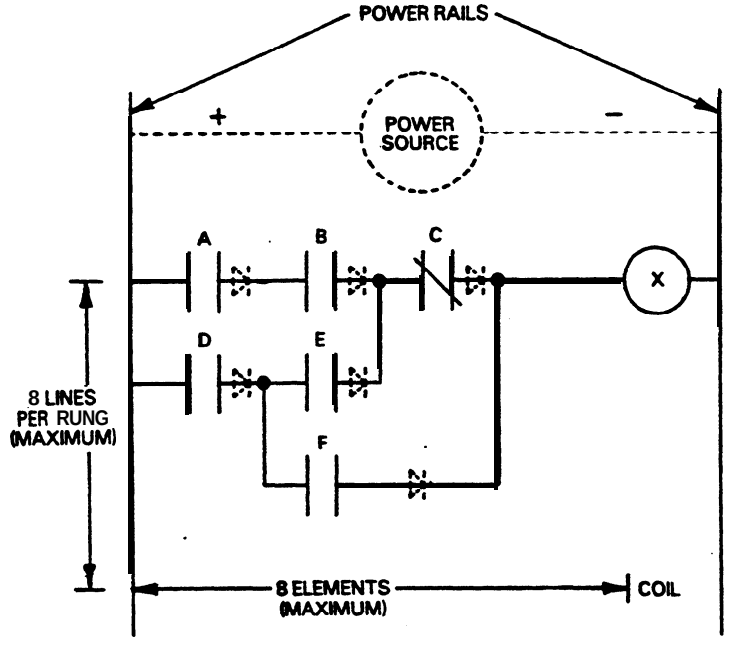


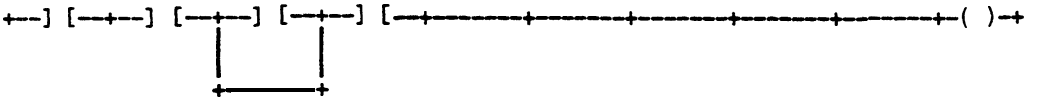
Figure 12.3 SAMPLE DIAGRAM SWOWING FLOW OF POWER

USING THE EDIT PROGRAM FUNCTION TO CREATE PROGRAMS

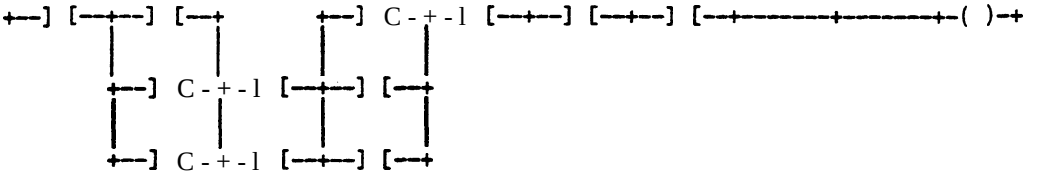
Programs are created using the Edit Program function, which is described in chapter 5. The Edit function has a number of special features that make even complex ladder diagrams easy to create. In addition, the Edit Program function is fully supported by Help screens, which you can refer to during editing.

The Edit function allows great flexibility in entering program elements. However, it will not allow you to program a rung with incorrect format or syntax.

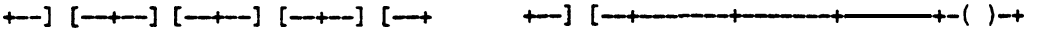
Illegal Rung: Short circuit



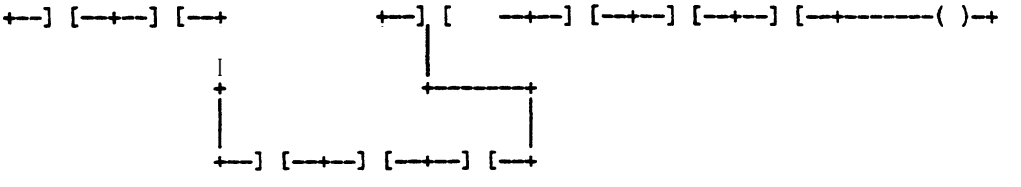
Illegal Rung: Connect contact to topmost available junction



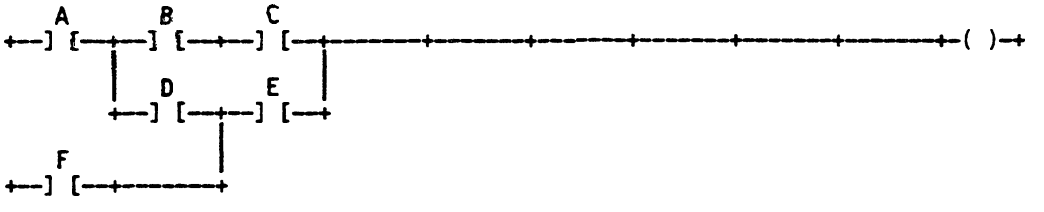
Illegal Rung: Open circuit



Illegal Rung: More than eight series contacts



Illegal Rung: Starting a branch within a branch



FORMAT OF A LADDER DIAGRAM FUNCTION

Whether simple or complex, the functions that make up a line of logic have a similar format.

```
   xxx
---| |---
```

Reference (an input)
Function (a contact)

```
   xxx
---( )
```

Reference (an output)
Function (out coil)

Each function is represented by a symbol or "mnemonic". For example:

```
---|/|---
```

symbol for a normally-closed contact

```
-[PRESC]-(HSC)-
```

functions in a program are either constants, or register or discrete references. During programming, the place for the reference (either an I/O or a register) appears on the screen directly above the symbol or mnemonic for the function.

A constant is a set value that is entered during programming and not changed by program execution. A discrete or register reference is a memory location that contains a status or value that may change during program execution. The Out Coil function above is an example.

REFERENCES

Reference numbers are a vital part of programming. Whenever a program is entered into a PLC, it must be accompanied by reference numbers. These references help to tell the CPU which function is specified; for example, which pushbutton controls the starting of which motor.

In the Series One (Model E) and Series One Plus PLC, reference numbers are octal based; that is, they start at 0 and go up to 7, then jump to 10; at 77 the next value is 100. The digits 8 and 9 in decimal numbers do not exist in octal.

The table below summarizes the various reference values and their sigificance.

Table 12.1 SUMMARY OF REFERENCES

OCTAL VALUES	REFERENCES	DECIMAL QUANTITY
000-157	I/O points (Series One Model E)	112 total
000-157	I/O points (Series One Plus)	168 total
700-767	(Series One Plus only)	
770-777	Special Function Coils (Series One Plus)	8
160-337	Internal Coils (Non-retentive)	112
340-373	Internal Coils (Retentive)	28 (1)
374-377	Special Functions	4 (1)
400-577	Shift Registers	128 (1)
600-677	Timers and/or Counters	64 (1)(2)
400-577	Data Registers, 16-bit (Series One Plus)	64 (3)

(1) Retentive upon power failure.
(2) Total maximum number of timers and/or counters.
(3) Shift register and data register references are identical. However, shift registers operate on bits, while data registers (located in a difference area of memory) operate on bytes.

SECTION 2
PROGRAMMING INSTRUCTIONS

This section provides a reference to the functions listed below.

Refer to the table on the following pages for the valid references with these functions.

Table **12.1** REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Normally Open Contact	x yyy ---| |---	YYY = 000-157 I/O Points 700-777 I/O Points 160-377 Internal Coils 400-577 Shift Registers x = T600-677 Timer Contacts C600-677 Counter Contacts
Normally Closed Contact	x yyy ---|/|---	YYY = 000-157 I/O Points 700-777 I/O Points 160-377 Internal Coils 400-577 Shift Registers x = T600-677 Timer Contacts C600-677 Counter Contacts
Drum Sequencer	xxx K YYYY ---| |---STEP---	xxx = 600-677 T/C Accumulate Registers K YYYY = K0000-K9999
Drum Sequencer	xxx R YYY ---| |---STEP---	xxx = 600-677 T/C Accumulate Registers R YYY = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Registers R400-R576 Data Registers R600-R677 J/C Accumulate Registers
Master Control Start	-[MCS]-	
Master Control Reset	-[MCR]-	
Out Coil	xxx ---( )	xxx = 000-157 I/O Points 160-373, 376 Internal Coils
Set Coil	xxx -(SET)	xxx = 000-373, 376 I/O Points 700-770 I/O Points 400-577 Shift Registers
Reset Coil	xxx ---(RST)	xxx = 000-373, 376 I/O Points 700-770 I/O Points 400-577 Shift Registers
Set Out Coil	xxx -(SO)	xxx = 000-157 I/O Points 700-767 I/O Points
Set Out Reset (One Shot) Coil	xxx ---(SOR)	xxx = 000-157 I/O Points 700-770 I/O Points 160-373, 376 Internal Coils

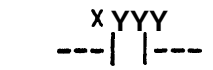
Table **12.1 (cont.)** REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Timer	R yyy T xxx -[PRESC]-(TMR)-	R YYY = R000-R014 I/O Points R016-R036 Internal Coi ls R040-R056 Shift Registers R070-R075 I/O Points R400-R576 Data Registers T xxx = T600-T673 Timer Accumulate Regi sters
Timer	K YYYY T xxx -[PRESC]-(TMR)-	KYYYY = K0000-K9999 (each unit = 0.1 sec) T xxx = T600-T673 Timer Accumulate Registers
Thumbwheel Timer	T xxx -[TH/WH]-(TMR)- T	(PRESC read from thumbwheels) xxx = T600-T673 Timer Accumulate Registers
Counter	R yyy C xxx -[PRESC]-(CNT)-	R YYY = R000-R014 I/O Points R016-R036 Internal Coils R040-R056 Shift Registers R070-R075 I/O Points R400-R576 Data Registers c xxx = C600-C673 Counter Accumulate Registers
Counter	K YYYY C xxx -[PRESC]-(CNT)-	K YYYY = K0000-K9999 (each unit = 0.1 sec C xxx = C600-C673 Counter Accumulate Registers
Thumbwheel Counter	c xxx -[TH/WH]-(CNT)- ( ) ——— ( )	(PRESC read from thumbwheels) c xxx = C600-C673 Counter Accumulate Registers
High Speed Counter	R yyy C xxx -[PRESC]-(HSC)-	R YYY = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Registers R400-R576 Data Registers R600-R677 T/C Accumulate Registers c xxx = C100-C107
High Speed Counter	K YYYY C xxx -[PRESC]-(HSC)-	K YYYY = K0000-K9999 C xxx = C100-C107
Shift Register	xxx yyy zzz aaa bbb -[SHIFT REGISTER DATA CLOCK RESET START STOP]—( )	xxx, yyy, zzz = 000-157 I/O Points 700-777 I/O Points 160-377 Internal I/O 400-577 Shift Registers 600-677 T/C Accumulate Registers aaa = 400-577 Shift Registers bbb =

NORMALLY OPEN CONTACT

Available with: Series One (Model E) and Series One Plus

Symbology:



X = (see note below)
YYY = see table 12.1

Operation:

ON = Passes power flow.

OFF = Does not pass power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Relay Sequence (F1) and then Normally Open (F1). The normally-open contact display will appear.
5. Using the numeric keypad, type in the reference for the contact on the machine reference line of the work area.

NOTE

References in the range 600–677 require a "T" or "C" prefix, identifying them as timers and counters. Use the 1 (for timer) and 0 (for counter) numeric keypad keys to identify these references before entering the value.

6. After entering the reference, press CTRL-E or the Enter key.
7. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: An I/O (or timer/counter) reference can be used in logic as many times as necessary.

NORMALLY CLOSED CONTACT

Available with: Series One (Model E) and Series One Plus

Symboiogy:

```
 X YYY
---|/|---
```

X = (see note below)
YYY = see table 12.1

Operation:

ON = Passes power flow.

OFF = Does not pass power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Relay Sequence (F1) and then Normally Closed (F2). The normally-closed contact display will appear.
5. Using the numeric keypad, type in the reference for the contact on the machine reference line of the work area.

NOTE

References in the range 600–677 require a "T" or "C" prefix, identifying them as timers and counters. Use the I (for timer) and 0 (for counter) numeric keypad keys to identify these references before entering the value.

6. After entering the reference, press CTRL-E or the Enter key.
7. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: An I/O (or timer/counter) reference can be used in logic as many times as necessary.

SHUNT/OPEN

Available with: Series One (Model E) and Series One Plus

Symbology: -------

Operation: SHUNT = Passes power flow.

OPEN = Does not pass power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program functionkeys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the shunt, select Relay Sequence (F1) and then Shunt (F3). The shunt display appears in the rung, and the cursor moves to the next column.
5. Shunt/Open (F3) can also be used to replace an existing element or shunt already displayed in the rung. If you are replacing an element, position the cursor at the location of the element and select Shunt (F3). The element will be replaced by a shunt. If you are replacing a shunt, position the cursor at the location of the shunt and select Open (F3). The shunt will be deleted from the rung.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

VERT/OPEN

Available with: Series One (Model E) and Series One Plus

Symbology:

Operation:

VERT = Passes power flow.

OPEN = Does not pass power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Relay Sequence (F1) and then Vertical (F4). A vertical connector will appear in the rung.
5. Vertical (F4) can also be used to delete an existing vertical connector in the rung. Position the cursor on the location of the existing connector, and then select Vertical/Open (F4). The connector will be deleted from the rung.
6. Complete the logic for the rung; then press CTRL-A or the Accept'key. The Edit key functions reappear at the bottom of the screen.

SEQUENCER NORMALLY OPEN

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    xxx   K yyyy
---| |----STEP---

    or

    xxx   R yyy
---| |----STEP---
```

xxx = Counter reference (600-677)
K yyyy = K000-K9999
R yyy = see table 12.1

Operation:

- When the current value of the counter equals K yyyy or the contents of R yyy, the normally open contact passes power flow.
- When the current value of the counter does not equal K yyyy or the contents of R yyy, the normally open contact does not pass power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Relay Sequence (F1) and then Sequencer Normally Open (F5). The sequencer contact display will appear.
5. Using the numeric keypad, type in the reference for the counter (600-677) and press CTRL-E or the Enter key.
6. Then type in the reference for the STEP operand that specifies the counter accumulate value on which the power flow is to be propagated. After entering the reference, press either the C (for constants, K) or R (for registers) numeric keypad key and then press CTRL-E or the Enter key.
7. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: The normally open sequencer can be used to emulate an electromechanical drum or sequencer.

SEQUENCER NORMALLY CLOSED

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    xxx    K YYYY
---|/|----STEP---

      or

    xxx    R YYY
---|/|----STEP---
```

xxx = Counter reference (600-677)
K YYYY = K0000-K9999
R YYY = see table 12.1

Operation:

- When the current value of the counter equals K yyyy or the contents of R yyy, the normally open contact does not pass power flow.
- When the current value of the counter does not equal K yyyy or the contents of R yyy, the normally open contact passes power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Relay Sequence (F1) and then Sequencer Normally Closed (F6). The sequencer contact display will appear.
5. Using the numeric keypad, type in the reference for the counter (600-677) and press CTRL-E or the Enter key.
6. Then type in the reference for the STEP operand that specifies the counter accumulate value on which the power flow is to be propagated. After entering the reference, press either the C (for constants, K) or R (for registers) keypad key and then press CTRL-E or the Enter key.
7. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: The normally closed sequencer can be used to emulate an electromechanical drum or sequencer.

MASTER CONTROL START (MCS)

Available with: Series One (Model E) and Series One Plus

Symbology: -[MCS]-

Operation:

- When receiving power flow, the function is inactive.
- When not receiving power flow, the function turns off (disables) all coils between the MCS/MCR pair of functions.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function. Logic located before the MCS in the rung will execute normally, and not be affected by the MCS.
4. Select Special Instructions (F7) and then MCS (F1). The MCS disptay will appear.
5. Enter the logic to be controlled by the Master Control Relay function.

Note:

- Rungs under the control of the Master Control Relay function are identified by a double left power rail.
- To complete this function, you must enter an MCR.

MASTER CONTROL RESET (MCR)

Available with: **Series One (Model E) and Series One Plus**

Symbology: –[MCR]–

Operation: **Designates the end of the MCS field of control.**

Entry: **To enter the Master Control Relay function, select Special Instructions (F7) and then MCR (F2). The MCR display appears.**

Note:

- **To operate correctly, there must be an equal number of MCS and MCR functions in your program.**
- **The amount of logic controlled by the Master Control Relay function is limited only by the memory provided.**

RELAY COIL

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    XXX
---(   )
```

XXX = valid output or see table 12.1

Operation:

ON = Receiving power flow.

OFF = Not receiving power flow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. With the cursor at the location for the coil, enter the first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then Out (F7). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the coil. It may be any valid output. After entering the reference, press CTRL-E or the Enter key.
6. Press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: A real world output or internal coil should only be referenced once as a Relay Coil in user logic.

SET COIL

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    xxx
---(SET)
```

xxx = valid output or see table 12.1

Operation:

- Upon receiving power flow sets (or latches) output/internal coil reference.
- Reference remains set until the matching Reset function is enabled.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. With the cursor at the location for the coil, enter the first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then Set (F1). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the coil. It may be any valid output. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: A particular output or internal coil can be referenced numerous times with Set functions throughout user logic.

RESET COIL

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    xxx
---(RST)
```

xxx = valid output or see table 12.1

Operation: Upon receiving power flow resets (unlatches/turns off) output/internal coil reference.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing tung.
3. With the cursor at the location for the coil, enter the first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then Reset (F2). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the coil. It must be the same reference number used for its matching Set coil. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: A particular output or internal coil can be referenced numerous times with Reset functions throughout user logic.

SET OUT COIL

Available with: Series One (Model E) and Series One Plus

Symbology:

```
    XXX
---(SO )
```

xxx = valid output or see table 12.1

Operation: Similar to Relay Coil but not affected by the output disabler coil 376.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. With the cursor at the location for the coil, enter the first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then Set Out (F3). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the coil. it may be any valid output. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SET OUT RESET COIL (ONE SHOT)

Available with: Series One Plus

Symbology:

```
    XXX
---(SOR)
```

xxx = valid output or see table 12.1

Operation: Upon receiving power flow enables output/internal coil reference for one scan (sweep).

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. With the cursor at the location for the coil, enter the first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then Set Out Reset (F4). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the coil. It must be the same reference number used for its matching Set Out coil. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

TIMER

Available with: Series One (Model E) and Series One Plus

Symbology:

```
  R yyy T xxx
-[PRESC]-(TMR)-
     Of
```

R YYY = see **table 12.1**
T XXX = **timer accumulate** registers

```
 K YYYY T xxx
-[PRESC]-(TMR)-
```

K YYYY = K0000-K9999 (each unit = 0.1 **sec**)
T xxx = timer accumulate registers

Operation: Upon receiving power flow, times up to preset and becomes enabled.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Timer/Counter insert (F5) and then Timer (F1). The cursor moves to the ninth column.
5. To enter the preset constant, press the C key on the numeric keypad and enter a constant (00004999) for the preset. After entering the constant, press CTRL-E or the Enter key.
6. To enter a reference for the preset, enter any valid register reference. After entering the reference, press CTRL-E or the Enter key.
7. After the preset is entered, the cursor moves to column 10. Enter the reference for the timer accumulate register, and then press CTRL-E or the Enter key.
8. When the rung is complete, press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: Accumulate values are only shown in the Reference Tables display or within a nmemonic instruction, such as DATA STORE.

If power flow to the timer is interrupted or the CPU stops operating, the timer will reset to zero.

THUMBWHEEL TIMER

Available with: **Series One** (Model E) **and Series One Plus**

Symbology:

```
        T xxx
-[TH/WH]-(TMR)
```

PRESC read from thumbwheels
T XXX = timer accumulate registers

Operation:

- **Presets are read from the Thumbwheel interface Unit.**
- **Upon power flow, the timer times up to the preset and then becomes enabled.**

Entry:

1. **From the Supervisor menu, select Edit** Program **(F2). The Edit Program function keys will be displayed at the bottom of the screen.**
2. **Select either Insert Rung (F5)** or Edit **Rung (F6), depending upon whether you wish to begin a new rung or** edit **an existing rung.**
3. **Enter any logic required to control power flow to the function.**
4. **With the cursor at the location for the element, select Timer/Counter Insert (F5) and then Thumbwheel Timer (F3). The cursor moves to the tenth column.**
5. **Enter the reference for the timer accumulate register. After entering the reference, press CTRL-E or the Enter key.**
6. **When the rung is complete, press** CTRL-A or **the Accept key. The Edit key.functions reappear at the** bottom **of the screen.**

Note: **If power flow to the timer is interrupted or the CPU stops operating, the timer will reset to zero.**

COUNTER

Available with: Series One (Model E) and Series One Plus

Symbology:

```
  R yyy C xxx
-[PRESC]-(CNT)-
```

R yyy = see table 12.1
c xxx = counter accumulate registers

Of

```
 K yyyy C xxx
-[PRESC]-(CNT)-
```

K yyyy = K0000-K9999 (each unit = 0.1 sec)
c xxx = counter accumulate registers

Operation: Upon transition from no power flow to power flow, the counter's current value is incremented. When the current value equals preset value, the function becomes enabled. When reset leg receives power flow, the current value is set to zero.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Timer/Counter Insert (F5) and then Counter (F2). The cursor moves to the ninth column.
5. To enter the preset constant, press the C key on the numeric keypad and enter a constant (0000-9999) for the preset. After entering the constant, press CTRL-E or the Enter key.
6. To enter a reference for the preset, enter any valid register reference. After entering the reference, press CTRL-E or the Enter key.
7. After the preset is entered, the cursor moves to column 10. Enter the reference for the counter accumulate register, and then press CTRL-E or the Enter key.
8. When the rung is complete, press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: The counter is retentive upon loss of CPU power.

THUMBWHEEL COUNTER

Available with: Series One (Model E) and Series One Plus

Symbology:

```
          C xxx
-[TH/WH]-(CNT)-
          (   )
---------(   )
```

PRESC read from thumbwheels
T xxx = counter accumulate registers

Operation:

- Presets are read from the Thumbwheel interface Unit.
- Upon transition from no power flow to power flow, the counter's current value is incremented. When the current value equals preset value, the function becomes enabled. When reset leg receives power flow, the current value is set to zero.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. With the cursor at the location for the element, select Timer/Counter Insert (F5) and then Thumbwheel Counter (F4). The cursor moves to the tenth column.
5. Enter the reference for the counter accumulate register, and then press CTRL-E or the Enter key.
6. When the rung is complete, press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: The counter is retentive upon loss of CPU power.

HIGH SPEED COUNTER

Available with: Series One (Model E) and Series One Pius

Symbology:

R *yyy* C *xxx*
-[PRESC]-(HSC)-

R YYY = register where preset resides
c xxx = C100-C107

Of

K yyyy C xxx
-[PRESC]-(HSC)-

K YYYY = K0000-K9999 preset value
c xxx = C100-C107

Operation:

- The High Speed Counter instruction is used to specify a hardware counter that exists in the High Speed Counter module and the preset value for that counter.
- Upon power flow, the preset value is sent to the High Speed Counter module or ,a counter reset is sent, depending on the counter specified.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the' first line of logic, which ends at the coil. Additional lines of logic may also be entered now.
4. Select Coils (F2) and then High Speed Counter (F6). The coil display will appear in the tenth column.
5. Using the numeric keypad, type in the reference for the contact. It may be any valid output. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: For more information on High Speed Counters, refer to GEK-90842, *Series One and Series One Plus User's Manual.*

SHIFT REGISTER

Available with: Series One (Model E) and Series One Plus

Symbology:

```
                          xxx   yyy   zzz   aaa bbb
-[ SHIFT REGISTER DATA CLOCK RESET START STOP ]-
```

xxx, yyy, zzz = 000-157 I/O points
700-777 I/O points
160-377 internal I/O
400-577 shift registers
600-677 T/C accumulate registers

aaa = 400-577 shift registers

bbb =

Operation: Each time the CLOCK operand is enabled:

- The status of each I/O point in the START shift register will shift one position towards the STOP reference.
- A status is moved into the shift register at the START reference from the DATA operand.
- When the RESET operand is enabled, all of the coils between the START and STOP shift registers are disabled.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Select Coils (F2) and then Shift Register (F5). The coil display will appear in the tenth column.
4. Using the numeric keypad, type in the reference for the contact. It may be any valid output. After entering the reference, press CTRL-E or the Enter key.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: For more information on Shift Registers, refer to GEK-90842, *Series One and Series One Plus User's Manual.*

CHAPTER 13
DATA OPERATION INSTRUCTIONS FOR THE SERIES ONE PLUS PLC

in addition to the basic ladder diagram functions, the Series One Pius PLC has a group of instructions that include data moves, math functions, logic operations, conversion, and external fault diagnosis. These instructions provide the Series One Plus PLC with the capability of performing various data operations. The instructions operate on multiple bits, rather than one bit at a time, and are available only with the Series One Plus PLC.

This chapter contains the following sections:

Section I. Data Operations: Section 1 describes how to use data operation instructions to program the Series One Plus PLC.

Section 2. Data Move Operations: Sect ion 2 covers the Data Move functions available in the Series One Plus PLC.

Section 3. Arithmetic Operations: Section 3 covers the Math functions available in the Series One Plus PLC.

Section 4. Logic Operations: Section 4 covers the Logic operations available in the Series One Plus PLC.

SECTION 1
DATA OPERATIONS

Data Operation Instructions require that the data being operated on first be loaded or stored into a 16-bit register called the accumulator. The data (numerical value) is processed in the CPU as BCD (Binary Coded Decimal). Each BCD value is represented by 4 corresponding bits in the accumulator. A BCD value can be any of the digits 0000 through 9999. When the specified operation is performed with the contents of the accumulator, the result of the operation is stored in the accumulator. This data can then be transferred to external outputs, or stored internally to be used as needed. Additionally, data can be stored in registers (sixty-four 16-bi t registers) and those registers referenced when programming the data operations. Each register can contain a 4-digit BCD number. Figure 13.1 below illustrates how these data operations are performed.

TPK.A.40848

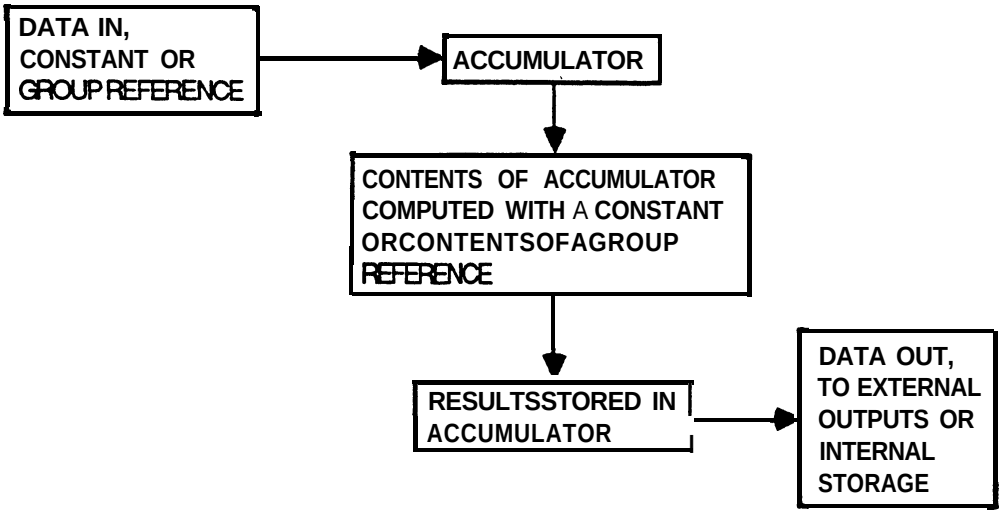


Figure 13.1 DATA OPERATIONS FLOW CHART

Registers and the accumulator may also contain binary data; however, arithmetic funtions cannot be performed until the binary values are converted to BCD.

The contents of the accumulator do not change until new data is loaded into it with a Data Store operation, or a computation takes place and the result is stored in the accumulator.

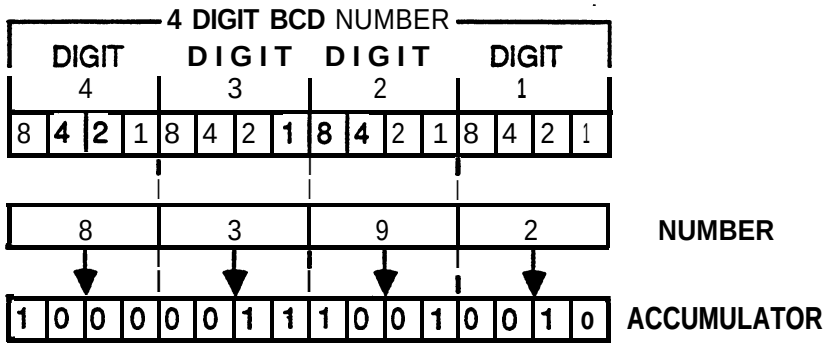
USING REFERENCES FOR DATA OPERATIONS

When entering an instruction for a data operation, the instruction is first specified, then the data. The data can be a constant value or a group reference that contains the data to be used.

Entering a Constant Value

When a constant (4-digit BCD number) is entered as the data value, the bits of the BCD numbers will be stored in the corresponding position in the accumulator. The least significant digit is stored in the lower 4 bits of the accumulator, and the most significant digit is stored inthe upper 4 bits of the accumulator.

TPK.A.42179



Entering a Group Reference

I/O points, internal coils, and shift registers are treated as 8-bit registers when programming data operations. The references are then referred to as group references. By selecting the R key before a value, that value is operated on as an 8-bit or 16-bit register. For example, R15 actually references 8 consecutive I/O points, 150 to 157. This is a convenient way of reading in data to the accumulator from input modules, or writing data from the accumulator to output modules for use as required by the user program. Certain instructions operate on 16 bits, in those cases the data will be read from or written to 16 consecutive references (one 16 circuit module or 2 adjacent 8 circuit modules). The group reference number for the references mentioned above can be either 1 or 2 digits.

DATA REGISTER REFERENCES

Data registers ate referenced as 3-digit octal values with a valid range from 400 to 577. Although each individual register actually refers to one 8-bit byte, most registers are operated on as 16-bit words (2 consecutive registers). For example, if the key sequence R402 is entered, the data operation uses data registers 402 and 403. If a 4-digit BCD value (for example 1234) were entered into the register, register 402 would contain the 2 least significant digits (34) and 403 the 2 most significant digits (12). A useful feature of the registers is that they can contain a value to be used as the preset for timers or counters.

TIMER/COUNTER REFERENCES

The timer/counter references are also 3-digit octal values. Each of the timer/counter references represent a 16-bit register. Valid range for the timer/counter references is 600 to 677. These registers contain the accumulated value of a timer or counter.

NOTE

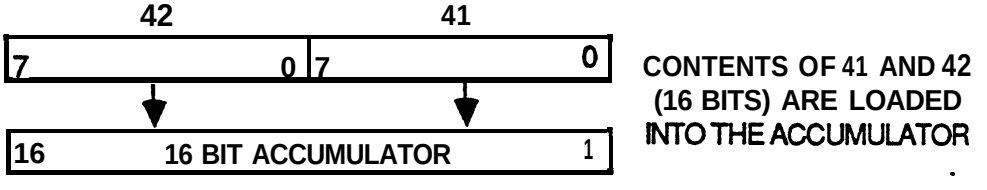
The timer/counter accumulated value is not the same as the accumulator read to or written from when programming a data operation.

Specifying a Group Reference

An example of specifying a group reference and how it relates to the accumulator is shown below.

Example: Reference specified is 41 .

TPK.A.42156



Discrete bit 410 will be stored in the first position of the accumulator; discrete bit 427 will be stored in the last position (16) of the accumulator.

SPECIAL FUNCTION COILS

Six special purpose internal coils are used in the Series One Plus PLC to indicate certain conditions that may occur when some of the data operations are performed. When these conditions occur, the applicable coil is turned on as a "flag" or indicator that the condition has occurred. These coils can be included in your program as conditional contacts to turn on an output or perform some function to indicate that a flag is on. These special purpose coils are listed below:

Coil Reference	Flag Indication
772	Greater than (>)
773	Equal to (=)
774	Less then (<)
775	Carry or Borrow
776	Zero
777	Overflow

SECTION 2
DATA MOVE OPERATIONS

This section is a reference to the Data Move operations:

- **Data Store 0 (Function 50)**
- **Data Store 1 (Function 51)**
- **Data Store 2 (Function 52)**
- **Data Store 3 (Function 53)**
- **Data Store 5 (Function 55)**
- **Data Out 0 (Function 60)**
- **Data Out 1 (Function 61)**
- **Data Out 2 (Function 62)**
- **Data Out 3 (Function 63)**
- **Data Out 5 (Function 65)**
- **External Fault (Function 20)**

Table 13.1 below lists the valid references for the Data Move operations described in this sect ion.

Table 13.1 REFERENCE RANGES FOR DATA MOVE OPERATIONS

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Data Store 0	K xxxx R yyy -|D-STR0 FUN 50|-	K xxxx = K0000-K9999 yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Register Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers
Data Store 1	R yyy -|D-STR1 FUN 51|-	R YYY = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers
Data Store 2	R yyy -|D-STR2 FUN 52|-	R YYY = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers

Table 13.1 (cont.) REFERENCE RANGES FOR DATA MOVE OPERATIONS

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Data Store 3	R YYY -|D-STR3 FUN 53|-	R YYY = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers
Data Store 5	R yyy -|D-STR5 FUN 55|-	R yyy = R000-R005 16-Point Input Module
Data Out 0	R yyy -|D-OUT0 FUN 60|-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Register Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers
Data Out 1	R YYY -|D-OUT1 FUN 61|-	R YYY = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers
Data Out 2	R yyy -|D-OUT2 FUN 62|-	R yyy = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers
Data Out 3	R YYY -|D-OUT3 FUN 63|-	R YYY = R000-R015 I/O Points R070-R076 I/O Points R016-R037 Internal Coils R040-R057 Shift Register Coils R400-R577 Data Registers
Data Out 5	R yyy -|D-OUT5 FUN 65|-	R yyy = R000-R005 16-Point Output Module
Ext. Fault Diagnostics	K xxxx R YYY -[EX FIT FUN 20]-	K xxxx = K0000-K9999 R YYY = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Inernal Coils R040-R056 Shift Register Coils R400-R576 Data Registers

DATA STORE 0 (FUNCTION 50)

Available with: Series One Plus

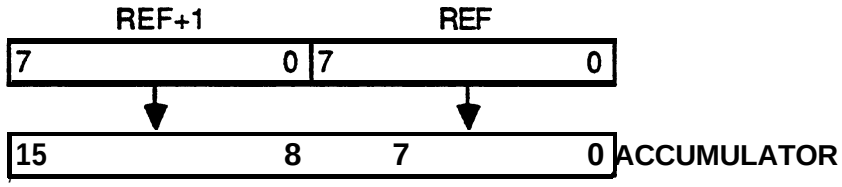
Symbology:

```
  K xxxx
  R yyy
-| D-STRO FUN 50|-
```

K xxxx = 0000-9999
R yyy = see table 13.1

Operation: Loads the accumulator with a 4-digit BCD constant or the contents of a specified Z-byte reference.

TPK.A.42157



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Data Move (F4) and then Data Store 0 - Function 50 (F1). The display will appear in the rung.
5. Using the numeric keypad, type in the reference. To enter a constant, press the C key on the numeric keypad and enter a constant value (00009999). To enter a reference, enter any valid register reference. After entering the reference, press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA STORE I (FUNCTION 51)

Available with: Series One Plus

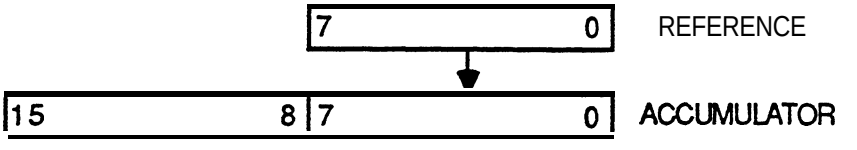
Symbology:

```
   R yyy
-|D-STR1 FUN 51 |-
```

R yyy = see table 13.1

Operation: Loads the lower 8 bits of the accumulator with the contents of a specified 1-byte reference. The upper 8 bits (8–15) will be zeros.

TPK.A.42158



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Data Move (F4) and then Data Store 1 – Function 51 (F3). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL–E or the Enter key.
6. Complete the logic for the rung; then press CTRL–A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA STORE 2 (FUNCTION 52)

Available with: Series One Plus

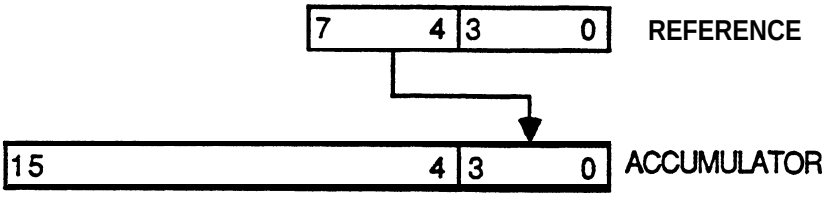
Symbology:

```
 R yyy
-ID-STR2 FUN 52|-
```

R yyy = see table 13.1

Operation: Loads the lower 4 bits of the accumulator with the upper 4 bits of a specified 1-byte reference.

TPK.A.42159



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Data Move (F4) and then Data Store 2 – Function 52 (F5). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA STORE 3 (FUNCTION 53)

Available with: Series One Plus

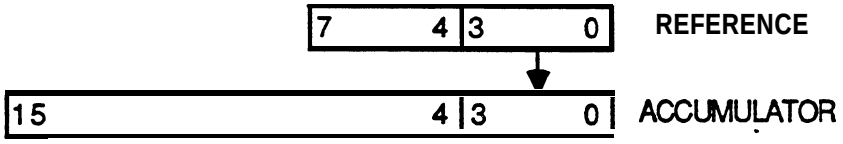
Symbology:

```
  R yyy
-ID-STR3 FUN 53|-
```

R yyy = see table 13.1

Operation: Loads the lower 4 bits of the accumulator with the lower 4 bits of a specified l-byte reference.

TPK.A.42160



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Logic (F6) and then Data Store 3 – Function 53 (F6). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA STORE 5 (FUNCTION 55)

Available with: Series One Plus

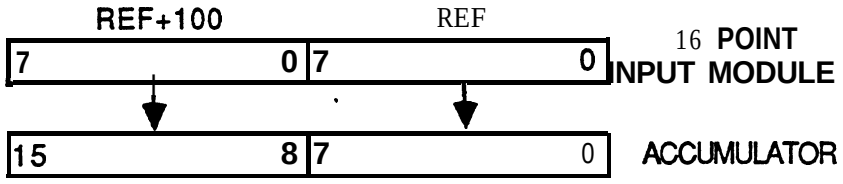
Symbology:

```
  R YYY
-|D-STR5 FUN 55|-
```

R YYY = see table 13.1

Operation: Loads the accumulator with a BCD value from the Z-byte contents of a 16-circuit input module.

TPK.A.42161



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Special Instructions (F7) and then Data Store 5 - Function 55 (F6). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: This function is used only with Series One Plus 16-point modules. Refer to GEK-90842, *Series One and Series One Plus User's Manual*, for more information.

DATA OUT 0 (FUNCTION 60)

Available with: Series One Plus

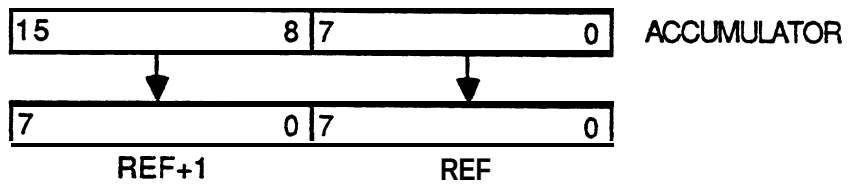
Symbology:

```
  R yyy
-|D-OUT0 FUN 60|-
```

R yyy = see table 13.1

Operation: Transfers the contents of the accumulator (16 bits) to a specified 2-byte (group) reference (Output, Internal Relay, Shift Register coils, Data Registers or Timer/Counter accumulate value register).

TPK.A.42162



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Data Move (F4) and then Data Out 0 – Function 60 (F2). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA OUT 1 (FUNCTION 61)

Available with: Series One Plus

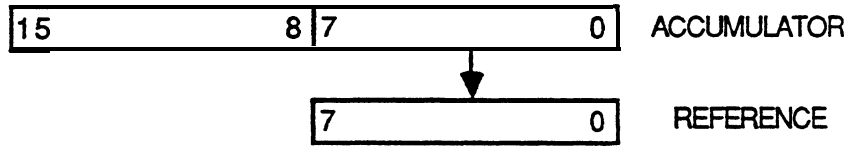
Symbology:

```
   R yyy
-|D-OUT1 FUN 61 |-
```

R YYY = see table 13.1

Operation: Writes the contents of the first 8 bits (O-7) of the accumulator to a specified reference.

TPK.A.42163



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Data Move (F4) and then Data Out 1 - Function 61 (F4). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA OUT 2 (FUNCTION 62)

Available with: Series One Plus

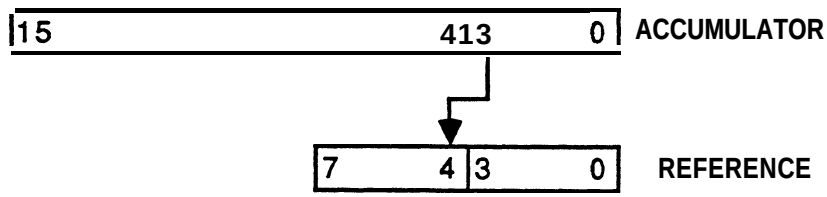
Symbology:

```
   R yyy
-| D-OUT2 FUN 62 |-
```

R yyy = see table 13.1

Operation: Writes the contents of the lower (first) 4 bits of the accumulator to the upper 4 bits of a specified reference.

TPK.A.42164



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic requiredto control power flow to the function.
4. Select Data Move (F4) and then Data Out 2 – Function 62 (F6). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA OUT 3 (FUNCTION 63)

Available with: Series One Plus

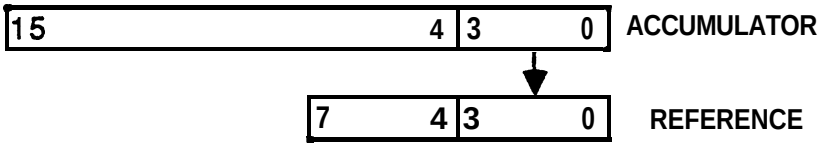
Symbology:

```
   R YYY
-| D-OUT3 FUN 63|-
```

R YYY = see table 13.1

Operation: Writes the contents of the lower 4 bits of the accumulator to the lower 4 bits of a specified reference.

TPK.A.42165



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Logic (F6) and then Data Out 3 - Function 63 (F7). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA OUT 5 (FUNCTION 65)

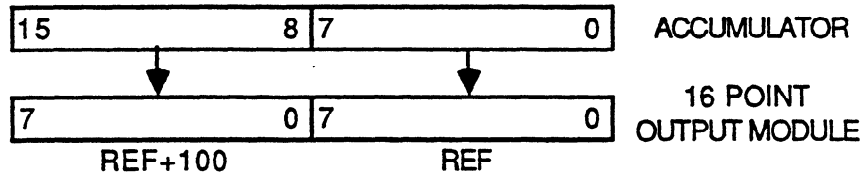
Available with: Series One Plus

Symbology:

```
  R yyy                          R yyy =   see table 13.1
-|D-OUT5 FUN 65|-
```

Operation: Writes the contents of the accumulator to a 2-byte reference which must be a 16-circuit output module.

TPK.A.42181



Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Special Instructions (F7) and then Data Store 5 - Function 55 (F6). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

Note: This function is used only with Series One Plus 16-point modules. Refer to GEK-90842, *Series One User's Manual*, for more information.

EXTERNAL FAULT DIAGNOSTICS (FUNCTION 20)

Available with: Series One Plus

Symbology:

```
   K xxxx                    K xxxx =   K0000-K9999
   R yyy                     R yyy  =   see table 13.1
-[ EX FLT FUN 20 ]-
```

Operation: Monitors external devices for unwanted conditions, such as switches that should not be on at the same time.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Special Instructions (F7) and then External Fault - Function 20 (F3). The display will appear in the rung.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SECTION 3
ARITHMETIC OPERATIONS

This section is a reference to the Arithmetic operations:

- Compare (Function 70)
- Add (Function 71)
- Subtract (Function 72)
- Multiply (Function 73)
- Divide (Function 74)

Table 13.2 on the following page lists the valid references for the Arithmetic operations described in this section.

Table 13.2 REFERENCE RANGES FOR ARITHMETIC OPERATIONS

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Compare	R yyy K xxxx -[CMPR FUN 70]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift REgister Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Add (BCD)	R yyy K xxxx -[ADD FUN 71]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Register Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Subtract (BCD)	R yyy K xxxx -[SUB FUN 72]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Register Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Multiply (BCD)	R yyy K xxxx -[MPY FUN 73]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift REgister Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Divide (BCD)	R yyy K xxxx -[DIV FUN 74]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Register Coils R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999

COMPARE (FUNCTION 70)

Available with: Series One Plus

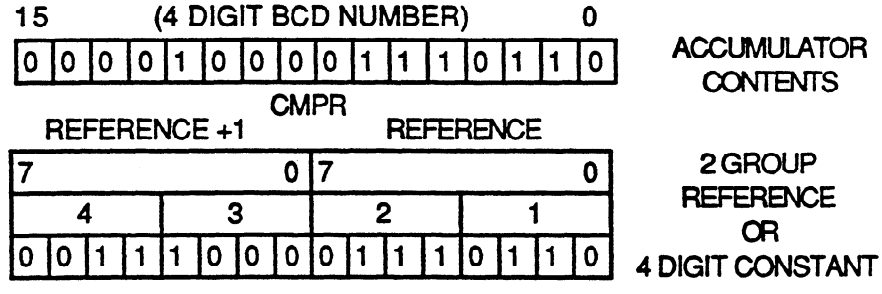
Symbology:

```
  R yyy
  K xxxx
-[ CMPR FUN 70 ]-
```

```
R yyy =     see table 13.2
K xxxx = K0000-K9999
```

Operation: Compares the contents of a specified 2-group reference, or a 4-digit BCD constant, to the contents of the accumulator.

TPK.A.42166



- If the contents of the accumulator is greater than the contents of the reference, then coil reference 772 turns on.
- If the contents of the accumulator is equal to the contents of the reference, then coil reference 773 turns on.
- If the contents of the accumulator is less than the contents of the reference, then coil reference 774 turns on.

COMPARE (FUNCTION 70) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then Compare - Function 70 (F5). The Compare display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

ADD (FUNCTION 71)

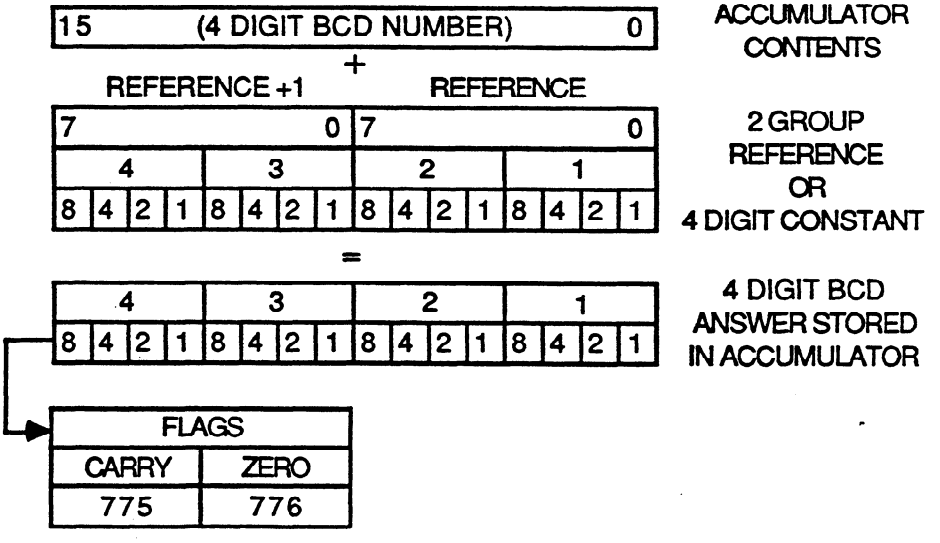
Available with: Series One Plus

Symbology:

```
  R yyy                    R yyy  =    see table 13.2
  K xxxx                   K xxxx = K0000-K9999
-[ ADD FUN 71]-
```

Operation: Adds the contents of a specified 2-group reference, or a 4-digit BCD constant, to the contents of the accumulator. The result of the addition is stored in the accumulator as a 4-digit BCD number.

TPK.A.42167



- If the result is greater than 9999, the carry flag (internal coil 775) will turn on.
- If the result is equal to 0000, the zero flag 776 will turn on.
- If the result is less than 9999 and the 4 BCD digits are 0000, both the carry and zero flags (775 and 776) will turn on.

ADD (FUNCTION 71) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.

2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.

3. Enter any logic required to control power flow to the function.

4. Select Arithmetic (F3) and then Add - Function 71 (F1). The Addition display appears.

5. Enter a valid register reference, and press CTRL-E or the Enter key.

6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SUBTRACT (FUNCTION 72)

Available with: Series One Plus

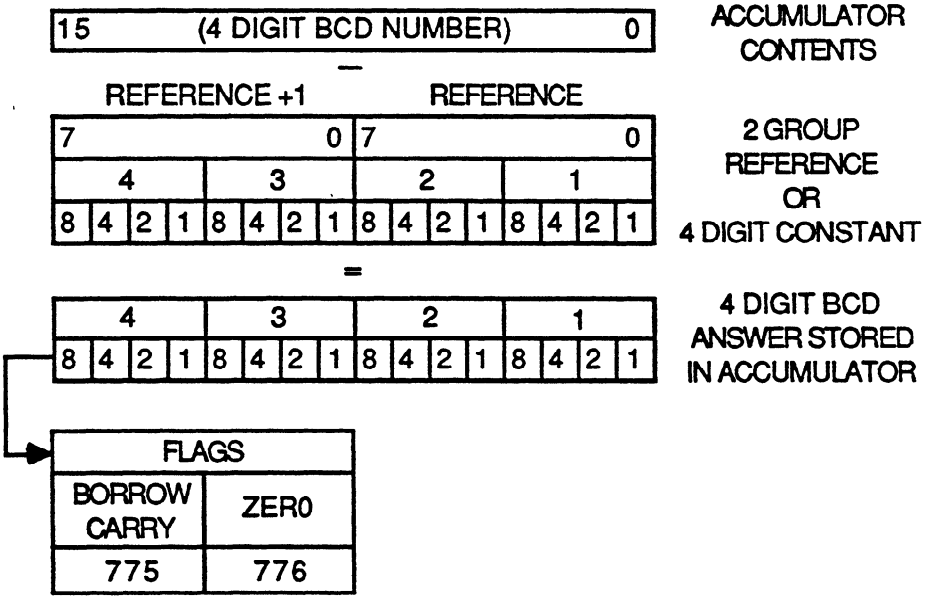
Symbology:

```
  R yyy
  K xxxx
-[ SUB FUN 72 ]-
```

R yyy = see table 13.2
K xxxx = K0000-K9999

Operation: Subtracts the contents of a specified 2-group reference, or a 4-digit BCD constant, from the contents of the accumulator.

TPK.A.42168



- If the result is positive, it is written directly to the accumulator.
- If the result is negative, the borrow flag (internal coil 775) turns on, the absolute value is subtracted from 10000, and the resulting value is written to the accumulator.
- If the result is equal to 0000, the zero flag (internal coil 776) turns on.

SUBTRACT (FUNCTION 72) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then Subtract - Function 72 (F2). The Subtraction display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

MULTIPLY (FUNCTION 73)

Available with: Series One Plus

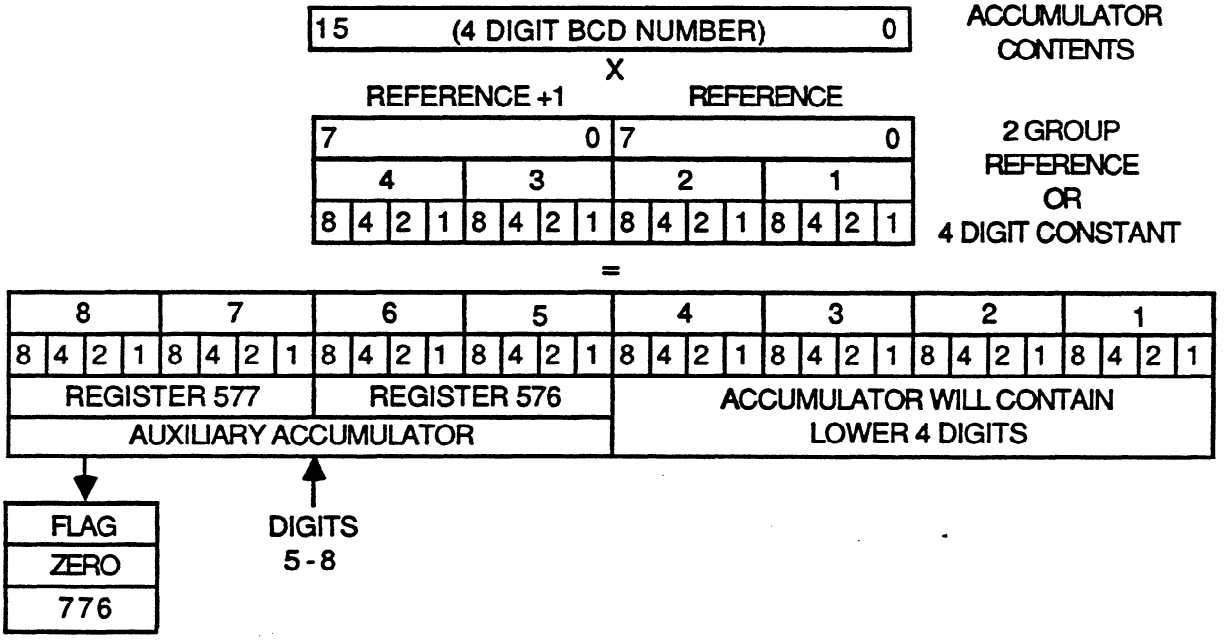
Symbology:

```
  R yyy
  K xxxx
-[ MPY FUN 73 ]-
```

R yyy = see table 13.2
K xxxx = K0000-K9999

Operation: The contents of the acumulator are multiplied by the contents of a specified 2-group reference or a 4-digit BCD constant. The answer can be from 1 to 8 digits.

TPK.A.42169



- The lower 4 digits of the result are stored in the acccumulator.
- Digits 5–8 are stored in data registers 576 and 577, which are the auxiliary accumulator.
- If the result is equal to zero, the zero flag (internal coil 776) will turn on.

MULTIPLY (FUNCTION 73) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then Multiply - Function 73 (F3). The Multiplication display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DIVIDE (FUNCTION 74)

Available with: Series One Plus

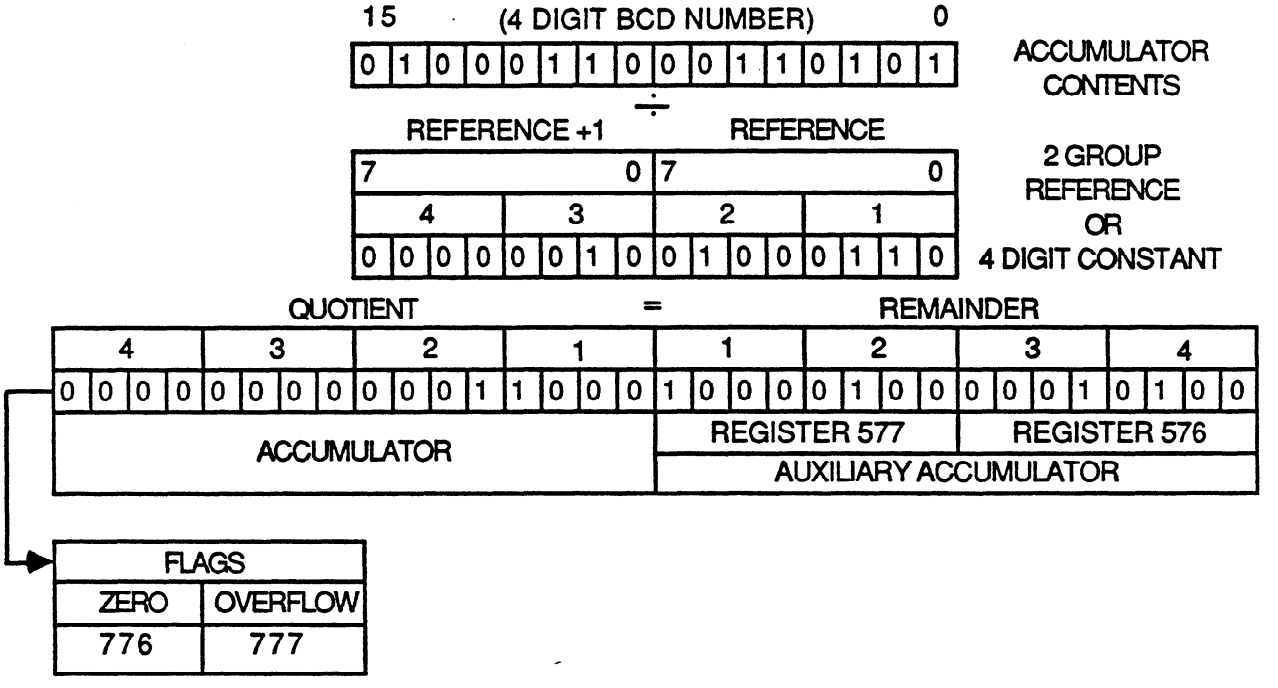
Symbology:

```
  R yyy
  K xxxx
-[ DIV FUN 74 ]-
```

R yyy = see table 13.2
K xxxx = K0000-K9999

Operation: The contents of the accumulator are divided by the contents of a specified 2-group reference or a 4-digit BCD constant.

TPK.A.42170



- The 4 digits of the quotient are stored in the acccumulator.
- The 4 digits of the remainder are stored in the auxiliary accumulator (data registers 576 and 577).
- If either the dividend or divisor is zero, the zero flag (internal coil 776) will turn on. If the divisor is zero, the overflag flag (777) will also turn on.

DIVIDE (FUNCTION 74) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then Divide - Function 74 (F4). The Division display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SECTION 4
LOGIC OPERATIONS

This section is a reference to the Logic operations:

- Data And (Function 75)
- Data Or (Function 76)
- Shift Right (Function 80)
- Shift Left (Function 81)
- Decode (Function 82)
- Encode (Function 83)
- Invert (Function 84)
- BCD to Binary (Function 85)
- Binary to BCD (Function 86)

Table 13.3 below lists the valid references for the Logic operations described in this section.

Table 13.3 REFERENCE RANGES FOR LOGIC OPERATIONS

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Data And	R yyy K xxxx -[D-AND FUN 75]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Registers R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Data Or	R yyy K xxxx -[D-OR FUN 76]-	R yyy = R000-R014 I/O Points R070-R075 I/O Points R016-R036 Internal Coils R040-R056 Shift Registers R400-R576 Data Registers R600-R677 T/C Accumulated Value Registers K xxxx = K0000-K9999
Shift Right 8 Bits	K xxxx -[SHF RT FUN 80]-	K xxxx = 1-16
Shift Left 8 Bits	K xxxx -[SHF LF FUN 81]-	K xxxx = 1-16

Table 13.3 REFERENCE RANGES FOR LOGIC OPERATIONS

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Decode	-|DECODE FUN 82|-	
Encode	-|ENCODE FUN 83|-	
Invert	-|INVERT FUN 84|-	
BCD to Binary	-|BCDBIN FUN 85|-	
Binary to BCD	-|BINBCD FUN 86|-	

DATA AND (FUNCTION 75)

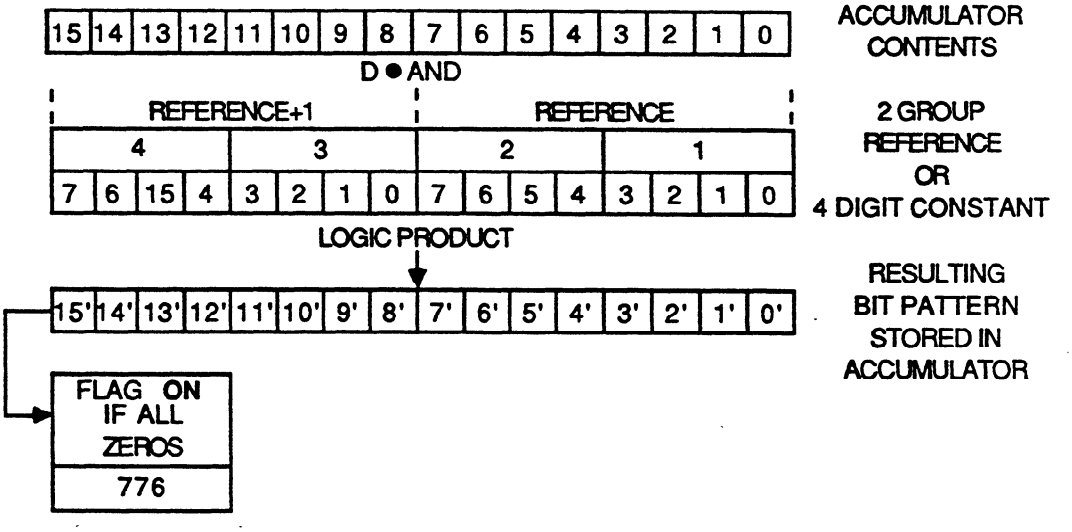
Available with: Series One Plus

Symbology:

```
  R yyy                          R yyy  =   see table 13.3
  K xxxx                         K xxxx =   K0000-K9999
-[ D-AND FUN 75 ]-
```

Operation: The contents of the accumulator are logically bit AND-ed with the contents of a specified 2-group reference or a 4-digit BCD constant. The result is stored in the accumulator.

TPK.A.42182



If the answer is zero, the zero flag (internal coil 776) will turn on.

TRUTH TABLE FOR DATA AND OPERATION

ACCUMULATOR		K or R NUMBER		ACCUMULATOR RESULT
	and		=	
0	and	0	=	0
0	and	1	=	0
1	and	0	=	0
1	and	1	=	1

DATA AND (FUNCTION 75) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Logic (F6) and then D-AND - Function 75 (F1). The Logical AND display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

DATA OR (FUNCTION 76)

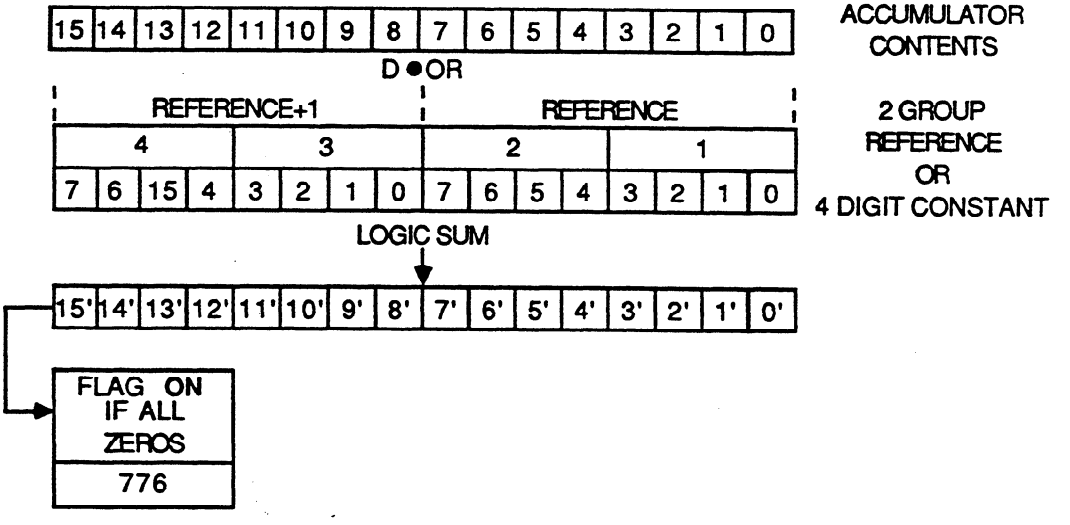
Available with: Series One Plus

Symbology:

```
  R yyy                          R yyy =    see table 13.3
  K xxxx                         K xxxx =   K0000-K9999
-[ D-OR FUN 76 ]-
```

Operation: The contents of the accumulator are logically bit OR-ed with the contents of a specified 2-group reference or a 4-digit BCD constant. The result is stored in the accumulator.

TPK.A.42183



If the answer is zero, the zero flag (internal coil 776) will turn on.

TRUTH TABLE FOR DATA AND OPERATION

ACCUMULATOR		K or R NUMBER		ACCUMULATOR RESULT
	and		=	

ACCUMULATOR		K or R NUMBER		ACCUMULATOR RESULT
0	and	0	=	0
0	and	1	=	1
1	and	0	=	1
1	and	1	=	1

DATA OR (FUNCTION 76) (Continued)

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Logic (F6) and then D-OR - Function 76 (F2). The Logical OR display appears.
5. Enter a valid register reference, and press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SHIFT RIGHT (FUNCTION 80)

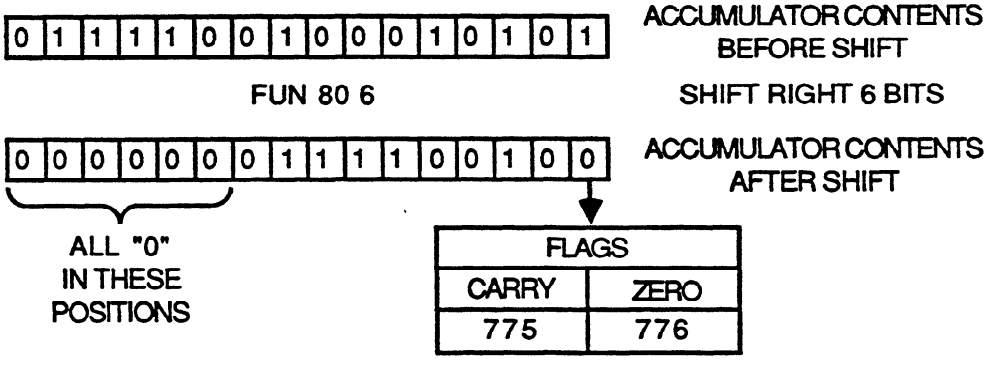
Available with: Series One Plus

Symbology:

```
   K xxxx                          K xxxx =   1-15
-[ SHF RT FUN 80 ]-
```

Operation: Shifts the contents of the accumulator 1 to 15 bits to the right. The bit positions left vacant are now filled with zeros.

TPK.A.42171



- If a 1 is shifted out of the accumulator as a result of the shift, the carry flag (internal coil 775) will turn on.
- If the accumulator contains only zeros after the shift, the zero flag 776 will turn on.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Logic (F6) and then Shift Right - Function 80 (F4). The Shift Right display appears.
5. Using the numeric keypad, press the C key and enter the constant value (1-15). Then press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

SHIFT LEFT (FUNCTION 81)

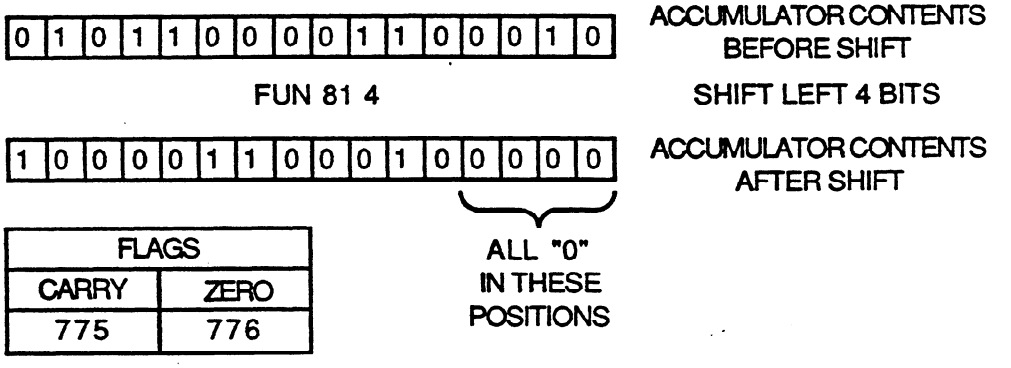
Available with: Series One Plus

Symbology:

```
   K xxxx                          K xxxx =    1-15
-[ SHF LF FUN 81 ]-
```

Operation: Shifts the contents of the accumulator 1 to 15 bits to the left. The bit positions left vacant are now filled with zeros.

TPK.A.42172



FLAGS	
CARRY	ZERO
775	776

- If a 1 is shifted out of the accumulator as a result of the shift, the carry flag (internal coil 775) will turn on.
- If the accumulator contains only zeros after the shift, the zero flag 776 will turn on.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Logic (F6) and then Shift Left - Function 81 (F5). The Shift Left display appears.
5. Using the numeric keypad, press the C key and enter the constant value (1-15). Then press CTRL-E or the Enter key.
6. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

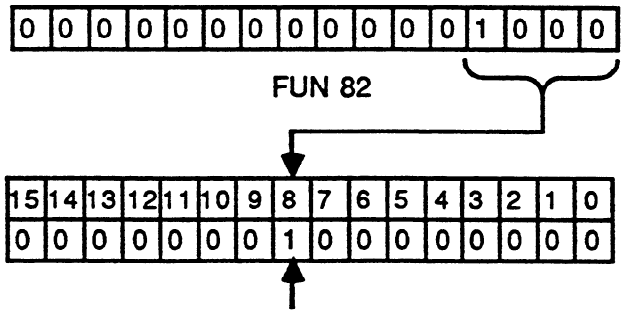
DECODE (FUNCTION 82)

Available with: Series One Plus

Symbology: -|DECODE FUN 82|-

Operation: Converts the lower four bits (least significant) of the accumulator to a decimal number from 0 to 15. A "1" is placed in the bit position in the accumulator that corresponds to the decoded decimal number. The upper 12 bits of the accumulator are disregarded for this operation.

TPK.A.42173



LOWER 4 BITS OF ACCUMULATOR CONTAIN 1 BCD DIGIT

WHICH IS DECODED TO A DECIMAL NUMBER

A "1" WILL BE PLACED IN THE ACCUMULATOR POSITION CORRESPONDING TO THAT DECIMAL NUMBER. ALL OTHER POSITIONS WILL CONTAIN ZEROS.

If the BCD digit to be decoded is an 8, a "1" will be placed in the accumulator at that position, as shown above.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Special Instructions (F7) and then Decode - Function 82 (F4). The Decode display appears.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

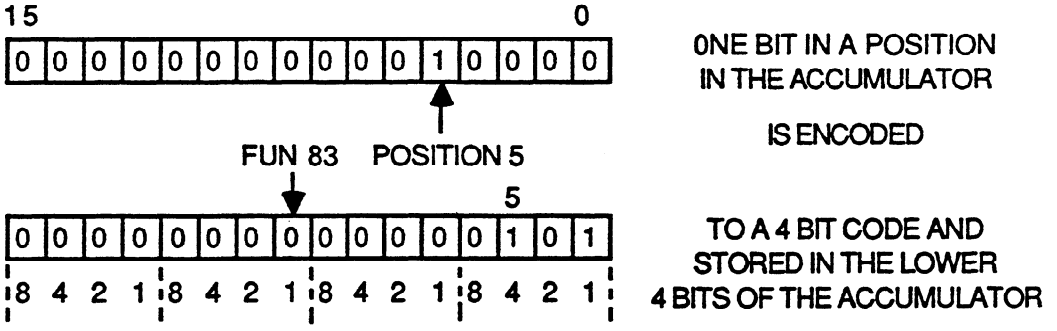
ENCODE (FUNCTION 83)

Available with: Series One Plus

Symbology: -|ENCODE FUN 83|-

Operation: Encodes the least significant bit that is TRUE (1) in the accumulator to a 4-bit binary number and puts it in the least significant byte of the accumulator.

TPK.A.42174



The upper 12 bits of the accumulator will contain zeros after the function has been executed.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Special Instructions (F7) and then Encode - Function 83 (F5). The Encode display appears.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

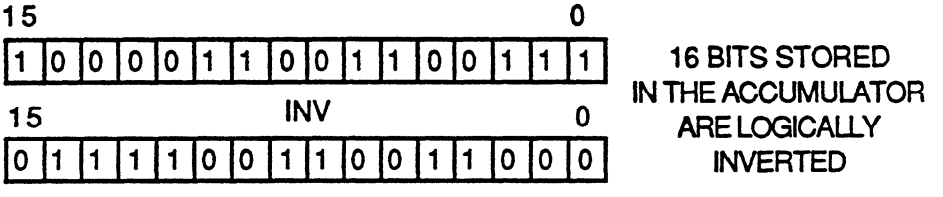
INVERT (FUNCTION 84)

Available with: Series One Plus

Symbology: -|INVERT FUN 84|-

Operation: Logically inverts 16 bits of the accumulator; i.e., 1 to 0 and 0 to 1.

TPK.A.42175



The upper 12 bits of the accumulator will contain zeros after the function has been executed.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter the logic required to control power flow to the function.
4. Select Logic (F6) and then Invert - Function 84 (F3). The Invert display appears.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reappear at the bottom of the screen.

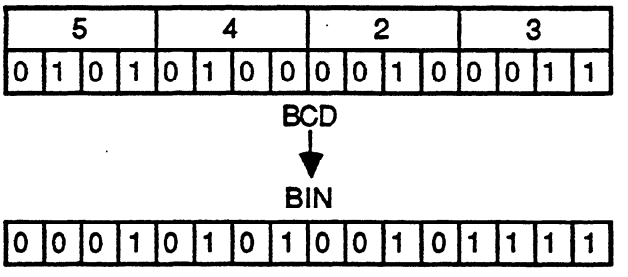
BCD TO BINARY (FUNCTION 85)

Available with: Series One Plus

Symbology: -|BCDBIN FUN 85|-

Operation: Converts the BCD value stored in the accumulator to a binary code corresponding to that value.

TPK.A.42176



4 BCD NUMBERS STORED IN ACCUMULATOR ARE CONVERTED TO A BINARY CODE

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then BCDBIN - Function 85 (F6). The BCD to Binary Conversion display appears.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reqppear at the bottom of the screen.

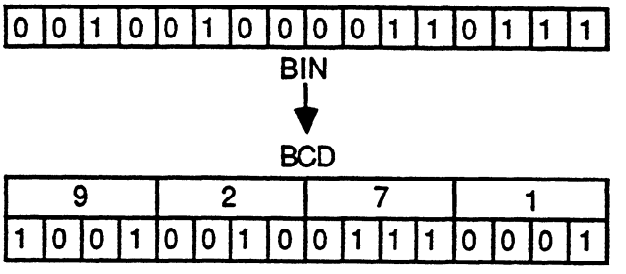
BINARY TO BCD (FUNCTION 86)

Available with: Series One Plus

Symbology: -|BINBCD FUN 86|-

Operation: Converts the binary code stored in the accumulator to a 4-digit BCD value.

TPK.A.42177



BINARY CODE STORED IN THE ACCUMULATOR IS CONVERTED TO A 4 DIGIT BCD NUMBER

FLAG
OVERFLOW
777

If the resulting BCD value is greater than 9999, the overflow flag (internal coil 777) will turn on. The flag coil can be used to turn on an output device as an indication of the overflow.

Entry:

1. From the Supervisor menu, select Edit Program (F2). The Edit Program function keys will be displayed at the bottom of the screen.
2. Select either Insert Rung (F5) or Edit Rung (F6), depending upon whether you wish to begin a new rung or edit an existing rung.
3. Enter any logic required to control power flow to the function.
4. Select Arithmetic (F3) and then BINBCD Function 86 (F7). The Binary to BCD Conversion display appears.
5. Complete the logic for the rung; then press CTRL-A or the Accept key. The Edit key functions reqppear at the bottom of the screen.

APPENDIX A
SETUP INFORMATION

The following pages provide information needed to connect the Workmaster computer and other computers to the Series One or Series One Plus PLC and peripherals, such as an external disk drive or printer. Included are port pin-outs, vendor part numbers for connectors and cables (GE Fanuc - NA cable numbers where applicable), and wiring diagrams.

This appendix contains the following sections:

Section 6. Using Modems: Section 6 explains how to connect and use modems with Logicmaster 1F software.

Section 7. Multidrop Configuration: The Logicmaster 1F system supports multidrop configuration up to eight CPUs and DCUs. Section 7 explains the hardware required and provides a cable drawing.

NOTE

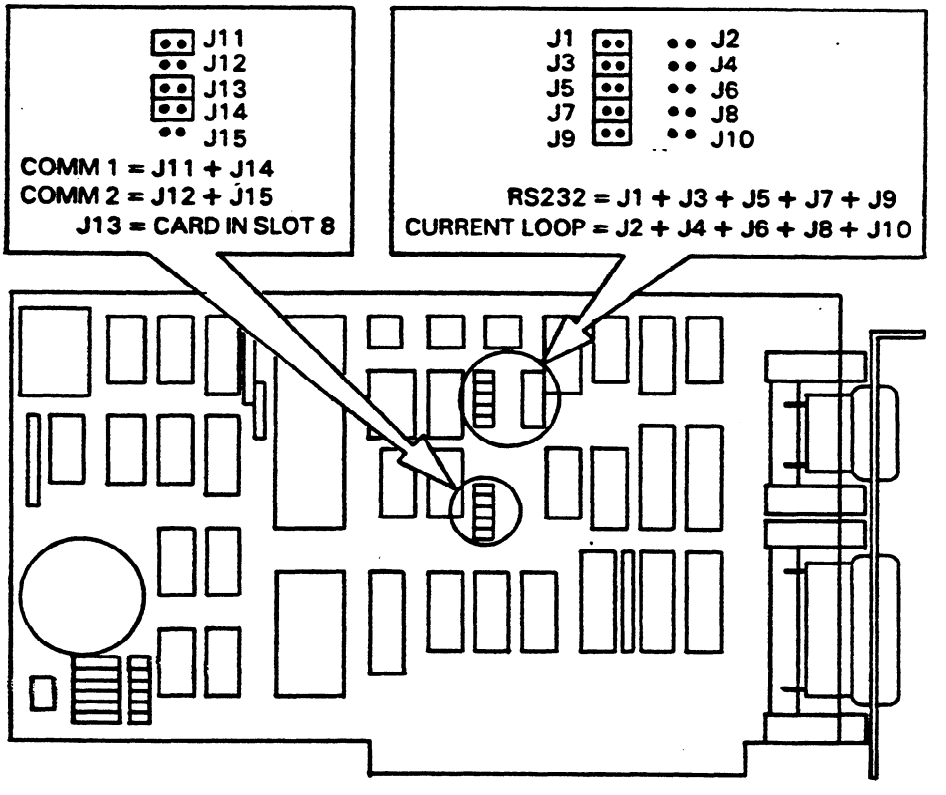
The vendor part numbers for connector hardware and cables included in this appendix are for reference only. Inclusion of these part numbers is neither an endorsement nor a recommendation for their use.

SECTION 1
WORKMASTER FACTORY-INSTALLED CARDS

COMBINATION ADAPTER CARD

The Combination Adapter card (expansion slot 8) contains 2 ports. The 9-pin port is used for communications to the Series One or Series One Plus PLC, to serial printers, and to other serial devices. It can be set up with jumpers as the COM1 or COM2 port, using either RS-232 or current loop communications. The Combination Adapter card is shipped to operate as COM1 using the RS-232 interface. The illustration below shows how to select each option.

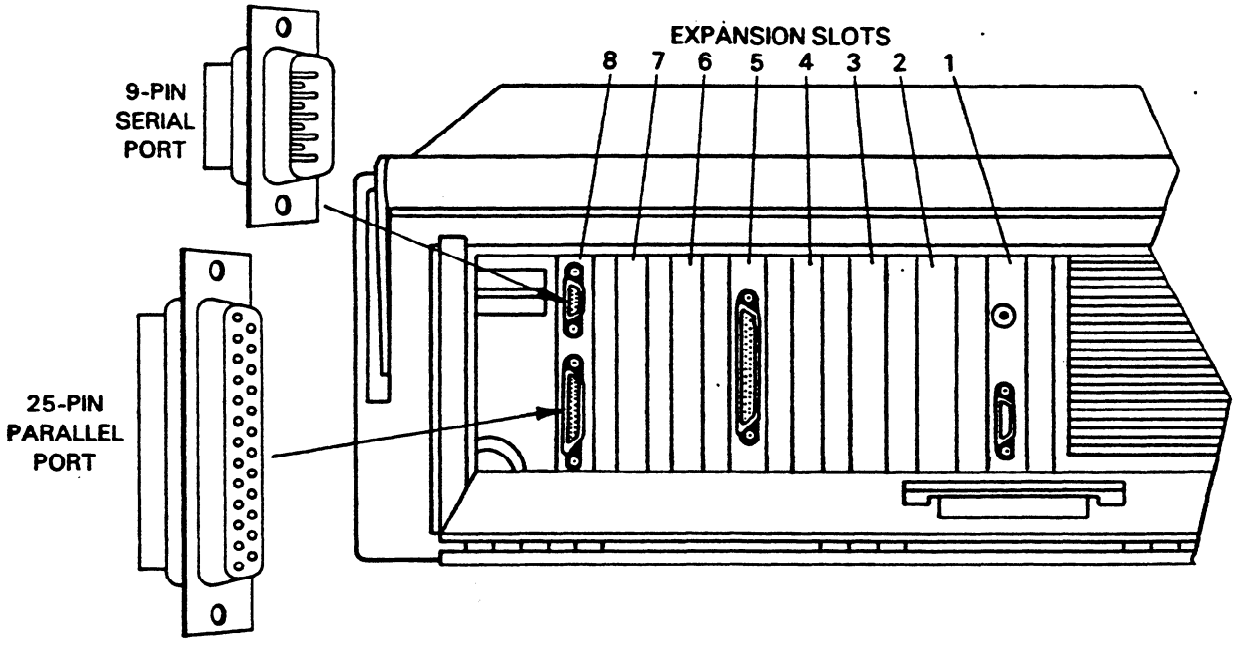
TPK.A.41043



At each location (J1-J15), there are 2 pins which may be jumpered to select the options indicated in the preceding illustration.

The 25-pin port is a parallel Centronics interface normally used to connect to a printer using parallel communications. The location of these ports is shown below.

TPK.A.40052

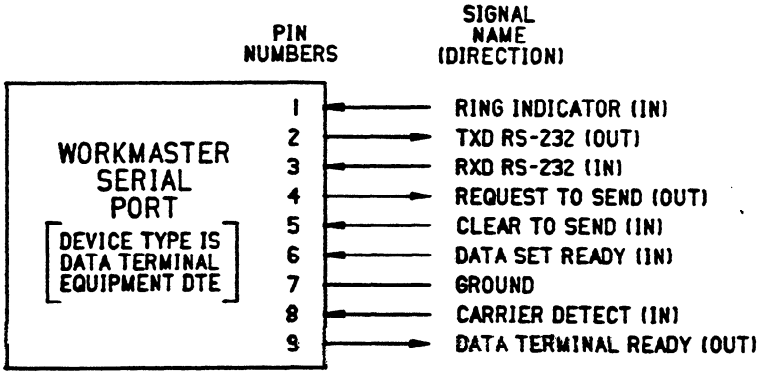


9-Pin Serial Port (Combination Adapter Card)

The pin-outs for the 9-pin connector depend upon whether it is to be used in an RS-232 interface or a current loop interface.

RS-232 Pin-Outs

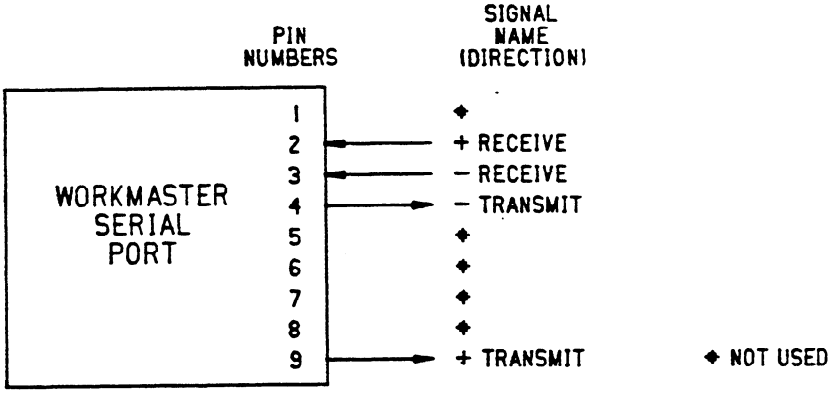
TPK.A.40053



GFK-0075

Current-Loop Pin-Outs

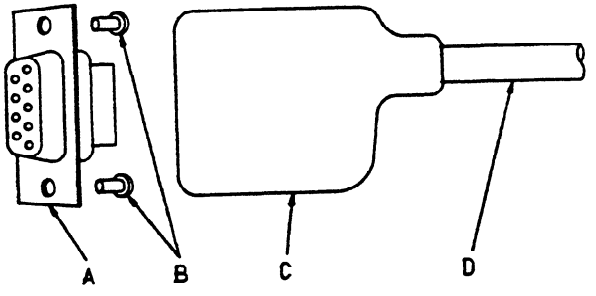
TPK.A.40054



User Connector and Cable Part Numbers

The illustration below shows the connector and cable for attachment to the Combination Adapter card.

TPK.A.40055



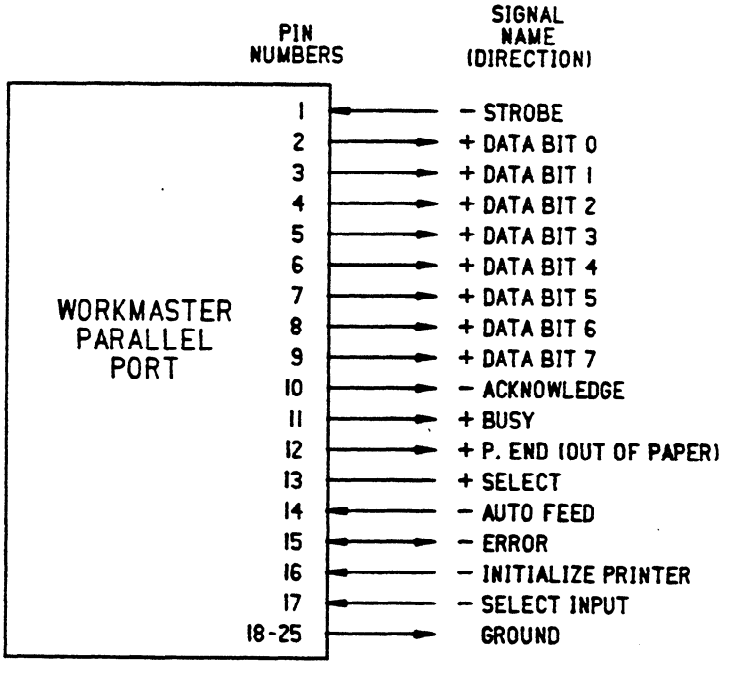
A	Connector....	Cannon DE9S (female)
B	Screwlock....	Cannon D20419
C	Hood.....	Cannon DE110963-1
D	Cable.....	Belden 9300 series (shielded twisted pair)

25-Pin Parallel Port (Combination Adapter Card)

Pin-Outs for the 25-Pin Connector

All outputs from this connector are real time (not latched) TTL signals.

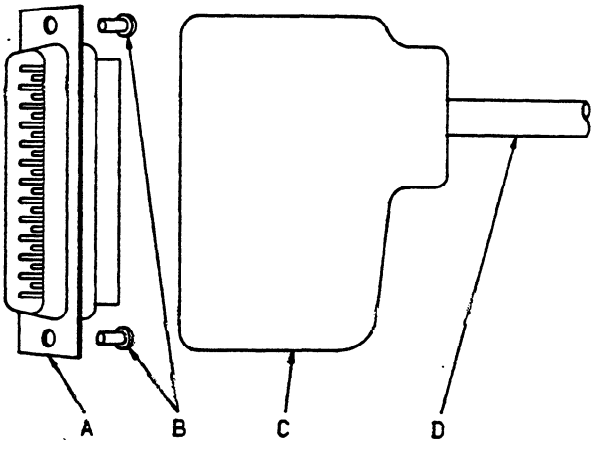
TPK.A.40056



User Connector and Cable Part Numbers

The illustration below shows the connector and cable for attachment to the Combination Adapter card.

TPK.A.40057

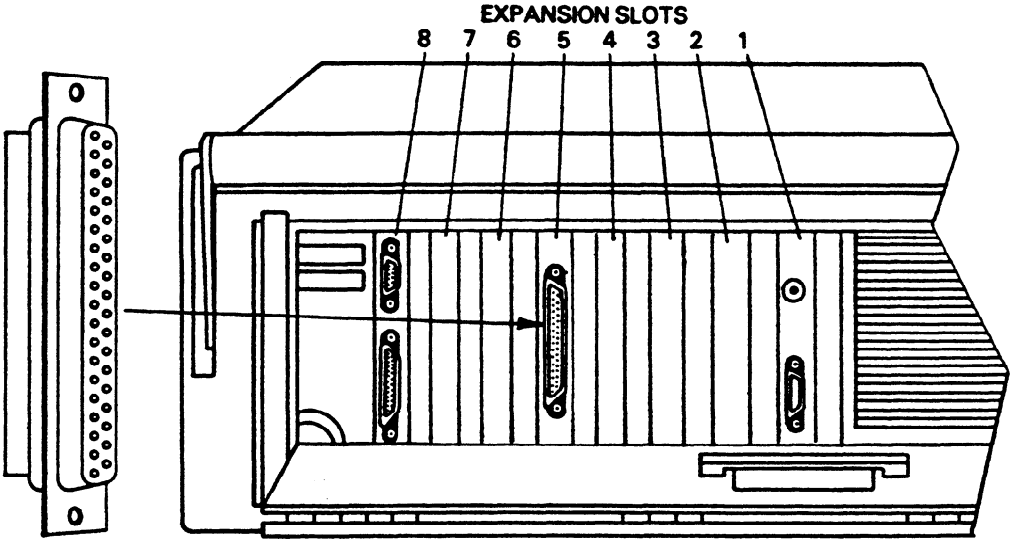


A	Connector....	Cannon DB25P (male)
B	Screwlock....	Cannon D20419
C	Hood.....	Cannon DB110963-3
D	Cable.....	Belden 9300 series (shielded twisted pair)

DISKETTE DRIVE ADAPTER CARD

The Diskette Drive Adapter card (expansion slot 5) provides an interface to an external 5¼-inch diskette drive. The location of the 37-pin port is shown in the illustration below.

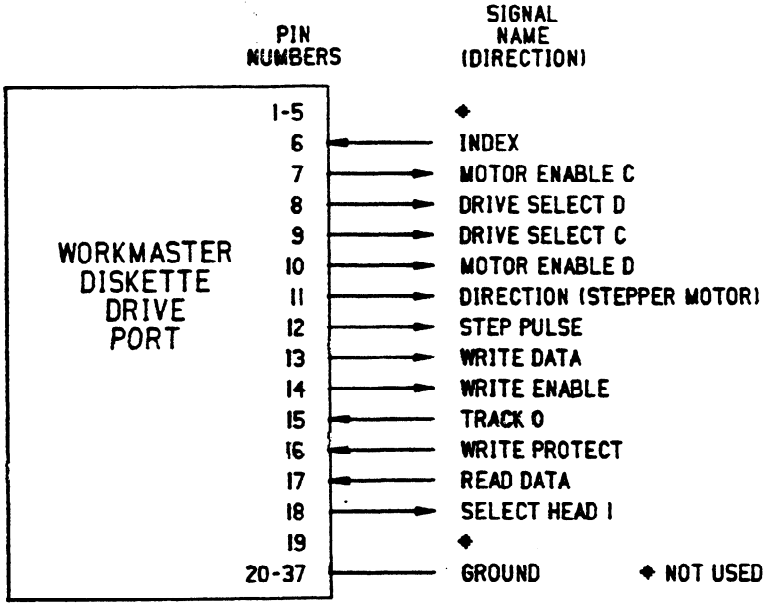
TPK.A.40058



Pin-Outs for the 37-Pin Diskette Drive Port

All outputs of this port are at standard TTL levels.

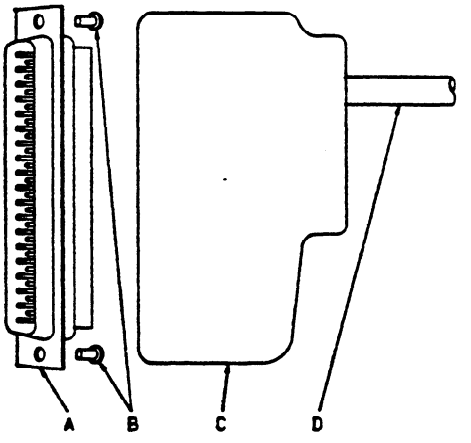
TPK.A.40059



User Connector and Cable Part Numbers

The illustration below shows the connector and cable for attachment to the Diskette Drive Adapter card.

TPK.A.40060

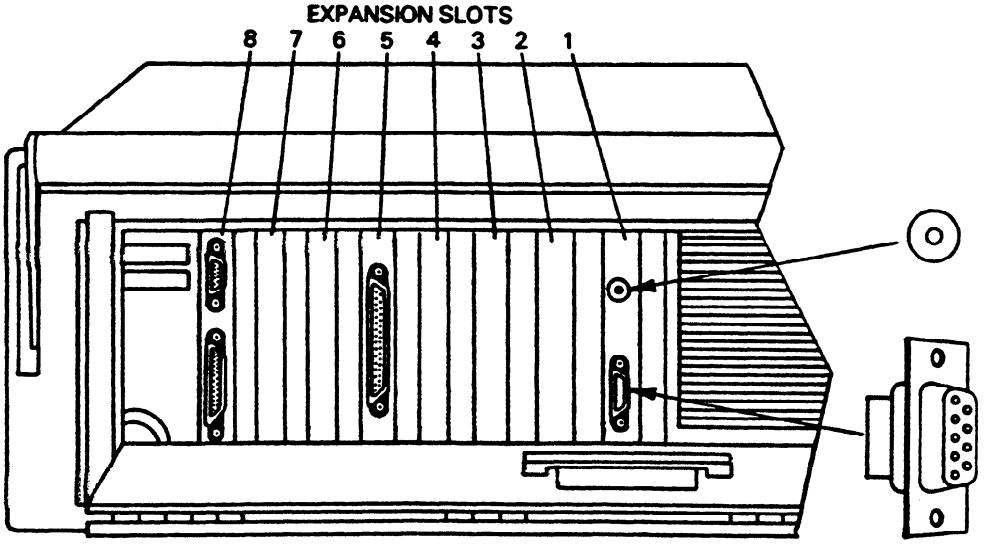


A	Connector....	Cannon DC37P (male)
B	Screwlock....	Cannon D20419
C	Hood.....	Cannon DC110963-4
D	Cable.....	Belden 9300 series (shielded twisted pair)

COLOR/GRAPHICS MONITOR ADAPTER CARD

The Color/Graphics Monitor Adapter card (expansion slot 1) provides a direct drive TTL interface and a composite video interface. The direct drive interface uses a 9-pin, D-type connector and the composite interface uses a phono-plug connector. The location of these interfaces is shown in the illustration below.

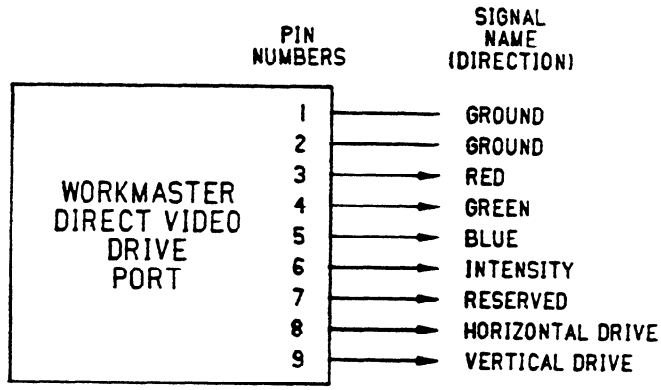
TPK.A.41234



Direct Drive Port (9-Pin)

Pin-Outs For the 9-Pin Connector

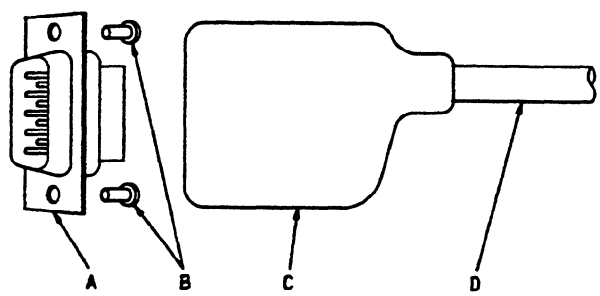
TPK.A.40062



User Connector and Cable Part Numbers

The illustration below shows the connector and cable for attachment to the Color/Graphics Monitor Adapter card.

TPK.A.40063

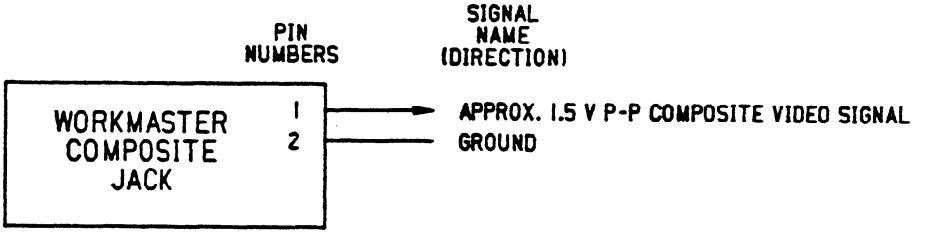


A	Connector....	Cannon DE9P (male)
B	Screwlock....	Cannon D20419
C	Hood.....	Cannon DE110963-1
D	Cable.....	Belden 9300 series (shielded twisted pair)

Composite Video Port

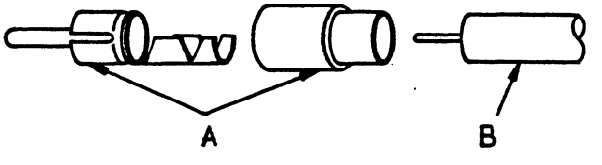
Circuits for Composite Video Port

TPK.A.40066



User Connector and Cable Part Numbers

TPK.A.40064



A	Connector....	Switchcraft 3558 phono plug
B	Cable.....	75 Ohm RG-58/U coaxial cable

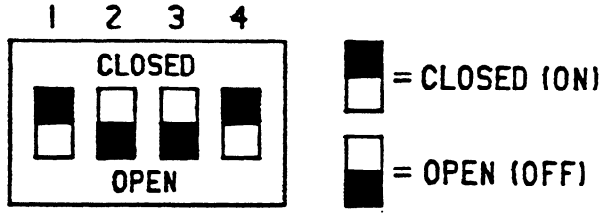
SECTION 2
USER-INSTALLED OPTION CARDS

384K RAM CARD

This card must be installed by the user to provide the 640K bytes of programmer (RAM) memory needed for Logicmaster 1F operation. For installation instructions, refer to GEK-25373, *Guide to Operation*.

This card has no user ports. The illustration below shows how the switches on the 384K RAM card should be set for use with Logicmaster 1F software.

TPK.A.41647



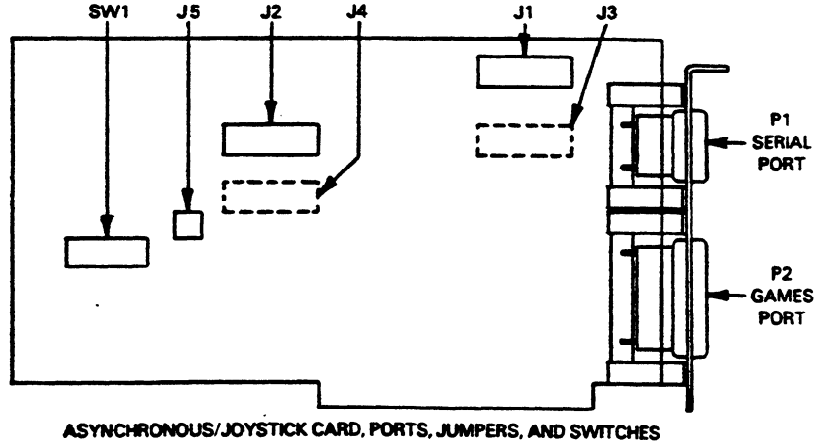
If you have purchased the Expanded Memory card, IC640BRM318, refer to GEK-96631, *Expanded Memory Card User's Guide*, for installation instructions.

ASYNCHRONOUS/JOYSTICK CARD

The Asynchronous/Joystick card, IC640BGB311A or B, is a user-installed option card which provides RS-422 or RS-232 communications to the Series One/One Plus CPU or another serial device. *If the card is used for connection to the Series One/One Plus CPU, the card can be configured as COM1 or COM2 as long as it is not the same as the configuration of the RS-232 port on the Combination Adapter card.*

The card has 2 ports. The 9-pin upper port is used for connection to the Series One/One Plus CPU. The lower port is for use with the joystick. The illustration below shows the location of the ports and the configuration jumpers and switches.

TPK.A.40427



ASYNCHRONOUS/JOYSTICK CARD, PORTS, JUMPERS, AND SWITCHES

Setting Up the Asynchronous/Joystick Card (Version A)

The electrical interface for the RS-232/RS-422 port is set up by placing two DIP shunt packages in the appropriate sockets, as shown below. The 14-pin pack is placed in socket J2 or J4 and the 20-pin pack is placed in socket J1 or J3. (Refer to the preceding illustration for the locations of J1, J2, J3, and J4).

INTERFACE TYPE	SHUNT PLACEMENT 20-PIN	14-PIN
RS-232	J3	J4
RS-422	J1	J2

The other card options for version A are selected using the DIP-switch package SW1.

SWITCH #	OPEN FUNCTION (OFF)	CLOSED FUNCTION (ON)
1	Game port enabled	Game port disabled
2	Serial port disabled	Serial port enabled
3	COM2 selected	COM1 selected
4	Enable COM2	Enable COM1
5	Enable COM1	Enable COM2
6	Force CTS true	CTS from interface
7	Force DSR true	DSR from interface
8	Force RLSD true	RLSD from interface

Switches 4 and 5 are for RS-422 only and should never both be ON at the same time.

Switches 7 and 8 pertain to RS-232 only. In the RS-422 configuration, DSR, and RLSD are forced to a true state regardless of the positions of these switches.

ASYNCHRONOUS/JOYSTICK CARD VERSIONS A OR B
LOGICMASTER 1F SWITCH 1 SETTINGS (RS-232 OR RS-422)

	SWITCH							
	1	2	3	4	5	6	7	8
COM1	OFF	ON	ON	ON	OFF	ON	ON	ON
COM2	OFF	ON	OFF	OFF	ON	ON	ON	ON

Setting Up the Asynchronous/Joystick Card (Version B)

The B version includes a jumper (J5) which is not on the A version. The electrical interface for the RS-232/RS-422 port is set up by placing two DIP-shunt packages in the appropriate sockets, as shown below. The 14-pin pack is placed in socket J2 or J4; the 20-pin pack is placed in socket J1 or J3. (Refer to the preceding illustration for the locations of J1, J2, J3, and J4).

INTERFACE TYPE	SHUNT PLACEMENT 20-PIN	14-PIN
RS-232	J3	J4
RS-422	J1	J2

The other card options for version B are selected using the DIP-switch package SW1 and positioning the jumper, J5, as shown below.

SWITCH #	OPEN FUNCTION (OFF)	CLOSED FUNCTION (ON)
1	Game port enabled	Game port disabled
2	Serial port disabled	Serial port enabled
3	COM2 selected	COM1 selected
4	XMIT data not enabled by RTS	XMIT data enabled by RTS
5	XMIT data not enabled by GND	XMIT data enabled by GND
6	Force CTS true	CTS from interface
7	Force DSR true	DSR from interface
8	Force RLSD true	RLSD from interface

Switches 4 and 5 should never both be ON at the same time.

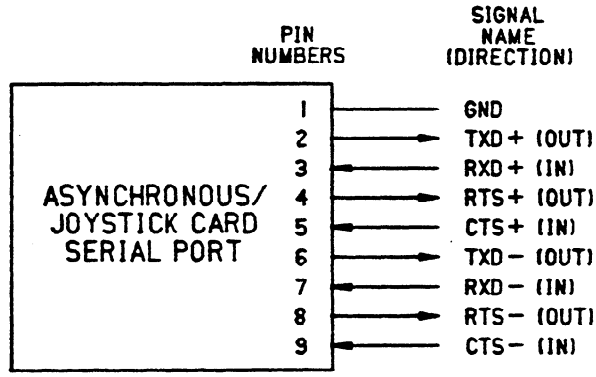
Switches 7 and 8 pertain to RS-232 only. In the RS-422 configuration, DSR, and RLSD are forced to a true state regardless of the positions of these switches.

FUNCTION	JUMPER 5 ON PINS
Select COMM1	2 3
Select COMM2	1 4

RS-232/RS-422 Port

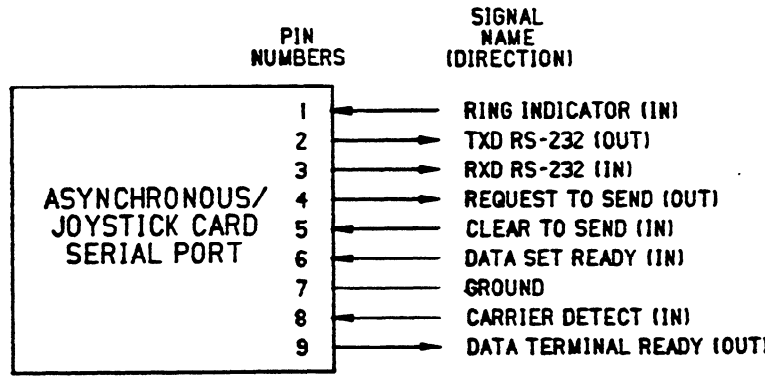
RS-422 Pin-Outs

TPK.A.40449



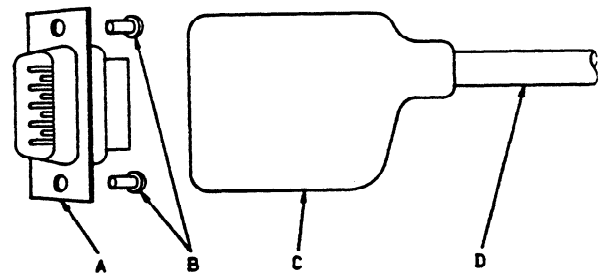
RS-232 Pin-Outs

TPK.A.40450



User Connector and Cable Part Numbers

TPK.A.40063



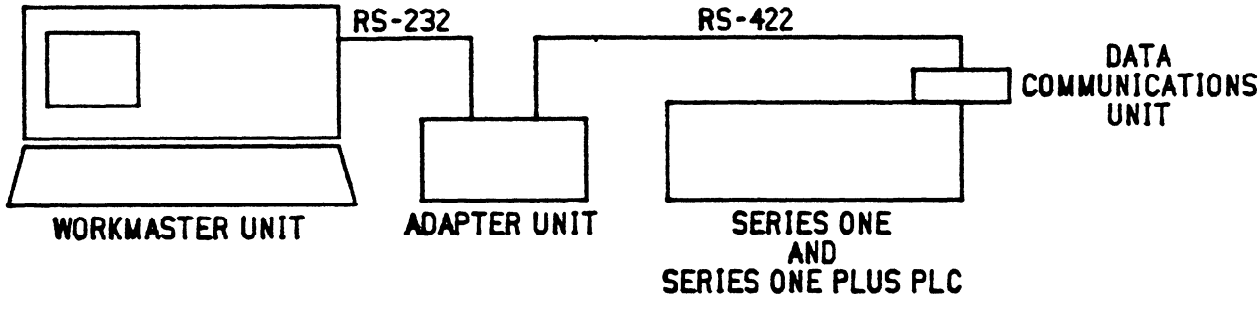
A	Connector....	Cannon DE9P (male)
B	Screwlock....	Cannon D20419
C	Hood.....	Cannon DE110963-1
D	Cable.....	Belden 9300 series (shielded twisted pair)

SECTION 3
CONNECTING THE WORKMASTER COMPUTER TO THE SERIES ONE/ONE PLUS PLC

There are 2 ways to connect the Workmaster computer to the Series One or Series One Plus PLC.

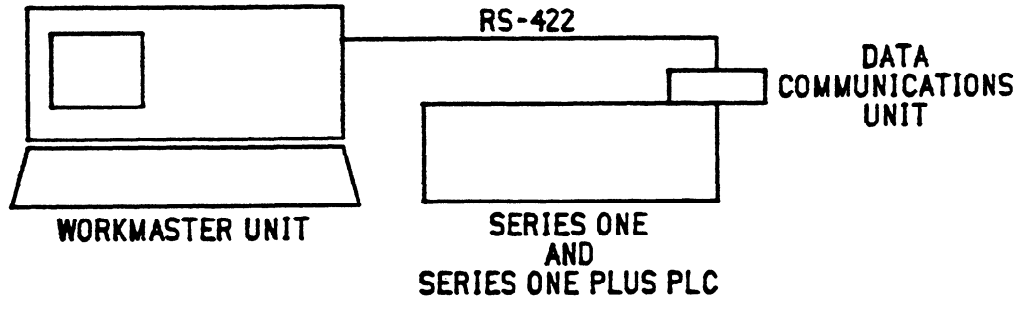
1. From the serial port (RS-232) on the Combination Adapter card through an RS-232 to RS-422 adapter unit, IC630CCM390B, to the Data Communications Unit (DCU) attached to the CPU.

TPK.A.42054



2. Directly from the RS-422 port of the user-installed Asynchronous/Joystick card, IC640BGB311, in the Workmaster computer to the Data Communications Unit (DCU) attached to the CPU. *If used in this way, the card must be configured as a different COM number than the Combination Adapter card.* (See the sections on these cards in this appendix).

TPK.A.42055



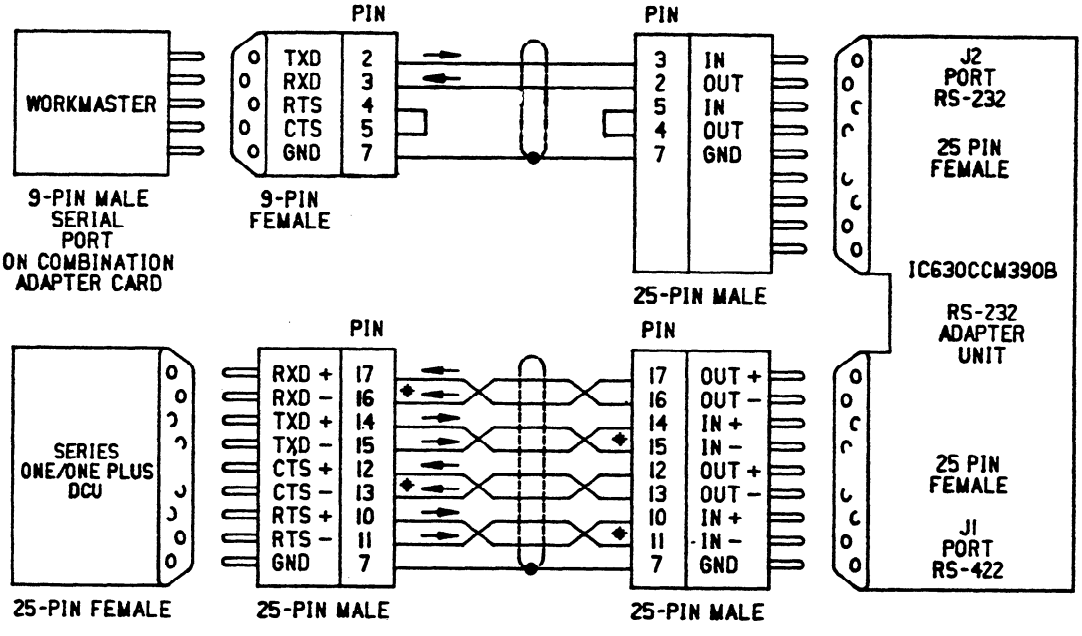
Once the cables are constructed and connected, refer to the section on establishing communications with the CPU (Load-Store-Verify menu) to complete the connection.

PREASSEMBLED CABLES

Catalog Number	Length	Description
IC630CBL390B	3' (1m)	Workmaster to Adapter RS-232 port, J2
IC630CBL391A	12' (4m)	Workmaster RS-422 port to DCU Comms. Port
IC630CBL392A	9' (3m)	Adapter RS-422 port to DCU Comms. Port

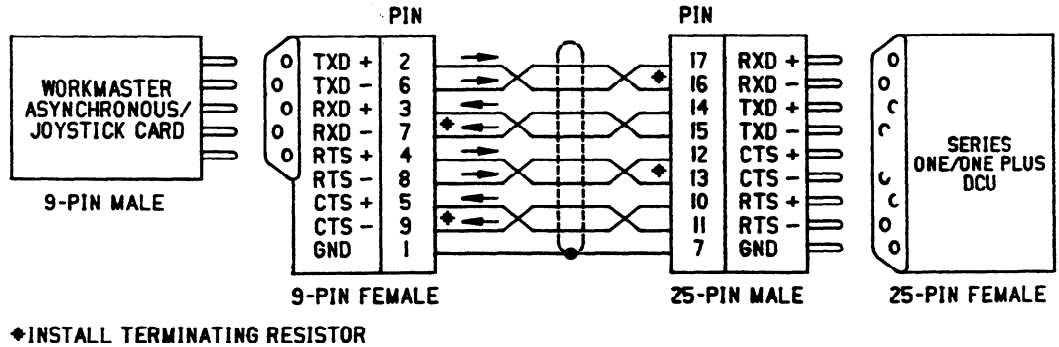
WORKMASTER COMPUTER TO DCU CABLE DIAGRAM (THROUGH ADAPTER UNIT)

TPK.A.42051



WORKMASTER COMPUTER TO DCU CABLE DIAGRAM (DIRECT)

TPK.A.40455



SETTING UP THE DATA COMMUNICATIONS UNIT

To set up the DCU:

1. Select the CPU ID (1-90) on the DCU. This should match the DCU ID entered on the Communications Setup menu.

2. Set up the communications parameters. They should match those entered into the Port Set-Up screen in the Utilities screen.

3. Place the On/Off-Line switch in the ON-LINE position.

CPU (UNIT) ID Selection

The bottom group of eight DIP switches located on the right side of the DCU determines the ID of the CPU (unit) from 1-90. The switch configuration associated with each ID is shown in the following table.

Table A.1 CPU (UNIT) ID SELECTION

TPK.A.42053

CPU ID	DIP SWITCH POSITION								CPU ID	DIP SWITCH POSITION								CPU ID	DIP SWITCH POSITION							
	8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1
1								X	31				X	X	X	X	X	61			X	X	X	X		X
2							X		32			X						62			X	X	X	X	X	
3							X	X	33			X					X	63			X	X	X	X	X	X
4						X			34			X				X		64		X						
5						X		X	35			X				X	X	65		X						X
6						X	X		36			X			X			66		X					X	
7						X	X	X	37			X			X		X	67		X					X	X
8					X				38			X			X	X		68		X				X		
9					X			X	39			X			X	X	X	69		X				X		X
10					X		X		40			X		X				70		X				X	X	
11					X		X	X	41			X		X			X	71		X				X	X	X
12					X	X			42			X		X		X		72		X			X			
13					X	X		X	43			X		X		X	X	73		X			X			X
14					X	X	X		44			X		X	X			74		X			X		X	
15					X	X	X	X	45			X		X	X		X	75		X			X		X	X
16				X					46			X		X	X	X		76		X			X	X		
17				X				X	47			X		X	X	X	X	77		X			X	X		X
18				X			X		48			X	X					78		X			X	X	X	
19				X			X	X	49			X	X				X	79		X			X	X	X	X
20				X		X			50			X	X			X		80		X		X				
21				X		X		X	51			X	X			X	X	81		X		X				X
22				X		X	X		52			X	X		X			82		X		X			X	
23				X		X	X	X	53			X	X		X		X	83		X		X			X	X
24				X	X				54			X	X		X	X		84		X		X		X		
25				X	X			X	55			X	X		X	X	X	85		X		X		X		X
26				X	X		X		56			X	X	X				86		X		X		X	X	
27				X	X		X	X	57			X	X	X			X	87		X		X		X	X	X
28				X	X	X			58			X	X	X		X		88		X		X	X			
29				X	X	X		X	59			X	X	X		X	X	89		X		X	X			X
30				X	X	X	X		60			X	X	X	X			90		X		X	X		X	

[X] = SWITCH IN OPEN POSITION (DEPRESSED TO THE LEFT)

Communication Port Configuration DIP Switches

The top group of eight DIP switches on the right side of the DCU determines the set-up parameters for the communication port. See Table B.2.

Table A.2 COMMUNICATIONS PORT CONFIGURATION DIP-SWITCH SETTINGS

Data Rate Selection (BPS)	DIP Switch Number 1	DIP Switch Number 2
*300	OFF	OFF
1200	ON	OFF
9600	OFF	ON
19.2 k	ON	ON

Parity Selection	DIP Switch No. 3
Parity ENABLED (Odd parity generated and checked.)	ON
*Parity DISABLED (No parity generated or checked.)	OFF

Loop-Back Test (Special Connector Required)	DIP Switch No. 4
Enabled	ON
*Disabled	OFF

Turn-Around Delay	DIP Switch No. 5
* 0 ms delay	OFF
10 ms delay	ON

Power-Up Mode	DIP Switch No. 6
Program/Stop Mode	ON
*Run Mode	OFF

*Factory set default position.

Once the cables are constucted and connected and the DCU set up, refer to the information on establishing communications with the CPU (in the discussion on the Load/Store/Verify menu) to complete the connection. Also, see the example on the following page.

RECOVERING FROM AN ERROR IN THE CPU

If the CPU contains a program with a fatal error in it and the DCU is power cycled, the Logicmaster system may not be able to communicate with the DCU/CPU even after power is restored. On power-up, the CPU performs a grammar check and the result is passed to the DCU. The DCU then inhibits communications until the error is cleared.

This situation is more likely to occur if the program was created or modified using either the handheld programmer or the LCD portable programmer. Creating or modifying a program directly on the Logicmaster system will usually prevent this situation.

If the Logicmaster system will not communicate with your CPU through the Data Communications Unit, even though the system was working previously, you should follow this procedure:

1. Take the DCU off-line, and attach a handheld programmer.

2. Press **CLR CLR SCH** to perform a manual grammar check. The error type (if any) will be displayed in the window.

4. Press **CLR NXT** to obtain the error address.

5. Correct the error using the appropriate edit keys. You may also clear the program by pressing **CLR CLR SHF 3 4 8 DEL NXT**.

6. Remove the handheld programmer, and place the DCU back on-line. The Logicmaster system should now be able to communicate properly with the CPU through the Data Communications Unit.

EXAMPLE FOR SETTING UP COMMUNICATIONS BETWEEN THE WORKMASTER UNIT AND THE DCU

1. Set up the Combination Adapter Card as COM1.

2. Assemble and connect the desired cable(s).

3. Set up DCU as follows:

   CPU (Unit) ID (Only switch 2 of top group ON).
   Set up CPU (Unit) ID as ID 2.

   Port Configuration (Only switch 2 of bottom group ON).

Data Rate:	9600 bps
Parity:	Disabled
Loop-Back Test:	Disabled
Turn-Around Delay:	0 ms
Power-Up Mode:	RUN

   On/Off-Line Switch (ON-LINE position).

4. Power up the Series One or Series One Plus PLC and the Workmaster computer.

5. Go to the Serial Port Set-Up screen in the Utilities function of the Logicmaster 1F software and enter the following parameters for port 1.

Baud Rate:	9600
Stop Bits:	1
Parity:	None
Data Bits/Word:	8
Mode:	Full duplex

Remember to press the Setup Port key.

6. Place the Workmaster keyswitch in the ON-LINE postion.

7. Go to the CPU Scratch Pad Display screen and enter a CPU ID number of 2 and a Communication Port of 1.

The CPU status should change to RUN or STOP, depending on the status of the CPU. This shows that communications have been established.

CONNECTING THE WORKMASTER COMPUTER TO A SERIAL PRINTER

To connect a serial printer to the Logicmaster 1F system:

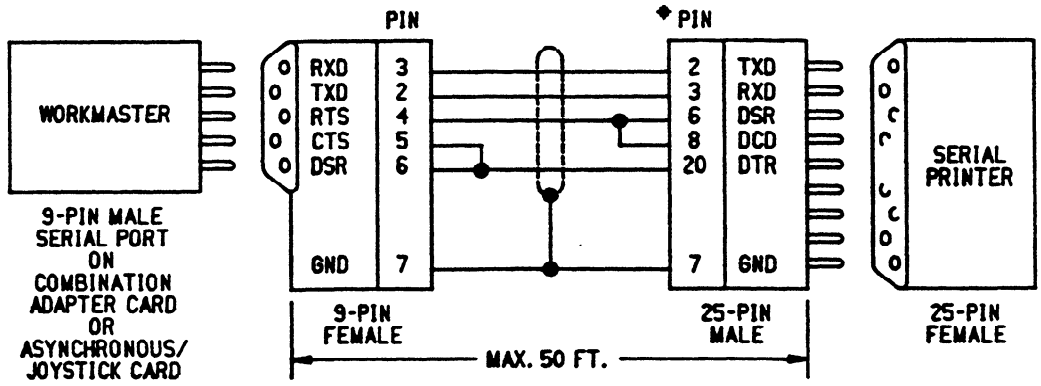
1. Construct and connect the cable as shown below.

2. Configure the serial card as a COM1 or COM2. If you have two serial cards in your system, be sure to configure one as COM1 and the other as COM2. They cannot have the same COM designation.

3. Configure the serial port (using the Utilities function) to correspond to the serial printer.

4. Initiate the Print function using the appropriate port.

TPK.A.40457



◆ PIN NUMBERS ARE CORRECT FOR EPSON SERIES DOT MATRIX PRINTERS. FOR OTHER PRINTERS, CONSULT THE PRINTER MANUAL.

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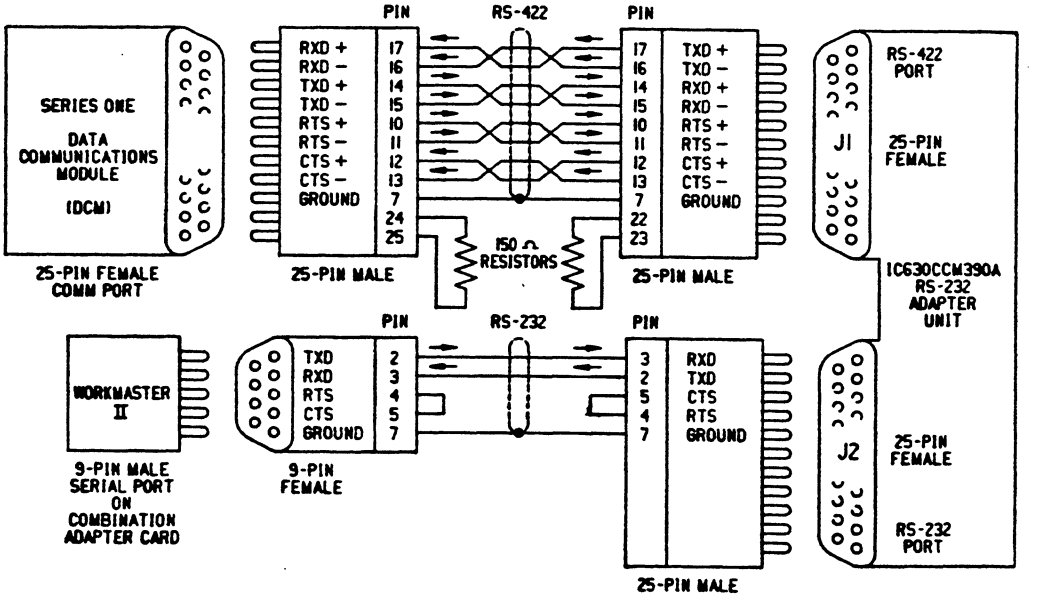
SECTION 4
CONNECTING THE WORKMASTER II COMPUTER TO THE SERIES ONE/ONE PLUS PLC

The Workmaster II computer is connected to the Series One or Series One Plus PLC through the J2 port on the RS-232 adapter unit, as shown in the following illustration.

TPK.A.43498



SECTION 5
CONNECTING THE IBM PERSONAL COMPUTER TO THE SERIES ONE/ONE PLUS PLC

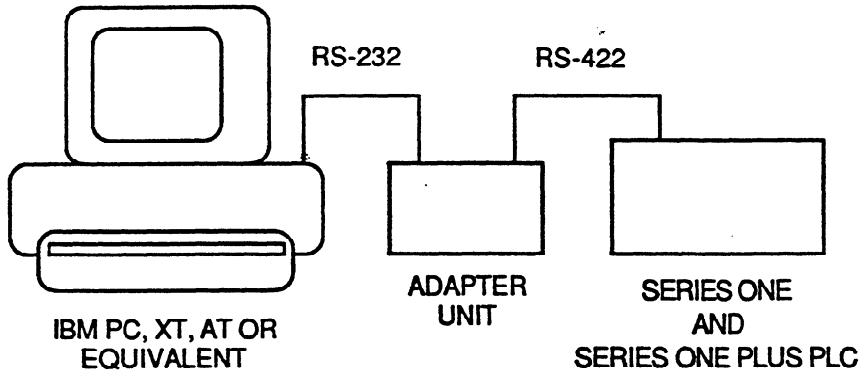
There are 2 basic ways to connect the IBM personal computer to the Series One or Series One Plus PLC:

1. From a standard, serial RS-232 port through an RS-232 to RS-422 adapter unit to the CPU.

NOTE

The standard PC-PC/XT serial ports are different in pin-out from the standard PC/AT serial ports.

TPK.A.41641

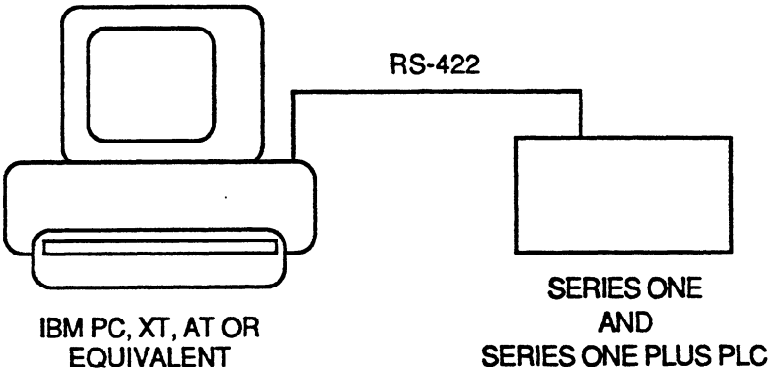


NOTE

When disconnecting your computer from the PLC, it is recommended that you disconnect the cable on the Series One side of the adapter. Failure to do so will require recycling the Series One/One Plus keyswitch to re-establish communications.

2. Directly from a standard RS-422 port to the CPU.

TPK.A.41642



NOTE

If you have two serial ports in your system to be used with Logicmaster 1F software, one must be set up as COM 1 and the other as COM 2. Logicmaster 1F software can communicate with the Series One/One Plus PLC or print to a printer using either port designation.

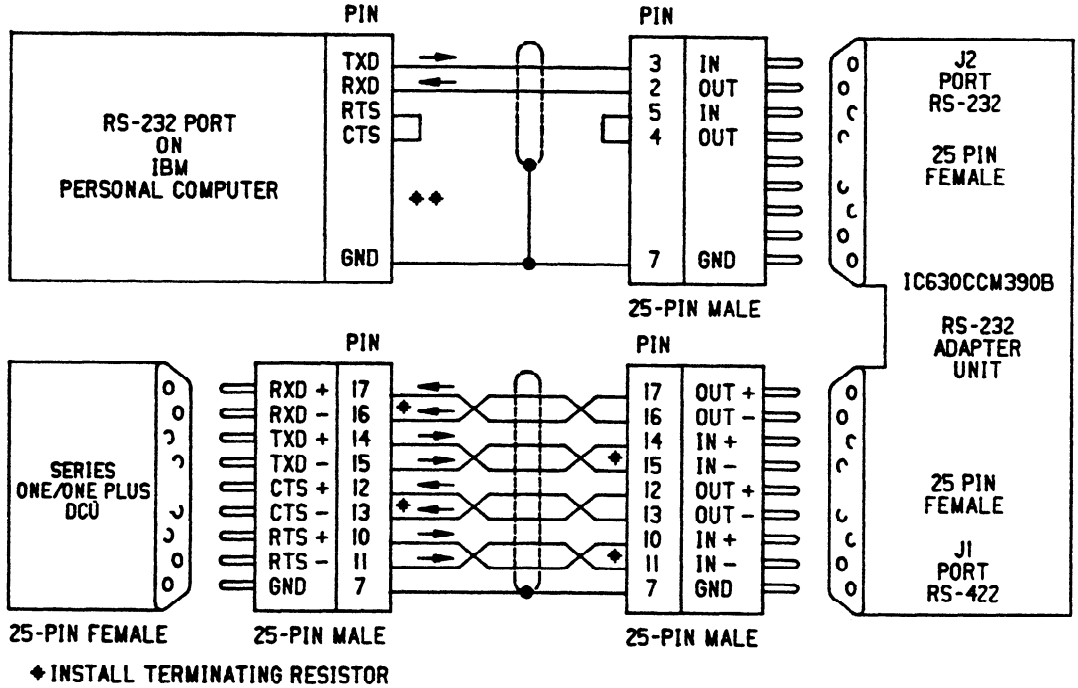
There are a number of converter boxes and serial port cards which can be used to connect your IBM computer to the PLC. The wiring diagrams below show tested configurations based on hardware available from GE Fanuc - NA. These diagrams can also be used as a basis for making connections with other available hardware.

COMPUTER TO CPU CABLE DIAGRAM (THROUGH ADAPTER UNIT)

The wiring diagrams below shows connections from a standard RS-232 port through a user constructed cable to Adapter Unit, IC630CCM390B or later, then through an RS-422 cable, IC630CBL392A, to the CPU.

Wiring Diagram for IBM PC, PC-XT, or IBM XT-Compatible Computer

TPK.A.41640

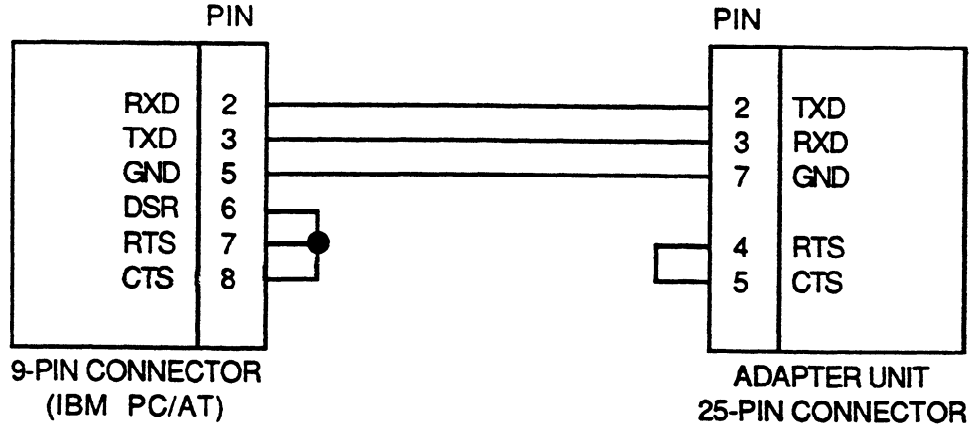


◆ INSTALL TERMINATING RESISTOR

◆◆ THE PINS, DTR, DSR, CARRIER DETECT, AND RING INDICATOR, MAY NEED TO BE JUMPERED TOGETHER DEPENDING ON THE SERIAL CARD.

Wiring Diagram for IBM PC-AT or AT-Compatible Computer

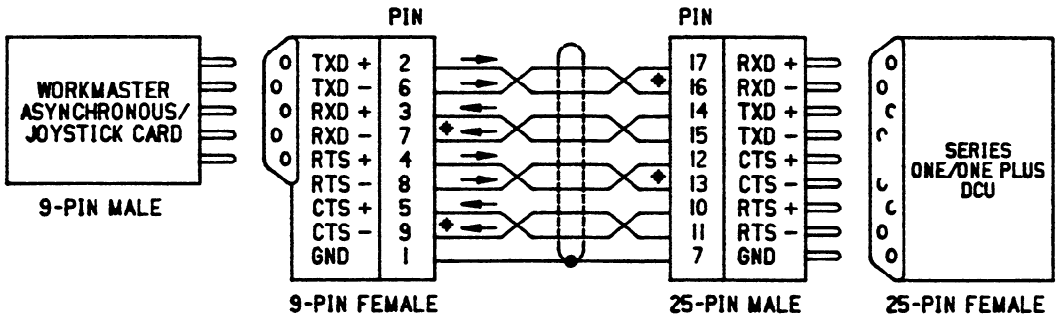
TPK.A.42147



COMPUTER TO CPU CABLE DIAGRAM (DIRECT)

The connection shown below is made from the Asynchronous/Joystick Adapter card, IC640BGB311, through the cable, IC630CBL391, to the CPU.

TPK.A.40455



SECTION 6
USING MODEMS

The Logicmaster 1F system supports full duplex modems which are compatible with the Bell system 212 standard. The following steps explain how to connect and use modems with Logicmaster 1F software.

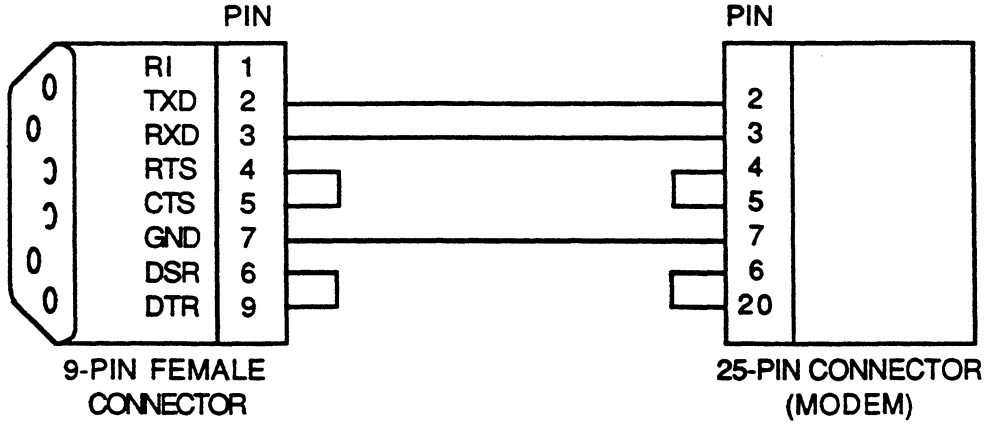
HARDWARE REQUIREMENTS

- Workmaster or Cimstar I industrial computer, or IBM personal computer (or IBM-compatible PC).
- Two smart modems (Bell system 212 compatible).
- RS-232/RS-422 converter box, IC630CCM390B from GE Fanuc - NA.
- Series One or Series One Plus system (CPU IC610CPU105, DCU IC610CCM105).
- Cable from host computer to modem.
- Cable from modem to RS-232/RS-422 converter box.
- Cable from RS-232/RS-422 converter box to DCU, IC630CBL392A.
- Two telephone cables.

CABLE DRAWINGS

Workmaster Computer to Modem

TPK.A.42148



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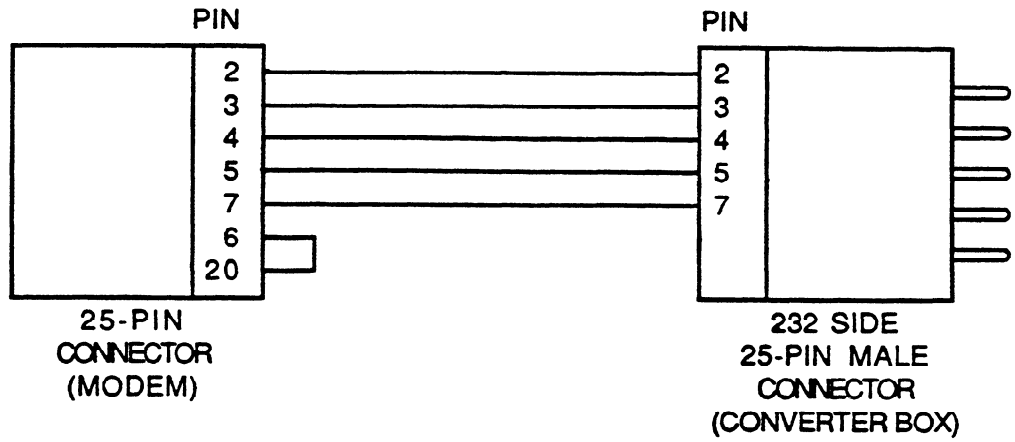
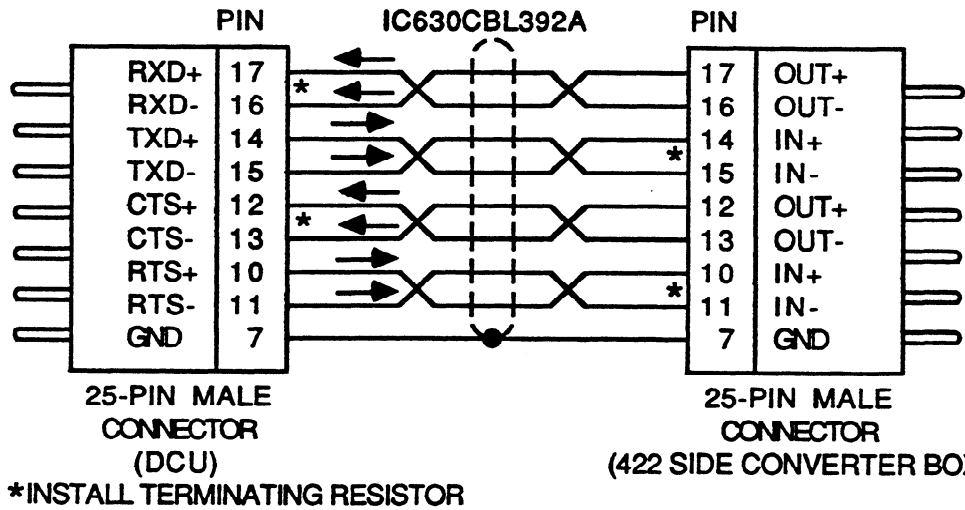
Modem to RS-232 Converter Box

TPK.A.42149



DCU to Converter Box

TPK.A.42150



SMART MODEM CONFIGURATION

A "smart modem" is one that can dial and answer the phone. To dial, the modem expects several control characters followed by the ASCII digits of the phone number. The Logicmaster 1F software does not provide a method of directly sending these characters to a serial port. To use a smart modem, follow these steps:

1. Create a text file with the control characters and the telephone number.

2. Background print the file.

3. Establish serial communications.

CREATING THE TEXT FILE

Create a text file using an editor, such as the DOS editor EDLIN. The file must contain the control and phone number characters. In DOS, this is done by typing:

```
COPY CON:PHONE.TXT
ATD 9785600
F6
```

You must press the Return key after entering each line. In this example, 9785600 is an example phone number; "F6" is function key 6.

SETTING UP THE MODEM

1. Boot up the Logicmaster 1F system.

2. Set up the serial port with these settings:

Serial port:	1
Baud rate:	1200 or 300
Stop bits:	1
Parity:	None
Data bits:	8
X-On/X-Off:	N

PRINTING THE FILE

1. In the Communications Setup menu, de-select the port 1 for CPU communication port.

2. Go to the Print menu, and print the file to the serial port 1.

3. Return to the Communications Setup menu, and select the port 1 for CPU Communications.

4. Go to the Scratch Pad menu, and turn the keyswitch to ON-LINE to place the computer in the On-Line mode.

SECTION 7
MULTIDROP CONFIGURATION

The Logicmaster 1F system supports multidrop configuration up to eight CPUs and eight DCUs. The following functions are provided in the multidrop configuration.

- Poll CPU/DCU.
- Start/Stop CPU.
- Load/Store/Verify operation with any CPU in the network.
- Monitor the I/O, Register table.
- On-line changes.
- Password operation.

HARDWARE REQUIREMENTS

- Workmaster or Cimstar I industrial computer, IBM personal computer, or IBM-compatible computer (but not a Workmaster II computer).
- RS-422 serial port adapter (Game port card).
- 8 Series One or Series One Plus PLC systems.
- Cable from Workmaster to multiple CPUs.

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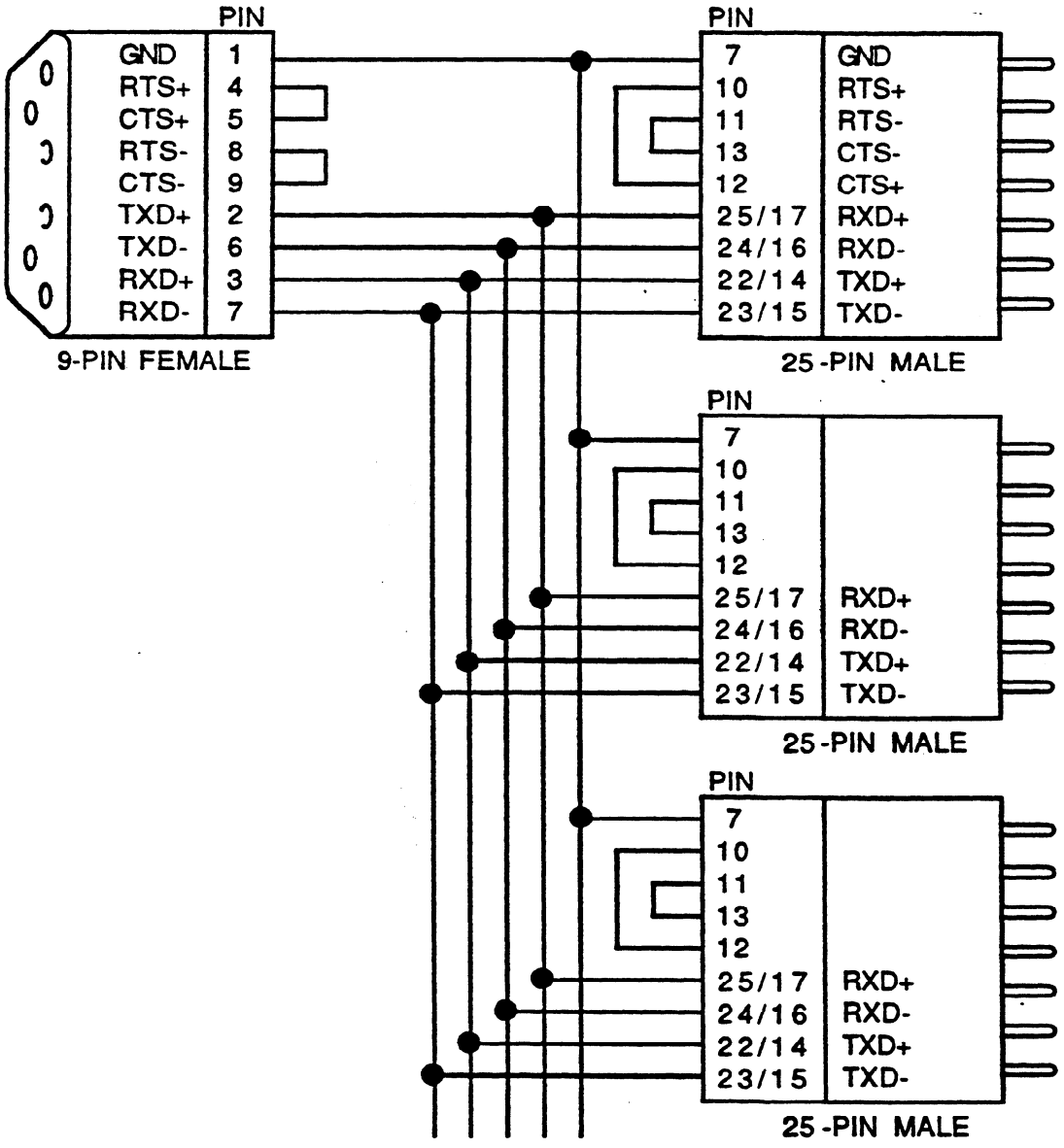
Multidrop Cable Drawing

TPK.A.42151



APPENDIX B
GLOSSARY OF TERMS

Address: A specific memory location.

AND (Logical): A mathematical operation between bits. All bits must be 1 for the result to be 1.

AND (Function): An operation that places two contacts or groups of contacts in series.

Annotation: Explanatory text in a program. Annotation includes names, nicknames, rung explanations, and coil labels.

ASCII: American Standard Code for Information Interchange. An eight-bit (7 bits plus 1 parity bit) code used for data.

Background: Some computer functions, such as background printing, can be performed in the "background" while other functions are being used.

Backup: A duplicate version of a program, created prior to editing the program.

Baud: A unit of data tramsmission. Baud rate is the number of bits per second transmitted.

BCD: Binary Coded Decimal. A 4-bit system in which individual decimal digits (0 through 9) are represented by 4-bit binary numerals. For example, the number 43 is represented by 0100(4) 0011(3) in the BCD notation.

Bit: Binary Digit. This represents the smallest unit of data storage in memory. The value of a bit can be either 1 or 0.

Byte: A group of 8 consecutive bits operated on as a single unit.

Byte Boundary: The bit which marks the beginning of a new 8-bit byte. For example, 1,9,17, etc.

Constants: A predetermined value stored in a register. This value does not change.

Counter: A circuit internal to the PLC, which can be programmed to control other devices according to a preset number of on/off transitions.

CPU: Central Processing Unit. The central device or controller that interprets user instructions, makes decisions, and executes the functions based on a stored program. This program specifies actions to be taken to all possible inputs.

CPU Version: The CPU contains operating instructions, called "firmware". The version of the firmware in the CPU determines which program functions the CPU can perform.

Cross-Reference Table: A table that keeps track of program references.

Directory: A file which contains the names and specifications of other files.

Discrete: Refers to the inputs and outputs in the system. The term "discrete" includes both real and internal I/O.

Disk: A hard disk or floppy diskette, used as an information storage and retrieval device.

DOS: Disk Operating System. A group of utility programs which provide the structure for system operations.

Double Left Rail: The graphic representation of an area of ladder logic, the execution of which is under the control of an MCR function.

Drive: A floppy-diskette drive or hard disk drive. The identification of the drive, such as Drive A.

Firmware: A series of software instructions contained in ROM (Read Only Memory). These instructions control internal operations.

Full Duplex: A method of data transmission. In full-duplex transmission, data may be sent and received in both directions, simultaneously.

Function Key: A key (F1-F8) whose function is controlled by software. This function which may change within the program. The Logicmaster 1F software displays the current assignments of the function keys at the bottom of the screen.

Group: A series of 8 consecutive references, such as I/O points or internal coils.

Half-Duplex: A method of data transmission. In half-duplex transmission, data can only be sent in one direction at a time.

Hardware: All of the mechanical, electrical, and electronic devices in the PLC system and its application.

Help Screens: Instructive text screens, displayed by pressing the Help (F10) key.

Input Devices: Devices that mechanically or electrically supply data to the PLC. Typical input devices are limit switches, pushbuttons, pressure switches, digital encoders, and analog devices.

Inputs: A signal, typically ON or OFF, that provides information to the PLC.

Instruction: A word, usually an acronym, or group of words and numerals that are part of a program entered into user memory.

Instruction Set: A group of program functions available in the Series One or Series One Plus CPU.

I/O: Input/Output. That portion of the PLC to which field devices are connected. Isolates the CPU from electrical noise.

I/O Scan: The CPU's monitoring of all inputs and all outputs within a prescribed time.

Internal Reference: A program reference that does not represent a hardware device.

INV (Logical Invert): A mathematical operation on bits in a matrix. All ones are replaced by zeros, and all zeros are replaced by ones. The results are placed in another matrix.

K: An abbreviation for kilo or exactly 1024 in the world of computers. Usually related to 1024 words of memory.

Ladder Diagram: A graphic representation of decisional logic.

Line of Logic: A rung of ladder logic may contain up to 7 lines of logic in parallel. A single line may contain up to 8 elements in series.

Load: The function used to transfer programs to the Logicmaster system's RAM memory.

Logic: A fixed set of responses (outputs) to various external conditions (inputs). Also referred to as the program.

Master Software: The original Logicmaster 1F software diskettes shipped from the factory.

Memory: A physical place to store information, such as programs and/or data.

Memory Size: The number of registers of memory in the CPU.

Millisecond (msec): One thousandth of a second (0.001 second).

Mnemonic: An abbreviation or other representation of a program instruction. The mnemonic appears in the ladder diagram where the function is used.

Mode Select Switch: The keyswitch on the front of the Workmaster computer that selects the mode of the Logicmaster 1F system. When using another type of computer, mode is selected in the software.

Monitor Mode: A mode of operation that allows the operating program to be monitored. No program changes can be made in Monitor mode.

OR (Logical): A mathematical operation between bits, whereby if any bit is a 1, the result will be a 1.

OR (Function): An operation that places two contacts or groups of contacts in parallel. Either controls the resultant status.

Off-Line Mode: A mode of operation used for program entry and editing, before the program is transferred to the CPU. This mode can be used for program development in a location remote from the CPU.

On-Line Changes: Changes to I/O or register references, and certain other changes, made when the Logicmaster 1F system is on-line to an operating CPU, and the programs in both are exactly the same.

On-Line Mode: A mode of operation that allows observation of an operating program. Certain changes may be made to the program while it is operating.

Output: A signal, typically ON or OFF, originating from the PLC with user-supplied power that controls external devices based upon commands from the CPU.

Override: To remove control of an relay reference from its normal source. For instance, overridden relay inputs ignore information from input devices such as pushbuttons or limit switches.

Parity: A type of integrity check on data.

Peripheral Equipment: External units that can communicate with a PLC.

PLC: A commonly-used abbreviation for Programmable Logic Controller.

Power Flow: In a ladder diagram, the symbolic flow of power represents the logical execution of program functions. For each function, it is important to know what happens when power is received, and under what conditions power flow is output.

Preset: A numerical value entered into a register which establishes a limit for counters or timers. A coil will energize when the stored value is reached.

Program: A sequence of functions and/or instructions entered into a programmable logic controller to be executed by the CPU for the purpose of controlling a machine or process.

Programmer: A device for entry, examination, and alteration of the PLC's memory, including logic and storage areas.

Rail: The symbolic connection between ladder rungs. The left rail represents the positive power source.

RAM: Random Access Memory. In this manual, the term RAM is used to refer to the volatile memory of the computer. This memory stores the Logicmaster software, program files, and related data while power is applied to the system.

Read: To have data entered into a PLC from a peripheral unit.

Reference: An I/O or register address that supplies status or data to an instruction in a program.

Reference Tables: A group of formatted tables which can display the values of I/O and registers in the system.

Register: A group of 16 consecutive bits in register memory. Each register is numbered, beginning at 0001. Register memory is used for temporary storage of numerical values, and for bit manipulation.

Retentive Output: An output that will remain on in its last state, even if power is removed.

Rung: A unit of ladder logic. One rung may have up to 7 parallel lines of logic connected to the left rail, but these must combine so that there is just one connection to the right rail.

Scan: The CPU's repeated execution of all program logic, I/O service, peripheral service, and self-testing. This occurs automatically, many times each second.

Scratch Pad: A memory storage area in the PLC, which stores the characteristics of the CPU. A similar function in the Logicmaster 1F software is also called the Scratch Pad.

Side File: A secondary ladder logic file, consisting of part of a ladder logic program. This file can be added to another program.

Status Line: The line at the top of the screen that shows the status of the CPU, the Logicmaster 1F mode, and other information.

Store: The function used to transfer programs from the Logicmaster system's RAM memory to the CPU or to disk.

Supervisor Menu: The main menu in Logicmaster 1F software. It lists all the principal system functions, and the function keys that control those functions.

Table: A group of consecutive storage locations in memory. The beginning address and length of the table are specified in the program. Data may be accessed randomly in a table.

Teach Mode: A function used to create customized key assignments for the F1 to F8 keys.

Thumbwheel Switch: A rotating numeric switch used to input numeric data to a PLC.

Timer: An internal function that can be used to control the operating cycle of other devices by a preset and accumulated time interval.

Verify: A function used to compare program content. The program in system RAM memory may be compared with a program from the CPU or from a disk drive.

View Mode: A playback display of the key functions defined in Teach mode.

Watch Dog Timer: A built-in timer which shuts down the CPU if the scan takes too long.

Word: A group of 16 consecutive bits in the Input or Output tables.

Work Area: The data-entry display in the lower right corner of the screen. The work area has three lines: the text (top) line, the reference (center) line, and the value (bottom) line.

Write: To output or transfer data from the PLC to a peripheral unit.

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APPENDIX C
KEYBOARD TRANSLATOR CHART

This appendix contains a keyboard translator chart to use with the IBM-PC, PC-XT, PC-AT, or IBM-compatible personal computer. The chart has been printed in triplicate to provide you with extra copies. The sheet has also been formatted so that you can remove each copy of the chart from the manual for easier reference.

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APPENDIX D
SOFTWARE FUNCTION KEY FLOW DIAGRAMS

The following diagrams illustrate the relationships between the software function keys. Position of functions within the diagram does not always represent actual key sequence.

Key function availability depends on the following conditions:

1. Available software options.
2. Scratch Pad content.
3. Cursor position.
4. Program logic at the cursor position.
5. Logicmaster 1F operating mode (computer keyswitch position).
6. CPU Memory Protect keyswitch position.
7. Instruction set selection.

If a key function does not display, check the list above.

TPK.A.42117

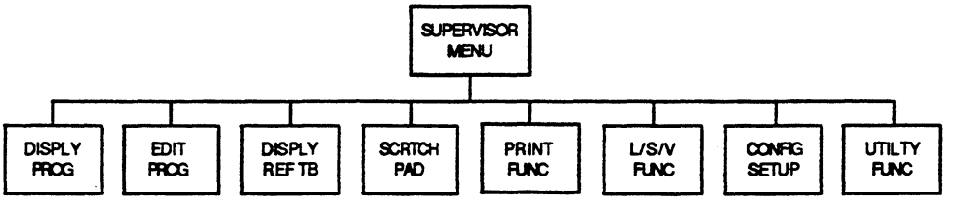

Figure D.1 SUPERVISOR MENU

TPK.A.42118

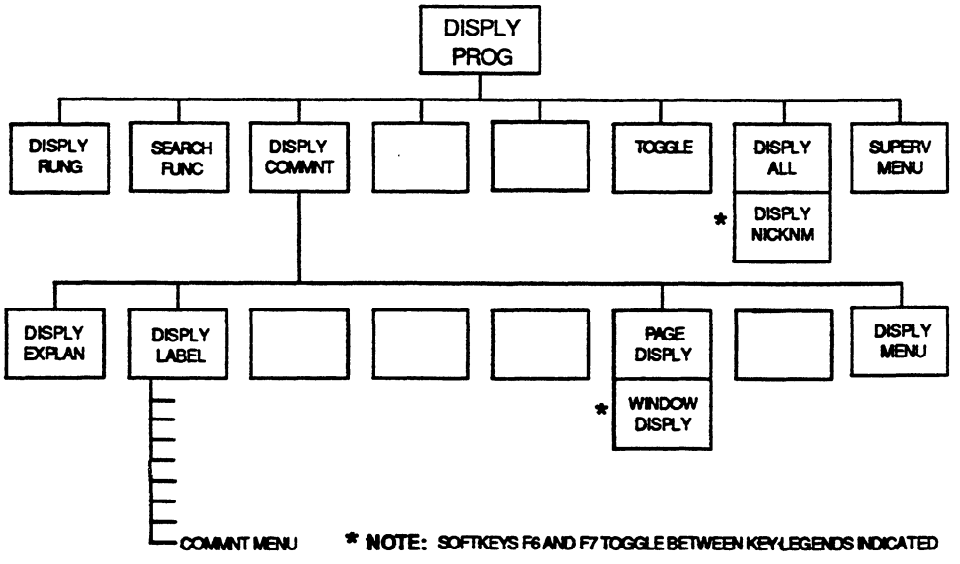

Figure D.2 DISPLAY PROGRAM SOFTWARE FUNCTIONS

This data flow is common for the Search menu in the both the Display Program and Edit functions.

TPK.A.42119

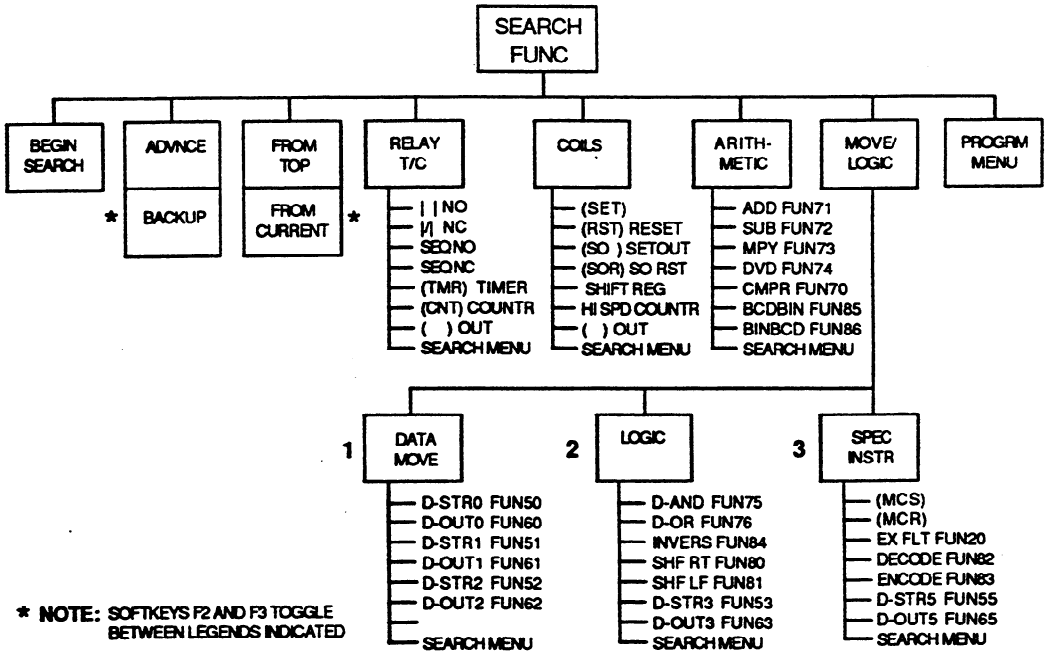

Figure D.3 SEARCH FUNCTION

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TPK.A.42120

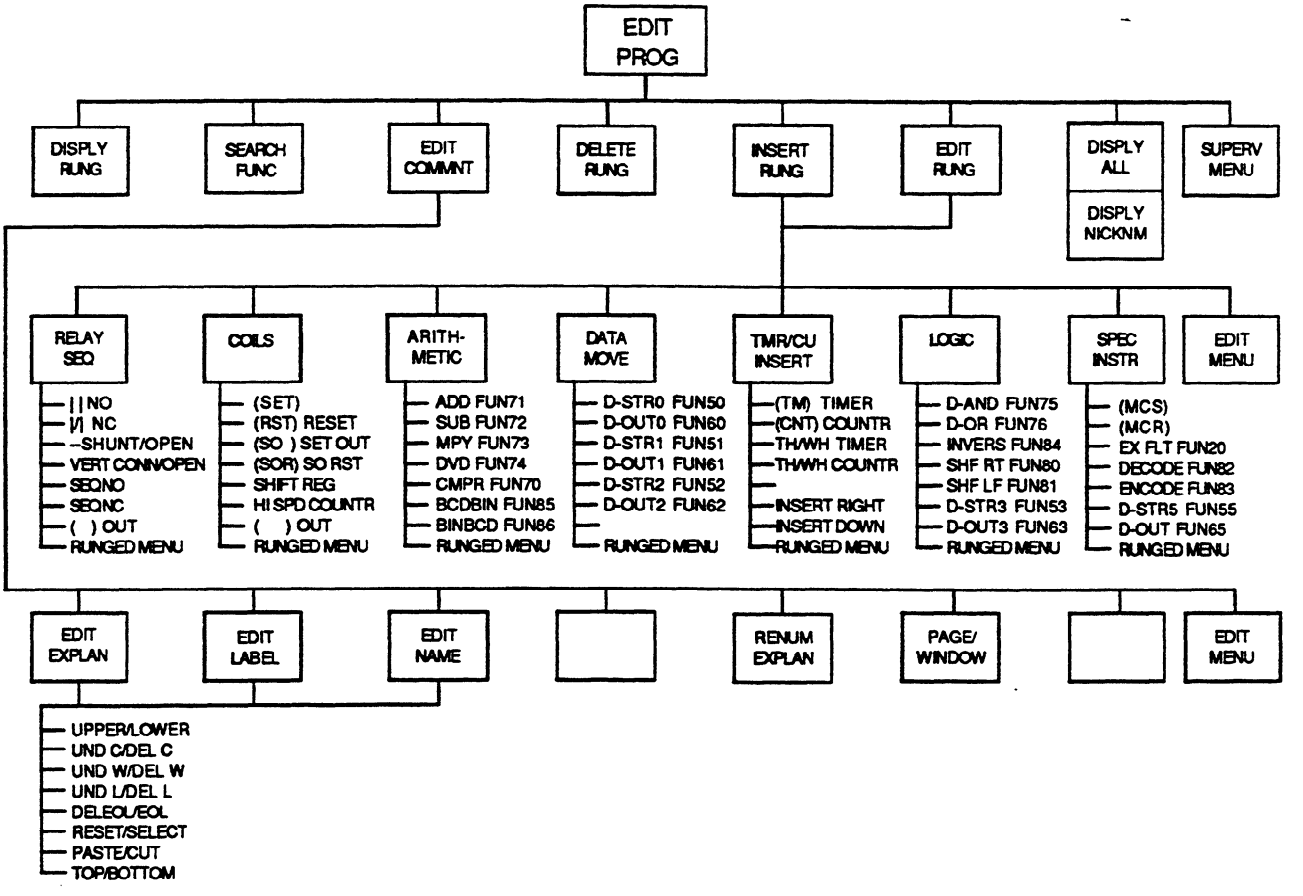

Figure D.4 EDIT PROGRAM SOFTWARE FUNCTIONS

TPK.A.42121

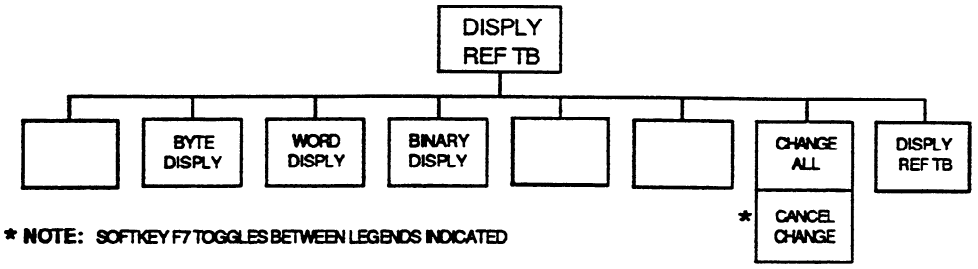

Figure D.5 DISPLAY REFERENCE TABLES

TPK.A.42122

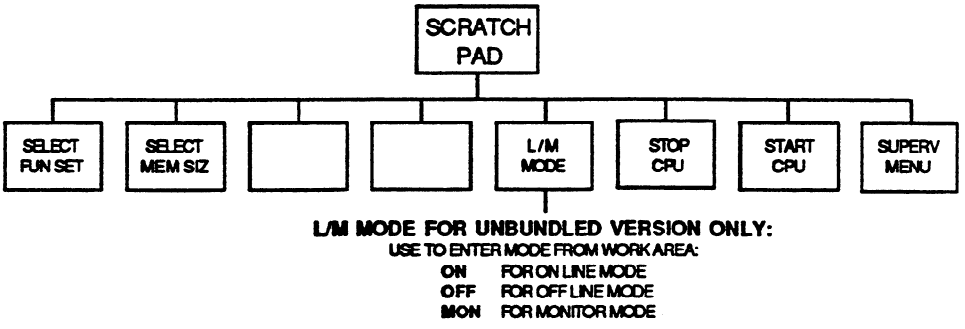

Figure D.6 SCRATCH PAD FUNCTION

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TPK.A.42123

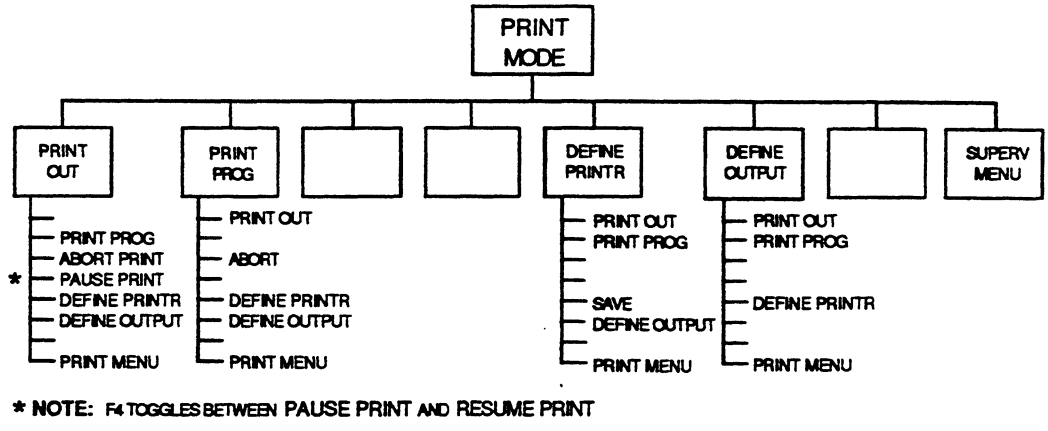

Figure D.7 PRINT FUNCTION

TPK.A.42124

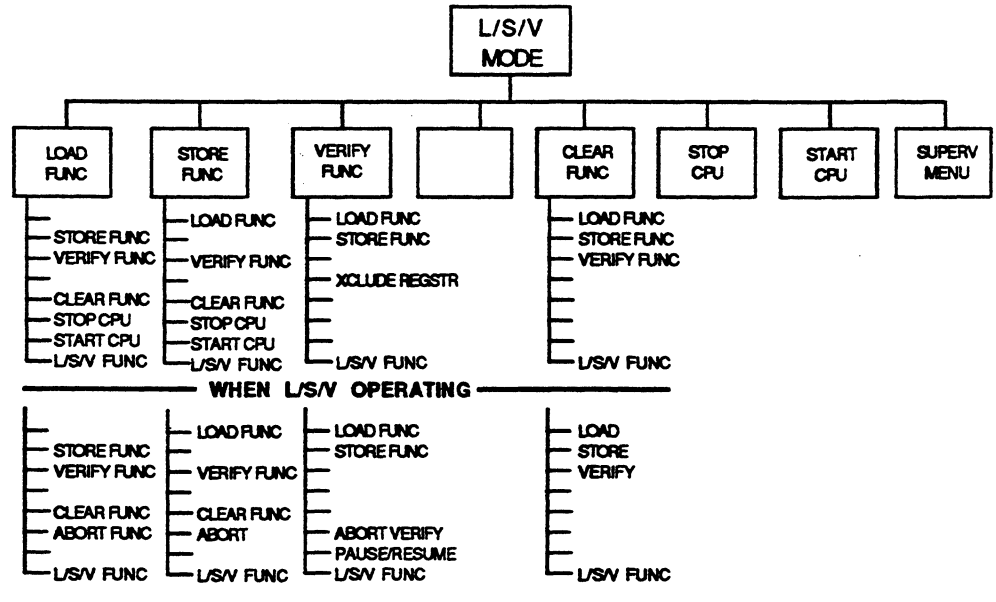

Figure D.8 LOAD/STORE/VERIFY FUNCTION

TPK.A.42125

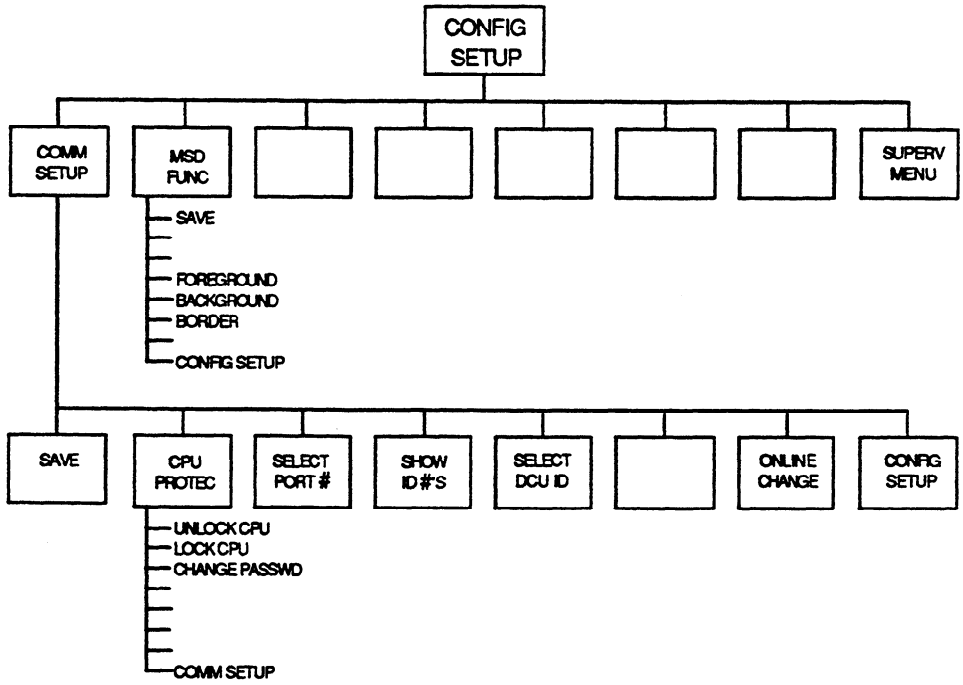

Figure D.9 CONFIGURATION SETUP MENU

TPK.A.42126

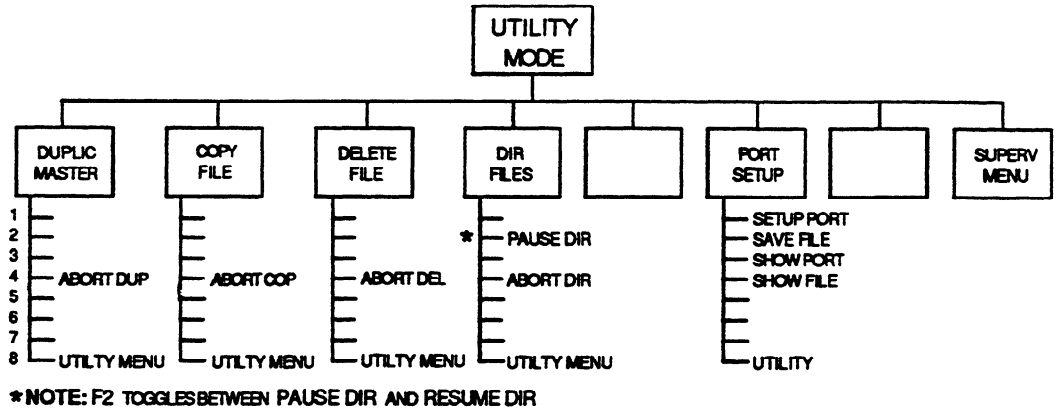

Figure D.10 UTILITIES FUNCTIONS

APPENDIX E
LOGICMASTER ONE SOFTWARE PACKAGE

The Logicmaster 1 Programming and Documentation package provides off-line programming and documentation for the Series One CPU (IC610CPU101A, IC610CPU101B, and IC610CPU101C). In general, the functions provided in this package operate the same as the Logicmaster 1F functions. This appendix describes the differences between the Logicmaster 1F and Logicmaster 1 software. Where the requirements are the same for these two packages, no mention will be made and reference should be made to the appropriate section(s) of this manual. Help text is also available.

OPERATION

Once installed and/or set up properly, according to chapter 2 of this manual, the Logicmaster Programming software will operate in one of two ways:

1. At the DOS prompt, enter **L1WM** to start the software for operation on the Workmaster or Cimstar I computer. The Logicmaster 1 software will recognize the Workmaster keyswitch.

2. At the DOS prompt, enter **L1PC** to start the software for operation on a Workmaster II computer, an IBM-PC, PC-XT, or PC-AT computer, or on an IBM-compatible personal computer. Refer to section 6 of chapter 2 for alternate key sequences.

When installing Logicmaster 1 software on a hard disk, the Duplicate Master function automatically creates a subdirectory called L1 on the hard disk. You may wish to add this directory to a path statement. This will supply DOS with a path to the \L1 subdirectory from other directories. This is normally done by placing a path statement in the AUTOEXEC.BAT start-up file. For example: PATH \L1.

DISPLAY PROGRAM

This function is not available in the Logicmaster 1 package.

REFERENCE TABLES

This function is not available in the Logicmaster 1 package.

COMMUNICATION SETUP

The password function is not available in the Logicmaster 1 package.

PROGRAMMING

Chapter 12 presents general programming concepts and describes basic programming instructions. Refer to chapter 12 and the information provided here when programming the Series One PLC using Logicmaster 1 software.

The pages listed below provide a reference to the functions described in chapter 12.

Refer to the table on the following pages for the valid references and ranges for these functions.

Table E.1 REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Normally Open Contact	x yyy ---| |---	yyy = 000-157 I/O Points 160-377 Internal Coils 400-577 Shift Registers x = T600-677 Timer Contacts C600-677 Counter Contacts
Normally Closed Contact	x yyy ---|/|---	yyy = 000-157 I/O Points 160-377 Internal Coils 400-577 Shift Registers x = T600-677 Timer Contacts C600-677 Counter Contacts
Drum Sequencer	xxx K yyyy ---| |----STEP---	xxx = 600-677 T/C Accumulate Registers K yyyy = K0000-K9999
Master Control Start	-[MCS]-	
Master Control Reset	-[MCR]-	
Out Coil	xxx ---( )	xxx = 000-157 I/O Points 160-373, 376 Internal Coils
Set Coil	xxx ---(SET)	xxx = 000-373, 376 I/O Points 400-577 Shift Registers
Reset Coil	xxx ---(RST)	xxx = 000-373, 376 I/O Points 400-577 Shift Registers
Set Out Coil	xxx ---(SO)	xxx = 000-157 I/O Points 700-767 I/O Points
Set Out Reset Coil	xxx ---(SOR)	xxx = 000-157 I/O Points 700-767 I/O Points

Table E.1 (cont.) REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Timer	K yyyy T xxx -[PRESC]-(TMR)-	Kyyyy = K0000-K9999 (each unit = 0.1 sec) T xxx = T600-T673 Timer Accumulate Registers
Thumbwheel Timer	T xxx -[TH/WH]-(TMR)-	(PRESC read from thumbwheels) T xxx = T600-T673 Timer Accumulate Registers
Counter	K yyyy C xxx -[PRESC]-(CNT)-	K yyyy = K0000-K9999 (each unit = 0.1 sec C xxx = C600-C673 Counter Accumulate Registers
Thumbwheel Counter	C xxx -[TH/WH]-(CNT)- ( ) ---------( )	(PRESC read from thumbwheels) C xxx = C600-C673 Counter Accumulate Registers
High Speed Counter	K yyyy C xxx -[PRESC]-(HSC)-	K yyyy = K0000-K9999 C xxx = C100-C107
Shift Register xxx yyy zzz aaa bbb -[SHIFT REGISTER DATA CLOCK RESET START STOP]--( )	xxx, yyy, zzz = 000-157 I/O Points 160-377 Internal I/O 400-577 Shift Registers 600-677 T/C Accumulate Registers aaa = 400-577 Shift Registers bbb =	

APPENDIX F
LOGICMASTER ONE JUNIOR SOFTWARE PACKAGE

The Logicmaster 1 Junior Programming and Documentation package provides off-line programming and documentation for the Series One Junior CPU (IC609SJRxxx). In general, the functions provided in this package operate the same as the Logicmaster 1F functions. This appendix describes the differences between the Logicmaster 1F and Logicmaster 1 Junior software. Where the requirements are the same for these two packages, no mention will be made and reference should be made to the appropriate section(s) of this manual. Help text is also available.

OPERATION

Once installed and/or set up properly, according to chapter 2 of this manual, the Logicmaster Programming software will operate in one of two ways:

1. At the DOS prompt, enter **LJRWM** to start the software for operation on the Workmaster or Cimstar I computer. The Logicmaster 1 Junior software will recognize the Workmaster keyswitch.

2. At the DOS prompt, enter **L1PC** to start the software for operation on a Workmaster II computer, an IBM-PC, PC-XT, or PC-AT computer, or on an IBM-compatible personal computer. Refer to section 6 of chapter 2 for alternate key sequences.

When installing Logicmaster 1 Junior software on a hard disk, the Duplicate Master function automatically creates a subdirectory called LJR on the hard disk. You may wish to add this directory to a path statement. This will supply DOS with a path to the \LJR subdirectory from other directories. This is normally done by placing a path statement in the AUTOEXEC.BAT start-up file. For example: PATH \LJR.

DISPLAY PROGRAM

This function is not available in the Logicmaster 1 Junior package.

REFERENCE TABLES

This function is not available in the Logicmaster 1 Junior package.

COMMUNICATION SETUP

The password function is not available in the Logicmaster 1 Junior package.

PROGRAMMING

Chapter 12 presents general programming concepts and describes basic programming instructions. Refer to chapter 12 and the information provided here when programming the Series One PLC using Logicmaster 1 Junior software.

The pages listed below provide a reference to the functions described in chapter 12.

Refer to the table on the following pages for the valid references and ranges for these functions.

Table F.1 REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Normally Open Contact	x yyy ---| |---	yyy = 000-157 I/O Points 160-377 Internal Coils x = T600-624 Timer Contacts C600-624 Counter Contacts
Normally Closed Contact	x yyy ---|/|---	yyy = 000-157 I/O Points 160-377 Internal Coils x = T600-624 Timer Contacts C600-624 Counter Contacts
Drum Sequencer	xxx K yyyy ---| |----STEP---	xxx = 600-624 T/C Accumulate Registers K yyyy = K0000-K9999
Master Control Start	-[MCS]-	
Master Control Reset	-[MCR]-	
Out Coil	xxx ---( )	xxx = 017-157 I/O Points 160-373, 376 Internal Coils
Set Coil	xxx ---(SET)	xxx = 017-373, 376 I/O Points
Reset Coil	xxx ---(RST)	xxx = 017-373, 376 I/O Points
Set Out Coil	xxx ---(SO)	xxx = 017-137 I/O Points

Table F.1 (cont.) REFERENCE RANGES

DESCRIPTION	EXAMPLE	VALID REFERENCE RANGE
Timer	K yyyy T xxx -[PRESC]-(TMR)-	Kyyyy = K0000-K9999 (each unit = 0.1 sec) T xxx = T600-T617 Timer Accumulate Registers
Thumbwheel Timer	T xxx -[TH/WH]-(TMR)-	(PRESC read from thumbwheels) T xxx = T620-T623 Timer Accumulate Registers
Counter	K yyyy C xxx -[PRESC]-(CNT)-	K yyyy = K0000-K9999 (each unit = 0.1 sec C xxx = C600-C617 Counter Accumulate Registers
Thumbwheel Counter	C xxx -[TH/WH]-(CNT)- ( ) ————( )	(PRESC read from thumbwheels) C xxx = C620-C623 Counter Accumulate Registers
High Speed Counter	K yyyy C xxx -[PRESC]-(HSC)-	K yyyy = K0000-K9999 C xxx = C624
Shift Register xxx yyy zzz aaa bbb -[SHIFT REGISTER DATA CLOCK RESET START STOP]—( )		xxx, yyy, zzz = 000-157 I/O Points 140-372 Shift Registers aaa = 140-372 Shift Registers bbb = 140-372 Shift Registers

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