Logicmaster 5 Programming and Documentation Software User's Manual

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FANUC

GE Fanuc Automation

Programmable Control Products

Logicmaster™ 5 Programming and Documentation Software

User's Manual

GFK-0023B

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Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

The Logicmaster™ 5 Programming and Documentation Software from GE Fanuc Automation North America, Inc. is used to create ladder logic programs for the Series Five™ programmable logic controller (PLC). This manual describes the Logicmaster 5 software package to be used with the Series Five PLC.

Using this Manual

Chapters 1 through 11 describe the features of the Logicmaster 5 software package. If you are starting up the system for the first time, or getting ready to do a printout, or displaying tables of data from the Series Five 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 Series Five Instruction Set.

The manual is organized as follows:

Chapter 1. Introduction: The Introduction provides an overview of the software package and options for running Logicmaster 5 software. Chapter 1 also describes the hardware requirements for using Logicmaster 5 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: Chapter 2 describes start-up procedures for floppy-diskette and hard-disk users. The basic operation of the Workmaster computer, and other computers when using Logicmaster 5 software, are also described.

Chapter 3. Scratch Pad: The Scratch Pad function is used to display and store information about the current program in Logicmaster memory, or about the CPU capabilities. Chapter 3 defines the entries on the Scratch Pad display, and explains how to change these entries. A summary of the Scratch Pad function keys is also provided.

Chapter 4. Display Program: The Display Program function is used to display ladder logic, showing power flow through the rungs. Chapter 4 explains how to use the features of Display Program: displaying a program, searching for a program element, and making on-line changes. A summary of the Display Program function keys is also provided.

Chapter 5. Edit Program: The Edit Program function is used to create or modify a ladder logic program in Logicmaster memory. Chapter 5 explains how to use the 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. A summary of the Edit Program function keys is also provided.

Chapter 6. Annotation: Annotation can be used to add explanatory text to a ladder logic program. Chapter 6 explains how to create, display, and print annotation.

Chapter 7. Display Reference Tables: The Display Reference Tables function is used to display the status of any group of references. Chapter 7 explains how to enter, use, and exit this function.

Chapter 8. Print: The Print function can be used to print copies of ladder logic and annotation. Chapter 8 explains how to use the Print functions: setting up the printer, defining printout content, printing in Foreground mode, and printing a file in Background mode. A summary of the Print function keys is also provided.

Chapter 9. Load/Store/Verify: The Load/Store/Verify function is used to transfer programs and tables to/from Logicmaster memory, transfer configuration data to/from the CPU, compare data, and clear Logicmaster memory. Chapter 9 explains how to perform these functions. A summary of the Load/Store/Verify function keys is also provided.

Chapter 10. Setup & Diagnostics: The Setup & Diagnostics functions are used to specify parameters for communications, lock/unlock the CPU and, when used, change the password, select the display colors for a color monitor, and assign I/O module addresses. Refer to chapter 10 for information on these functions. A summary of the function keys is also provided.

Chapter 11. Utilities: The Utilities functions are used for disk and file management. Chapter 11 explains how to perform these functions. A summary of the Utilities function keys is also provided.

Chapter 12. Programming: Chapter 12 presents general programming concepts. Refer to this chapter for information on basic ladder diagram format and the elements of a ladder diagram.

Chapter 13. Series Five Instruction Set: Chapter 13 should be used as a reference guide for the Series Five Instruction Set. Within the chapter, functions are grouped into sections that correspond to the function key assignments used during programming. Page 13-2 provides a complete listing of the contents of this chapter.

Appendix A. Setup Information: Appendix A describes setup information for using Logicmaster 5 software.

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

Appendix C. Logicmaster 5 Error Codes: describes several common error codes and the corrective action to take for each one.

Appendix D. Software Function Key Flow Diagrams: provides a map of the software function keys.

Appendix E. Keyboard Translator Chart: provides a handy tear-out reference chart for use with IBM-PC computers plus a listing of the Alternate and Control key functions.

Series Five PLC Bulletin Board

GE Fanuc - NA now has a computer bulletin board for the Series Five PLC. This service is provided free of charge to our customers and is intended to:

- Provide Series Five PLC users with instant access to new information.
- Allow sharing of information among Series Five PLC users.
- Provide GE Fanuc with feedback from Series Five PLC users.

To access this bulletin board, you will need a computer or terminal, modem, and modem software. The telephone number for the bulletin board is (804) 978-5046. Refer to GFK-0122, *Series Five PLC User's Manual*, for information on using this bulletin board.

Related Publications

- GEK-25373 *Workmaster™ Guide to Operation*
- GEK-90527 *Cimstar™ I Industrial Computer Reference Manual*
- GFK-0122 *Series Five PLC User's Manual*
- GFK-0123 *Series Five PLC I/O Module Specifications Manual*
- GFK-0248 *Series Five Genius Bus Controller User's Manual*
- GFK-0269 *Series Five ASCII/BASIC Module User's Manual*

Linda McCoy
Technical Writer

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Table

Chapter 1 Introduction

Logicmaster™ 5 Programming and Documentation Software from GE Fanuc Automation North America, Inc. is used to create ladder logic programs for the Series Five™ family of programmable logic controllers (PLCs). Program development may be done on a Workmaster ® or Cimstar™ I industrial computer; on an IBM PC, PC-XT, or PC-AT; or on most IBM-compatible personal computers.

Both the Workmaster® 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 computer has 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 5 software. Although such a keyboard lacks the additional programming keys of the 91-key keyboard, it can be used with Logicmaster 5 software by referring to the information in section 6, *Using Your Keyboard*, of chapter 2.

After a program is developed, it is simple to transfer it to the CPU. Then, the Logicmaster 5 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 monitored.

Programming Features

Logicmaster 5 software offers a full range of programming features, such as:

- Basic contacts, coils, timers, and counters.
- Binary, signed single-precision, and double-precision arithmetic.
- Data Move, Table Move, List operations, and Matrix functions.
- Up to 32 subroutines in a single program. Other control functions such as Master Control Relay and Skip.
- Support for up to 16K CPU registers.
- 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.

Content of Chapter 1

Chapter 1 contains the following sections:

Section 1. System Configuration: Section 1 lists the hardware requirements and characteristics of Logicmaster 5 software.

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

Section 3. Guide to Using Logicmaster 5 Software: Section 3 contains brief descriptions of the principal features of Logicmaster 5 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 5 software. Chapters 1 through 11 are about Logicmaster 5 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.
- Chapter 13 of this book contains descriptions of all the Series Five programming instructions.

Each chapter contains related information about one aspect of programming or operating Logicmaster 5 software. To locate a major subject area, refer to the tables 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 5 software that are available. It also describes the general hardware configuration required for each version.

The two versions are:

- A 3.5-inch version for the Workmaster or Cimstar I industrial computer, or for any other 3.5-inch disk drive-based personal computer with the appropriate hardware.
- A 5.25-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 manual, when we use the term IBM PC, the information also applies to the PC-XT, PC-AT, and IBM-compatible PC, unless otherwise indicated. Operation with IBM-compatible PCs is not assured.

While programs are under development, both the 3.5-inch and 5.25-inch versions are functionally similar. With a completed program transferred to a Series Five 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.
- Operation with or without the Extended Memory card.
- Support of the Enhanced Graphics Adapter (EGA) card.

Using a Workmaster Computer

To run Logicmaster 5 software, the Workmaster computer must have the following:

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

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

Compatibility with DOS

To run Logicmaster 5 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 5 software can be used on an IBM PC, PC-XT, or PC-AT, or on most IBM-compatible personal computers, with the following characteristics:

- 640K total available Logicmaster memory (RAM).
- PC-DOS version 2.1 or 3.1 for the IBM PC and PC-XT. PC-DOS version 3.1 or 3.2 for the IBM PC-AT.
- 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-compatible personal 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.

Logicmaster 5 software communicates with the Series Five PLC via the CCM port in the CPU.

RAM Memory Requirements

To run Logicmaster 5 software, your system needs 640K of Logicmaster RAM memory (main memory). Due to hardware limitations with most PCs, it is not possible to have more than 640K of main memory. Additional memory can be installed above 640K, but this memory is *only* available to Logicmaster 5 as "RAM Disk" and is not available for LM5 execution. This means that Logicmaster 5 software can read and write the additional memory as through it were a disk drive, but it cannot execute from this RAM Disk memory or directly access it.

Of the physical 640K of main memory, DOS uses a portion, the driver files listed in the CONFIG.SYS file use a portion, and Logicmaster 5 software uses the rest. It is not possible to have SIDEKICK or other "memory resident" programs installed in main memory and still have enough memory left for the LM5 software. If you attempt to install another "memory resident" program, you will either get an initialization error on bootup or you will run out of main memory during Logicmaster 5 operation (even though you may have megabytes available in the RAM Disk).

If you get the message "Software Initialization Failure Number 2" when starting up the software, check for batch files that are loading other software into Logicmaster memory at startup.

Caution must be observed to ensure that the AUTOEXEC.BAT file does not automatically load any additional programs into memory. There is enough spare memory, however, for the GE Fanuc-supplied RAM Disk driver.

Communicating with the Series Five PLC

Logicmaster 5 software communicates with the Series Five PLC over a serial communications channel. Communication is possible over a long distance, using a wide range of baud rates, with or without modems. The system can communicate with a single CPU, or be used in a multidrop configuration with up to eight CPUs.

For point-to-point RS-232 communications over distances of 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.

For RS-422 multidrop communications or point-to-point communications over distances of greater than 50 feet, connection must be made to the serial port on the optional Asynchronous Joystick card, IC640BGB311. Or, you may also connect to the RS-232/RS-422 converter box, IC630CCM390B.

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

Optional Configuration

The host computer may be equipped with an Expanded Memory card for overlay loading. Refer to chapter 2 for information.

SECTION 2
Operating Modes

The Logicmaster 5 system has three operating modes:

Off-Line: Off-Line mode is used for program development. Power flow display or table contents do not reflect those in the CPU when the system is in Off-Line mode.

On-Line: On-Line mode provides real-time displays, data table changes, on-line changes, data value changes, and overrides.

Monitor: Monitor mode allows programs to be examined and real-time status displayed, but no changes to program 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.

In a computer without a keyswitch, the Logicmaster 5 software package starts up in Off-Line mode. Because the computer lacks this keyswitch, mode selection must be made in the software. This is done through the Scratch Pad menu, by pressing the appropriate softkey. The mode can also be changed by pressing the Alt/1 keys from any menu. For instructions, refer to chapter 3, *Scratch Pad*.

CPU Keyswitch

In addition to the mode selection performed using the Logicmaster 5 system, an additional safeguard is provided when the system is connected to an operating CPU. The mode keyswitch on the CPU must be in the STOP position to store I/O tables and register tables. The ladder diagram may be transferred to the CPU when it is stopped or running. The CPU can be started or stopped from the Scratch Pad menu, or by pressing the Alt/2 keys from any menu.

On-Line Mode

In On-Line mode, the CPU periodically sends an updated input and output status table, register memory, override table, and Scratch Pad to the Scratch Pad to the Logicmaster 5 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, Logicmaster 5 software can read data from the CPU, but may not transfer data to the CPU. All registers, tables, and displays are updated automatically to reflect the current operating state of the CPU. For the Workmaster and Cimstar I computers, this is the only operating mode that allows removal of the keyswitch key.

Off-Line Mode

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

Summary

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

Table 1-1. Summary of 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 5 Software

This section introduces many of the features of Logicmaster 5 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 and its utilities to set up programming parameters, and how to change the configuration of the Series Five PLC.
- 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 Five CPU.
- How to transfer programs between the computer and the Series Five CPU, and between the computer and disks.
- The format of ladder logic, and how to display a program.
- The features of the Series Five instruction set.

Using Help Screens

Logicmaster 5 software includes detailed Help screens. It is easy to enter and exit from the Help function. To access the Help screen for the feature you are using, just press the Help key on your keyboard. (On the personal computer keyboard, press the F10 key to access the Help screens.) Program data will not be lost when you press the Help key.

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.

For a dual-floppy-diskette drive system, the program diskette is usually in drive A and the Help diskette in drive B. For a single-floppy-diskette drive system, you must remove the program diskette from the drive and insert the Help diskette in order to use the Help files.

Utilities

Utilities are probably the first functions of the Logicmaster 5 system 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 5 software on the hard disk. Chapter 11, *Utilities,* explains how to copy your master diskettes.

Setting up 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, *Utilities,* for instructions.

For CCM communication with the CPU, a port setup file named PORT1.PSU is supplied on the system diskette. It contains a default value for communication data compatible with the factory setup of the CPU. If the DIP switches in the CPU which control the parameters of the CCM port have not been changed from the factory setting, you need not use the Port Setup function in this menu. The PORT1.PSU file will be used to set up COM1 port on the IBM PC.

Using File Utilities

You will use the File Utilities often. These are a group of DOS file-handling programs built into 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. Information on copying, deleting, and renaming files is found in chapter 11, *Utilities.*

Scratch Pad

The Logicmaster 5 system can easily be used to create programs off-line, perhaps in a location far from the programmable logic controller (PLC). With Logicmaster 5 software, one computer can be used to create programs for many Series Five PLCs. These programs can be stored on diskettes or a hard disk, and used whenever and wherever they are needed.

Logicmaster 5 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, it may have less than 16K memory, or you may be creating programs for several PLCs that have CPUs with different configurations.

A function called "Scratch Pad" is used to match the programming features of Logicmaster 5 software to the CPU, and to set up CPU operational parameters. When you select the Scratch Pad function from the Supervisor menu, the Scratch Pad display appears. Here, you can select the features you want to include in the program for a specific CPU. For example (shown in Off-Line mode):

```
                                                        LM:OFFLINE    11:13:45

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

      PROGRAM NAME:      NONE     25-JAN-88  09:33:40     PRG ID:  21

      REGISTERS:           4K       SUBROUTINES USED:               00

      MEMORY SIZE:         4K       MEMORY USED:                     4
                                        AVAIL:                3,836


              MEMORY SIZE AND REGISTERS SELECTION ARE LIMITED
                 BY ACTUAL PROGRAM SIZE AND REGISTERS USED.


         SELECT   SELECT                         TIME             SUPERV
 1       2MEM SZ  3REG SZ  4          5        6 DATE   7       8 MENU
```

The Scratch Pad display shows the number of words of memory and the number of subroutines that have been used by the program, and the number of words still available. In this example, only 4 words have been used so the number of remaining words available is 3,836.

Changing Scratch Pad

When off-line, the Scratch Pad menu allows you to configure the Logicmaster 5 software to match the memory characteristics of the Series Five PLC. For example, if you are developing a program in the Off-Line mode which will be run on a CPU with 4K of registers, then you should set the parameter in the Scratch Pad menu for register size to 4K. (Some versions of the Series Five CPU support 16K registers.) Then, when you are writing your program, the Logicmaster 5 software will not allow you to enter register addresses or length parameters which would access registers beyond 4096. Similarly, by setting the memory size parameter in Scratch Pad to match the target CPU, Logicmaster 5 software will prevent you from writing a program that is too long to be stored in the CPU.

Using Scratch Pad to Control the CPU

You can also use the Scratch Pad when the Logicmaster 5 system is on-line with the CPU, or in Monitor mode. Then, the information you see on the Scratch Pad screen comes from the CPU itself.

When the Logicmaster 5 system is on-line to a CPU and the DIP switch in the CPU is set properly, you can change the ID number *in the CPU* by changing the CPU ID NUMBER in the Scratch Pad. You can also turn the CPU scan on or off by simply pressing one key on your computer keyboard. Pressing another key allows the CPU to run with outputs disabled for system debugging.

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:

```
|
| I0201    I0202    I0203    I0204    I0205                                         O0058
|--| |-----| |-----| |-----| |-----| |-----|/|------------------------------------( )
|
```

With nicknames for the inputs and outputs, the same line can be more meaningful when read. The following example is shown in Display Nickname mode:

```
|
|SWITCH1 SWITCH2 SWITCH6 SWITCH7   PB2                                          LIGHT 8
|--| |-----| |-----| |-----| |-----| |-----|/|------------------------------------( )
|
```

In Display All mode, this same example would also include the name and reference for each input and output.

"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 (on 3 lines). 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):

```
|
| ONGOING  DATA    OPEN    BOARD
| ONESHOT  VALID   WIRE     OK                                              AOK
|
| O0025    I0009   I0011   I0013                                          O0027
|--| |-----| |-----|/|-----| |------------------------------------------------( )
|
```

"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:

```
        ADD 3000 FOR IDENTIFICATION AS A RIGHT PROXIMITY SWITCH ERROR

|
|                                      name1
|                                      name2
|                                      name3                             LOW
| FAULT 3                             nicknam                           ALARM
| O0107  R00806   Const    R00790      I1024                            O0006
|--| |---|  A  ADDX B  =      C |-----|/|---------------------------------( )
|              +03000
|
```

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:

```
                                   IF THE DATA IS LESS THAN OR EQUAL TO THE
                                   ALARM SETPOINT, OUTPUT 6 COMES ON
|
|              LOW
|             ALARM                                                      LOW
| DATA       SETTING   UTILITY                                          ALARM
|
| R00008      R00009     R00256                                         O0006
|-| A   SUBX    B    =     C |------------------------------------------( )
|
```

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 printout 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 Series Five instruction set. All of the program elements may be reached by selecting either Insert Rung or Edit Rung.

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. Explanations of the Series Five instruction set are featured in chapter 13 of this manual.

Copying and Combining Programs

Similar logic may be needed in more than one program. With Logicmaster 5 software, it is simple to copy part or all of one program into another program. This is done by combining program files, as explained in chapter 4. 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.

Load/Store/Verify

While programs are being worked on, they are contained in the Logicmaster memory (RAM) of the computer. Logicmaster 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, type in the file name, and press the Shift/Enter keys. The Store Program screen is also used to send a program to the programmable controller CPU.

"Loading" a program is the opposite of storing it. When you load a program, you transfer it into Logicmaster memory, where the program can be viewed or changed. 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 Logicmaster memory (RAM). It can be a new program, or one you have placed in Logicmaster 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 appear on the computer screen.

```
|I0001   I0002   I0003   I0004   I0005                                    00001
|--| |-----| |--+--| |--+--| |--+--| |------------------------------------( )
|00001   00002  |       |       |
|--| |-----| |--+       |       |
|I0001                  |       |
|--| |--+---------------+       |
|00001  |                       |
|--| |--+                       |
|I0006   I0002   00002          |
|--| |--+---| |-----| |-+-------+
|00003  |               |
|--| |--+               |
|I0004                  |
|--| |------------------+
```

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 Series Five CPU. The current values of the program elements will be displayed. The program display will include I/O states, overrides, and register contents. The Logicmaster 5 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.

Series Five Function Set

The ladder diagram functions available with Logicmaster 5 software can be considered the building blocks for a relay ladder diagram. These instructions reference discrete bits that are to be part of an operation. The functions available in the Series Five PLC are listed in the following table:

Table 1-2. Series Five Function Set

GROUP	FUNCTION
Relay	Normally Open and Normally Closed Contacts
	Real Outputs
	Internal Outputs
	Latches
	One-Shot Coils
	Timers (tenths, hundredths, seconds)
	Counters (up and down)
Arithmetic	Addition
	Subtraction
	Multiplication
	Division
	Signed Double Precision Addition
	Signed Double Precision Subtraction
	Greater Than
	Compare
Control	Master Control Relay
	Skip
	Do Subroutine and Return
	Transfer
	Read/Write CCM
	Read/Write Device
	Do I/O and Suspend I/O
Move/Convert	Table to Destination Move
	Source to Table Move
	Move Table
	Move Right 8 Bits
	Move Left 8 Bits
	Block Move
	Move A to B
	BCD to Binary Conversion
	Binary to BCD Conversion
Matrix	AND
	Inclusive and Exclusive OR
	Invert
	Set Bit
	Clear Bit
	Sense Bit
	Shift Bit Right
	Shift Bit Left
List	Add to Top
	Remove from Bottom
	Remove from Top
Miscellaneous	End of Sweep
	No Op

Display Reference Tables

The Logicmaster 5 system maintains a set of tables showing the values of the inputs, outputs, and registers used in a program. To display an input reference table, press the I key in the numeric keypad, enter the address of the reference on the center line of the work area, and then press the Disply Ref Tb (F3) key from the Supervisor menu. The screen will display the table that includes the reference you entered.

For example, to display the input table for I0173, press the I key and then enter the address (in this case, 0173) on the center line of the work area. Then, press the Disply Ref Tb (F3) key from the Supervisor menu. The screen will display the table for I0173.

If you selected the input table, the first three lines of values in the Input table would look like this:

```
POINT #                    INPUT     0173        (nickname)
0064 00000000 00000000 10010100 00000000 10111111 00010010 01001001 0101010
0128 10101010 01001010 11010100 10101001 10101001 10010010 01010100 0101010
0192 11110101 11101000 10101000 00000100 00000100 01010111 11110111 0110010
```

The entire table shows 16 lines of input values, like the three example lines illustrated above. 1024 values are shown on the same page.

Outputs and register values are shown similarly.

If the Logicmaster 5 system is connected to a CPU and in On-Line mode, the values shown are from the CPU. Otherwise, they are from the Logicmaster memory.

It is easy to change the numeric base for some or all of the items on the I/O displays or register displays. For instance, the I/O values can be in binary:

```
0064    00000000 00000000 10010100 00000000 10111111 00010010 01001001 01010100
```

Or converted to decimal. Here just 16 bits are converted:

```
                                     ___DECIMAL___
                                    |             |
0064    00000000 00000000 10010100              0191 00010010 01001001 01010100
```

Or to hexadecimal. Here the same 16 bits are converted to hexadecimal:

```
                                    _HEXADECIMAL_
                                    |             |
0064    00000000 00000000 10010100              00BF 00010010 01001001 01010100
```

Register values can be converted similarly.

In addition to being able to display values, I/O references can be overridden and their status toggled on/off from the reference tables displays.

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

Communicating with the CPU

The Logicmaster 5 system can transfer programs to and from the Series Five 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 5 system communicates with the Series Five CPU through a serial link. Logicmaster 5 software includes a screen called the Communications Setup menu. On this screen, you enter the port number and the identifying number of the CPU. On-line changes are enabled/disabled via this screen.

```
                                                LM:OFFLINE   10:47:42

              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  (1,2)

                 SELECTED CPU ID NUMBER:  1   (1-90)

                 ONLINE CHANGES:  ENABLED




  SAVE     CPU   SELECT               SELECT   SHOW   ONLINE  SETUP
 1 FILE  2PROTEC 3 PORTS 4           5CPU ID 6 ID #S 7CHNGES 8& DIAG
```

After this screen is completed and the selected port is properly configured, the Logicmaster 5 system can communicate with the selected CPU.

A Setup file will be provided on the system disk that contains the default values for the communication setup data compatible with the CPU factory setup values. The default values will be COM1 port and CPU ID=1. Initially, on-line changes are enabled.

For information on the Setup/Diagnostic Functions menu, refer to chapter 10, *Setup/Diagnostic Functions.*

Chapter 2 Operation

This chapter explains what you will need to know to start up the Logicmaster 5 system, and to use the features described in this manual.

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 to section 3 to start up the software.

One copy of GFJ-015, *Logicmaster 5 Software Startup Information,* has been included with this manual. It provides a quick guide to getting started with Logicmaster 5 software. The information is sufficient to allow most users to install and run the software with a minimum expenditure of time and effort. Please refer to this document to determine if it is applicable to your system configuration before referring to sections 1-3 of this chapter.

Section 1. Using DOS: Section 1 describes how to start up DOS, use DOS commands, format diskettes, and exit from Logicmaster 5 software to DOS.

Section 2. Installing Logicmaster 5 Software: Before you use Logicmaster 5 software for the first time, follow the installation instructions in section 2.

Section 3. Starting Up Logicmaster 5 Software: Refer to section 3 for instructions to start up Logicmaster 5 software using diskettes or a hard disk.

Section 4. Using the 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. Starting Up the Series Five PLC: Section 5 explains how to set up serial communications between the Series Five programmable logic controller and the Logicmaster 5 system. It also explains how to start up the Series Five system with Logicmaster 5 software.

Section 6. Using Your Keyboard: Section 6 explains the types of keyboards that may be used with Logicmaster 5 software. This section also explains how to define special key assignments to make programming easier.

Section 7. Entering Data: Section 7 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 8. Working with Numbers: Refer to section 8 for information about number types: binary, signed and unsigned decimal, BCD, hexadecimal, and double precision.

SECTION 1
Using DOS

Before you can use Logicmaster 5 software, your computer must first be started up with DOS. DOS is not contained on the Logicmaster diskettes 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 System. DOS is a software program that interfaces other programs (like Logicmaster 5) with the computer hardware. *DOS must be used to start up Logicmaster 5 software.*

Versions of DOS

As with other types of software, there are different versions of DOS. To run Logicmaster 5 software, you must use version 3.2 (GE Fanuc version 1.10). Earlier versions of DOS are *not* compatible with Logicmaster 5 software.

If you are not sure what version of DOS you have, start up the computer in DOS, as described below. 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 a 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/Delete, or the Reset button. Otherwise, turn on the power to the computer.

3. The copyright screen will appear while the DOS software is loaded into Logicmaster memory. When the date and time prompts appear, 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 a 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 Logicmaster 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 will appear. 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 will appear.) If the system files are on a hard disk, it will load those files into Logicmaster memory and the hard disk drive prompt will appear. 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. The Copy, Rename, and Type commands are used to install and start up Logicmaster 5 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  CONFIG.SYS
```

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

```
REN CONFIG.WM  CONFIG.SYS
```

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 5, load the file into Logicmaster 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 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 diskette in drive A,
            when drive A is the current drive.
A> DIR B:   displays the directory of the diskette in drive B,
            when drive A is the current drive.
B> DIR      displays the directory of the diskette 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 diskette 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 diskette. For example:

```
A> DIR B:*.LAD
```

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

Exiting to DOS

When Logicmaster 5 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 when exiting to DOS if there is a ladder logic program in Logicmaster memory that you want to keep. Exiting to DOS is just like restarting the computer; the contents of Logicmaster memory will be lost.

If you have been editing a program that has an active file name, it has automatically been saved to diskette each time you pressed the Accept key. If the program does not have an active file name, you should use the Load/Store/Verify function to save the program before exiting to DOS. If necessary, you can use any formatted diskette to store the program.

To exit to DOS from the Logicmaster 5 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 5 software from diskettes, the screen may now prompt:

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

   If that prompt appears, place a diskette with a batch file in drive A. Diskette 1 of the Logicmaster 5 diskettes contains a batch file. Press any key to continue.

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

   ```
   A>
   ```

3. When you want to return to Logicmaster 5 software, enter its command line:

   ```
   LM5WM     or     LM5PC
   ```

   depending on whether you are using a Workmaster or Cimstar I industrial computer, or an IBM PC, PC-XT, PC-AT, or IBM-compatible computer. If you are using diskettes, the Logicmaster 5 diskette 1 must be in the default drive. Press the Return key.

SECTION 2
Installing Logicmaster 5 Software

Ordinarily, you will use the information in this section once, to prepare Logicmaster 5 software for regular use. This section describes:

- The diskettes supplied with Logicmaster 5 software.
- The types of System Configuration file that are supplied with Logicmaster 5 software.
- The correct content of the CONFIG.SYS file for the type of computer you are using.
- Editing the System Configuration file, if necessary.
- Installing Logicmaster 5 software on a hard disk.
- For the Workmaster or Cimstar I computer, 3.5-inch diskette only: customizing the Logicmaster 5 system diskettes so that they can be started up without DOS.

Before Using Logicmaster 5 Software

Before you use Logicmaster 5 software regularly, you should follow the instructions in this section.

1. Check the content of your System Configuration CONFIG.SYS file (see page 2-9). This file must agree with your hardware setup. If necessary, edit or create this file on your startup diskette.
2. If your computer has a hard disk, install Logicmaster 5 software on the hard disk.
3. If you are using either a Workmaster or Cimstar I computer with 3.5-inch diskettes, you can create a startup diskette. This will eliminate the need for using a DOS diskette to start up Logicmaster 5 software.

Logicmaster 5 System Diskettes

Logicmaster 5 software is supplied on diskettes in two configurations, as described below:

- For computers with 3.5-inch drives with 80 track format, such as that provided with the Workmaster or Cimstar I computer, the software is provided on two 3.5-inch diskettes.
  - **Diskette 1:** The files on diskette 1 (system diskette) will take you to the Supervisor menu. Following the instruction in this section, you can make diskette 1 into a startup diskette.
  - **Diskette 2:** The files on diskette 2 (overlay diskette) provide the features of the Supervisor (main) menu. These files are called "Overlay" files. Following the instructions in this section, you can load these files to another diskette, a hard disk, or RAM Disk for faster execution. Diskette 2 also contains the Help files. These files contain the explanatory text for the Help screens.
- For IBM PC, PC-XT, PC-AT, and most IBM-compatible computers with 5.25-inch disk drives with 40 track format, the software is provided on three 5.25-inch diskettes.
  - **Diskette 1:** The files on diskette 1 (system diskette) will take you to the Supervisor menu.
  - **Diskette 2:** The files on diskette 2 (overlay diskette) provide the features of the Supervisor (main) menu. These files are called "Overlay" files. Following the instructions in this section, you can load these files to another diskette, a hard disk, or RAM Disk for faster execution.
  - **Diskette 3:** Diskette 3 (system diskette) contains the Help files. These files contain the explanatory text for the Help screens.

Once installed and/or set up properly, either configuration of the Logicmaster 5 programmer (described above) will operate in either of two ways:

1. Enter **LM5WM** to start the software for operation on the Workmaster or Cimstar I computer. The Logicmaster 5 software will recognize the Workmaster keyswitch.
2. Enter **LM5PC** to start the software for operation on IBM PC, PC-XT, PC-AT, 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 5 Files

Most system files provided with Logicmaster 5 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 diskette; they will not interfere with the operation of Logicmaster 5 software.

Before Starting up Logicmaster 5 Software the First Time

Use the original diskettes to start up the system the first time. Then, use the Duplicate Master utility of Logicmaster 5 software to make copies of these diskettes.

CAUTION

When duplicating the master diskettes to other diskettes or to hard disk, the Duplicate Master function must be used. Any other means of copying the diskettes may result in unpredictable system operation.

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, *Utilities*.

NOTE

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

System Configuration File (CONFIG.SYS)

To run Logicmaster 5 software, the diskette 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 startup 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 file is changed after boot-up, the computer must be re-booted before the changes will take effect.

The content of the CONFIG.SYS file must be appropriate for your system. For a Workmaster or Cimstar I computer, a version of the file supplied with Logicmaster 5 software can be copied and used as is, in many cases. After copying the file, check its content. Content requirements are explained below, and on the following two pages.

1. For all applications, the CONFIG.SYS file must contain these three lines:

```
buffer = 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 diskette for Logicmaster 5 software to run.

2. For Workmaster computers, the CONFIG.SYS file must also contain the following line to enable the device driver for the Workmaster clock:

```
device=wmclock.sys
```

3. If you are using a RAM Disk card from GE Fanuc - NA, your CONFIG.SYS file must contain one of the following pairs of lines:

   A. For a computer with diskette drives:

```
device=gexmem2.sys -c21c
device=gexdisk.sys -k640
```

   B. For a computer with a hard disk, to install the software on the hard disk:

```
device=\lm5\gexmem2.sys -c21c
device=\lm5\gexdisk.sys -k640
```

   The values for the device drivers (-c21c and -k640) may not be correct if you have changed the RAM Disk's configuration register address (switch 2) or memory allocation (switches 7 and 8). The value (-k640) refers to the amount of expanded memory that you wish to reserve for use as a fast-access floppy diskette. You may reserve up to the total listed in the table in appendix A. For more information, refer to appendix A and to the instructions shipped with your Expanded Memory card.

4. If you are using MS-DOS version 3.2 and your Workmaster computer has an external 5.25-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 3.5-inch drives (A and B) and an external 5.25-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 (0=A, 1=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 3.5-inch drives. Refer to your DOS manual for more information on the DRIVPARM command.

If the CONFIG.SYS file on your DOS diskette does not contain the above information, you must create a file that does. You can copy one of the files on the following page, 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 are 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 later in this section.

Running Other Software with the Logicmaster 5 CONFIG.SYS File

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 CONFIG.SYS file and using the one required for a specific application. Remember to re-boot your system if the CONFIG.SYS file is changed. Your DOS manual contains more information about the CONFIG.SYS file.

Versions of the System Configuration File

Versions of sample System Configuration files are shown below. The list shows the content of each file, the diskette where it is located, and the type of computer for which it is intended. *Use this information as a guide only.*

Table 2-1. Example CONFIG.SYS Files for the Workmaster or Cimstar I Computer

DISK	FILE NAME	FILE CONTENT	COMPUTER TYPE	RAM DISK
Diskette 1	CONFIG.PC	buffers=5 files=20 device=ansi.sys	Cimstar I and IBM PC	no
	CONFIG.WM	buffers=5 files=20 device=ansi.sys device=wmclock.sys device=gexmem2.sys -c21c device=gexmdisk.sys -k640	Workmaster	yes
Diskette 1 (continued)	NOT PROVIDED	buffers=5 files=20 device=ansi.sys device=wmclock.sys	Workmaster	no
	NOT PROVIDED	buffers=5 files=20 device=ansi.sys device=wmclock.sys device=\lm5\gexmem2.sys -c21c device=\lm5\gexmdisk.sys -k640	Workmaster	yes
***MS-DOS Disk**	CONFIG.SYS	break=on buffers=20 files=20 device=ansi.sys	Cimstar I	no
	CONFIG.WM	break=on buffers=5 files=20 device=ansi.sys device=wmclock.sys	Workmaster	no

*The latest GE Fanuc version of MS-DOS 3.20 is supplied only for the Workmaster and Cimstar I industrial computers.

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 diskette. If there is a CONFIG.SYS file on the disk, you can display its contents by entering:

```
TYPE CONFIG.SYS
```

and pressing the Return key.

Creating a CONFIG.SYS File

If you do not have a CONFIG.SYS file, create one as described below.

NOTE

This procedure will write over any existing version of the CONFIG.SYS file. If a previous version does exist, rename it CONFIG.BAK before following this procedure.

1. At the DOS prompt, type:

   ```
   COPY CON CONFIG.SYS
   ```

2. Press 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 5 software, edit the file using a line editor such as EDLIN.

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 CONFIG.SYS
   ```

   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 5 software. You can insert, delete, or edit lines as described below. *Note that these 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:

```
*5I
```

and press the Return key. This line number will appear 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 appears:

```
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.sy
    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 appears 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.

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

```
TYPE CONFIG.SYS
```

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 Hard Disk

With the correct CONFIG.SYS file on the DOS diskette, start up the computer in DOS. Insert the Logicmaster 5 system diskette #1 in drive A: and start up the computer by entering one of the following commands:

```
LM5WM     (if using a Workmaster or Cimstar I computer.)

LM5PC     (if using an IBM PC or IBM-compatible computer.)
```

For detailed startup instructions, refer to section 3 of this chapter. Also, refer to the instructions on CONFIG.SYS files, provided earlier in this section.

Preparing Bootable Logicmaster 5 System Diskettes

It is sometimes desirable to produce a bootable copy of the software, which combines both DOS and Logicmaster 5 software. This provides a stand-alone product which simplifies the startup procedure.

Copies of the 3.5-inch version of the software can be made ''bootable'' by preparing a system diskette containing DOS system files, and then transferring a copy of Logicmaster 5 software to the diskette. The master diskette shipped from GE Fanuc - NA cannot be made bootable. To prepare a Logicmaster 5 bootable 3.5-inch system diskette, it is best to use a computer with two disk drives.

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

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

   ```
   FORMAT B:/S
   ```

   This formats the diskette and transfers certain DOS files to the diskette. Mark this diskette as Logicmaster 5 diskette 1.

3. Format another 3.5-inch diskette as a non-system diskette. Mark this diskette as Logicmaster 5 diskette 2. The command is:

   ```
   FORMAT B:
   ```

4. Insert the master copy of Logicmaster 5 software into drive A. Boot up the software by entering one of the following commands:

   ```
   LM5WM     (if using a Workmaster or Cimstar I computer.)
   LM5PC     (if using an IBM PC or IBM-compatible computer.)
   ```

   For detailed startup instructions, refer to section 3 of this chapter.

5. From the Supervisor menu, select the Utilities function by pressing the Utilty Func (F8) key. Then, select ***Duplicate Master*** by pressing the F1 key. Duplicate the master diskette 1 to the newly formatted Logicmaster 5 diskette 1. For more information on Duplicate Master, refer to chapter 11, *Utilities*.
6. In the same way, proceed to duplicate the master diskette 2 to the newly formatted Logicmaster 5 diskette 2. Diskette 3 must also be duplicated, if applicable.
7. Return to the Supervisor menu and press the Alt/Z keys to exit Logicmaster 5 software.
8. Now, at the DOS level you must custom-tailor your new copy of the Logicmaster 5 diskette 1 to fit your specific hardware configuration. No changes are required to Logicmaster 5 diskette 2 or diskette 3.

   A. A CONFIG.SYS file must exist on diskette 1 which meets the requirements of your system.

   B. The ANSI.SYS file must be copied from your DOS diskette to the new Logicmaster 5 diskette 1.

   C. The WMCLOCK.SYS file must be copied from your DOS diskette to the new Logicmaster 5 diskette 1, *only* if the diskette will be used on a Workmaster industrial computer.

Your new copies of the Logicmaster 5 diskettes 1 and 2, and 3 if applicable, should now be ready to use as a stand-alone bootable software product. They contain a copy of certain DOS system files, the proper configuration files, appropriate device drivers, and a copy of the Logicmaster 5 system files.

You may now insert the new Logicmaster 5 diskette 1 into drive A and restart the computer. After DOS starts up, you will be prompted to start up Logicmaster 5 software.

NOTE

The AUTOEXEC.BAT file can be modified to automatically start up the software after DOS boots up. Simply add the LM5WM or LM5PC startup command line to the end of the AUTOEXEC.BAT file.

Logicmaster performance can be improved by making use of the RAM Disk, if available on your system. This is done by copying the Logicmaster 5 overlay files from the Logicmaster 5 diskette 2 to the RAM Disk during the startup procedure. For more information on the RAM Disk, refer to section 3 of this chapter.

AUTOEXEC.BAT Files

Two sample AUTOEXEC.BAT files have been included on the Logicmaster 5 diskettes. These files were written for a Workmaster computer with floppy drives and a RAM Disk card. (For information on installing the RAM Disk, refer to appendix A of this manual.) These files allow you to automatically start Logicmaster 5 software and use the Workmaster RAM Disk for speed and convenience during operation of the product.

AUTO1.BAT: This file was created for a Workmaster computer with 1 or 2 floppy disk drives (A and B) and a RAM Disk card (IC640BRM318) as drive C. Use this file when you want to use only drive A as a system drive during startup. To use the AUTO1.BAT file, rename it to AUTOEXEC.BAT and copy it to both Logicmaster diskettes 1 and 2.

```
ECHO OFF
REM ** FILENAME = AUTO1.BAT
REM ** THIS IS A SAMPLE AUTOEXEC.BAT FILE FOR LOGICMASTER 5 USERS.  IT IS
REM ** DESIGNED FOR USE ON A WORKMASTER WITH 1 OR 2 FLOPPY DISK DRIVES
REM ** (A AND B) AND A GE FANUC RAM DISK CARD (IC640BRM318) AS DRIVE C.
REM ** THIS FILE SHOULD BE APPLIED WHEN IT IS DESIRED
REM ** TO UTILIZE ONLY DRIVE A AS A SYSTEM DRIVE DURING STARTUP.
REM ** TO USE, RENAME THIS FILE TO AUTOEXEC.BAT AND COPY TO BOTH
REM ** LOGICMASTER DISKETTES 1 AND 2.
REM **
CLS
IF EXIST C:%%GSLM5.001 GOTO LOAD
ECHO 2J14;25HINSERT DISK 2 INTO DRIVE A
PAUSE
CLS
COPY A:*.* C:
CLS
ECHO 12;25HINSERT DISK 1 INTO DRIVE A
PAUSE
:LOAD
LM5WM C
```

AUTO2.BAT: This file was created for a Workmaster computer with 2 floppy disk drives (A and B) and a RAM Disk card (IC640BRM318) as drive C. Use this file when you want to use both drive A and B as system drives during startup. To use the AUTO2.BAT file, rename it to AUTOEXEC.BAT and copy it to Logicmaster diskette 1.

```
ECHO OFF
REM ** FILENAME = AUTO2.BAT
REM ** THIS IS A SAMPLE AUTOEXEC.BAT FILE FOR LOGICMASTER 5 USERS.
REM ** IT IS DESIGNED FOR USE ON A WORKMASTER WITH 2 FLOPPY DISK DRIVES
REM ** (A AND B), AND A GE FANUC RAM DISK CARD (IC640BRM318) AS DRIVE C.
REM ** THIS FILE SHOULD BE APPLIED WHEN IT IS DESIRED TO UTILIZE BOTH
REM ** DRIVE A AND B AS SYSTEM DRIVES DURING STARTUP.  TO USE, RENAME
REM ** THIS FILE TO AUTOEXEC.BAT ON LOGICMASTER DISKETTE NUMBER 1.
REM **
CLS
IF EXIST C:%%GSLM5.001 GOTO LOAD
ECHO 2J12;25HINSERT DISK 2 INTO DRIVE B
PAUSE
CLS
COPY B:*.* C:
:LOAD
LM5WM C
```

Installation: Computer with a Hard Disk

These instructions describe steps to install Logicmaster 5 files on a Workmaster, Cimstar I, IBM PC, and most IBM-compatible computers with a hard disk. (If you prefer to run the software from 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:

   CONFIG.SYS: must be custom tailored to fit specific hardware configuration of your system and Logicmaster 5 requirements.

   ANSI.SYS: should have been provided on your DOS diskette.

   WMCLOCK.SYS: only required for the Workmaster computer. This file is only provided on the DOS diskette purchased from GE Fanuc - NA.

   NOTE

   If the CONFIG.SYS file used during startup is revised, you must restart the computer before the revised/new file becomes active.

2. With proper files in the hard disk root directory, start up the computer in DOS. Then start up the software by entering one of the following commands:

   ```
   LM5WM      (if using a Workmaster or Cimstar I computer.)

   LM5PC      (if using an IBM PC or IBM-compatible computer.)
   ```

   For more information on startup instructions, refer to section 3 of this chapter.

3. From the Supervisor menu, select the Utilities function by pressing the Utilty Func (F8) key. Then, select ***Duplicate Master*** by pressing the F1 key. Duplicate the master diskette 1 to the hard disk. For more information on Duplicate Master, refer to chapter 11, *Utilities*. In the same way, proceed to duplicate the master diskette 2 to the hard disk. If using 5.25-inch diskettes, also duplicate diskette 3 to the hard disk.
4. Once the duplication process is complete, you may return to the Supervisor menu and exit to DOS by pressing the Alt/Z keys. Remove the master diskettes and place them in a protected location.
5. You will note that a new Logicmaster 5 directory, containing a copy of the Logicmaster 5 system files, was created on the hard disk. Type **CD\LM5** to ''Change Directory'' (to the LM5 directory) and start up the software from the hard disk, using either the LM5WM or LM5PC command.

Specifying the Path for a Hard Disk

Since Duplicate Master automatically creates a subdirectory called LM5 on the hard disk, you may wish to add this directory to a path statement. This will supply DOS with a path to the \LM5 subdirectory from other directories or disk drives. This is normally done by placing a path statement in the AUTOEXEC.BAT startup file. For example:

```
PATH \LM5
```

This statement will define the path each time the system is booted. If you already have a path statement, you can add the \LM5 path to the end of that statement. For example:

```
PATH D:\;D:\DOS;D:\LM5
```

will tell DOS to first look for the command in the root directory of drive D, then look in the DOS subdirectory on drive D, and finally look in the LM5 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 5 Software

After the installation procedures described in the preceding section have been completed, you can start up Logicmaster 5 software normally. This section describes the following procedures for regular startup of the software.

- Entering the Logicmaster 5 command line.
- Specifying a drive for the overlay files.
- Copying the overlay files to a hard disk or RAM Disk.
- Displaying the Logicmaster 5 title screen.
- Displaying the Supervisor menu.

Using Other Types of Software: RAM Requirements

To run Logicmaster 5 software, your system needs 640K of Logicmaster RAM memory (main memory). Due to hardware limitations with most PCs, it is not possible to have more than 640K of main memory. Additional memory can be installed above 640K, but this memory is *only* available to Logicmaster 5 as "RAM Disk" and is not available for LM5 execution. This means that Logicmaster 5 software can read and write the additional memory as through it were a disk drive, but it cannot execute from this RAM Disk memory or directly access it.

Of the physical 640K of main memory, DOS uses a portion, the driver files listed in the CONFIG.SYS file use a portion, and Logicmaster 5 software uses the rest. It is not possible to have SIDEKICK or other "memory resident" programs installed in main memory and still have enough memory left for the LM5 software. If you attempt to install another "memory resident" program, you will either get an initialization error on bootup or you will run out of main memory during Logicmaster 5 operation (even though you may have megabytes available in the RAM Disk).

If you get the message "Software Initialization Failure Number 2" when starting up the software, check for batch files that are loading other software into Logicmaster memory at startup.

Caution must be observed to ensure that the AUTOEXEC.BAT file does not automatically load any additional programs into memory. There is enough spare memory, however, for the GE Fanuc-supplied RAM Disk driver.

Entering the Logicmaster 5 Command Line

Follow these steps to start up Logicmaster 5 software.

NOTE

> If you are using a computer with a hard disk, Logicmaster 5 software should be installed on the hard disk as described in the preceding section. 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/Delete keys at the same time. After the DOS software is loaded, the DOS command prompt will appear:

```
A>
```

2. Insert Logicmaster 5 diskette 1 in drive A.
3. At the DOS command (drive) prompt, type the following:

```
LM5WM (drive ID)   (if using a Workmaster or Cimstar I computer.)

LM5PC (drive ID)   (if using an IBM PC or IBM-compatible computer.)
```

   The drive ID is optional. Enter a drive ID *only* if you want the computer to look for overlay files on a different drive. See below for more information.

   If you specify the hard disk or RAM Disk, the files on the overlay diskette(s) must have been copied to that drive previously. The procedure is described in this section.

4. After entering the Logicmaster 5 command line, press the Return key. Follow the prompts that will appear to display the Supervisor menu.

Specifying a Drive for the Overlay Files

Overlay files are the files on diskette 2 of Logicmaster 5 software. These files provide the functions (for example, Edit Program or Scratch Pad) of the Supervisor menu. They can be loaded from another drive for convenience, or for faster execution. The drive may be a diskette drive, hard disk, or the RAM Disk card.

For example, if you are using a Workmaster computer with dual disk drives, you may place Logicmaster 5 diskette 1 in drive A, the overlay diskette (diskette 2) in drive B, and enter the following command when you start up the software:

```
LM5WM B
```

If the overlay files have already been loaded to a RAM Disk card (as explained on a subsequent page), enter the RAM Disk drive ID in the command line. For example:

```
LM5WM C
```

The RAM Disk is not always assigned the drive ID letter C. If you are not sure of the drive ID of the RAM Disk card, refer to the explanation that follows. The overlay files must be loaded to the RAM Disk card each time the computer is powered up.

Copying Overlay Files to a Hard Disk or RAM Disk

You can store the overlay files to a hard disk or RAM Disk. The hard disk provides permanent storage for the files. If you store the files to a RAM Disk, they will only remain as long as power is present. When the system is turned off, files stored on the RAM Disk are lost. They must be re-loaded when you start up Logicmaster 5 software again.

Using a RAM Disk for Overlay Files

If you will be using the RAM Disk to store Logicmaster 5 overlay files, copy the overlay files to the RAM Disk before issuing the startup command line (LM5WM). *Logicmaster 5 software will not automatically copy the overlay files to the RAM Disk.*

Identifying the Drive ID of the RAM Disk

If this is the first time you have started up the computer with the RAM Disk drivers activated, determine the drive name DOS has assigned to the RAM Disk. DOS assigns the drive name depending on the numbers and types of disk drives in the system at the time the RAM Disk is set up by the instructions in the CONFIG.SYS file. The RAM Disk becomes the highest available drive. For example, if you have dual diskette drivers on a Workmaster computer, then the RAM Disk becomes drive C. (Drive names A and B are always reserved for one or two floppy disk drives.) If you have a hard disk drive, then the RAM Disk may become drive D or drive G, depending on the version of DOS you are using.

If you are not sure where the RAM Disk has been assigned, you can locate the drive experimentally by using the DOS Directory (DIR) command. The RAM Disk is the last drive in the chain of drive names assigned by DOS. If you do a DIR on the RAM Disk, you should get either a list of files or the message "File not Found" because the RAM Disk is empty. To test whether or not you have located the last drive in the chain, attempt to read the directory for a drive named with the next letter of the alphabet. For example, to test if the RAM Disk is drive G, issue the command DIR H:. You should get the message "Invalid drive specification" from DOS. If you do not get this message, then drive G is not the last drive in the chain and it is not the RAM Disk.

Copying Overlay Files to the RAM Disk

Once you have determined the drive ID for the RAM Disk, you can copy the Logicmaster 5 overlay files to the RAM Disk using the Copy command. The wildcard character * may be used to simplify this process. For example, if your RAM Disk is drive G, you could place the overlay diskette in drive A and issue the command:

```
COPY A:%GSLM5.00* G:
```

This command will copy all seven overlay files for your Logicmaster 5 software to the RAM Disk.

Copying Overlay Files to the RAM Disk Automatically at Startup

Remember that the overlay files must be loaded to the RAM Disk each time you power up the computer. If you want this copying to be done automatically, you can put a Copy command into a batch file, such as AUTOEXEC.BAT. Simple instructions for creating an AUTOEXEC.BAT file follow. Refer to your DOS manual for more information about batch files.

1. If you are using a DOS diskette to start up Logicmaster 5 software, create the .BAT file on the DOS diskette. If you are using DOS on a hard disk to start up Logicmaster 5 software, create the .BAT file in the root directory of the hard disk. Do this *only* if you want the overlay files loaded to the RAM Disk every time you start up the computer.

2. Enter the following:

```
COPY CON AUTOEXEC.BAT
COPY A:%%GSLM5.00* G:
```

Notice that there are now *two* percent signs in the file name for the Copy command.

3. Press the Ctrl and Z keys to end the file. Press the Return key.

The procedure above will load the overlay files to the RAM Disk automatically. It is still necessary to specify the location of these files when you start up Logicmaster 5 software. For example, if the RAM Disk were drive C, you would enter:

```
LM5WM C
```

Overlay files will remain on the RAM Disk until you delete them, or until power is turned off. You can do a software start (Ctrl/Alt/Delete) of the system without deleting the files, but using the Reset button will clear the RAM Disk.

Displaying the Title Screen

At power-up, the title screen appears:

```
          GE Fanuc Automation North America, Inc.

            LOGICMASTER (TM) 5 version 02.xx
          Programming and Documentation Software

           for SERIES FIVE Programmable Controls




       Copyright GE Fanuc Automation N.A., Inc. 1988
                   ALL RIGHTS RESERVED

               Strike a key when ready . . .
```

This screen identifies the version of software being used.

Establishing Communications with the CPU

Logicmaster 5 software contains default communications parameters which match the factory default settings of the CPU DIP switches. These defaults are contained in the files COMSET.SET and PORT1.PSU.

The default communications port in the Workmaster industrial computer is serial port 1 (COM1), and the default CPU ID is 1. These parameters can be altered from the Communications and Password Setup menu (F1 function key) of the Setup/Diagnostic function (refer to chapter 10). When the Save File (F1) key is pressed, the updated parameters are stored in a file called COMSET.SET.

The default settings for port 1 are:

- 19200 baud.
- 1 stop bit.
- No parity.
- 8 data bits/word.
- No xon/xoff handshaking.

These parameters can be altered from the Port Setup menu (F6) of the Disk/Port Utility function (refer to chapter 11). When the Save File (F2) key is pressed, the updated parameters are stored in the file specified by the file name entry in the menu. The filename PORT1.PSU should be used for saving parameters for port 1 (COM1), and PORT2.PSU should be used for saving parameters for port 2 (COM2).

The default settings for serial communications using port 1 (COM1) will allow the Logicmaster 5 software to communicate with a Series Five CPU, as shipped from the factory. These defaults will be acceptable for most users, and eliminate the process of switch setting and software configuration. If you must change the default configuration, the Communications and Password Setup menu and the Port Setup menu are available to simplify the configuration process.

SECTION 4
Using Features of the Supervisor Menu

The Supervisor menu screen provides access to the primary functions of the Logicmaster 5 system. The menu lists the name and function of each function key.

```
                    L O G I C M A S T E R  (TM)  5

                    S U P E R V I S O R   M E N U

     KEY #                                                    FUNCTION

     F1 -  DISPLY PROG . . . . . . . . . . . Display Ladder Diagram
     F2 -  EDIT PROG . . . . . . . . . . . . . .Edit Ladder Diagram
     F3 -  DISPLY REF TB . . . . . . . . . Display Reference Tables
     F4 -  SCRTCH PAD. . . . . . . . . Display/Modify Scratch Pad
     F5 -  PRINT FUNC. . . . . . . . . . . . . . . .Print Hard Copy
     F6 -  L/S/V FUNC. . . . . . Load/Store/Verify Program/Tables
     F7 -  SETUP & DIAG  . . . . . . . Setup/Diagnostic Functions
     F8 -  UTILTY FUNC . . . . . . . .Disk/Port Utility Functions

 DRIVE ID: B             FILE NAME: NONE          BACKUP: Y (Y/N)


 DISPLY   EDIT   DISPLY  SCRTCH      PRINT   L/S/V   SETUP   UTILTY
1 PROG  2 PROG  3REF TB 4  PAD      5 FUNC  6 FUNC  7& DIAG 8 FUNC
```

Supervisor Menu Function Key Summary

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

Disply Prog (F1): Select ***Display Program*** to display a ladder diagram program stored in Logicmaster 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 Prog (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.

Disply Ref Tb (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 Logicmaster memory status image. In On-Line or Off-Line mode, the values of I/O and register tables can be modified. I/O points can also be overridden. Refer to chapter 7 for information about this function.

Scrtch Pad (F4): Select ***Scratch Pad Display*** to display and change information about memory size, CPU software version, time/date function, 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 Func (F5): Select ***Print Function*** to print out the ladder logic program and other information in either foreground or background mode. Refer to chapter 8 for information about this function.

L/S/V Func (F6): Select ***Load/Store/Verify*** to transfer programs between the Logicmaster 5 system, the CPU, and your disks. Refer to chapter 9 for information about this function.

Setup & Diag (F7): Select ***Setup/Diagnostic Functions*** to display or modify communications, CPU setups, or machine setup data. Refer to chapter 10 for information about this function.

Utility Func (F8): Select ***Disk/Port Utility Functions*** to copy diskettes and 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: 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 the Enter key on the numeric keypad (not the Return key). For example:

```
A:PROGRAM1      (and press the Enter key.)
```

File Name: The program name to be used for disk operations.

Backup: Shows whether backup files (copies) will be made before program files are edited. File backup is selected by entering **Y** for the prompt that appears at the beginning of an editing session.

Loading Program Files from the Supervisor Menu

Program files can be loaded into Logicmaster 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. Enter the program file name. Type the program file name into the work area; it is not necessary to include a file name extension. For example:

   ```
   PROGRAM1
   ```

   If the drive ID does not show the drive where the program file is located, include the drive ID with the file name. For example:

   ```
   B:PROGRAM1
   ```

3. Press 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 Logicmaster memory.* The message "BUSY" appears on the screen until the files are loaded. If an error occurs, a message appears 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 file name before leaving the Supervisor level to edit, display, or print a program. The name is retained until a new program is loaded, or the name is cancelled by entering the word "NONE", or 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, data values for registers, I/O and overrides, and 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 Logicmaster 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 can have up to 8 characters. Do *not* use the following reserved words in a program name: NONE, CON, NUL, PRN, AUX, COM1, COM2, LPT1, LPT2, or LPT3.

SECTION 5
Setting up Communications with the Series Five PLC

Sections 2 and 3 explain how to start up Logicmaster 5 software. This section explains how to set up serial communications between the Series Five PLC and the Logicmaster 5 system.

Logicmaster 5 software communicates with the Series Five PLC over a serial link to a CCM port in the CPU. Communication can be at up to 19,200 baud. The steps to set up communications are summarized below. For more information, refer to the appropriate sections of this manual; hardware setup is described in appendix A.

NOTE

Factory defaults are set so that the following steps should only be necessary when a different operation is desired.

Step 1: Programming the Serial Port (Utility Functions)

Initialize the computer's serial port (COM1 or COM2) for communications with the CCM port in the CPU. This is done through the Serial Port Setup menu, which is a submenu of the Utility functions. Select the port and baud rate. Also, select 8-bit data characters with no parity and one stop bit.

You can save the selections you make as files on the Logicmaster 5 startup diskette. If the selections are saved, they will be used automatically the next time you start up Logicmaster 5 software. Since the Serial Port Setup utility may be used to set up more than one port, you must specify the name of the file into which the setup parameters are to be stored:

For the COM1 port, use the file name PORT1.PSU.

For the COM2 port, use the file name PORT2.PSU.

NOTE

Always press F1 after changing the port setup. If you forget to do so, the port will continue to operate with the old selections.

Step 2: Selecting the Communication Port Enabling On-Line Changes (Setup/Diagnostic Functions - Comm & Password Setup)

1. From the Supervisor menu, press the Setup & Diag (F7) key. The Setup/Diagnostic Functions menu will appear.
2. Press the Comm & Psword (F1) key. The Communications Setup menu will appear.
3. Type the entry for the desired port number into any field of the work area, and press the Select Ports (F3) key. (The port number is usually number 1.)
4. If the CPU is locked or a new password is required, press the CPU Protec (F2) key to access the CPU Password Protection menu. This menu allows you to unlock the CPU with the Unlock CPU (F1) key or change passwords with the Change Passwd (F3) key.

NOTE

Most users will not need to use the Password function.

Step 3: Changing Operating Modes (Keyswitch/Scratch Pad Functions)

For communications to occur, the system must be in either On-Line or Monitor mode. A three-position keyswitch located on the Workmaster and Cimstar I industrial computers is used to select the operating mode.

An IBM PC, PC-XT or PC-AT personal computer always starts up in Off-Line mode when running Logicmaster software. For these computers, go to the Scratch Pad display after startup if you want to change to either On-Line or Monitor mode. You can also change the operating mode by pressing the ALT/1 function keys from any screen.

SECTION 6
Using Your Keyboard

This section explains:

- The keyboards available for use with Logicmaster 5 software.
- Control key functions for the personal computer-type keyboard.
- Alternate key functions.
- How to create and use customized key functions for easier programming.

The 91-Key Keyboard

The 91-key keyboard for the Workmaster computer, from GE Fanuc - NA, was developed especially for use in ladder diagram programming. It was designed to satisfy the special requirements of PLC programming and monitoring. It has several keys that are not on standard personal computer keyboards. While a personal computer keyboard can be used for programming, the 91-key keyboard is recommended.

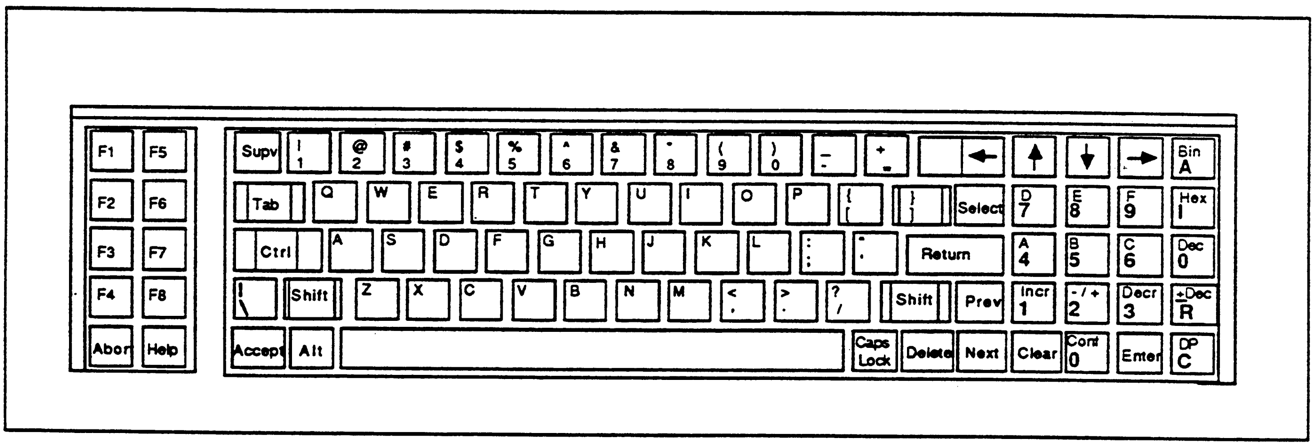


Figure 2-1. 91-Key Keyboard Layout

The 91-key keyboard for the Workmaster computer has two modes of operation:

1. In its default mode, the keys of the 91-key keyboard execute their normal functions, as described here in this section. The keyboard is compatible with Logicmaster programming and documentation software. Its extra keys perform special programming functions, such as number base conversions.
2. In its alternate mode, it functions as a standard 83-key IBM PC-XT keyboard.

Pressing the Ctrl and Select keys at the same time toggles this keyboard between the 91-key and 83-key (PC-XT) mode.

Personal Computer Keyboard

Figure 2.2 shows the layout of a standard IBM personal computer-type keyboard. This keyboard can be used with Logicmaster 5 software; however, you will note that it lacks the additional programming keys of the 91-key keyboard.

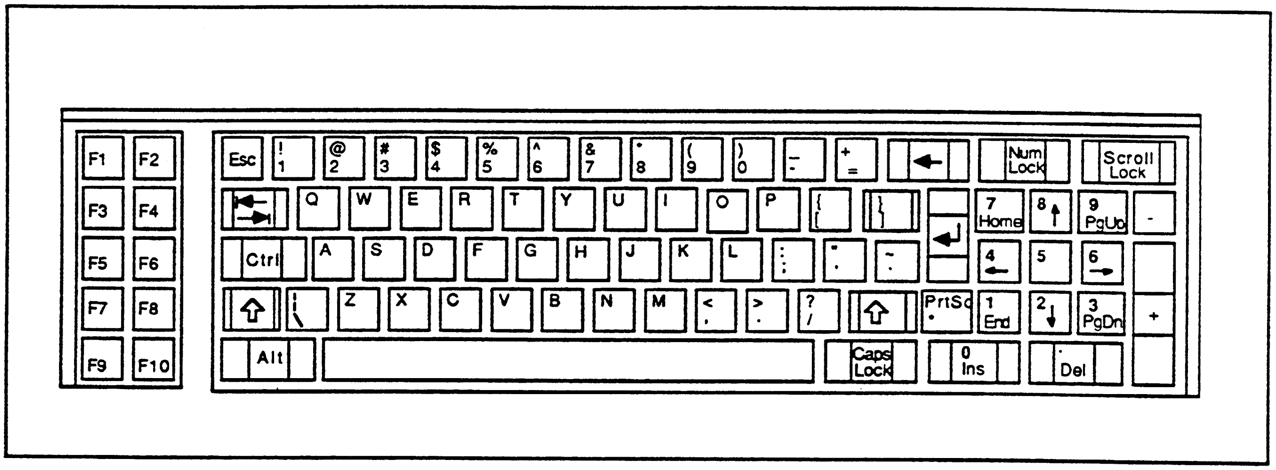


Figure 2-2. Personal Computer Keyboard Layout

Key Functions

The following table describes the key functions of the 91-key keyboard, in conjunction with Logicmaster 5 software. These same key functions are available on a personal computer keyboard through the use of Control key sequences, as listed in the third column of the table. Control key sequences and Alternate key sequences are produced by pressing the Ctrl key or the Alt key at the same time as another key.

Table 2-2. Key Functions

91-KEY KEYBOARD FOR WORKMASTER COMPUTER	FUNCTION DESCRIPTION	PC-TYPE KEYBOARD
Supervisor (Suprv) key	Returns the display to the Supervisor menu	**Escape (Esc) key**
Control (Ctrl) 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.	**Control (Ctrl) key**
Alternate (Alt) key	When pressed at the same time as another key, controls the execution of a function or command.	**Alternate (Alt) key**
Abort key	Ends the current function or operation.	**F9 function key**
Help key	Displays the Help screen associated with the current operation taking place in the software.	**F10 function key**
Accept key	Verifies and accepts an operation, such as entering the rung of a ladder diagram in the Edit Program function.	**Ctrl A**
Caps Lock key	Locks the characters A through Z into uppercase letters. However, it does not lock in the shifted functions of other keys.	**Caps Lock key**
Arrow keys	Move the position of the cursor.	**Arrow keys with Num Lock off**
Select key	Moves the reverse-video banner in the work area of the screen. This allows data to be entered in the text line, reference line, or value line of the work area. For more information, refer to the explanation of the screen format.	**Ctrl S**
Previous (Prev) key	Scrolls the program display downward to the previous rung.	**Ctrl P**
Next (Next) key	Scrolls the program display upward to the next rung.	**Ctrl N**
Delete key	Erases the previous/last character.	**Ctrl D**
Clear key	Clears the work area line.	**Ctrl Z**
Confirm (Conf) key	Confirms the prompt.	**Alt X**
Enter key	Enters the current function. Places the value currently in the work area into the program.	**Ctrl E**
(no equivalent 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.	**Num Lock key**
Data Entry keys	Unshifted, they are used to enter values into the work area during programming:	
Bin/A	Indirect register references	**Ctrl U**
Hex/I	Input references	**Ctrl I**
Dec/O	Output references	**Ctrl O**
±Dec/R	Register references	**Ctrl R**
DP/C	Constants	**Ctrl C**
	Shifted, they change the number base of the work area, or of a selected item in one of the display tables:	
Bin/A	Binary	**Ctrl B**
Hex/I	Hexadecimal	**Ctrl H**
Dec/O	Unsigned Decimal	**Ctrl ,**
±Dec/R	Signed Decimal	**Ctrl /**
DP/C	Double Precision	**Ctrl .**

Alternate Key Functions

Alternate key functions provide a quick and simple method of performing various software functions with a minimum of keystrokes. These key functions are available on the 91-key keyboard, as well as the personal computer-type keyboard, by pressing the Alt key at the same time as another key. The following table provides a description of these Alt key functions.

Table 2-3. Alternate Key Functions

KEY(S)	FUNCTION DESCRIPTION
All Modes	
Alt 1	Toggle between On-Line, Off-Line, or Monitor mode on an IBM-compatible personal computer.
Alt 2	Start or stop the CPU from anywhere in Logicmaster 5 software, if the CPU keyswitch is *not* in Stop mode.
Alt P	Print a screen. (The Logicmaster system must be in Off-Line mode, the printer must already be set up, and Background Printing must be enabled.)
Alt X	Confirm a prompt.
Supervisor Menu	
Alt L	Load user program and related tables, without entering L/S/V functions.
Alt Z	Exit to DOS. (Type *LM5WM* or *LM5PC* to return.)
Display Program Mode	
Alt E	Display the rung explanation for the current rung if annotation is available. (Invalid only when the Logicmaster system is set to Page display.)
Alt L	Display the coil label for the current rung if annotation is available. (Invalid only when the Logicmaster system is set to Page display.)
Alt O	Display the On-Line Change menu.
Display Reference Tables	
Alt A	Display register contents in ASCII format.
Edit Program Mode	
Alt D	Delete the number of rungs specified in the data line of the work area.
Alt G	Read an .LAD or .SDE file specified in the work area from disk storage. Alt/G only functions when there is no file name active.
Alt S	Initiate a global substitution of all occurrences of the old reference with the new reference.
Alt W	Write a block of rungs specified in the work area from the current location to an .SDE file.
Edit Ladder Diagram Rung (also Search Mode)	
Alt B	Display the Bit Matrix keys.
Alt C	Display the Control Function keys.
Alt D	Display the Data Move keys.
Alt F	Display the List Function keys.
Alt H	Display the Move keys.
Alt I	Display the Timer/Counter keys.
Alt M	Display the Matrix Function keys.
Alt R	Display the Relay keys.
Alt S	Display the Special Function keys.
Alt T	Display the Table Move keys.
Alt W	Display the Read/Write function keys.
Alt —	Display the Arithmetic Function keys.

Table 2-3. Alternate Key Functions - Continued

KEY(S)	FUNCTION DESCRIPTION
Teach Mode	
Alt J	Start a teach session.
Alt K	End a teach session.
Alt V	View a stored key sequence.
Alt	Invoke a teach session.
F1-F8	Teach Mode: Select the softkey to be taught.
	View Mode: Select the softkey sequence to be viewed.
	Normal Mode: Select the softkey sequence to be played back.
Reserved for System Use	
**Alt **	Do not use - Reserved for system use.
Alt Q	Do not use - Reserved for system use.
Alt =	Do not use - Reserved for system use.

Defining Sequences of Frequently-Used Keystrokes (Teach Mode)

Logicmaster 5 software allows you to program the softkeys (F1 through F8) to reproduce sequences of keystrokes. These "mini-programs" allow frequently used keystrokes to be duplicated with only two 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, and Abort functions. Use of these keys may lead to unpredictable results when using the customized function. Do not include keystrokes for storing a program to the CPU and compiling it. This, and other timing-related functions, should not be done with Teach files because they involve two keystrokes (Shift/Enter and Shift/Confirm). The Shift/Confirm keystroke, which initiates the CPU Compile function, must be executed after the prompt for it. It cannot be buffered and then executed.

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 (Teach Mode)

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 usually 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 Alt and K are pressed. After each 100 keystrokes, the system stores the key sequence in the program file.
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.
7. If an error condition is encountered during the playback of the stored sequence, the sequence will be stopped and the following message displayed:

```
ERROR IN PLAYBACK :  PRESS ANY KEY TO CONTINUE
                            ABORT TO STOP
```

Respond to the prompt that appears to either resume or terminate the key sequence.

As an example of a key function that might be defined, you could create the following simple line of ladder logic using Teach mode.

```
| I0023                                                         00699
|--| |---------------------------------------------------------( )
|
|
```

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 F1 - 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 by pressing 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 Abort to stop the function. Pressing Abort does not "undo" 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 you must either abort or continue.

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).

To display the function, while pressing the Alt key, first press the letter V key and then the function (F1-F8) key that is assigned to that function. The View Mode screen appears, listing the stored keystroke sequence. For the line of ladder logic shown in the example above, the screen would display the following:

```
F6,004,009              V I E W   M O D E
F1,F1,INPUT,#2,#3,ENTER,F7,OUTPUT, #6,#9,#9,F7,
```

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.

A number pair will appear in the upper left corner of the View Mode screen, directly after the function key designation. The values of this number pair represent the starting screen and key functions that were active when the function was defined. To use the defined function, the same screen and key functions must be active.

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 karet (^) character indicates a press of the Ctrl key.
- An exclamation point (!) indicates a press of the Alt key.
- The number symbol (#) appears before numbers input from the numeric keypad. No number symbol appears before numbers input from the ASCII keyboard.
- Refer to the following table for a list of the abbreviations which may be used:

Table 2-4. Keyname Abbreviations

ABBREVIATION	EXPLANATION
F1 - F8	Function key F1 - F8
ABORT	Abort key
ACCEPT	Accept key
BIN	Binary Base key
CLEAR	Clear key
CHAN_1	Channel One key
CHAN_2	Channel Two key
CHNCLR	Channel Clear key
CONF	Confirm Upper Case Zero
CONST	Constant Reference key
DEC	Decimal Base key
DECR	Decrement key
DELETE	Delete key
DOWN	Down cursor key
DP	Double Precision key
ENTER	Enter key
HELP	Help key
HEX	Hexadecimal Base key
INCR	Increment key
INDIR	Indirect Register key
INPUT	Input Reference key
LEFT	Left cursor key
NEXT	Next key
OUTPUT	Output Reference key
PREV	Previous key
REG	Register Reference key
RETURN	Return key
RIGHT	Right cursor key
SELECT	Select key
SUPRV	Supervisor key
UP	Up cursor key

Ending the View Mode Display

To end the View Mode display, press the Alt/V keys, the Abort key, or the Supervisor key.

SECTION 7
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.
- How to determine whether the Num Lock key is active with the IBM PC-XT version of Logicmaster 5 software.
- How to enter text, references, and data values in the work area of the screen.
- The steps for entering references and values.

Format of the Display

The screen uses the following basic format:

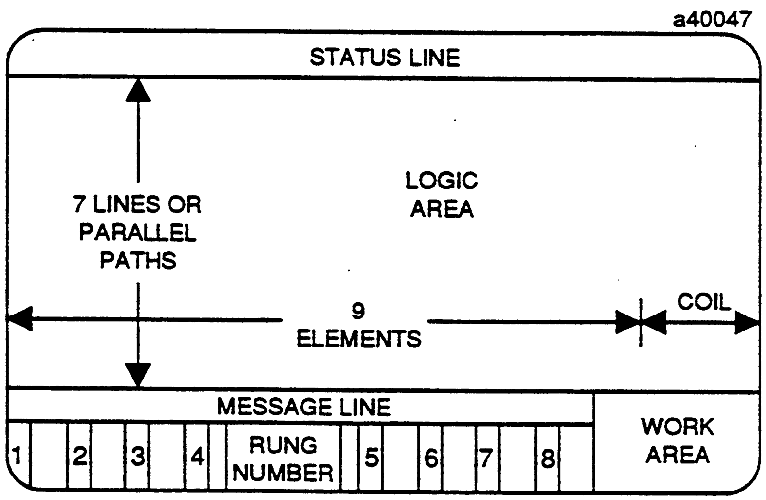


Figure 2-3. Screen Display Format

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. Otherwise, the current time is displayed.

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, such as 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 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 5 software has the following format:

```
CPU:RUN/ENBL/UNLOCKED  CPU ID: 1  LM NOTEQ CPU  LM:ONLINE        15:02:21
```

Status Line: Definitions

Definitions for the items on the Status Line are:

CPU Status: shows the current state of the CPU (in On-Line or Monitor mode with a CPU connected). The status may be: Run/Enabled/Lock, Run/Disabled/Lock, Run/Enabled/Unlock, or Stopped. (In Off-Line mode, the CPU status field is blank.)

Run: Executing program.

Enable: Hardware outputs in the I/O structure will turn on or off, as dictated by the ladder diagram program.

Disable: Physical outputs are disabled: forced to the default state regardless of the program. Inputs are read by the CPU, and the Output table is updated.

Stop: Halted.

Lock/Unlock: shows whether the CPU is locked or unlocked.

CPU ID: shows the ID number of the CPU. Range = 1 to 90 for master/slave communications.

LM-CPU Program: shows whether the program in Logicmaster memory and in the CPU are equal or not equal (NOTEQ).

Num: appears when the Num Lock key is active. This optional field is used only for the IBM personal computer.

Mode: 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.)

Cursor Address: shows the cursor address in hexadecimal in the ladder diagram. When the ladder diagram is being displayed, the cursor address occupies the field where time is normally displayed.

Time: displays the current time, when the ladder diagram is not displayed on the screen.

Work Area

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

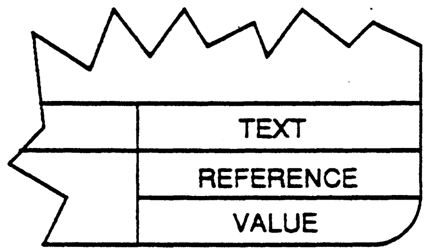


Figure 2-4. Work Area of the Screen Display

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 in this area from the keypad area.

The *bottom* line of the work area is called the *data value line*. The base of the entry (Hex, Decimal, Double Precision, or Signed Decimal) can be changed by pressing the Reference Type keys.

The Incr key (shift of the "1" key in the keypad) and Decr key (shift of the "2" key in the keypad) 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 ('/~) key.

The Delete key removes one character from the selected line; the Clear key removes all characters. The Shift/Clear key combination blanks all three lines. The Enter key and the Shift/Enter key combination are used to transfer values from the work area to the screen display.

Entering Program References and Values

The following paragraphs explain how to enter program references and how to enter values for those references. This is how a typical program function, a Source to Table Move, looks on the screen when first entered in the logic.

```
 ******* ******* Const
-| SRC-TO-TABLE    LEN|-
                   ***
```

The reference for this function can be either a valid register or word aligned I/O reference (beginning on a word boundary). You enter the reference for a function by using the numeric keypad and pressing the Enter key, as described on the next page. For example, suppose that the reference for the source of the data is register R0004. After entering the reference, the display looks like this:

```
 R00004  ******* Const
-| SRC-TO-TABLE    LEN|-
  +00000           ***
```

After the Enter key is pressed, the cursor moves to the next position in the function, where you must enter the reference for the table, and then after that the value for the length of the table. You may want to enter a value for the reference of the source data. There are two methods for entering reference values.

The first way is to move the cursor back (using the Left cursor key) to the SRC. Use the Select key to move the work area cursor to the bottom line, and enter the value for the reference. Here, suppose we enter the value 25. After entering the value, press the Enter key. The value appears below the function on the display.

```
  R00004   ******* Const
 -| SRC-TO-TABLE     LEN|-
   +00025            ***
```

The second way to enter a value for a program reference is easier, but should be used carefully. You can enter the reference and the value at the same time, and then press the Shift/Enter keys. Using the same example, here is the program function as it first appears:

```
  ******* ******* Const
 -| SRC-TO-TABLE     LEN|-
                     ***
```

With the work area cursor at the center line, enter the reference for the function. Do not press the Enter key yet. With the work area cursor at the bottom line, enter the value to be placed in the reference. When the entries are correct, press the Shift and Enter keys to place both the reference and its value into the program.

```
  R00004   ******* Const
 -| SRC-TO-TABLE     LEN|-
   +00025            ***
```

Do not get into the habit of using Shift/Enter for all programming. You may inadvertently enter incorrect values.

Entering Conventional References

Enter references in the *center* line of the work area. To enter a reference other than a Channeled I/O reference, follow the steps below. These steps show which keys to use on the 91-key keyboard. Keys to use on a personal computer keyboard are given in parentheses.

1. Enter one of the following:

A and R	For an Indirect Register, you must press the A key first and then the R key (or Ctrl/U).
I	for an Input (or Ctrl/I).
O	for an Output (or Ctrl/O).
R	for a Register (or Ctrl/R).
C	for a Constant (or Ctrl/C).

   If the reference line was previously used for a Channeled I/O reference, it may be necessary to press the Clear or Shift/Clear keys first.

2. Use the numeric keypad to type in the reference. (For a PC keyboard, use the numeric keypad with Num Lock on).

3. After entering the reference, press the Enter key. For a register reference be careful not to press Shift and Enter, which enters any value in the *data (bottom)* line of the work area into the register.

Entering Channeled I/O References

To enter a Channeled I/O reference, follow these steps:

1. In the *center* line of the work area, enter an I for an Input or O for an Output. This can be done using the I or O key on the numeric keypad, or by using the Ctrl/I or Ctrl/O key combinations, as described in chapter 2.
2. Press and hold the Ctrl key. At the same time, press either number 1 or 2 on the numeric keypad to enter table 1 or 2.

NOTE

Pressing the Ctrl/Clear keys removes the table number and the ± sign from the reference line of the work area. If you are using a PC keyboard, refer to the Alternate and Control key functions described in chapter 2.

3. Press the Shift and ±2 keys to toggle the sign field. Enter a plus (+) or minus (-) sign, depending upon whether the I/O is real (+) or internal (-). You may also use the Ctrl/= keys to toggle between the plus and minus sign in the work area.
4. Enter the point address, which is a number from 0001 to 1024.

SECTION 8
Working With Numbers

To use the Logicmaster 5 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 5 software.

Binary Data

In binary, data can be either a 0 or a 1. These two choices represent on/off conditions.

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 0001.

```
Inputs, Outputs     0001
                    0002
                    0003
                    0004
                     .
                     .
                    1024
```

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 0001, the second is 0009, and so on to the last at 1017.

Registers and Words

A group of 16 consecutive bits may be referred to as either a register or a word.

The term REGISTER refers to a group of 16 consecutive bits located in register memory. The structure of these registers is fixed. Each register is numbered, beginning at 00001. The number of registers that is available depends on the amount of register memory available in the CPU.

```
Registers              00001
                       00002
                       00003
                         .
                         .
                         .
          04096 or 16,384
```

The term WORD refers to a group of 16 consecutive bits in the Input or Output tables. The assignment of bits to words is done by several program functions. References to the I/O tables in an instruction must be on even word boundaries, e.g., I0001, I0017, I0033. Each word is referenced by the address of the least significant bit. In the illustration below, the explicit reference for the word is input I0009.

```
                   ___________________________________________
                  |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_||_|
                  |_______________________________________| |
                                                   |        |
I0002-I0016, Implicit References               ___|        |
                                                           |___   Explicit Reference
```

Decimal

Decimal numbers use 10 digits, 0 through 9. The range of decimal numbers that can be stored in one register depends on whether the number is signed, and whether it is a variable or a constant.

			MAXIMUM	MINIMUM
Unsigned Binary	Single	Variable	65,535	0
	Precision	Constant	32,767	0
Signed	Single	Variable	+32,767	-32,768
(2's Complement)	Precision	Constant	+16,383	-16,384

The differing values occur because of the way the number is stored within the 16 bits of the register or word.

If the number is a constant, only 15 bits are available to represent the value. The exception to this rule is the Block Move instruction, which allows the entry of 16-bit constants.

If the number is signed, the leftmost available bit becomes the sign bit.

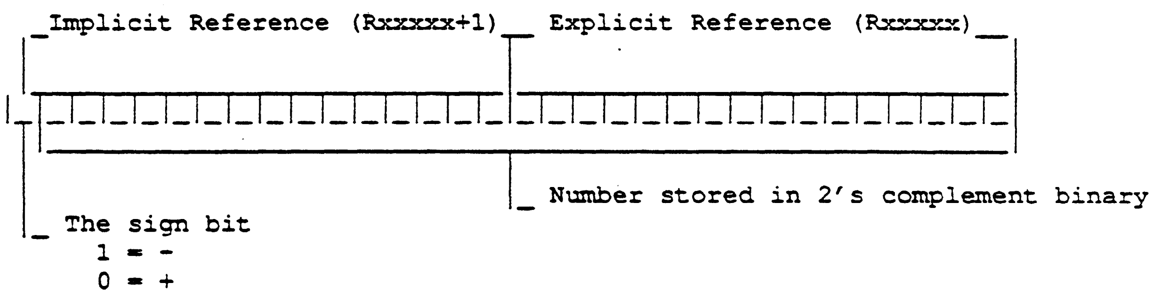
In a Logicmaster 5 display, you can tell if a number is being displayed in signed decimal or unsigned decimal. Signed decimal numbers will always have a plus (+) or minus (-) sign followed by 5 decimal digits. Unsigned decimal numbers will be displayed as five decimal digits with *no* plus or minus sign. Leading zeros will be used, if necessary, to insure that five digits are always displayed. The one exception to this is the display of LEN (length) operands which are displayed as three digit decimal constants in a range of 1 to 255.

Double Precision Decimal

The Logicmaster 5 system can store the value of a number in two adjacent registers, providing 32 bits for storing the number in 2's complement binary format. Double precision numbers are always signed.

When entering double precision references, you must enter (and the Logicmaster system will display) the address of the least significant word of the number. For example, a double precision reference to R00085 means that R00086 is used to store the most significant word of data (including the sign bit) and R00085 is used to store the least significant word of data. The Logicmaster 5 system will always display double precision numbers with a plus (+) or minus (-) sign followed by 10 decimal digits.

The first (lowest numbered) register is called an EXPLICIT reference, because it is explicitly identified. The second register is called an IMPLICIT reference, because its address is implied, although not explicitly given.



The leftmost bit of the implied reference becomes the sign bit.

The range of decimal numbers that can be stored in two registers depends on whether the reference is a variable or a constant.

			MAXIMUM	MINIMUM
Unsigned Binary	Single	Variable	65.535	0
	Precision	Constant	32.767	0
Signed	Double	Variable	+2,147,483,647	-2,147,483,648
	Precision	Constant	+1,073,741,823	-1,073,741,824

Hexadecimal

Hexadecimal uses 16 digits, 0 through F. The digits 0 through 9 represent their exact binary equivalent. The digits 10 through 15 are represented by the letters A through F.

Hexadecimal allows eight bits to be represented by two hexadecimal digits. The table on the following page 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

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 Number:              |1|0|1|1|1|1|0|0|0|1|0|0|0|0|0|0|
                            |_______|_______|_______|_______|
                                |       |       |       |
                                |       |       |       |

Hexadecimal Equivalent:         B       C       4       0

Decimal Equivalent:                0 x  1  =      0
                                   4 x 16  =     64
                              12 x 16 x 16  =   3072
                         11 x 16 x 16 x 16  =  45056
                                               _____
                                               48192
```

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.

BINARY CODED 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

As an example, the number 226 is represented in BCD format, as shown below:

```
                          |0|0|0|0|0|0|1|0|0|0|1|0|0|1|1|0|
                          |_______|_______|_______|_______|
                              |       |       |       |
                              |       |       |       |
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 Logicmaster memory, as well as CPU capabilities. Select the Scratch Pad function in order to:

- Initialize the CPU.
- Set the watchdog timer.
- Clear overrides.
- Enable/Disable the CPU I/O configuration check.
- Select the LED Display mode of the I/O modules.
- Set the clock functions.

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, memory size, number or registers available, and CPU status.

SECTION 1
Scratch Pad Display

If a CPU is connected and the Logicmaster system is in On-Line or Monitor mode, the Scratch Pad values displayed will be those of the CPU. In Off-Line mode, the Scratch Pad screen will display the values stored in Logicmaster memory. Any fields relating to current CPU status (i.e., CPU ID, error flags) will not be displayed.

This section explains:

- How to access the Scratch Pad Display screen.
- How to set the system mode (On-Line, Monitor, or Off-Line) without a keyswitch.
- Definitions of the items on the Scratch Pad display.

Accessing the Scratch Pad Display Screen

When the Scrtch Pad (F4) key is pressed from the Supervisor menu, the Scratch Pad Display screen appears.

On-Line or Monitor Mode

Workmaster and Cimstar I computers have a mode keyswitch to select either On-Line, Off-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:

```
CPU:STOP/UNLOCK     CPU ID: 1     LM NOTEQ CPU      LM:ONLINE    11:19:39

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

     PROGRAM NAME:         NONE     25-JAN-88 09:33:40    PRG ID:  21

     REGISTERS:              4K          SUBROUTINES USED:          00

     MEMORY SIZE:            4K          MEMORY USED:                4
                                            AVAIL:          3,836
     CPU SOFTWARE VERSION:    2.0 / 2.9
     MEMORY TYPE:             CMOS - WRITE ENABLED

     SCAN TIME:  LAST--    6 ms.         I/O CONFIG:  WAS NOT CHECKD
                 MIN --    4 ms.
                 MAX --    8 ms.

     CPU ERROR FLAGS:  00000000 00000000 00000000 00000000

NO ERROR DETECTED


  CPU      I/O      CPU    OUTPUT        MAKE     TIME           SUPERV
1CONFIG 2CONFIG 3 START 4ENABLE      5 EQUAL 6 DATE  7        8 MENU
```

For IBM-compatible personal computers without the mode keyswitch, the Scratch Pad Display includes an additional function key: L/M Mode (F7) key. The function keys for these computers are displayed as shown below:

```
  CPU      I/O      CPU    OUTPUT                      TIME     L/M      SUPERV
 1CONFIG 2CONFIG 3 START 4ENABLE      5              6 DATE  7 MODE   8 MENU
```

The screen on the previous page shows the Scratch Pad Display in On-Line mode with the CPU connected. When the Logicmaster 5 software package is in the Scratch Pad function and the keyswitch is in the ON-LINE or MONITOR position, the screen is updated continuously.

In Monitor mode, the F1, F2, F3, F4, and F5 function keys are inactive. If a CPU is connected and the Logicmaster 5 system is in On-Line or Monitor mode, the initial information on this screen comes from the CPU. Otherwise, it comes from Logicmaster memory and the CPU-related entries are blank.

In On-Line and Monitor mode, when a connected CPU has capabilities that are different from the settings in the Logicmaster system, both values are displayed. The values of the CPU are shown beside the values stored by the Logicmaster system; however, the real CPU values are shown in reverse-video blocks.

If the keyswitch is in the ON-LINE or MONITOR position and the CPU is not connected when you press the Scrtch Pad (F4) key in the Supervisor mode, the Scratch Pad Display will appear with the following message:

```
NO COMMUNICATIONS WITH SERIES 5
```

No default values will be shown for the 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:

```
                                                        LM:OFFLINE    11:19:39

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

        PROGRAM NAME:          NONE      25-JAN-88 09:33:40     PRG ID:   21

        REGISTERS:              4K              SUBROUTINES USED:          00

        MEMORY SIZE:            4K              MEMORY USED:                4
                                                      AVAIL:            3,836


                  MEMORY SIZE AND REGISTERS SELECTION ARE LIMITED
                     BY ACTUAL PROGRAM SIZE AND REGISTERS USED.




         SELECT  SELECT                         TIME               SUPERV
 1      2MEM SZ 3REG SZ 4           5         6 DATE   7          8 MENU
```

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

```
        SELECT  SELECT                          TIME    L/M     SUPERV
1       2MEM SZ 3REG SZ 4           5          6 DATE  7 MODE  8 MENU
```

In Off-Line mode, information from the CPU Scratch Pad (CPU version number, memory type, scan time, and CPU error flags) is inactive and will not be displayed on the screen.

To return to the Supervisor menu, press the Superv Menu (F8) key.

Setting System Mode without the Keyswitch

IBM-compatible personal computers do not have the mode keyswitch, similar to that on Workmaster and Cimstar I computers. Without a mode keyswitch, mode must be selected through the software. Follow these steps to set the mode of the system:

1. On the Scratch Pad Display page, press the L/M Mode (F7) key. The system will display the following keys:

   F1 = Off-Line mode
   F2 = Monitor mode
   F3 = On-Line mode

2. Press the function key which corresponds to the mode you wish to select. (The system defaults to Off-Line mode.)

Without a mode keyswitch, you can also change the mode from any menu within the Logicmaster system by pressing the Alt/1 keys.

Scratch Pad Display: Definitions

Refer to the following definitions when making changes to the Scratch Pad Display screen:

Status Line: In Off-Line mode, this line only displays the time and an indication that you are in Off-Line mode. In On-Line or Monitor mode with a CPU connected, it shows the state of the CPU. The status may be:

```
CPU:RUN/ENBL/UNLOCK
CPU:RUN/ENBL/LOCK
CPU:STOP/UNLOCK
CPU:STOP/LOCK

where:   RUN = executing user program.
         STOP = not executing user program.
         Refer to chapter 10 for information on
         locking and unlocking the CPU.
```

In On-Line or Monitor mode, the Status line also displays the CPU ID number and whether the program in Logicmaster memory is equal or not equal to the program stored in the CPU memory.

Program Name: The name of the program in the CPU memory cartridge. This includes a time stamp indicating the last time the program was modified, either in Edit mode or through on-line changes.

Prg Id: Identification of where the program was created. This number will be 21 if the program was created with Logicmaster 5 software.

Registers: This entry shows the number of 16-bit storage locations (registers). In On-Line or Monitor mode, when connected to a CPU, this is the total number of registers available. The CPU controls this entry. In Off-Line mode, this entry can be changed, as described in this chapter. It initially defaults to 4K (4096).

Subroutines Used: This entry shows the number of subroutines that have been used in the program. The valid range is 0 to 32. If more than 32 subroutines are placed in a program, an error message will appear while storing the program to a CPU or disk.

Memory Size: This is the number of 16-bit words of total Logicmaster memory available (i.e., 16K). The abbreviation K stands for 1024. This value is fixed by the hardware if the system is in On-Line or Monitor mode with a connected CPU. In Off-Line mode (only), this value can be changed. However, memory size is limited by the actual program size and the registers used.

Memory Used: This entry shows the exact length of the current program, in words.

Memory Available: This entry shows the exact number of words remaining for program storage. Memory Available equals Memory Size minus Memory Used.

The following fields are only displayed in On-Line or Monitor mode, with a CPU connected:

CPU Software Version: This entry shows the revision level of the CPU software.

Memory Type: This entry displays the type of memory in the memory cartridge. Memory types available are CMOS RAM, UVPROM, and EEPROM. It also shows the write-enable state of the memory cartridge.

Scan Time: This entry displays the amount of time taken by the CPU to complete one scan. Scan time consists of the time taken to execute the user logic program, service I/O, service peripherals, self-test, and housekeeping. "Min" and "Max" display the shortest and longest sweeps, respectively, since the CPU entered the Run mode. Going from Stop to Run, or cycling power, will reset these values. "Last" displays the time for the last completed scan.

I/O Config: Logicmaster 5 software allows you to enable or disable the I/O configuration check. If enabled, the old and new configurations are compared each time the system is powered up or the CPU is reset. This entry indicates whether the I/O configuration was checked, or was not checked.

CPU Error Flags: This entry shows the CPU errors detected since the last time these errors were cleared. The error flags are 32 bits of memory within the Scratch Pad. The CPU uses these flags to indicate which faults were found during normal operation, or during self-checks. This field is always controlled by the CPU in On-Line or Monitor mode; in Off-Line mode, the field is blank.

If an error flag is set, a message will also appear below the flag to interpret the content of the flag. A list of error messages and their meaning is shown below.

- I/O errors: These errors will be indicated by a "BASE X/SLOT Y" message,

```
where:   X  =  the address of the base where the error occurred.
         Y  =  the I/O module, if Y = 0 through 7.
               the CPU or local if module, if Y = 13.
               the power supply, if Y = 14.
               the rack itself, if Y = 15.
```

- Program errors: These errors will be indicated by "PROGRAM ERROR XXXX", where XXXX is the program address where the error occurred.

Scratch Pad Errors

The Scratch Pad error display is made up of 4 bytes (Scratch Pad bytes 10 through 13), with each bit prioritized to ensure that all error messages are reported in a prioritized order. The contents of all 4 bytes are displayed in binary format on the Scratch Pad display. This allows all of the error bits to be displayed, even though only one error message can be displayed at a time.

Only the most important message of all bits set is shown. The other errors are noticed only because the bit is set in the bytes shown. Many error messages will display an address to help isolate the problem area.

Table 3-1. CPU Error Messages

SCRATCH PAD BYTE	BIT	PRIORITY	MESSAGE
byte 10	bit 0	26	Compilation Error
	bit 1	28	Program Parity Error (E04)
	bit 2	27	Program Error
	bit 3	25	I/O Parity Error (E251)
	bit 4	09	Genius I/O Setup Error
	bit 5	24	I/O Bus Error (E250)
	bit 6	05	No Memory Cartridge Error (E101)
	bit 7	08	I/O Config Changed (E252)
byte 11	bit 0	18	User Memory - System Only
	bit 1	19	User Memory - Data Only
	bit 2	20	Reserved for Future Use
	bit 3	21	Rung Too Complex (E152)
	bit 4	22	Reserved for Future Use
	bit 5	13	I/O Module Removed (E202)
	bit 6	14	Duplicate I/O Address Error (E261)
	bit 7	15	I/O Address Range Error (E262)
byte 12	bit 0	29	Reserved for Future Use
	bit 1	30	Reserved for Future Use
	bit 2	23	Watchdog Timer Timed Out (E03)
	bit 3	12	I/O Error
	bit 4	10	Memory Battery Low (E41)
	bit 5	11	CPU Battery Low (E41)
	bit 6	06	No Battery in Memory Cartridge (E44)
	bit 7	07	No CPU Battery (E42)

Table 3-1. CPU Error Messages - Continued

SCRATCH PAD BYTE	BIT	PRIORITY	MESSAGE
byte 13	bit 0	01	Operating System Error (not displayed)
	bit 1	02	Operating System Error (not displayed)
	bit 2	03	Operating System Error (not displayed)
	bit 3	04	Operating System Error (not displayed)
	bit 4	16	Operating System Error (not displayed)
	bit 5	17	Operating System Error (not displayed)
	bit 6	31	Operating System Error (not displayed)
	bit 7	32	Operating System Error (not displayed)

SECTION 2
Editing the Scratch Pad Display

This section explains:

- The function key assignments in Off-Line mode.
- How to change the memory size.
- How to change the number of registers.
- How to access the CPU Configuration Utilities menu.
- How to initialize the CPU to factory defaults.
- How to set the watchdog timer.
- How to select a CPU, or change the entry for CPU ID.
- How to clear overrides.
- How to access the I/O Configuration Utilities menu.
- How to verify and update the I/O configuration.
- How to set the LED Display mode.
- How to change the CPU status.
- How to set the clock functions.

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 to the Scratch Pad entry for memory size. If the CPU memory is less than the Scratch Pad entry, the system compares the actual size of the program to the available CPU program memory. The program will not be stored if either of these comparisons shows that it is not suitable for use in the CPU.

The system compares the Scratch Pad entry for registers with the available CPU registers. If the CPU register size is less than the Scratch Pad entry, the system compares the actual size of the registers in the program to the available CPU register size. The program will not be stored if either of these comparisons shows 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:

- In On-Line mode, the CPU controls the values for memory size, run status, registers, version, and error flags.
- In Off-Line mode, if there is a program loaded into Logicmaster memory, changes are limited to those compatible with the program.
- In Monitor mode, the Scratch Pad parameters cannot be changed.

Function Key Assignments in Off-Line Mode

In Off-Line mode, the function keys shown below are used to change the Scratch Pad. These function keys are displayed only when their functions can be used.

```
         SELECT  SELECT                L/M     TIME          SUPERV
1       2MEM SZ 3REG SZ 4            5 MODE  6 DATE  7      8 MENU
```

Changing the Entry for Memory Size

Total available memory reflects the values in the CPU hardware, if the system is in either On-Line or Monitor mode. In Off-Line mode, you can change this value by pressing the Select Mem Sz (F2) key. The F2 function key toggles the total memory size from 4K to 8K to 16K, and back to 4K again. The number of words used in the program may not exceed the memory size number multiplied by 1024.

If there is a program in Logicmaster memory which uses more memory space than the value entered here, the change is not permitted. For example, if the program in memory uses 5021 words, the change will only toggle between 8K and 16K.

Changing the Entry for Registers

In On-Line or Monitor mode, the register memory size field is controlled by the CPU and cannot be changed. In Off-Line mode, you can change the entry for this field by pressing the Select Reg Sz (F3) key. The F3 function key toggles the entry for registers between 4K and 16K.

If there is a program in Logicmaster memory with more registers (including implied table lengths) than the value entered, a change will not be permitted.

Accessing the CPU Configuration Utilities Menu

The Scratch Pad CPU is connected and the Logicmaster system is in On-Line mode. Press the CPU Config (F1) key from the Scratch Pad Display screen to access the CPU Configuration Utilities menu.

```
CPU:STOP/UNLOCK     CPU ID: 1     LM NOTEQ CPU        LM:ONLINE   11:19:39

          C P U   C O N F I G U R A T I O N   U T I L I T I E S

       KEY #                                                  FUNCTION

       F2 -   I/O CONFIG. . . . . . . . . . .I/O Configuration Utilities
       F3 -   INIT CPU. . . . . . . Initialize CPU to Factory Settings
       F4 -   SET WD TMR. . . . . . . . Set CPU Watchdog Timeout Value
       F5 -   SELECT TARGET CPU . .Select Target CPU for Communication
       F6 -   CHANGE CPU ID . . . . . . . . . . . . Change Target CPU ID
       F7 -   CLR OVERIDE . . . . . . .Clear All CPU's Override Tables
       F8 -   SCRPAD MENU . . . . . . . . . . Return to Scratch Pad Menu

              CURRENT CPU WATCH DOG TIMEOUT VALUE :     200   MSEC



         I/O     INIT    SET        SELECT  CHANGE   CLEAR  SCRPAD
1       2CONFIG 3  CPU  4WD TMR    5CPU ID 6CPU ID 7OVRIDE 8 MENU
```

Accessing the I/O Configuration Utilities Menu

In On-Line mode, the I/O Configuration Utilities can be accessed in one of two ways:

- By pressing the CPU Config (F1) key from the Scratch Pad Display screen to access the CPU Configuration Utilities menu, and then pressing the I/O Config (F2) key.
- By pressing the I/O Config (F2) key from the Scratch Pad Display screen.

Initializing the CPU

The Initialize CPU function allows you to initialize the CPU to the factory settings. Normally, this function is only used when:

- You have forgotten your password. This function will clear the password, but it will *also* clear your program and all input, output, override, and register tables in the CPU.
- You have accidentally overwritten part of the scratch pad using CCM-based communications.
- A parity error exists in the memory cartridge, but not in Logicmaster memory. Normally, downloading a new program to the CPU will clear the error. If the error is in the parameters part of the cartridge, however, you may need to initialize the CPU in order to clear it.

CAUTION

The Initialize CPU function will clear *all* tables. Be sure you have a backup copy of the program currently in Logicmaster memory and have saved the CPU operating parameters before initializing the CPU.

To initialize the CPU, press the Init CPU (F3) key. Then, press the Confirm (Shift/0) key to proceed.

The internal CPU parameters will be reset, as described below:

- Watchdog timer: 200 ms
- Password: 00000000 (No password; the previous password will no longer be in effect.)
- User Logic: 2 ENDSW op codes
- Clears all error flags.
- Sets CCM address to 1. If the ID number was other than 1, communications will be lost after the initialize operation.
- Sets the file name to NONE.
- Enables I/O configuration checking.
- Sets the LED mode display to I/O status.
- Clears the Genius I/O setup. Previous assignments will be lost.
- Clears the I/O address assignment. Previous assignments will be lost.
- Sets scan timers and counters to zero.

After completing the Initialize CPU function, you should set the target ID to 1 to re-establish communications with the CPU. Then, download a new copy of your program, as well as a CPU configuration file, from disk.

Setting the Watchdog Timer

The watchdog timer is used to detect abnormal operation of the Series Five CPU. The valid range for the value of this timer is from 20 to 998 ms. This value should be set higher than the largest expected scan time for the program to be executed.

The value of the watchdog timer is displayed each time you access the Scratch Pad Utilities screen. It can be updated by using the SET WD TMR function. To set the watchdog timer value:

1. From the Scratch Pad Display screen, press the CPU Config (F1) key. The CPU Configuration Utilities screen will appear.
2. Using the keys on the numeric keypad or on the ASCII keyboard, enter the desired value in the data value (bottom) line of the work area.
3. Press the Set Wd Tmr (F4) key, and then the Confirm (Shift/0) key to confirm this value. The new value will be displayed on the Scratch Pad menu.

Selecting the Target CPU

In a multidrop network, each CPU connected to the system has a unique identification number. This ID number can be a value from 1 to 90. In On-Line or Monitor mode, you can use this ID number to select a CPU for communication. To select a CPU:

1. From the Scratch Pad Display screen, press the CPU Config (F1) key. The CPU Configuration Utilities screen will appear.
2. Enter a new value (1-90) into the data value (bottom) line of the work area, and press the Select CPU ID (F5) key.

If the selected value is valid, the Logicmaster system will begin communicating with the new CPU.

NOTE

If a valid CPU ID number is selected but no CPU with that ID number exists in the network, communication within the system will be lost.

Changing the Entry for CPU ID

Each CPU connected to the system must have a unique identification number. This CPU ID number can be a value from 1 to 90. The entry for this field can only be changed in On-Line mode, with the CPU stopped. To change this entry:

1. From the Scratch Pad Display screen, press the CPU Config (F1) key. The CPU Configuration Utilities screen will appear.
2. Enter the new value (1-90) into the data value (bottom) line of the work area, and press the Change CPU ID (F6) key.

CAUTION

DIP switch 2 on the CPU module must be in the OFF position. If this switch is in the ON position, the CPU's target CCM number will be forced to 1. Any attempt to change the CPU ID number from 1 will result in a loss of communication.

Clearing Overrides

An override removes control of the reference from its normal source. Overridden inputs ignore information from devices wired to the I/O structure. Similarly, overridden outputs ignore programmed logic and internal power flow.

Press the Clear Ovride (F7) key to clear all overrides. Then, press the Confirm (Shift/0) key to execute the function.

Returning to the Scratch Pad Menu

Press the Scrpad Menu (F8) key to return to the Scratch Pad menu.

Accessing the I/O Configuration Utilities Menu

The Scratch Pad I/O Configuration Utilities can only be accessed when the CPU is connected and the Logicmaster system is in On-Line mode. Press the I/O Config (F2) key from the Scratch Pad Display screen to access the I/O Configuration Utilities menu.

```
CPU: STOP/UNLOCK     CPU ID: 1     LM NOTEQ CPU        LM:ONLINE    11:19:39

          I / O   C O N F I G U R A T I O N   U T I L I T I E S

      KEY #                                                     FUNCTION

      F1 -    CPU CONFIG. . . . . . . . . . .CPU Configuration Utilities
      F3 -    NEW CONFIG. . . . . . . Record Present I/O Configuration
      F4 -    OLD CONFIG. . . . .Use Old I/O Configuration (TEMPORARY)
      F5 -    SET/CLR IO CFG CK . .Enable/Disable CPU I/O Config Check
      F6 -    IO MOD ADDRESS/STATUS . Set IO module's LED Display Mode
      F8 -    SCRPAD MENU . . . . . . . . . . Return to Scratch Pad Menu

   CAUTION:   When changing from I/O CONFIG CHECK disabled to enabled
              via F5, the CPU will record the present I/O configuration.



  CPU             NEW      OLD          CHECK   LED IO            SCRPAD
 1CONFIG 2       3CONFIG 4CONFIG       5IO CFG 6 ADDR  7          8 MENU
```

Accessing the CPU Configuration Utilities Menu

In On-Line mode, the CPU Configuration Utilities can be accessed in one of two ways:

- By pressing the I/O Config (F2) key from the Scratch Pad Display screen to access the I/O Configuration Utilities menu, and then pressing the CPU Config (F1) key.
- By pressing the CPU Config (F1) key from the Scratch Pad Display screen.

Updating the I/O Configuration

I/O Configuration provides the CPU with information about the I/O module types and the number of I/O points. At power-up, the Series Five CPU loads the I/O module configuration data from the memory cartridge into the CPU Scratch Pad. If I/O configuration checking is enabled, the CPU will check the

I/O configuration data from the memory cartridge against the I/O modules in the rack. Any differences, which prevent the CPU from running, will be noted.

If the Scratch Pad Display screen shows that the previous I/O configuration does not equal the current I/O configuration, you can select the I/O configuration you wish to use. The contents of this configuration will then be copied into the registration area to use for future comparisons on power-up.

In addition to selecting which I/O configuration you wish to use, you can also select whether you wish to enable/disable CPU I/O configuration checking. The LED I/O Addr (F6) key can be used to select whether the LEDs on the I/O modules are used to display the starting address of the module or the I/O point status.

To use the I/O configuration data of the I/O modules currently installed in the rack, press the New Config (F3) key. Then, press the Confirm (Shift/0) key to proceed. The new configuration data will be placed into the memory cartridge, replacing the previously registered data. The CPU will use this new configuration data for checking the next time the system is powered up.

Checking I/O Configuration

In On-Line mode, you can enable/disable the I/O configuration check performed when the system is powered up, and when the CPU goes from STOP to RUN. If you press the Check IO CFG (F5) key, the configuration data stored in the memory cartridge will be compared with the data in the I/O modules during subsequent power-up sequences.

If the CPU Configuration Check function is currently enabled, the Check IO CFG (F5) key will be replaced by the No I/O Config (F5) key. Pressing the No I/O Config key tells the CPU *not* to perform any I/O config checking on subsequent power-up sequences or CPU transitions from STOP to RUN.

To enable or disable the I/O configuration checking, press the available function on the F5 key. Then, press the Confirm (Shift/0) key. The Scratch Pad display screen indicates whether or not I/O configuration checking was performed.

I/O Configuration Changed Error Recovery

On each power-up cycle, the CPU checks its I/O configuration to determine if the structure has changed. If it has changed, an I/O CONFIG CHANGED error will occur.

If the error was caused by a newly added module that has not yet been assigned an address, you should assign a reference to the module and store the new I/O map to the CPU. Refer to chapter 10 for detailed information on assigning I/O references.

The NEW CONFIG function allows you to tell the CPU to register and accept the presently installed I/O configuration as the new valid configuration. If any modules have been installed but have not had addresses assigned, the CPU will automatically assign addresses to these modules starting at I0001 and/or O0001. Because of this, you should only use the NEW CONFIG function after you have assigned references on the I/O assignment screen to all installed modules. This function causes the I/O configuration stored in the memory cartridge to be overwritten by the "real" installed I/O configuration.

The OLD CONFIG function allows you to use the I/O configuration stored in the memory cartridge, even though this is not the same configuration presently installed in the system. The configuration stored in the memory cartridge will not change, as it does when the NEW CONFIG function overwrites the configuration data stored in the memory cartridge. When this option is selected, an I/O Configuration Changed error will occur on the next power cycle.

Setting the LED Display Mode

The 16 LEDs, located directly below the four diagnostic LEDs on an I/O module, perform a dual function. They can display either the status of the input/output points on the module or the address (in BCD) of the module. Logicmaster 5 software allows you to toggle between these two modes when the system is on-line.

1. In the Scratch Pad menu, press the I/O Config (F2) key. The I/O Configuration Utilities menu will be displayed.
2. Press the LED IO Addr (F6) key, and then press the Confirm (Shift/0) key to execute this function. The I/O module LEDs will indicate the selected data. If the I/O module LEDs are displaying address information, the green ADR LED on the I/O module will be on.

The opposite mode of the current mode is shown on the F6 function key. When the CPU is displaying in Address mode, the function of the F6 key will be I/O LED STATUS. When the CPU is displaying in Status mode, the function of the F6 key will be I/O LED ADDRESS.

NOTE

The display mode requested applies to *all* I/O modules installed in the CPU. With the OIU, it is possible to display the addresses of *only* input or *only* output modules.

When Address mode is selected, the ADR indicator on the top row of LEDs will turn on. The starting address of each module will be displayed on the LED as a 4-digit BCD number. The least significant bit (1's digit) is read on the four LEDs in the right vertical column, and the most significant bit (1000's digit) is read on the four LEDs in the left vertical column. The binary weight of the four LEDs in each column, reading from top to bottom, is 1-2-4-8. The following example shows how to read a typical starting address of an I/O module. If the module has been assigned an address in the Remote I/O tables, the GEN indicator on the top row of LEDs will be on.

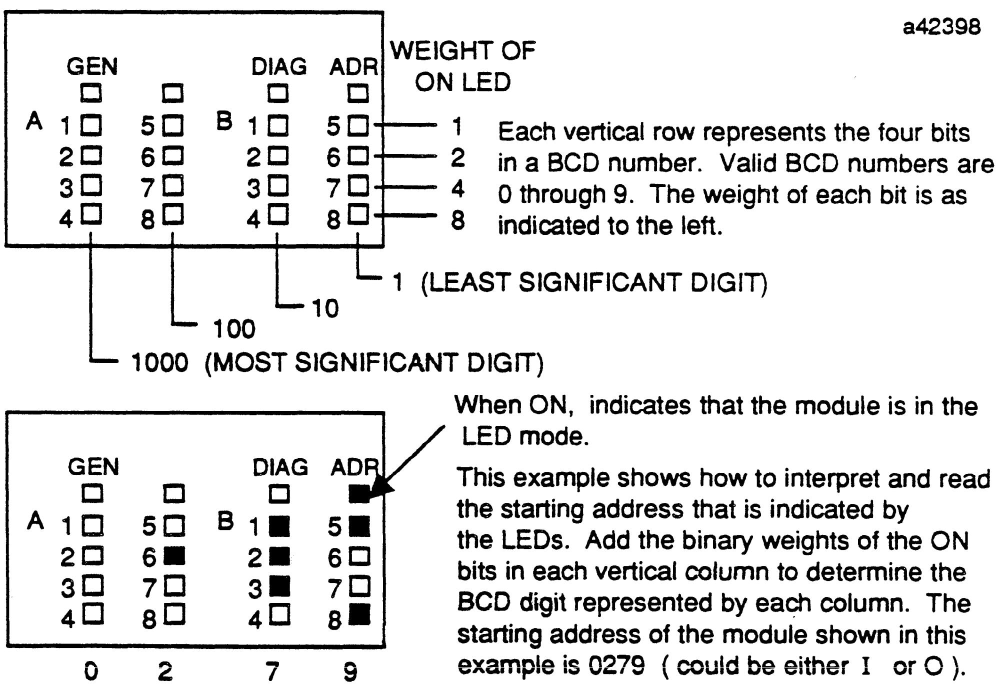


Figure 3-1. Explanation of a Typical Starting Address

Returning to the Scratch Pad Menu

Press the Scrpad Menu (F8) key to return to the Supervisor menu.

Changing the Entry for CPU Status

The CPU status is displayed if the Logicmaster system is in On-Line or Monitor mode. It can be changed only in On-Line mode with a CPU connected. The CPU Run keyswitch must be in the ON position.

Function keys F3 (CPU Start/Stop) and F4 (Output Enable/Disable) will be labeled with the opposite state of the current display.

1. From the Scratch Pad Display screen, press the CPU Start (F3) key to toggle the CPU status between STOP and RUN (scanning logic).
2. When the CPU is stopped, press the F4 key to toggle between enabling or disabling the selection of outputs on the next RUN status.
   A. **Enable** allows the hardware outputs to be ON or OFF, as dictated by the ladder diagram program.
   B. **Disable** forces all hardware outputs to their default state, regardless of the program.

NOTE

Neither enable nor disable has any effect on the CPU if it is stopped.

Changing the Time and Date

In On-Line and Monitor mode, both Logicmaster and CPU time and date will be displayed on the Time/Date Functions screen while the Logicmaster system is actually communicating with the CPU. In Off-line mode, only the time and date of the Logicmaster system will be displayed.

To access the Time/Date Functions screen, press the Time Date (F6) key from the Scratch Pad Display screen. The following screen will appear:

```
CPU:RUN/ENBL/LOCK     CPU ID: 1   LM NOTEQ CPU    LM:ONLINE    11:19:39
                T I M E   /   D A T E   F U N C T I O N S

                                   CURRENT          NEW

        LOGICMASTER DATE:         27-JAN-88
                    TIME:          09:27:45

        CPU         DATE:         27-JAN-88
                    TIME:          09:27:45




 CPU TO  LM5 TO                                          SCRPAD
1  LM5  2  CPU  3      4          5       6       7      8 MENU
```

The Time/Date screen displays the time and date presently set in the CPU and Logicmaster system. You can change the time and date by moving the cursor to the associated line under the new column, entering the new value, and pressing the Enter key. More than one entry may be entered at the same time, before pressing the Enter key.

The current date must be entered in the following format:

```
                                  DD-MMM-YY
                                   |  |   |
      Day of the month (1-31)  ___|  |   |___  Last 2 digits of the year
                                      |
     First 3 letters of the month ___|
```

For example, a current date of November 15, 1987 would be entered as: 15-NOV-87.

The current time must be entered in the following format:

```
                      HH:MM:SS
                       |  |  |
      Hours (00-23) ___|  |  |___ Seconds (00-59)
                          |
      Minutes (00-59) ____|
```

For example, a current time of 2:10 p.m. would be entered as: 14:10:00.

The time and date between the Logicmaster system and the CPU can be synchronized by pressing either the CPU to LM5 (F1) key or the LM5 to CPU (F2) key. However, the time displayed on the

Logicmaster screen may still differ slightly due to the delay in communications between the CPU and the Logicmaster 5 system.

Returning to the Supervisor Menu

Press the Superv Menu (F8) key, or the Suprv key, to return to the Supervisor menu.

```
CPU:STOP/UNLOCK     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE    11:19:39

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

     PROGRAM NAME:          NONE     25-JAN-88 09:33:40    PRG ID:  21

     REGISTERS:               4K           SUBROUTINES USED:         00

     MEMORY SIZE:             4K           MEMORY USED:               4
                                              AVAIL:          3,836
     CPU SOFTWARE VERSION:    2.0 / 2.9
     MEMORY TYPE:             [CMOS - WRITE ENABLED]

     SCAN TIME:  LAST--   6 ms.            I/O CONFIG:  WAS NOT CHECKD
                 MIN --   4 ms.
                 MAX --   8 ms.

     CPU ERROR FLAGS:  00000000 00000000 00000000 00000000

NO ERROR DETECTED


  CPU      I/O      CPU    OUTPUT        MAKE    TIME             SUPERV
1CONFIG 2CONFIG 3 START 4ENABLE      5 EQUAL 6 DATE   7        8 MENU
```

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 single-word changes when the system is on-line to an operating CPU. References and some instructions can be changed, relays overridden, and new data values entered.

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 single-word changes to the program. This section also explains how to use overrides, and how to identify overridden references during program display.

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 Logicmaster memory. If the program you want to display has just been loaded or stored from/to the CPU, go to step 5.
2. If the program is not currently in Logicmaster memory, you can load it using the Load/Store/Verify functions, or the quick-load feature from the Supervisor menu.

NOTE

For On-Line display, the program in the CPU and the program in Logicmaster memory must be equal. If the program is loaded from the CPU, they are equal. Otherwise, the program in system 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.
   B. When the file name is active, press the Alt/L keys 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 the Load/Store/Verify (F6) function from the Supervisor menu.
   A. In the Load/Store/Verify menu, press the Load Func (F1) key.
   B. On the Load Program/Tables page, 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 the Enter key.
   C. When the Load operation is complete, you can use the Verify function to check program content. For more information, refer to chapter 9.

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

5. In the Supervisor menu, type in the name of the program to be displayed. Then, press the Disply Prog (F1) key.

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 the word "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.

```
| I0001   I0002   I0003   I0004   I0005                                O0001
|--| |-----| |--+--| |--+--| |--+--| |---------------------------------( )
|               |        |       |
| O0001   O0002 |        |       |
|--| |-----| |--+        |       |
|                        |       |
| I0001                  |       |
|--| |--+----------------+       |
|        |                       |
| O0001  |                       |
|--| |--+                        |
|                                |
| I0006   I0002   O0002          |
|--| |--+--| |-----| |--+--------+
|        |               |
| O0003  |               |
|--| |--+                |
|                        |
| O0004                  |
|--| |-------------------+

 DISPLY  SEARCH  DISPLY  ONLINE  rung  OVRIDE  TOGGLE  DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4CHANGE   # 5   REF   6STATUS 7 ALL   8 MENU
```

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 appear.

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 will appear 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 On-Line Change, Override Reference, and Toggle Status functions cannot be used. Therefore, the F4, F5, and F6 keys display no function assignments. The functions appropriate to the current cursor location are the ones which are displayed. These 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  ONLINE rung  OVRIDE  TOGGLE  DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4CHANGE    # 5  REF  6STATUS 7 ALL   8 MENU
```

Disply Rung (F1): Use ***Display Rung*** to select another rung for display. Refer to "Selecting a Rung for Display" in this section.

Search Func (F2): Use ***Search Function*** to search for a program element. Refer to section 2 of this chapter for instructions.

Disply Commnt (F3): Select ***Display Comment*** to display annotation in Window mode or in Page mode. Use this key in conjunction with the Display All/Display Nicknames (F7) key to select the format for annotation display. Refer to "Displaying Annotation" in this section for more information.

Online Change (F4): Select ***Online Change*** to make single word changes to a program.

Ovride Ref (F5): Use ***Override Reference*** to toggle the override status of the input or output at the cursor position. This function is only available when on-line with an operating CPU. Refer to section 2 for more information.

Toggle Status (F6): ***Toggle Status*** toggles the status of the input or output reference at the cursor position. If the reference is currently overridden, the new status is retained until the Toggle Status (F6) key is pressed again. If the reference is not currently overridden, the new status is retained only until changed by the program. For more information, refer to section 3.

Disply All (F7): Use ***Display All/Display Nicknames*** 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 appear over each element. In Display Nickname mode, only the nicknames will appear over each element. *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, *Annotation*, for more information.

Superv Menu (F8): Select ***Supervisor Menu*** to return to the Logicmaster Supervisor Menu screen.

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 (bottom) line of the screen's work area.

   B. A memory address: Enter a hexadecimal value in the numeric (bottom) line of the screen's work area.

   C. A coil reference: Enter an appropriate output value in the reference (center) line of the work area.

   D. A nickname: Enter a nickname into the text (top) line of the work area.

2. Press the Disply Rung (F1) key.

The rung will be displayed at the top of the screen. The cursor will be positioned at the first element, or memory address, or coil - depending on which was selected in step 1. If the selection is by memory address to a word that is not displayable, the cursor will be placed adjacent to the requested address.

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 or Down cursor key 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 the Next or Return key to display the next rung (up to seven lines) of the program. Press the Shift key and the Next key at the same time to display the next seven lines of the program.

3. Press the Prev key to display the previous rung (up to seven lines) of the program. Press the Shift key and the Prev key at the same time to display the previous seven lines of the program.

SECTION 2
Searching for a Program Element

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

```
 BEGIN          REF    FROM  rung  RELAY   BASIC   ADVNCD  PROGRM
1SEARCH 2ADVNCE 3 EXP  4 TOP     # 5ELEMNT 6 FUNC  7 FUNC  8 MENU
```

Searching for a Reference or Nickname

To search for a reference or nickname:

1. Enter the reference or nickname in the work area.
2. To search for a specific instruction, use the Search Function keys. If an instruction and a nickname or reference are entered together, the combination is searched for.
3. After you identify the element to be searched for, select the method of searching:

   A. Use the Advnce (F2) key, as needed, to toggle the search direction between advance (forward) and backup (backward).

   B. Use the Ref Exp (F3) key, as needed, to toggle between:

      (1) **REF EXP:** Explicit References only - to search only for references actually entered in the ladder diagram and displayed on the screen.

      (2) **REF IMP:** Explicit and Implied - to search for both Explicit and Implied References. Implied References are not displayed, but are included in tables, matrices, and similar functions.

   C. Use the From Top (F4) key to select the starting place for the search. It may be either the top of the ladder diagram (from top) or the current rung (from current).

4. Press the Begin Search (F1) key to start the search.

"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 PB, PB1, PB2, PB3, or PB44.

1. Enter the nickname in the work area, using the * to replace the variable characters at the end.
2. Use the From Top/From Curent (F4) key to select the starting point.
3. Use the Advnce/Backup (F2) key to select the direction of the search.
4. Press the Begin Search (F1) key to start the search.

Search Keys: Definitions

The Search Function keys are summarized below:

Begin Search (F1): Use ***Begin Search*** 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.

Advnce/Backup (F2): Use ***Advance/Backup*** to toggle the search direction between forward and reverse.

Ref Exp/Ref Imp (F3): Use ***REF EXP/REF IMP*** to toggle the search between explicit (REF EXP) and implicit (REF IMP) references.

From Top/From Curent (F4): Use ***From Top/From Current*** to toggle the starting point for the search between the top of the program and the current cursor location.

Each of the following three 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:

Relay Elemnt (F5): Press the F5 key to display the Relay Element Search function keys.

Basic Func (F6): Press the F6 key to display additional Search function keys:

Shift/Move (F3)
Special Functions (F5)

Advncd Func (F7): Press the F7 key to display additional Search function keys:

Data Move (F1)
Arithmetic Functions (F2)
Search Table (F3)
List Functions (F4)
Matrix Functions (F5)
Control Functions (F6)

Progrm Menu (F8): Press the F8 key 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 or Skip can control the execution of the rungs. To locate the cause of a double left rail, search backward from the current rung. Search first for an MCR, then for a Skip if necessary. Do not include references.

SECTION 3
Making On-Line Single Word Changes in the Program

This section explains:

- How to make single word changes.
- The effect of on-line changes in the program.
- Under what conditions on-line changes may be made.
- How to change the number base of a reference.
- How to change a reference.
- How to change an instruction (for example, normally-open contact to normally-closed contact).
- How to override an input or output, removing it from program control.
- How to toggle the status of a contact or coil.
- How to change register and I/O values.

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 Logicmaster 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, override status, and register content. To ensure an accurate display, the Logicmaster 5 system requires that the CPU and system programs be equal. If they are not equal, on-line changes will not be 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. *If rungs are added, deleted, or changed while in the Editor mode, the program in memory and the CPU become ''Not Equal''.*

When the system is in Off-Line mode, the status and power flow are always obtained from Logicmaster memory.

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 5 system is On-Line to the CPU, and that the active program is exactly the same (''equal''). For example:

```
CPU:RUN/ENBL/UNLOCK    CPU ID: 1    LM EQUAL CPU    LM:ONLINE    CURSOR: 000C
```

Major changes to the ladder diagram program are usually made using the Edit Program function. However, it is possible to make single word changes to a program using the Display Program function.

Changing the Base of References on the Display

Numeric values may be displayed in decimal, signed decimal, double precision, or hex. The base displayed depends on the type of function that uses the reference. For instructions that permit it, the base can be changed by following these steps:

1. Place the cursor on the reference to be changed.
2. Press the Shift key, and the appropriate Display Mode key.

Changing the base does not change the value in the CPU. Only the display format on the screen is changed.

Changing the Reference Only

To change a reference only, type the new reference or its nickname into the work area and press the Enter key. The Shift/Enter keys can be used to change both the reference and the data at the same time.

Making On-Line Changes

To make an on-line single word change using the Display Program function, place the cursor on the element to be changed and continue as described below.

Changing the Element Type

To change the element type, press the appropriate function key, as shown at the bottom of the screen. The exact function key assignments shown vary with the location of the cursor. You can change the element type as follows:

Contact	Reverse contact type: NO to NC, or NC to NO.
Coil	Reverse coil type between relay and one-shot.
Counter	Change counter type, or replace counter with timer.
Timer	Change timer type, or replace timer with counter.

Changing the Content of a Numeric Field

To change the content of a register or I/O reference:

1. Place the cursor on the item to be changed.
2. Type the new value into the data value (bottom) line of the work area, and press the Enter key.

Overriding an Input or Coil

You can override the status of each input and each coil. An override removes control of the reference from its normal source. Overridden inputs ignore information from the devices wired to the I/O structure, such as limit switches or pushbuttons. Similarly, overridden outputs ignore programmed logic and internal power flow. If an I/O reference is used in a mnemonic instruction (such as an ADD function), the override bits have no meaning and are ignored.

All local and channeled I/O references (with the exception of the I1- table) can be overridden.

When a reference is overridden, all occurrences of that reference in the program will remain in either their ON or OFF state. References that were off when overridden will remain off. References that were on will remain on. These changes will occur throughout the program.

Overrides are retained even when power is removed from the system. The ladder diagram logic cannot change overrides; however, non-relay functions *can change* the state of an overridden reference.

Using Overrides

To insure that unintended overrides have not been left set in the CPU, you can use the Clear All Overrides function in the Scratch Pad Display to eliminate all overrides.

I/O points can be overridden from either the Display Program function or the Display Reference Table function.

WARNING

Overrides should be used on an operating system only with extreme care. Improper use of the override can damage equipment or cause personal injury.

1. Place the cursor on the reference to be overridden.

CAUTION

The reference will be overridden throughout the program, not just at the cursor location.

2. Press the Ovride Ref (F5) key. This key toggles the state of the reference between overridden and not overridden.

The Override is a very powerful tool for program checkout and for maintenance. You can test a program in a PLC that is not connected to an I/O structure by using overrides to simulate inputs. You can also check out a program when I/O is connected, by using overrides to prevent coil operation.

After the I/O is wired up, it can be tested by activating each coil with an override to toggle and verify I/O communications, module addressing, module operation, power to a device, wiring to a device, indicator lights, fuses, and other hardware.

After the control system is thoroughly checked out and placed in operation, the override is very useful in a monitored system. If a sensor or input module should fail while the process is in operation, that input can be overridden. Thus, the process can be continued until it can be shut down safely.

Identifying Overrides during Display Program

When a reference is overridden in Display Program mode, the first character of its nickname blinks. The prefix (I or O) blinks if the reference is displayed.

Forcing the Status of a Reference

In either the Display Program or Display Reference Table function, the Toggle Status (F6) key is used to toggle the status of any reference in the program between on and off. If the reference that is toggled is currently overridden, it retains its new status until the Toggle Status key is pressed again. If the reference is not overridden, it retains its new status 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 program displayed on the screen, place the cursor on the reference to be forced.
2. Press the Toggle Status (F6) key to change that reference to its opposite state. All logic elements in the program that use the reference will reflect the new status.

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 Logicmaster memory. However, register contents and I/O numeric values are shown in Off-Line mode only.

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 the Enter key or the Edit Prog (F2) 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 Logicmaster 5 software 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 Logicmaster 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 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. Press the Edit Prog (F2) key. 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 Logicmaster memory. If the program you want to edit is the one now in memory, go to step 5.

   If a program must be loaded from disk or from the CPU, as described in steps 2 and 3, be sure to select windowing if the program may exceed 6000 rungs or 2K nicknames. Instructions for selecting windowing are given in chapter 10, section 5. *Logicmaster 5 software must be re-started after changing the selection for windowing. Selection of windowing is stored in a file named MACHINE.SET. This file is only read at start-up.*
2. If the program is not currently in Logicmaster 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 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, press the L/S/V Func (F6) key from the Supervisor menu.

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

   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.

   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 Suprv key.

   D. In the Supervisor menu, type in either:

      (1) 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.

      (2) 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. Press the Edit Prog (F2) key. If a program with the name entered is located on the disk, the system checks the contents of its Logicmaster memory against the contents of the disk. If any differences are found, access into the Edit Program mode will be denied. However, the Logicmaster 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

Ifeither the .LAD file, .EXP file, or .NAM file exists on your data disk when you enter the 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 the Abort key. If any text was changed during the edit session, you must confirm the request to abort by pressing the Confirm (Shift/0) key. 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 Abort key was accidentally pressed, pressing any key other than the Confirm key 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 appears on the screen:

```
                                         L/M: OFFLINE   CURSOR:

 |
 |-|   Start of Program   |-
 |
 |-|ENDSW|-
 |
 |-|ENDSW|-
 |


 DISPLY  SEARCH   EDIT          rung  INSERT          DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4         0 5 RUNG   6       7  ALL   8 MENU
```

If it is a new program, as shown above, it has a Start of Program rung (rung 0), and two End of Sweep elements. 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, neither the EDIT COMMNT (F3) nor the DISPLY ALL (F7) function will be displayed.

```
 DISPLY  SEARCH   EDIT   DELETE rung  INSERT   EDIT   DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4 RUNG     0 5 RUNG  6 RUNG  7  ALL   8 MENU
```

Disply Rung (F1): Use ***Display Rung*** to display the rung number, output coil, or memory address entered in the work area.

Search Func (F2): Use ***Search Function*** to search for a program element. Refer to section 3 of this chapter for instructions.

Edit Commnt (F3): Select ***Edit Comment*** to edit annotation in Window mode or in Page mode. Use this key in conjunction with the Display All/Display Nicknames (F7) key to select the format for annotation display. Refer to chapter 6 for information on editing annotation.

Delete Rung (F4): Use ***Delete Rung*** 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 ***Insert Rung*** 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 ***Edit Rung*** to edit the rung at the cursor location. This function displays the Edit Rung keys, which are used to select the program elements.

Disply All (F7): Use ***Display All/Display Nicknames*** to toggle the format of the ladder logic display between reference and nickname display, or annotated display. *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 the Superv Menu (F8) key when you want 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 the coil reference in the reference line.

   C. Enter the memory address in the data line, in hex format.

   D. Enter the nickname in the text line.

2. Press the Disply Rung (F1) key. The selected rung appears 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 the Insert Rung (F5) key.

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 the Edit Rung (F6) key.
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 the Delete Rung (F4) key. Go immediately to step 5. The following message will be displayed:

   ```
   PRESS 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 the Alt/D keys to delete the rungs. The following message will be displayed:

   ```
   PRESS CONFIRM TO DELETE RUNG x - x
   ```

5. To confirm the deletion, press the Confirm (Shift/0) key. To cancel the deletion, press any other key.
6. Repeat this procedure for the next group of rungs to be deleted.

Reference Substitution in a Program

The Reference Substitution function allows you to replace all occurrences of an explicit reference in a program. This allows you to randomly select I/O and register points during program development. After the real hardware points are established, the Reference Substitution function can replace these randomly-selected points with correct reference types and 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 in the data (bottom) line of the work area. Enter only the reference number, not the reference type. The following entries would replace reference R0003 with R0143:

Text Line		(no entry)
Reference Line	R0143_	New Reference
Data Line	0003_	Old Reference

3. Press the Alt/S keys to begin the replacement. The following message will be displayed:

```
PRESS CONFIRM TO REPLACE ALL OCCURRENCES OF _____ BY _____
```

4. Press the Confirm (Shift/0) key 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.
6. 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.
7. 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 LIMITSW (for example, O0053) with reference I0017:

Text Line	LIMITSW_	Nickname
Reference Line	I0017_	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 the Alt/S keys to begin the replacement. The following message will be displayed:

   `PRESS CONFIRM TO REPLACE ALL OCCURRENCES OF _____ BY _____`

4. Press the Confirm (Shift/0) key 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.
6. 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.
7. 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.

Time Stamp

The time used in the time stamp is based on the Logicmaster 5 software (DOS), not on the real-time clock in the CPU. After a normal edit session is completed, the program in Logicmaster memory will reflect the date and time of the most recent edit session. The time stamp will then transfer to the memory cartridge during a program download.

If the program is uploaded and then downloaded, without performing any edit operations, the time stamp will not change. In addition, if a program is edited but never downloaded to the CPU, the time stamp in the memory cartridge will not change.

For on-line changes, the time stamp in the memory cartridge will be changed when the on-line change is stored to the memory cartridge.

For information on synchronizing the clock functions in the Logicmaster software with the real-time clock in the CPU, refer to section 2 of chapter 3, *Scratch Pad*.

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:

```
        TIMER/  SHIFT/          rung  SPEC         ADVNCD  OPEN
1RELAY  2COUNTR 3 MOVE  4         0 5 FUNC  6      7MN GRP 8 SPACE
```

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 the Edit Rung (F6) key.
2. For a simple function such as a relay, you can enter the reference and then select the element. The element will appear with the reference above it.
3. 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 Move A to B function:

```
 *******        *******
-|  A     MOVE     B  |-
```

   Here, you must first enter the reference for A, the source of the data. The reference may be any valid register or I/O reference beginning on a word boundary, or a constant of -16,384 to +16,383.

4. After entering the reference for A and pressing the Enter key, the cursor moves to B, where you enter the destination of the copied data. It may also be any valid register or I/O reference beginning on a word boundary.

Refer to chapter 2 for more information on entering values in the work area.

Some instructions occupy more than one column on the screen. The softkey assignment for a function is only visible when the edit cursor is in a position that allows enough space for the function to fit on the line. Note that it is only legal to enter mnemonic functions on the top line of a rung. In the case of timers, counters, and latches, mnemonics can be entered on the top line of both the enable and reset strings.

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 the Enter key.

To enter both the reference and a value for the reference: enter the reference in the middle line of the work area, and enter the value in the bottom line of the work area. Then, press the Shift/Enter keys at the same time.

Many functions require references that begin on a word boundary. If a value is entered which is not word aligned, the system adjusts the entry to be on a word boundary. The screen displays the new value assigned to the reference.

Adding an Open Space to a Rung

Use the OPEN Space (F8) key in the Edit mode to open element spaces in a rung. Use the function keys to select the direction, as described below:

```
  MOVE              MOVE          rung                            EDIT
1 RIGHT 2         3 DOWN   4         # 5        6        7      8 MENU
```

Use these keys as follows:

Move Right (F1): 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.

Move Down (F3): Select ***Move Down*** 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 there is room to move the line down.

Edit Menu (F8): Select ***Edit Menu*** to return to the basic Edit function key assignments.

Exiting a Rung

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

1. Complete the rung, and enter it into the program by pressing the Accept key. At this time, the system checks the construction of the rung. If the rung is accepted, the Edit functions appear 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 the Abort key. Respond to the prompt that appears by pressing the Confirm (Shift/0) key. If any other key is pressed, that rung remains open for further editing and is not aborted.
3. Press the Suprv key and the Confirm (Shift/0) key to return control to the Supervisor menu without updating the rung.

Adding a Relay to the Program

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

```
 -| |-   -|/|-   +----+ | VERT rung                             EDIT
1  NO   2  NC   3 SHUNT 4| CONN    # 5       6       7 COIL  8 MENU
```

Adding a Timer or Counter to the Program

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

```
                              rung                     T/C     EDIT
1PRESET 2ACCUML 3       4       # 5       6       7 COIL  8 MENU
```

Adding a Shift/Move Function to the Program

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

```
                              rung  BI/BCD  BCD/BI          EDIT
1       2       3       4       # 5CONVRT 6CONVRT 7 COIL  8 MENU
```

Adding a Special Function to the Program

When the Spec Func (F5) key is selected in Edit mode, the screen displays the following function key assignments:

```
                  NO     END    rung                           EDIT
1 MCR   2 SKIP  3 OPER  4SWEEP    # 5       6       7 COIL  8 MENU
```

Adding an Advanced Function to the Program

When the Advncd Mn Grp (F7) key is selected in Edit mode, the screen displays the following function key assignments:

```
  DATA    ARITH  TABLE    LIST   rung  MATRIX  CONTRL  BASIC    OPEN
1 MOVE  2  FUNC 3 MOVE  4 FUNC     # 5 FUNC  6 FUNC  7MN GRP 8 SPACE
```

NOTE

For more information about using these functions in a program, refer to chapter 12, *Programming*, and chapter 13, *Series Five Function Set*.

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 Func (F2) key from the Edit or Display Program function. The screen displays these function key assignments:

```
 BEGIN             REF      FROM  rung  RELAY    BASIC    ADVNCD  PROGRM
1SEARCH 2ADVNCE 3 EXP   4  TOP      # 5ELEMNT 6 FUNC  7 FUNC  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 the Advnce/Backup (F2) key 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 the Ref Exp (F3) key to select:

   A. Explicit References only - to search only for references actually entered in the ladder diagram and displayed on the screen.

   B. Explicit and Implied - to search for both Explicit and Implied References, which are not shown, but which are included in tables, and similar functions.
6. Use the From Top/From Curent (F4) key 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.
7. Press the Begin Search (F1) key 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 F1 key again.
8. To exit from the Search Function, press the Progrm Menu (F8) key. The system returns to either the Display Program or 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 PB, PB1, PB2, PB3, or PB44.

1. Enter the nickname in the work area, using the * to replace the variable characters at the end.
2. Use the F4 (From Top/From Curent) key to select the starting point.
3. Use the F2 (Advnce/Backup) key to select the direction of the search.
4. Press the Begin Search (F1) key to start the search.

Search Keys: Definitions

The Search function keys are summarized below:

Begin Search (F1): Select ***Begin Search*** to start searching for the element defined in the work area. Selections relating to the search operation must be made before pressing this key.

Advnce/Backup (F2): Select ***Advance/Backup*** to toggle the search direction between forward and reverse.

Ref Exp/Ref Imp (F3): Select ***Reference Explicit/Reference Implicit*** to toggle the search between explicit (REF EXP) and implicit (REF IMP) references.

From Top/From Curent (F4): Select ***From Top/From Current*** to toggle the starting point of the search between the top of the program and the current cursor location.

Relay Elemnt (F5): Select ***Relay Element*** to display the Relay Element Search function keys.

Basic Func (F6): Select ***Basic Functions*** to display these additional Search keys:

Shift/Move (F3)
Special Functions (F5)

Advncd Func (F7): Select ***Advanced Functions*** to display thes following Search keys:

Data Move (F1)
Arithmetic Functions (F2)
Search Table (F3)
List Functions (F4)
Matrix Functions (F5)
Control Functions (F6)

Progrm Menu (F8): Select ***Program Menu*** to return to the Edit Program menu.

Searching for a "Bad Opcode"

The Special Function keys include the Bad Opcode (F7) key. This key can be used to locate invalid instructions. For example, certain commands in a program may be incompatible with the Logicmaster 5 software. This is indicated by the message "UNRECOGNIZED OPCODE" when a program is loaded from the CPU into the Logicmaster 5 system. Use the Bad Opcode search function to locate each bad opcode. Edit out each bad opcode using the Open Space and Move Right edit functions. Then, enter the appropriate element. For example:

```
|---| F031 |
|---| 0306 |
|
|   R00272            R00274
|---|   A GREATER THAN  B        |-
```

This is an opcode from a program not compatible with Logicmaster 5 software. For this rung, you would delete the illegal lines, open a space before the A Greater Than B mnemonic, and edit in a compatible reference. The same rung might then look like this:

```
  00100    R00272            R00274
|---| |-----|   A GREATER THAN  B        |-
```

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 a .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 the Alt/W keys. 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 the Alt/G keys. The extra rungs appear in the display.

CAUTION

Using these functions can create an incorrect program. For example, it is possible to insert an End of Sweep in the middle of a program, or more than 32 subroutines in the program. Be sure to check the program you create for correct format. The system will not store a file with incorrect format.

Chapter 6
Annotation

Annotation is an important feature of the Logicmaster 5 Programming and Documentation software. 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

Logicmaster 5 Programming and Documentation software 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 from R0001 to R16384 can be assigned a nickname. The total number of nicknames permitted in a program is either 2048 or 4096. The number depends upon the selection made for "Windowing" on the Machine Setup menu. Refer to chapter 10 for more information on Windowing.

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 can be assigned a name.

NOTE

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 appear 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 5. 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:

Disply All (F7): In the Edit menu, select ***Display All/Display Nicknames*** to toggle the format of the program display between reference display (or nickname only) and annotated display (reference, nickname, name). The .NAM file for the program must be present in the default drive for proper annotation display.

Edit Commnt (F3): ***Edit Comment*** allows access to the annotation entry and editing functions. When the F3 key is pressed, the following functions become available:

```
  EDIT    EDIT    EDIT          rung  RENUM   PAGE/          EDIT
1EXPLAN 2 LABEL 3 NAME  4         # 5EXPLAN 6DISPLY 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 Explan (F1): Select ***Edit Explanations*** to enter or edit rung explanations.

Edit Label (F2): Select ***Edit Label*** to enter or edit coil labels. See "Entering Annotation in Window Mode" for more information.

Edit Name (F3): Select ***Edit Name*** to enter or edit names and nicknames.

Renum Explan (F5): Select ***Renumber Explanations*** if rungs have been added or deleted in the program at a time when the file containing the annotation was not present.

Page Disply (F6): Select ***Page/Window Display*** 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 the Enter key. Then, press the Alt/L keys 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 Logicmaster memory.

   A. From the Supervisor menu, press the L/S/V Func (F6) key.

   B. In the Load/Store/Verify menu, press the Load Func (F1) key.

   C. Enter the disk drive ID (P = CPU), and press the Enter key. 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 the Enter key. The file name will be displayed below the menu selections.

   Or, press the Edit Prog (F2) key. When the backup prompt appears, 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/Enter keys at the same time, or select an instruction function key. A message will be displayed, confirming the nickname deletion.

Changing Nicknames and References On-Line

Nicknames and references can be changed on-line. However, a nickname cannot be added to a reference on-line.

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.

NOTE

It is significantly faster to edit nicknames in Page mode. For contiguous references, using the increment key in Page mode is, by far, the fastest way to enter nicknames.

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, press the Edit Commnt (F3) key. The Edit Comment menu appears:

```
 EDIT     EDIT     EDIT              rung  RENUM   PAGE           EDIT
1EXPLAN 2 LABEL 3 NAME  4              # 5EXPLAN 6DISPLY 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 the F6 key is labeled Window Disply, press the F6 key 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 the Edit Explan (F1) key. 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 the Accept key to save it (or the Abort key to delete it). Saved text will be stored in the program's .EXP 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 the Edit Label (F2) key. 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 the Accept key to save it (or the Abort key to delete it). Saved text will be stored in the program's .EXP file.

Editing Names in Window Mode

To enter a name for a reference in Window mode, follow the steps below:

1. In Display All mode, with the cursor at the rung element where the name will appear, press the Edit Name (F3) key. A window appears above the reference.
2. Enter text for the name into the window. If necessary, refer to the editing instructions given later in this section.
3. When the name is complete, press the Accept key to save it (or the Abort key to delete it). If saved, the name will be stored in the program's .NAM 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. In the Edit menu, press the Edit Commnt (F3) key. The Edit Comment menu appears:

```
 EDIT    EDIT    EDIT            rung  RENUM   PAGE            EDIT
1EXPLAN 2 LABEL 3 NAME  4           # 5EXPLAN 6DISPLY 7        8 MENU
```

2. Press the F6 function key if it currently is labeled Page Disply. 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 (or Alt/U keys on some IBM-compatible computers).

   The Increment and Decrement keys are shifted key functions. These keys can be used when entering rung explanations in sequential order.

2. Press the Edit Explan (F1) key. 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 the Accept key to save it (or the Abort key to delete it). The text will be stored in the program's .EXP 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.

   The Increment and Decrement keys are shifted key functions. These keys can be used when entering coil labels in sequential order.

2. Press the Edit Label (F2) key. 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 the Accept key to save it (or the Abort key to delete it). The text will be stored in the program's .EXP 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.

   The Increment and Decrement keys are shifted key functions. These keys can be used when entering references in sequential order.

2. Press the Edit Name (F3) key. The following display appears. Here, the illustration assumes that I0601 was entered in the second line of the work area.

```
NAME FIELD #1 ----------------
NAME FIELD #2 ----------------
NAME FIELD #3 ----------------
NICKNAME FIELD ---------------
REFERENCE ADDRESS FIELD ------        I0601
```

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 the Accept key to save it (or the Abort key 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 Buffer). 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 the Accept key to save it in an .EXP 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 the Accept key, or by pressing the Abort key or Supervisor key.

Upper (F1): Select ***Upper/Lower*** to toggle the active functions of the other keys. Press the F1 key to select Upper (as shown above) or Lower functions.

Und C/Del C (F2): Select ***Delete Character*** to delete the character at the cursor position, and move the following text one character to the left.

Select ***Insert Character*** 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.

Und W/Del W (F3): Select ***Delete Word*** to delete all the characters (255 maximum) from the cursor position to the next word or the next carriage return.

Select ***Insert Word*** to insert the most recently deleted character string (word segment) immediately before the cursor position.

Und L/Del L (F4): Select ***Delete Line*** to delete all characters from the cursor position to the end of the line, including the carriage return.

Select ***Insert Line*** 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.

DELEOL/EOL (F5): Select ***End of Line*** to move the cursor to the end of the line.

Select ***Delete End of Line*** 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*** to mark a location in the window from which text will be removed using the Cut (F7) key. After pressing the F6 key, move the cursor to indicate the area from which text will be removed.

Use ***Reset*** to reset (or deselect) the selection made with the F6 key.

Paste/Cut (F7): Select ***Cut*** to remove the characters selected with the F6 key. These characters are placed in a buffer; they can be placed elsewhere in the text window using the Paste key.

Select ***Paste*** 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 F7 key.

Top/Bottom (F8): Select ***Top*** to move the cursor to the first character of the text block.

Select ***Bottom*** 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 signed 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 Renum Explan (F5) key from the Comment Editing display. The screen displays the following message:

```
PRESS CONFIRM TO MOVE EXPLANATIONS - SOME MAY BE LOST
```

4. Press the Confirm key 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 5 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  ONLINE rung  OVRIDE  TOGGLE  DISPLY  SUPERV
1 RUNG  2 FUNC  3COMMNT 4CHANGE   # 5  REF  6STATUS 7 ALL   8 MENU
```

The Display Program menu provides two function keys for annotation display:

Disply All (F7): Select ***Display All/Display Nicknames*** 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.

Disply Commnt (F3): Select ***Display Comment*** to access the Annotation Display functions. When the F3 key is pressed, the following functions become available:

```
 DISPLY  DISPLY               rung        PAGE         DISPLY
1EXPLAN 2 LABEL 3      4        # 5      6DISPLY 7      8 MENU
```

The Display Label function is available *only* when the cursor is on a rung with a coil. The Page Disply (F6) key is available in Window mode; in Page mode, the Window Disply (F6) key is available.

Display Comment Functions

Disply Explan (F1): Select ***Display Explanation*** to view rung explanations.

If the Window Display (F6) function has been selected and Window mode is active, then ***Display Explanation*** 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 (F6) function has been selected and Page mode is active, then ***Display Explanation*** 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.

Disply Label (F2): Select ***Display Label*** to display coil labels.

If the Window Display (F6) function has been selected and Window mode is active, then ***Display Label*** 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 (F6) function has been selected and Page mode is active, then ***Display Label*** 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 Display (F6): Select ***Page/Window Display*** 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. From the Supervisor menu, press the Utilty Func (F8) key and then the Port Setup (F6) key. Enter parameters for port A which correspond to those set up for the printer. Then, press the Setup Port (F1) key to implement the printer parameters at the port.

   C. Return to the Supervisor menu. Press the Print Func (F5) key. If no file name is active, enter the file name of the annotation to be printed, on the text (top) line of the work area.

   D. Define the printer parameters. From the Print menu, press the Define Printr (F5) key. The default printer parameters can be changed, as described in chapter 8.

2. From the Print menu, select Define Output (F6) 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, select Print Out (F1) 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 the Enter key to start the printout.

   To print the annotation in background mode, select Print Prog (F2) from the Print menu. Specify the printer port and the source drive for the file. Enter the program name. Press the Enter key to start the printout.

a40050

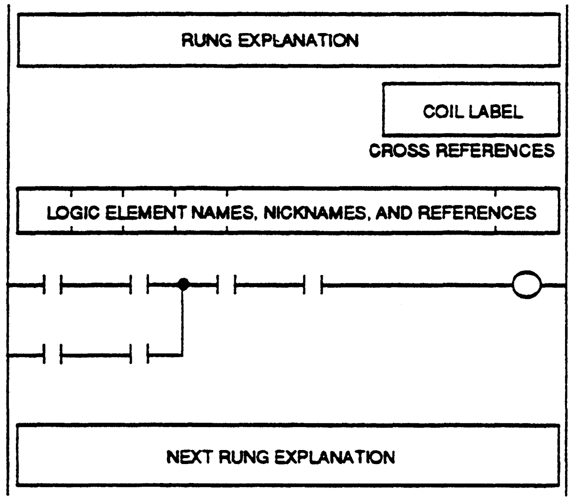


Figure 6-1. 80-Column Format of Printout with Annotation

a40051

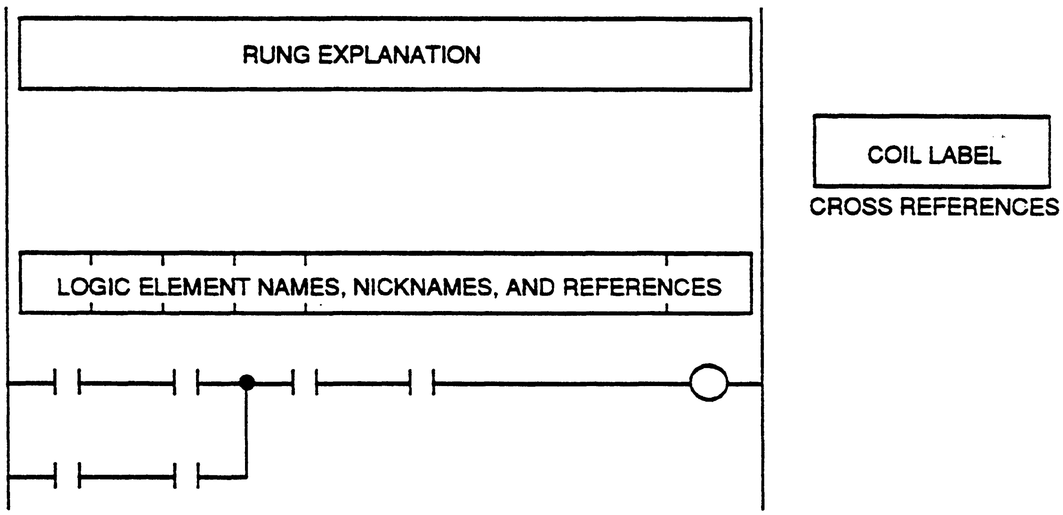


Figure 6-2. 132-Column Format of Printout with Annotation

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 appears at the top of the page, before the rung explanation, and will continue until it is changed again 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 do not appear on the screen.

Chapter 7
Display Reference Tables

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The Display Reference Tablesfunction is used to display the status of any group of references. These may be discrete references (Local I/O or Channeled I/O) 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 Logicmaster 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 one of the I/O reference tables, refer to the instructions in section 2. In addition to describing entry and exit steps, section 2 explains how to change the format of discrete references to decimal, signed decimal, or hex format.

Section 3. Displaying Data Register Contents: To display the Data Register table, refer to the instructions in section 3. In addition to describing entry and exit steps, section 3 explains how to change the format of registers to signed decimal, hex, double precision, ASCII, or text format.

Section 4. Combining Discretes and Registers in Displays: Refer to section 4 for instructions if you want to create mixed displays of both discrete and register references.

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.

Displaying Reference Tables for a Program

To display the reference tables values for a program, follow the steps below:

1. The Display Reference Tables function displays the tables for the program currently in Logicmaster memory. If the program you want to display is the one now in Logicmaster memory, go to step 5.
2. If the program is not currently in Logicmaster 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 Logicmaster memory must be equal. If the program is loaded from the CPU, they are equal. Otherwise, the program in Logicmaster 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.

   B. When the file name is active, press the Alt/L keys 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, press the L/S/V Func (F6) key from the Supervisor menu.

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

   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 "File Name." Enter the name of the program to be displayed, and press 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.

   D. Return to the Supervisor menu through the Load/Store/Verify menu, or by pressing the Supervisor key.

5. 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 input table is selected.

   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 will appear.

   C. To display one of the mixed reference screens, enter its number (1-8).

6. Press the Disply Ref Tb (F3) key. The reference table will appear.

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 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 the Disply Ref Tb (F8) key.

Returning to the Supervisor Menu

Press the Suprv 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 5 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 Suprv key.

2. Press the Disply Prog (F1) key.

The ladder diagram appears, at its last viewing position.

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SECTION 2
Displaying Discrete References

This section explains:

- How to display one of the discrete reference tables.
- How to convert the number base at the cursor position.
- How to convert the number base of the entire table.

Using the Discrete Reference Displays

The discrete display screens show status tables of each of the discrete reference (Local I/O or Channeled I/O) types. The data is displayed in hexadecimal, decimal, signed decimal, or binary format. When displayed in binary format, the data in the discrete table may be overridden.

The override state of an I/O point is changed with the Override Reference/Cancel Override function key. Overridden reference points flash on the display. The value of an overridden point can be changed with the Toggle Reference function key.

I/O Addressing

Local mode I/O addressing provides access to 1024 input and 1024 output references located in the local I/O chain.

Channeled I/O addressing provides up to 2048 input and 2048 output references for remote I/O. In addition, 2048 internal coils and 512 internal status inputs are provided. Channeled I/O references have the following format:

```
    Input (I) or ___    ________ Plus (+) for Remote I/O
    Output (O)      | |         Minus (-) for Internal I/O
                    I2+0342
                      |   |
Table Number (1-2) ___|   |______ I/O Reference Number
```

Entering Conventional References

Enter references in the *center* line of the work area. To enter a reference other than a Channeled I/O reference, follow the steps below. These steps show which keys to use on the 91-key keyboard. Keys to use on a personal computer keyboard are given in parentheses.

1. Enter one of the following:

A and R	for an Indirect Register. You must press the A key first and then the R key (or Ctrl/U).
I	for an Input (or Ctrl/I).
O	for an Output (or Ctrl/O).
R	for a Register (or Ctrl/R).
C	for a Constant (or Ctrl/C).

If the reference line was previously used for a Channeled I/O reference, it may be necessary to press the Clear or Shift/Clear keys first.

2. Use the numeric keypad to type in the reference. (For a PC keyboard, use the numeric keypad with Num Lock on).
3. After entering the reference, press the Enter key. For a register reference be careful not to press Shift and Enter, which enters any value in the *data (bottom)* line of the work area into the register.

Entering Channeled I/O References

To enter a Channeled I/O reference, follow these steps:

1. In the *center* line of the work area, enter an I for an Input or O for an Output. This can be done using the I or O key on the numeric keypad, or by using the Ctrl/I or Ctrl/O key combinations, as described in chapter 2.
2. Press and hold the Ctrl key. At the same time, press either number 1 or 2 on the numeric keypad to enter table 1 or 2.

NOTE

Pressing the Ctrl/Clear keys removes the table number and the ± sign from the reference line of the work area. If you are using a PC keyboard, refer to the Alternate and Control key functions described in chapter 2.

3. Press the Shift and ±2 keys to toggle the sign field. Enter a plus (+) or minus (-) sign, depending upon whether the I/O is real (+) or internal (-). You may also use the Ctrl/= keys to toggle between the plus and minus sign in the work area.
4. Enter the point address, which is a number from 0001 to 1024.

Displaying a Table of Discrete References

To display one of the I/O reference tables, follow the instructions below:

From the Supervisor menu, or from within the Display Reference Tables function, type the reference or its nickname into the work area.

For I/O references, enter the address specification into the work area as follows:

```
I0001
||__|
| |
| |____________  Point Address (1-1024)
|______________  Input (I) or Output (O)
```

```
                                                     LM:OFFLINE    11:19:39
POINT #                     INPUT      0173         (nickname)
0064 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00101100
0128 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0192 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

0256 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0320 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0384 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

0448 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00101100
0512 00000000 00000000 00001111 00000000 11111111 00000000 00000000 00000000
0576 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

0640 11011100 00000000 00000000 00000000 00000000 00000000 00000000 00101100
0704 00000000 00000000 00000000 00000000 00000000 00000000 00000000 10101110
0768 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

0832 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00101100
0896 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0960 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
1024 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

  DEC    SIGNED   HEX    BINARY           OVRIDE  TOGGLE  CHANGE  DISPLY
1DISPLY 2DISPLY 3DISPLY 4DISPLY          5 REF   6STATUS 7 ALL   8REF TB
```

Format of the Discrete Reference Display

- Point numbers are indexed in the left column.
- Discrete values are shown as 0 (off) or 1 (on).
- Overridden references are displayed as blinking.

Format for Channeled I/O Reference Display Table

- The word STATUS appears in the header line (line 2) if the display is for an internal point.
- The word STATE appears in the header line if the display is for a remote point.
- Beside the nickname of the element, the channel number and the entire reference address for the current Channeled I/O are shown.

Discrete Reference Tables Function Key Summary

The bottom of the Discrete Display screen displays the following function keys:

Dec Disply (F1): Select ***Decimal Display*** to display the values in decimal format.

Signed Disply (F2): Select ***Signed Display*** to display the values in signed decimal format.

Hex Disply (F3): Select ***Hexadecimal Display*** to display the values in hexadecimal format.

Binary Disply (F4): Select ***Binary Display*** to display the values in binary format.

Ovride Ref (F5): Select ***Override Reference*** to toggle the override status of the reference at the cursor position.

Toggle Status (F6): Select ***Toggle Status*** to toggle the status (on or off) of the reference at the cursor position.

Change All (F7): Select ***Change All*** to display all references in the selected format.

Disply Ref Tb (F8): Select ***Display Reference Table*** to display the table which includes the reference currently entered in the work area.

Returning to the Supervisor Menu

Press the Suprv 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 Suprv key.
2. Press the Disply Prog (F1) key.

The ladder diagram appears, at its last viewing position.

Displaying Discrete References in Non-Binary Format

The reference display shows values in groups of 8 bits in binary format. This is one line:

```
    |__ Leftmost reference.
0512 00000000 00000000 00000111 00000000 10111111 00000000 00000000 00000000
```

You can change the format of the display to show some or all of the values in decimal, signed decimal, or hexadecimal format. After the display is set up, exiting to the Supervisor menu automatically saves the new format in the reference display format (.RDF) file, if there is an active file name. When you return to the reference table display in the future, it will have the new format.

Displaying 16 Bits in Decimal Format

To display the value of 16 bits as a decimal number (00000 to 65535):

1. With the Reference display on the screen, move the cursor to the first (lower-numbered) group of eight bits (low byte) to be converted. For example:

```
                                       |__ 16 bits to be converted.
0512 00000000 00000000 00000111 0000000 10111111 000000000 00000000 0000000
                                               T___ cursor position
```

2. Press the Dec Disply (F1) key, or the DEC/0 key on the 91-key keyboard. The value of the 16 bits is right-justified within the location of the 16 converted bits:

```
                                        |__ Decimal value is displayed.
0512 00000000 00000000 00000111                 00191 00000000 00000000 00000000
                                                T___ cursor position
```

Displaying 16 Bits in Signed Decimal Format

To display the value of 16 bits as a signed decimal number (-32768 to +32767):

1. With the Reference display on the screen, move the cursor to the first group of eight bits (low byte) to be converted. For example:

```
                                               16 bits to be converted.

0512 00000000 00000000 00000111 00000000 10111111 00000000 00000000 00000000

                                                     cursor position
```

2. Press the Signed Disply (F2) key, or press the ±DEC/R key on the 91-key keyboard. The value of the 16 bits is right-justified within the location of the 16 converted bits. The leftmost binary value is used as the "sign bit". The digit 0 in the leftmost position means the number is positive. The digit 1 in the leftmost position means the number is negative. Because the leftmost of the 16 bits above is a 0, it is converted to a positive number.

```
                                               Decimal value is displayed.

0512 00000000 00000000 00000111            +00191 00000000 00000000 00000000

                                                     cursor position
```

Displaying 16 Bits in Hexadecimal Format

To display the value of 16 bits as four hexadecimal values (0-9, A-F):

1. With the Reference display on the screen, move the cursor to the first group of eight bits (low byte) to be converted. For example:

```
                                               16 bits to be converted.

0512 00000000 00000000 00000111 00000000 10111111 00000000 00000000 00000000

                                                     cursor position
```

2. Press the Hex Disply (F3) key, or press the HEX/I key on the 91-key keyboard. The 16 bits are converted to four hex values:

```
   Hexadecimal values are displayed.

0512 00000000 00000000 00000111              00BF 00000000 00000000 00000000

                                                     cursor position
```

Converting All References to Another Format

To convert all the references to binary, decimal, signed decimal, or hexadecimal format:

1. With the reference display on the screen, press the Change All (F7) function key.
2. Next, press the function key for the display type you want:

Dec Disply (F1)	displays all values in decimal format.
Signed Disply (F2)	displays all values in signed decimal format.
Hex Disply (F3)	displays all values in hex format.
Binary Disply (F4)	displays all values in binary format.

Returning the Display to Binary Format

After changing the display in one of the ways described above, press the Binary Disply (F4) key to return *only this reference* to binary format.

SECTION 3
Displaying Register Contents

This section explains:

- How to display the register reference table.
- How to convert the number base at the cursor position.
- How to convert the number base of the entire table.
- The bit patterns of ASCII character displays.
- How to display register contents as text.
- How to create a text display.

Displaying a Table of Register References

To display one of the Register tables:

Type the reference or nickname into the work area.

Press the Disply Ref Tb (F3) key from the Supervisor menu or the F8 function key from a screen in the Display Reference Tables function. The first time this screen is entered, register contents are shown in unsigned decimal format (range = 00000 to 65535).

Register Reference Display

```
                                                                LM:OFFLINE    11:19:39
 REG        REGISTER  00029 (nickname)  EQUALS 0101101001011001
00010       29811  29297  28783  28269  27755  27241  26727  26213  25699  2518
00020       18503  17989  17475  16961  13877  13363  12849  31353  30839  3032
00030       14391  23129  22615  22101  21587  21073  20559  20045  19531  1901

00040       26214  30076  08303  09237  34098  29344  26365  28365  14363  1267
00050       19769  28770  27370  28707  16279  16580  12858  08650  02651  1650
00060       28608  28502  29297  32001  18066  00036  22437  15745  20658  1585

00070       12658  28653  16586  28657  26586  26586  16589  16279  29762  1769
00080       11761  00606  01266  02687  20876  20680  18760  02876  28760  2870
00090       07607  18762  18760  28608  08786  17676  14670  10974  08766  0016

00100       00298  18764  09764  19766  10807  01876  18787  29769  10960  2987
00110       28766  18088  18707  05656  03636  19397  24627  03372  02737  0128
00120       01227  13833  26589  02326  25858  02686  01424  02423  00224  0002

00130       13343  24798  00286  13730  23619  03641  28749  24646  21010  2111
00140       11128  33716  00030  22217  21796  22277  27767  11986  16626  0002
00150       02312  02412  08098  00123  12312  12314  12414  12415  13513  1879

   DEC     SIGNED    HEX     DBPREC           ASCII     TEXT    CHANGE  DISPLY
 1DISPLY 2DISPLY 3DISPLY 4DISPLY          5DISPLY 6DISPLY 7 ALL    8REF TB
```

Format of the Register Reference Display

The top line of the Register Reference display shows the register number at the cursor location (register 00029 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. Register number 00001 is in the upper right corner of the display. The highest number register is on the bottom left.

Register Reference Tables Function Key Summary

The Register Reference table screen displays the following function keys:

Dec Disply (F1): Select ***Decimal Display*** to display the values in decimal format.

Signed Disply (F2): Select ***Signed Display*** to display the values in signed decimal format.

Hex Disply (F3): Select ***Hexadecimal Display*** to display the values in hexadecimal format.

Dbprec Disply (F4): Select ***Double Precision Display*** to display the values in double precision format.

ASCII Disply (F5): Select ***ASCII Display*** to display the values as ASCII characters, from right to left.

Text Disply (F6): Select ***Text Display*** to display the values as ASCII text, from left to right.

Change All (F7): Select ***Change All*** to display all references in the selected format.

Disply Ref Tb (F8): Select ***Display Reference Table*** to display the reference table which includes the reference currently entered in the work area.

Changing the Format of the Register Display

The reference display shows register contents as lines of 10 registers. This is one line:

```
00030   14391   23129   22615   28005   26740   21073   11376   25957   19531   19017
```

You can change the format of the display to show some or all of the values in signed decimal, hexadecimal, Double Precision Decimal, ASCII, or Text format. After the display is set up, exiting to the Supervisor menu automatically saves the new format in the program display format (.RDF) file, if a file name is active. When you return to the display in the future, it will have the new format. In addition, the new format will be used for printing out register contents.

Displaying One Register in Signed Decimal Format

To display the contents of one register as a signed decimal number (-32768 to +32767):

1. With the Reference display on the screen, move the cursor to the register to be converted. For example:

```
                                                     Register to be converted.

00030  14391  23129  22615  28005  26740  21073  11376  25957  19531  19017
```

2. Press the Signed Disply (F2) key, or press the ±DEC/R key on the 91-key keyboard. The number is now displayed in signed decimal format.

```
                                                     Signed decimal value is displayed.

00030  14391  23129  22615  28005 +26740  21073  11376  25957  19531  19017
```

Displaying One Register in Hexadecimal Format

To display the value of one register as hexadecimal values (0000 to FFFF):

1. With the Reference display on the screen, move the cursor to the register to be converted. For example:

```
                                  Register to be converted.

00030  14391  23129  22615  28005  26740  21073  11376  25957  19531  19017
```

2. Press the Hex Disply (F3) key, or press the HEX/I key on the 91-key keyboard. The register is converted to a hex value:

```
                          Hexadecimal values are displayed.

00030  14391  23129  22615  28005  26740  21073  11376   6565  19531  19017
```

Displaying Two Adjacent Registers in Double Precision Format

To display the value of two adjacent registers as a signed double precision decimal number (-2,147,483,648 to +2,147,483,647):

1. With the Reference display on the screen, move the cursor to the right register of the pair to be converted. For example:

```
                              Registers to be converted.

00030  14391  23129  22615  28005  26740  21073  11376  25957  19531  19017
```

2. Press the Dbprec Disply (F4) key. The value of the pair of registers appears in two's complement double precision format.

```
                 Double precision value is displayed here.

00030  14391  23129  22615  22101  26740  21073   +0745563493  19531  19017
```

Displaying One Register in ASCII Format

To display the value of one register as two ASCII characters:

1. With the Reference display on the screen, move the cursor to the register to be converted. For example:

```
                             Register to be converted.

00030  14391  23129  22615  28005  26740  21073  11376  25957  19531  19017
```

2. Press the Alt/A keys, or the ASCII Disply (F5) key. The sixteen bits in the register currently represented on the screen (here, it is represented as its decimal equivalent) are divided into two bytes (bits 15-8 and 7-0). Each byte is represented as its ASCII character equivalent:

```
                              Characters displayed here.

00030  14391  23129   X W  22101  21587  21073  20559  20045  19531  19017
```

The high order bits in each byte (bits 15 and 7) are the parity bits, and are ignored. The remaining 7 bits in each section are converted as shown in the table on the next page. Command codes and non-displayable characters are represented on the screen by the characters ^ @.

The table below shows the bit pattern of the ASCII characters:

Table 7-1. Bit Patterns for ASCII Characters

ASCII CHARACTER DISPLAYS							
Bit Pattern	Character	Bit Pattern	Character	Bit Pattern	Character	Bit Pattern	Character
x0000000	^@	x0100000	(blank)	x1000000	@	Xl 100000	'
x0000001	^A	x0100001	!	x1000001	A	xl-100001	a
x0000010	^B	x0100010	‘‘	x1000010	B	x1100010	b
x000001 1	^C	x0100011	#	X100001 1	C	x1100011	c
x0000100	^D	x0100100	$	x1000100	D	x1100100	d
x0000101	^E	x0100101	%	x1000101	E	X1 100101	e
x00001 10	^F	x01001 10	&	x1000110	F	x1100110	f
x00001 11	^G	x0100111	'	x1000111	G	x1100111	g
x0001 000	^H	x0101000	(	x1001000	H	Xl 101000	h
x0001001	“I	x0101001	)	x1001001	I	x1101001	i
x0001010	^J	x0101010	*	x1001010	J	x1101010	j
x000101 1	^K	x0101011	+	x1001011	K	X1101011	k
x0001 100	^L	x0101 100	,	x1001100	L	x1101100	1
x0001 101	^M	x0101 101	-	x1001 101	M	x1101101	m
x0001110	^N	x0101110	.	x1001110	N	x1101110	n
x0001 111	“ 0	x0101111	/	x1001111	0	x1101111	0
x0010000	^P	X01 10000	0	x1010000	P	Xl 110000	p
x0010001	^Q	X01 10001	1	x1010001	Q	x1110001	q
x0010010	^R	X01 10010	2	x1010010	R	x1110010	r
x001001 1	^S	x0110011	3	x101001 1	S	x1110011	s
x0010100	^T	x0110100	4	x1010100	T	Xl 110100	t
x0010101	^U	X01 10101	5	x1010101	U	x1110101	u
x00101 10	^V	x0110110	6	x1010110	V	x1110110	v
x0010111	^W	x0110111	7	x1010111	W	x1110111	w
x0011000	^X	X01 11000	8	X1011000	X	x1111000	x
x0011001	^Y	x0111001	9	X101 1001	Y	X1111001	y
x0011010	^Z	x0111010	:	x1011010	Z	x1111010	z
x0011011	^[	x0111011	;	x1011011	[	x1111011	{
x0011100	^	x0111100	<	x1011100	\	x1111100	|
x0011 101	^]	x0111101	=	X101 1101	]	x1111101	}
x0011110	^^	x0111110	>	x1011110	^	x1111110	.
x0011111	^-	x0111111	?	X1011111		x1111111	delta

Displaying Register Contents as Text

The ASCII display shows the contents of registers as their ASCII character equivalents. This function is especially useful when used in conjunction with the user-defined operator message feature of the OIU.

If the registers from R00001 to RO0013 contained the binary values (X)1100001 through (X)1 111010, it would look like this on the ASCII display:

```
00010    t s   r q   p o       nm      lk   j i  h g  f e  d c  b a
00020  00000 00000 00000 00000 00000 00000 00000  z y  x w  v u
```

The lowest-numbered register appears at the right of the display, so the letters are not in normal sequence for reading.

The Text Display function reformats the entire screen. In Text Display format, the screen displays 16 registers on a line, beginning at the upper left. The registers shown above would now look like this:

```
00001     a b c d e f g h i j k l m n o p q r s t u v w x y z^@^@^@^@^@^@
00017    ^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@^@
```

In Text Display mode, the bottom of the screen displays these function key assignments:

```
                                                  DATA    EDIT   DISPLY
1      2      3      4            5            6DfSPLY 7 TEXT   8REF TB
```

Typing in New Text Characters

New characters can be typed in from the keyboard while the screen is in Text Display mode.

To enter a single character, place the cursor at the character to be replaced, and type in the new character.

To enter strings of characters:

1. Place the cursor at the position where you want the first character to appear.
2. Press the Edit Text (F7) key.
3. Type in the new characters.
4. When the entry is complete, press the End Edit (F7) key.
5. Press the Data Disply (F6) key if you want to return to the register data display.

Converting All Registers to Another Format

To convert all the registers to the same fomat:

1. With the register reference display on the screen, press the Change All (F7) key.
2. Next, press the key(s) for the display type you want:

Dec Disply (F1)	displays values in decimal fomat.
Signed Disply (F2)	displays values in signed decimal format
Hex Displg (F3)	displays values in hex fomat.
Dbprec Disply (F4)	displays values in double precision format.
ASCII Disply (F5)	**or** press the **Alt/A** keys, to display values as ASCII characters, right to left.
Text Disply (F6)	displays values as ASCII characters, left to tight.

SECTION 4
Combining Discretes and Registers in Displays - Mixed Reference Tables

As many as eight customized screens combining discrete and register values can be created. Each screen can have a different format. These formats are used only for the mixed reference displays. They do not affect discrete or register table printouts. This section explains:

- How to access a Mixed Reference display from the Supervisor menu or another reference table.
- How discrete and register values are combined on the screen.
- How to create customized displays that combine both discrete and register references.
- How to create a title for the Mixed Reference display screen.
- How to change or add a line to a Mixed Reference display.
- How to change the number base of a line in a Mixed Reference display.

Displaying a Mixed Reference Screen

Each Mixed Reference display has a screen number, from 1 to 8. To access an existing or unused Mixed Reference screen, follow these steps:

1. Type its screen number.
2. From the Supervisor menu, press the Disply Ref Tb (F3) key. Or, from one of the other reference tables, press the Disply Ref Tb (F8) key.

An example Mixed Reference display is shown below:

```
                                                                  LM:OFFLINE   11:19:39
      MIXED REFERENCES TABLE NO1     R00020 (NICKNAM) = 1111111111111111
      TITLE: REFERENCE DISPLAY FOR PRESS #1234
00064                    0124 01000100 10010010 01000010 00000010 00000000 +105
00128        32767   FFFF     00000000    12122  FE00    4545     12345    FE00 FE
I0064     00000000 10011001 00000000 00000000 00000000 00000000 00000000 101011

I1+0064   10000010 11010001 10101101 00001000 11101010                +13561 111010
O2+0064   10010100 10100101 00010000 10101010 11110100                +34681 101001
O1+0064   11010101 11111100 00000000 00000000 00000100                -41119   -402

00070     00000000 00000000 00000000 00000000 00000000 00000000 00000000 000000
00260     00000000  32767    FFFE   12212   12742   FFOE    4545     12423    FEE0  FF
00270        27395   FFFF  19287   23FF  27633   11128    33EE      455B  83849  547

10704     00000100 00110101 10101011 01010100 11101010 10101010 10101101 111010
I0128     00000000 00000100 00001000 11101001 11111101 11111000 00000010 001000
10512     00000000 00000000 00000000    45672    47129 00010001 11110101 111110

10192     11101011 10101010 00010000 00100100 00010100   t56217   t52729 011010
I0576     00011010 11010111 10101010 00000000 00000000 00000000 00000000 000001


   DEC     SIGNED   HEX    DBPREC          ASCII    TEXT   CHANGE  DISPLY
 1DISPLY 2DISPLY 3DISPLY 4DISPLY         5DISPLY 6DISPLY 7 ALL   8REF TB
```

Each line in a Mixed Reference display shows the values for one type of reference. It may be a line of ten register values, or a line of 64 I/O values. The left column shows reference addresses.

NOTE

Register lines do not have the prefix **R.**

Mixed Reference Display Function Keys

The function key assignments change, depending on the location of the cursor. If the cursor is on a line of register values, the function key assignments shown above will appear. If the cursor is on a line of discrete values, the following function key assignments are available:

```
  DEC    SIGNED   HEX    BINARY          OVRIDE  TOGGLE   PROG   DISPLY
1DISPLY 2DISPLY 3DISPLY 4DISPLY         5 REF   6STATUS  7 LINE  8REF TB
```

Creating a Title for a Mixed Reference Display

Each Mixed Reference screen can have a unique title, consisting of up to **60** characters. To create a title, follow these steps:

1. With the page displayed on the screen, move the cursor to the heading, "Title".
2. A reverse-video banner appears. Type in the title for the page, Use the ASCII keys. As you type, characters will appear from the right of the banner and move to the left. You can use space characters to position a short title where you want it to appear on the page.

   If you want to delete all the characters you have typed, press the Clear key while the banner cursor is displayed. If you want to delete only one character at a time, you can use the Delete key.
3. After typing the title, press the Down cursor key to move the cursor into the main area of the screen.

Changing or Adding a Line on a Mixed Reference Display

To change or add a line of discrete or register references, follow these steps:

1. Move the cursor to the line where you want the data to appear. It is not necessary to start at the top.
2. Enter a reference from the new line in the work area.
3. Press the Prog Line (F7) key. A line of 64 discrete or 10 register values appears. The reference on the right side of a discrete line is divisible by 64 with a remainder of 1. The reference on the right side of a register line has a final digit of 0 on the left and 1 on the right (unless it is the last line of the register display).
4. Continue to add or change lines as needed. Remember to move the cursor before making each new selection.

Register Displays on a Mixed Reference Screen

In a mixed reference display each line of register values begins with a five-digit reference address. The reference address is followed by ten values, which may be decimal, signed decimal, hexadecimal, double precision, or ASCII. Two example register lines are shown below:

```
00260  +0765563493  32767   FFFE  12212  12742   FF0E  4545  12423   FEE0  FFFF
00270        27395   FFFF  19207   23FF  27633  11128  33EE   455B  83049  5473
```

Discrete Displays on a Mixed Reference Screen

In a mixed reference display, each line of discrete values begins with letters that identify the I/O type, followed by the reference address. The reference address is followed by 64 values, which may be decimal, signed decimal, hexadecimal, or binary. Two example lines of discrete references are shown below:

```
10064    00000000 10011001 00000000 00000000 00000000  00000000 00000000 10101000
I1+0064 10000010 11010001 10101101 00001000 11101010             +13561 11101010
```

Changing the Format of a Line in a Mixed Reference Display

When a line of discrete references first appears, it is in binary format. When a line of register values appears, it is in decimal format. You can change the format of a reference by following these steps.

1. Move the cursor to the item whose format you want to change. The function key assignments for discrete or register display appear at the bottom of the screen.
2. Press the appropriate key(s) to change the format. More information on each of these formats appears earlier in this chapter.

Discrete:	Decimal (Decimal Display, F1)
	Signed Decimal (Signed Display, F2)
	Hexadecimal (Hexadecimal Display, F3)
	Binary (Binary Display, F4)
Register:	Decimal (Decimal Display, F1)
	Signed Decimal (Signed Display, F2)
	Hexadecimal (Hexadecimal Display, F3)
	Double Precision (Double Recision Display, F4)
	ASCII (ASCII Display, F5, or Alt/A)

SECTION 5
Making On-Line Changes to Reference Tables

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 override an input and output, removing it from program control.
- How to toggle the status of a contact or coil.
- How to change register and I/O values.

Information on changing the numeric base of the display for discrete and register references appears in sections 2 and 3.

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 Logicmaster memory, and whether on-line changes are enabled.

When the system is in On-Line or Monitor mode, information can be obtained from a connected CPU. This information includes I/O state, expanded table state, override state, and register content. To ensure an accurate display, be sure that the Logicmaster 5 system and the CPU programs are equal.

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, as the CPU status changes displays are updated.

When the system is in Off-Line mode, status is always obtained from internal memory. In the Off-Line mode, power flow is shown using the data from internal memory.

Changing Register Values

If the system is on-line and connected to the CPU, you can change the contents of CPU registers. If the system is off-line (not in Monitor mode), changes are loaded into Logicmaster memory.

A register value can be entered in decimal, signed decimal, hexadecimal, or double precision format. To change a register, follow these steps:

1. With the register table displayed on the screen, place the cursor on the register to be changed.
2. Using the numeric keypad, type in the value for the register. The entry appears in the work area.
3. When the entry is correct, press the Enter key to load the value into the register. The register will be updated with the value in the work area.

Using Overrides in the I/O Tables

Discrete references (Local I/O and Channeled I/O) can be overridden from the Display Reference function using the Override Reference (F5) or Toggle Status (F6) function key.

An override removes control of the reference from its normal source. Overridden inputs ignore information from the devices wired to the I/O structure, such as limit switches or pushbuttons. Similarly, overridden outputs ignore programmed logic and internal power flow. Non-relay (mnemonic) functions, such as Arithmetic functions and Move functions, still function when a coil is overridden.

Overrides are retained even when power is removed from the system. The ladder diagram logic cannot change overrides; however, non-relay (mnemonic) functions, such as Arithmetic functions and Move functions, can change the state of an overridden reference.

The Override is a very powerful tool for program checkout and for maintenance. You can test a program in a PLC that is not connected to an I/O structure by using overrides to simulate inputs. You can also check out a program when I/O is connected, by using overrides to prevent coil operation.

After the I/O system is wired up, it can be tested by activating each coil with an override to verify I/O communications, module addressing, module operation, power to a device, wiring to a device, indicator lights, fuses, and other hardware.

After the control system is thoroughly checked out and placed in operation, the override is very useful in a monitored system. If a sensor or input module should fail while the process is in operation, that input can be overridden. Thus, the process can be continued until it can be shut down safely.

Using Overrides

Overrides should be used on an operating system only with extreme care.

WARNING

Improper **use of the override can damage equipment or cause personal injury.**

To use an override:

1. Place the cursor on the reference to be overridden.

CAUTION

The reference will be overridden throughout the program, not just at the cursor location. Rungs which are not visible on the display may be affected by an override.

2. Press the Ovride Ref (F5) key. This key toggles the state of the reference between overridden and not overridden.

Forcing the Status of a Reference

In the Display Discrete References function, the Toggle Status (F6) key is used to toggle the status of a reference between ON and OFF. If the reference being forced is currently overridden, it retains its new status until the Toggle Reference key is pressed again. If the reference is not overridden, it retains its new status until changed by some other function, such as rung solution or I/O servicing.

To toggle a reference:

1. With the table displayed on the screen, place the cursor on the reference to be forced.
2. Press the Toggle Status (F6) key 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 Discrete Reference

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 register where the cursor is located. To do that, first you must change the number base of a word of the discrete reference table.

```
                                               References 0217 to 0232
0256  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

Follow the steps below to change the value of a discrete reference:

1. To enter data in the desired base, press one of the following keys from the numeric keypad. Or, you may also use the Ctrl key combination given in parentheses. This will automatically convert the display to the correct base:

A and R	for an Indirect Register. You must press the A key first and then the R key (or Ctrl/U).
I	for an Input (or Ctrl/I).
0	for an Output (or Ctrl/O).
R	for a Register (or Ctrl/R).
C	for a Constant (or Ctrl/C).

2. Using the numeric keypad keys, type in the reference.
3. Press the Enter key to change the reference table value at the cursor position to the new value.
4. Press the Binary Disply (F4) key to convert the register back to binary values.

The Print function can be used to print copies of ladder logic and annotation. You can print all of a program, or just part of it. The program currently in Logicmaster 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 printout, 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 Printout Content: Section **3** explains how to select the content of a printout. 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 printout 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 system must be in Off-Line mode and the printer 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 printout stops when the screen has been printed. To stop the printout sooner, press any other key.

NOTE

> Before pressing the Alt/P keys to initiate a Print Screen function, you must be in Off-Line mode. If you attempt to initiate this function in Monitor or On-Line mode, the following message will be displayed on the screen: **"PRINT SCREEN** REQUEST DENIED".

SECTION 1
Print Menu

This section describes the use of the Print menu.

Displaying the Print Menu

When the Print Func (F5) key is pressed from the Supervisor menu, the Print Hard Copy menu appears:

```
                                         LM:OFFLINE   11:19:39


              P R I N T   B A R D   C O P Y   M E N U


      KEY #                                        FUNCTION

      F1 -   PRINT OUT. . . . . . . . . . . . .Print to Disk or Printer
      F2 -   PRINT PROGRAM. . . . . . . . Background Print to Printer
      F5 -   DEFINE PRINTR. . . . . . . . . Define Printer Parameters
      F6 -   DEFINE OUTPUT. . . . . . . . . .Define Print-Out Content
      F8 -   SUPERV MENU. . . . . . . . . .  Return to Supervisor Menu






  PRINT   PRINT                      DEFINE  DEFINE         SUPERV
1  OUT  2 PROG  3       4          5PRINTR 6OUTPUT 7       8 MENU
```

Print Menu Function Key Summary

The Print menu displays the following function keys:

Print Out (F1): Select Print ***Out*** to send the program to either a printer or a diskette. The Print Out function is done in foreground mode. Use this function to store a program on a diskette for printing with the Print Background function.

Print Prog (F2): Select Print ***Program*** 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 out.

Define Printr (F5): Select Define ***Printer*** to specify the print format to be used with the printer.

Define Output (F6): Select Define ***Output*** to specify the content of printouts. For example, with annotation or with cross-references.

Superv Menu (F8): Select ***Supervisor Menu*** to return to the Logicmaster Supervisor Menu screen.

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. The parallel printer will be port 3. This corresponds to DOS device LPT1.
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, press the Print Func (F5) key. Press the Print Prog (F2) key to set up background printing.

   B. Enter the number of the destination port. For the Workmaster industrial 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. Serial ports 1 and 2 correspond to DOS devices COM1 and COM2, respectively.

NOTE

A port currently selected for communications cannot be used for other Logicmaster 5 functions. In order to use port 1 for printing, you would first have to deselect it from communications. This can be done in the Communications Setup menu by blanking out the work area and then pressing the Select Ports (F3) key (see section 2 of chapter 10).

3. In the Supervisor menu, press the Utilty Func (F8) key.

   A. From the Utilities menu, press the Port Setup (F6) key. Enter the parameters for the port (1 or 2) which correspond to those set up for the printer.

   B. Press the Setup Port (F1) key 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, press the Print Func (F5) key. Press the Print Prog (F2) key to set up background printing.

   B. Enter the number of the destination port. For the Workmaster industrial computer, this is port 1 or 2.

NOTE

Do not disconnect the printer cable while printing. When the cable is reconnected, the printout 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 the Define Printr (F5) key from the Print menu. The Define Printer parameters screen will appear

```
                                                  LM:OFFLINE   11:19:39


          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)

    FORMFEED         Y (Y/N)

               << PRESS F5 TO SAVE PARAMETERS TO DISK >>




  PRINT   PRINT                        SAVE   DEFINE          PRINT
1  OUT  2 PROG  3        4           5 FILE  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 (and then return to the default parameters), press the Print Menu (F8) key to exit.

   B. To. save the printer parameters until this screen is changed again, press the Save File (F5) key 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 5 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 8 -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:

```
   RUNG 1

--|    Start of Program I--

                                     Cross-reference for 00539
                                     | |  1,  2,  5

                                     |/|     3
                                     MNE    (4)

 I0058   00100   10193   10017                                   00539
--| |-----| |--+--|/|--+--| |--+------------------------------------(  )
             2 |        |      |
 10081  00100  |        | 00539 |
-- || -----|/|--+       +--| |--+
             2
```

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 is spread over 132 characters instead of 80.

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. 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 (no) 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/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.
3. 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 Printout Content

When a printout is done through the Print menu, you can select which parts of the program, tables, or annotation to print. Otherwise, the printout will have the default content (shown below). This section explains:

- How to change the printout 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 printout.
- How long it may take to complete various types of printouts.

Displaying the Define Printout Content Screen

The first step in defining the content of the printout is to display the Define Printout 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 the Define Output (F6) key. The Define Printout Content screen appears. If a program name was not entered, the annotation choices default to No (N) and you will not be. allowed to change this to Yes.

The illustration below shows the Define Printout Content screen:

```
                                                      LM:OFFLINE   11:19:39

          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 5999
TEXT ANNOTATION:              STARTING  PAGE  NUMBER:     0001
   RUNG  EXPLANATIONS   Y
   COIL LABELS          Y     ADDRESS  RANGE:   FROM           TO
   NAMES                Y                       I  0001       I  1024
   NICKNAMES            Y                       0  0001       0  1024
   SORTED NICKNAMES     N                       I1+ 0001      I1+ 1024
CROSS REFERENCE:                                O1+ 0001      O1+ 1024
   IN LADDER            N                       I1- 0001      I1-  512
   XREF TABLE           Y                       O1- 0001      O1- 1024
   IMPLICIT XREF        N                       R  0001       R  4096
   VALUE TABLE          N
   USE TABLE            Y
HEADER PAGE             Y



  PRINT   PRINT                     DEFINE                    PRINT
1  OUT  2 PROG  3       4          5PRINTR  6        7       8 MENU
```

Changing the Entries on the Printout Content Screen

To change entries on the Printout 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 printout, 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 printout time.
3. When the entries are complete, press the Print Menu (F8) key. The Print menu reappears. If the printer parameters have been established, the content can be printed using the Print function.

Defining Printout Content Screen: Definitions

Refer to the following definitions when making entries on the Printout 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 printout, 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 does not appear 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.

Ladder Diagram (Y/N): Select whether or not the printout 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 printout shows the number of the last rung where the scan encountered that reference as a coil.

```
|
|                                  | |ss-reference  for  00539
|                                  |/| / 1, 3 2,  5
|                                  MNE
|                                            (4)
|
| 10058   00100    10193   10017                                       00539
+-- II -----|  |--+--|/|--+--|  |--+----------------------------------(   )
|              2  |       |        |
| 10081   00100   |       | 00539  |
+--|  |-----|/|--+        +--|  |--+
               2                1
|
```

In the ladder, constants are printed with their decimal values.

```
|
| I0021   O0539                                                        Const      O0100
+--| |-----| |--+-----------------------------------------------------| SKIP |----( )
|               1                                                       015
```

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.

Print Limits: Enter the rung in the program where **you** want the ladder diagram printout to begin, and to end. Include **any** leading zeros. 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 printout 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 printout 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. To change the default selections, enter Y or N.

The illustration below shows the basic format for an 80-column printout with annotation. A 132-column printout is the same, except that the coil label and in-ladder cross-references, if printed, appear to the right of the ladder diagram.

a40050

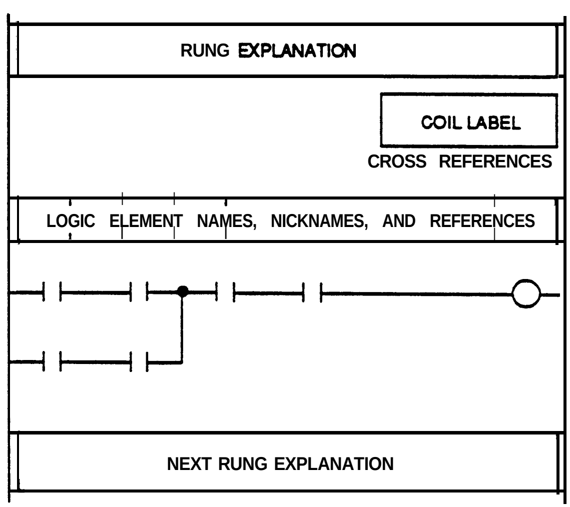


Figure 8-1. SO-Column Printout

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 printout).

When selecting the annotation options, the corresponding .EXP and .NAM files must be present on the selected diskette.

Sorted Nicknames: Select whether to print a list of all the nicknames used in the program, sorted alphabetically. If the selection for names is Y, then the names will also be printed.

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 printout 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:

```
|
|                               Cross-reference for 00539
|                               | |     1, 2, 5
|                               |/|     3
|                               MNE     (4)
|
| I0058    00100    10193    10017                                  00539
+--| |----- II --+--|/|--+--| |--+-----------------------------------------( )
|            2
|
```

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.

Xref Table: Select whether to print at the end of the ladder diagram a listing of all the references that appeared in the printout. Note that printing cross-reference tables takes a considerable amount of time.

1. **Discrete References Cross-Reference Printouts: This** listing groups discrete references into normally-open contacts, normally-closed contacts, various types of coils, and non-relay (MNE-monk) functions. The left column of the discrete references printout lists the references in ascending numerical order. Under the reference, the override status of that reference may be displayed. To the right, all occurrences of that reference in the program are listed by rung number. For example:

```
          *****  I N P U T   S T A T U S   T A B L E   *****

INPUT/             CROSS REFERENCES
(OVR)

11004        :     | | 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 27
                    28, 29, 30, 31, 32, 33, 34, 35, 36
                   MNE 88, 92, (199), 204, (286)

10013              |/| 13

[A 10100      :    |/|  14
[Ovr On]

10101        :     | | 108

10605        :     | | 114
[Ovr Off]          MNE 100, 101, 101, (102), 105, (150), 200

      ( ) = implicit references
      MNE = mnemonic references
```

2. **Register Cross-Reference Printouts:** Register cross-reference printouts list the references on the left side. Under each reference, its value appears 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 V S   T A B L E   *****

REGISTER/          CROSS REFERENCES
VALUE

R00004       :        11, 112, (117), 143, 186, 192, 193, 195, 199, 200
[00886]               229, 229, 229, 230, 32, (337), 433, 535, 647

R00013       :        13
[+01023]

R00100       .       147
[-00008]

R00102       :       140
[D.P.]

       ( ) = implicit references
```

Implicit Xref: Select whether the printout will also include implicit references (for example, references included in tables, matrices, convert functions, and similar multiple-reference functions). Rungs that include only implicit references are enclosed in parentheses, as shown in the example printout above.

The maximum number of implicit references that will be printed out for one reference is 1000.

Value Table: Select whether to print the values of all references at the end of the ladder diagram. Reference printouts have the format set up with the Display Reference Tables function.

Discrete references are printed as individual pages of each type of reference (Local I/O or Channeled I/O). The override status of inputs and outputs is also printed as individual pages. The partial example below shows discrete references printed out in binary format.

```
          *****  I N P U T   V A L U E   T A B L E   *****

INPUT    |64      |48      I 40     |32      124      |16      |8       |1
ADDRESS  +-------- +-------- +-------- +-------- +-------- +-------- +--------+

 0064    01101011 11001011 10010100 11011010 11110000 00001000 00110100
 0128    01010101 00100100 11101011 01010101 10100101 10101001 10101100
 0192    11110100 00100100 00000000 01001000 11111010 11010001 10100010
 0256    10100110 10100101 10100100 10101000 10101011 11001011 10101000

 0320    10101010 10100110 10100101 10101001 11100111 10100101 10100110
 0384    10101100 10010101 10010101 10010101 10010101 10010000 00100100
```

The next partial printout 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          |10  |9  |8  |7     |6     |5     |4     |3     |2     |1   |
ADDRESS  +------ +---- +---- +------ +------ +------ +------ +------ +------ +----+

00010 +00003 -00345 +00000 +23233 +00000 +00000   11D6 +00000 +00000 +01233
00020    +0023566777 +00000 +00000 +00000 +00000 +00000 +00000 +00000 +01001
00030 +ooooo +ooooo   01C8 +00000 +00000 +00000 +00000 +00000 +00000 +00000
00040 +00000 23446 +00000 +00000 +00000 +00000 +00000 +00000 +00000 +00000
```

Use Tables: The References Use tables show how references are used in a program. This is a partial example:

```
              *****   O U T P U T   U S E D   T A B L E   *****

OUTPUT  |64      |56      |48      |40      |32      |24      |16      |8
ADDRESS +------- +------- +------- +------- +------- +------- +------- +----

 0064   **---*** **--*--- -------- -------- -----*** ***-**-- -------- -----
 0128   -------- -------- -------* **-*---- -------- -------- -------- --***
 0192   -------- -------- -------- -------- -------- -------- -------- -----
 0256   **--*--- ----**** -------- ---***** *******- -------* ****-*-- -----
```

The following symbols may appear in the Reference Use tables:

+   The reference is used as an implicit reference.

*   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.

Address Range: Printouts 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 printout. The header page has the title and subtitle entered on the Define Printout Contents page. It displays information about the program. For example:

```
**************************************************************************
*                                                                        *
*                                          LAST REFERENCE USED:          *
*                                          --------------------          *
*                   CPU ID:         1             REGISTER:    R16384    *
*          CPU  MEMORY  SIZE:     16384              INPUT:     I0001    *
*      PROGRAM MEMORY SIZE:     16384             OUTPUT:     00333    *
*     REGISTER MEMORY SIZE:     16384    EXP STATE INPUT:    I2+0032    *
*                                                 OUTPUT:    O2+1020    *
*                                        EXP STATUS INPUT:   I1-0120    *
*                                                 OUTPUT:    02-1001    *
*                                                                        *
**************************************************************************
```

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 appear.

SECTION 4
Printing in Foreground Mode

Use the Print function to print out or store as a print file, the program currently in Logicmaster 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 printout 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 the Print Out (F1) key from the Print menu. The Print to Disk or Printer screen appears:

```
                                          LM:OFFLINE   11:19:39

              P R I N T   T O   D I S K   O R   P R I N T E R

                   PRINTER PORT/DRIVE ID   _   (3/A,B)
                   FILE NAME

              << PRESS ENTER TO START THE PRINT FUNCTION >>




           PRINT                        DEFINE  DEFINE           PRINT
  1      2 PROC   3     4             5PRINTR 6OUTPUT 7        8 MENU
```

Printing in Foreground Mode

To send the print output directly to the 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 printout:

   A. Enter the number 3 if the printer is connected to the parallel port. This corresponds to DOS device LPT1.

   B. Enter the number 1 or 2 if the printer is connected to a serial port, depending on the number of the serial port. Ports 1 and 2 correspond to DOS devices COM1 and COM2, respectively.

NOTE

A port currently selected for communications cannot be used for other Logicmaster 5 functions. In order to use port 1 for printing, you would first have to &select it from communications. This can be done in the Communications Setup menu by blanking out the work area and then pressing the Select Ports (F3) key (see section 2 of chapter 10).

3. Press the Enter key to start the printout. The screen continues to display the Print to Disk or Printer screen until the printout 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 "File Name" and enter the name for the printout.

   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 .TXl. 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 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 Printout Temporarily

To stop a printout temporarily (for example, to change the printer ribbon), press the Pause Print (F4) key. To resume the printout at the place it was stopped, press the F4 function key again.

Canceling a Printout

To end a printout in progress, press the Abort Print (F3) key. This requires a confirmation. When confirmed, it cancels the printout completely. Aborting a printout stops the printing only. It does not delete the print files that were created. Print files must be deleted using the Utilities function.

While waiting for confirmation, the printout continues. Pressing any key except Confirm 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 can 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 printout 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 printout 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, select the Print Prog (F2) key from the Print Hard Copy menu. The Print Program screen appears:

```
                                              LM:OFFLINE 11:19:39


                               P R I N T   P R O G R A M

                            DESTINATION:
                                  PRINTER PORT _  (2,3)

                            SOURCE:
                                  DRIVE ID      B  (A,B)
                                  FILE NAME


                    << PRESS ENTER TO START BACKGROUND PRINT FUNCTION >>



      PRINT                                     DEFINE  DEFINE         PRINT
    1  OUT  2       3       4                  5PRINTR 6OUTPUT 7      8 MENU
```

Entering the Destination and File 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 printout:
   A. Enter the number 3 if the printer is connected to the parallel port. This corresponds to DOS device LPT1.
   B. Enter the number 1 or 2 if the printer is connected to a serial port, depending on the serial port. Ports 1 and 2 correspond to DOS devices COM1 and COM2, respectively.
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 "File 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 the Enter key to start the printout. The screen displays the message:

```
BACKGROUND PRINT IN PROGRESS
```

6. Press the Print Menu (F8) key to return to the Print menu.

Stopping a Printout

To end a printout in progress, press the Abort Print (F3) key. This requires a confirmation. When confirmed, it terminates the printout completely. While waiting for confirmation, the printout continues. If the Confirm key is not pressed, the printout will continue.

Chapter 9
Load/Store/Verify

The Load/Store/Verify function is used to:

- Transfer programs and tables to and from Logicmaster memory (RAM).
- Transfer configuration data to and from the CPU.
- Compare the data in memory with the stored data.
- Clear Logicmaster memory.

In Off-Line mode, the user program, scratch pad, registers, and I/O tables are transferred to and from the CPU. However, the CPU must be stopped before you can store to the CPU.

In On-Line mode, *only the* user program is transferred to and from the CPU. In Monitor mode, only the user program can be transferred *from* the CPU. Nothing may be stored *to the* CPU in Monitor mode.

For information about using the bad/Store/Verify function, 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 Data into Logicmaster Memory: Section **2** explains how to load Logicmaster memory with a program and its associated tables. The program may be loaded from the CPU, or from a drive.

Section 3. Storing Data from Logicmaster Memory: Section 3 explains how to transfer a program and its associated tables from Logicmaster memory to the CPU, or to a drive.

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 Logicmaster Memory: Section 5 explains how to delete any program and tables currently present in Logicmaster memory.

Section 6. **Loading CPU Configuration Data:** Section **6** explains how to transfer the configuration data from the CPU to a named file.

Section 7. Storing CPU Configuration Data: Section 7 explains how to transfer the configuration data from a specified file to the CPU.

NOTE

If the CPU is locked, data cannot be transferred to or from the CPU.

SECTION 1
Load/Store/Verify Menu

This section describes the use of the Load/Store/Verify menu.

Displaying the Load/Store/Verify Menu

When the L/S/V Func (F6) key is pressed from the Supervisor menu, the Load/Store/Verify menu appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1    LM NOTEQ CPU     LM:ONLINE    11:19:39

   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 LM Memory
        F2 - STORE.     ..... .Store Program/Tables from the LM Memory
        F3 - VERIFY...   .. Verify Program/Tables with the LM Memory
        F4 - CLEAR.     ...............Clear  the  LM     Memory
        F5 - CONFIG TO DSK. Load Configuration from CPU, Store to Disk
        F6 - CONFIG TO CPU. Load Configuration from Disk, Store to CPU
        F8 - SUPERV MENU. . . . . . . . . . .Return to Supervisor Menu




  LOAD    STORE VERIFY   CLEAR       CONFIG  CONFIG          SUPERV
1 FUNC  2 FUNC  3 FUNC  4 FUNC      5TO DSX 6TO CPU 7       8 MENU
```

Load/Store/Verify Menu Function Key Summary

The Load/Store/Verify menu displays the following function keys:

Load Func (F1): Select *Load* Function to copy the program, and the register and I/O tables into Logicmaster memory (RAM). This writes over any program or data already in Logicmaster memory.

Store Func (F2): Select *Store Function* to copy program and table data from Logicmaster memory to a drive, or to the CPU.

Verify Func (F3): Select *Verify Function* to compare data in Logicmaster memory with data in the CPU memory, or on a disk drive. **A** listing of differences can be printed out.

Clear Func (F4): Select *Clear Function* to remove the program, register, and I/O tables from Logicmaster memory (for example, after storing it on diskettes).

Config to Disk (F5): Select *Configuration to Disk* to transfer the configuration data from the CPU to a named file.

Config to CPU (F6): Select *Configuration to* CPU to transfer the configuration data from a specified file to the CPU.

Superv Menu (F8): **Select** *Supervisor Menu* to return to the Logicmaster Supervisor Menu screen.

SECTION 2
Loading Data into Logicmaster Memory

Use the Load function to copy a program and its associated tables into Logicmaster memory from disk, or from the CPU. The Load function copies the program, which remains unaltered in its original location.

This section explains:

- How to display the Load Program screen.
- How to load a program into Logicmaster memory from a drive.
- How to load a program into Logicmaster memory from a CPU.

Displaying the Load Program Screen

When you press the Load Func (F1) key, the Load Program screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LM NOTEQ CPU     LM:ONLINE   11:19:39


   L O A D   P R O G R A M / T A B L E S   I N T O   L M   M E M O R Y
                 DRIVE ID / CPU   P (A,B/P)        P = CPU
                 FILE NAME






              << PRESS SHIFT ENTER TO START LOAD FUNCTION >>


          STORE   VERIFY  CLEAR      CONFIG CONE'16          L/S/V
1       2 FVNC  3 FUNC  4 FUNC      5TO DSK 6T0 CPU 7       8 FUNC
```

CAUTION

Copying a program into Logicmaster 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 to the System from a Disk

To copy the program into Logicmaster memory from a disk, follow these steps:

1. With the cursor at "Drive ID/CPU," enter the character that represents the disk drive where the program is stored.
2. Move the cursor to "File Name" and enter the name of the program.

NOTE

The File Name field must be left blank, unless a disk drive is specified.

3. Press the Enter key to begin copying the program into Logicmaster memory. The screen displays the word "BUSY" during the transfer. If the system finds any fault or inconsistency in the data, the Load operation will be terminated and an error message will appear. While the program is loading, the screen displays the message:

   PROGRAM NAME : LOAD IN PROGRESS

   After a successful LOAD, the screen will display this message:

   PROGRAM NAME : LOAD COMPLETE

Loading a Program to the System from the CPU

Use the Load function to copy a program from the CPU into Logicmaster memory. (The CPU must be unlocked.)

If the Logicmaster system is in Off-Line mode, the entire program including the ladder logic and tables, is copied into Logicmaster 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. (This letter represents the CPU.)
2. Press the Enter key to begin copying the program into Logicmaster memory. The screen displays the word "BUSY" during the transfer. If the system finds any fault or inconsistency in the data, the Load operation will be terminated and an error message will appear. While the program is loading, the screen displays this message:

   PROGRAM NAME : LOAD IN PROGRESS

   The program name is the title of the program stored in the CPU. You may want to make the program name the same as the corresponding disk file.

   After a successful Load operation is completed, the screen will display this message:

   PROGRAM NAME : LOAD COMPLETE

Canceling the Load Function

To stop a program transfer in progress, press either the Abort key or the F4 (Abort) function key.

SECTION 3
Storing Data from Logicmaster* Memory

Use the Store function to copy a program and its associated tables currently in Logicmaster 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 to the CPU.

Displaying the Store Program Screen

When you press the Store Func (F2) key from one of *the* Load/Store/Verify screens, -the Store Program/Tables screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LMNOTEQ  CPU     LM:ONLINE   11:19:39


   S T O R E   P R O G R A M / T A B L E S   F R O M   L M   M E M O R Y
               DRIVE ID / CPU P  (A,B/P)         P = CPU
               FILE NAME
               PROGRAM NAME
             SERIES 5 TABLE MEMORIES WILL BE OVERWRITTEN




              << PRESS SHIFT ENTER TO START STORE FUNCTION >>


  LOAD          VERIFY   CLEAR      CONFIG  CONFIG   CLEAR   L/S/V
 1 FUNC  2     3 FUNC  4 FUNC     5TO DSK 6TO CPU 7 BUSY  8  FUNC
```

Storing a Program to a Drive

When storing to a disk file, the system will search for the specified file. If the file is found, its contents will be replaced with the new data If the file is *not* found, a new file will be created to contain the data.

To copy the program in Logicmaster 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 "File Name" and enter the name of the file. This is the name which will be used to identify *the* program on the disk.

3. A program name may also be specified.

CAUTION

If a program with the same name is already stored on the disk, the new data will overwrite it.

4. **Press the** Enter key to begin copying the program.

Storing a Program to the CPU

The Series Five CPU contains a compiler program which takes the relay ladder logic and converts it into executable code. The execution of the program is divided between a custom gate array, which is optimized for fast execution of relay and math functions, and a 16-bit microprocessor. This results in efficient, high-speed program execution. Another benefit is the ability to download a new program while the CPU continues to execute the original program.

If the CPU is locked or the memory cartridge is write-protected, the program cannot be copied into the CPU. When a program is loaded into the CPU, the source code is stored in a buffer area in the memory cartridge. Once the new program is stored in the buffer, you activate the compiler. The scan is interrupted for a short time to allow the compiler to load the new program into the execution area of the memory cartridge, and then resumes execution with the new program.

In order to store to a CPU, the memory cartridge in the CPU must contain RAM or **EEPROM** memory that may be written over. The memory protect jumper on this memory cartridge must be in the Write Unprotected position (factory default setting).

1. With the cursor at "Drive ID/CPU," enter the letter P. (This letter 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 overwrite it and the original program in the CPU will be lost,

2. Press the Enter key to begin copying the program. This is a 2-step process. The program is first **written** into a source buffer, where the system checks the size and functions used by the program. If the program is compatible with the CPU, the following message will be displayed:

   << PRESS CONFIRM KEY TO COMPILE >>

   NOTE

   You should continue with the compile so that the source buffer is equal to the executing program. **However, if you decide** to abort, the source buffer and executing program will *not* be the same. When the Logicmaster system is connected to this **CPU, the status** line will reflect a "not equal" status. **You** cannot upload a program from the **CPU to the** Logicmaster system unless the source and object code in the Series Five **CPU are** equal. **You** should always complete the compile portion of the Store operation.

3. Press the Shift/Confirm keys to invoke the compiler. If the CPU is in Run mode, the I/O update will be suspended while the compilation is in progress; and the following message will be displayed:

   I/O UPDATES WILL BE SUSPENDED FOR 1 -10 SEC

4. When this process is complete, the following message will be displayed:

```
[program name] :STORE COMPLETE
```

If there is an error in the compilation and the CPU remains in a compiler busy state, you must press the Clear Busy **(F7)** key to clear the compiler busy status.

Canceling the Store Function

To stop a program transfer in progress, press the Abort function key. If the screen displays a "TRANSLATOR BUSY" message, you must press the F4 key to clear the CPU Program Transfer function.

If the Store function is aborted, the program which the CPU executes is not the same as the partially stored program. For this reason, the Load from CPU function will not be allowed; and the status line will show the "LM NOTEQ CPU" message until a program is successfully stored from the Logicmaster 5 system to the CPU.

SECTION 4
Verifying the Content of Program Data

The Verify function compares versions of a program after a Load or Store operation by comparing the version in the Logicmaster system with the version in the CPU, or in storage. Any differences, called *''miscompares''*, are displayed and can be printed out.

If the verification is with a scanning CPU, dynamic data such as Scratch Pad, timer and counter registers, override table and I/O states can be omitted from the verification.

NOTE

The top registers in the CPU (R4000-R4096) are reserved for CPU functions and status. These registers cannot be used for register storage and will not be included in the Verify function.

This section explains:

- How to display the Verify Program screen.
- How to select the types of program data to be compared.
- What the results of the comparison mean.

Displaying the Verify Program Menu

When vou press the Verify Func (F3) key, the Verify Program screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LM NOTEQ CPU     LM:ONLINE    11:19:39

   V E R I F Y   P R O G R A M / T A B L E S   W I T H   L M   M E M O R Y

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

                  FILE NAME

                  PRINTER PORT           (2, 3)
                           - MEMORY SELECTION -
        SCRATCH PAD   REGISTERS   OVERRIDES   LOCAL f/O   CHANNEL I/O




                 << PRESS ENTER TO START VERIFY OPERATION >>


  LOAD     STORE  XCLUDE  XCLUDE      XCLUDE  XCLUDE  XCLUDE   L/S/V
1 FUNC   2 FUNC  3SCRPAD 4REGSTR     5OVRIDE 6 LOCAL 7CHANNL 8 FUNC
```

NOTE

The Verify function compares relative memory locations. If one version of the program has an additional element, all memory locations from that point on may miscompare.

Verifying Program Data

To compare the program in Logicmaster memory with the version in the CPU, or in storage:

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 "File 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. For the serial ports, you must enter a 1 or 2; for the parallel port, enter a 3. Be sure that the printer is on-line and connected to the system.

   NOTE

   This field must be left blank, unless a printer is connected to the selected port.

4. To exclude tables from the comparison:

   A. Press the Xclude Scrpad (F3) key to exclude the contents of the Scratch Pad memory. The function of this key then becomes Verify Scratch Pad.

   B. Press the Xclude Regstr (F4) key to exclude the contents of the Registers. The function of this key then becomes Verify Registers.

   C. Press the Xclude Ovride (F5) key to exclude the Overrides. The function of this key then becomes Verify Overrides.

   D. Press the Xclude Local (F6) key to exclude the contents of Local I/O status tables. The function of this key then becomes Verify Local.

   E. Press the Xclude Channl (F7) key to exclude the contents of Channeled I/O tables. The function of this key then becomes Verify Channel.

5. Press the Enter key to begin the Verify operation. While the comparison is underway, the screen displays the "BUSY" message. Also, two key functions, Pause Verify (F6) and Abort Verify (F7), appear.
6. To temporarily halt the Verify operation, press the Pause/Verify (F6) key. To resume the verification, press the F6 key again.
7. To end a verification before it is finished, press the Abort Verify (F7) key. Respond to the prompt to confirm the abort. This ends the function completely.
8. Any miscompares encountered are listed on the screen, in two columns on five lines. 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.
```

Miscompares found in the I/O Status Table will be displayed on a byte boundary. For example: If 10003 miscompares, it will be listed as 10001. If more than 1 bit within a boundary (I3 and 14) miscompares, it will only be listed once, as 10001.

Miscompare Screen: Defmitions

Each miscompare displays the memory type where the miscompare occurs; and gives the corresponding values in the program, and in the CPU or storage. These items are abbreviated as shown in the following table:

Table 9-1. Types of Memory

ABBREVIATION	DEFINITION
SP	Scratch pad memory
OVR	Override memory
0	Output Status table
I	Input Status table
IS	Instruction set
R	Storage registers
PRG	Ladder program
LM	Logic memory (size in K)
RM	Register memory (size in K)
ID	ID of the CPU

SECTION 5
Clearing Logicmaster Memory

Use the Clear function to delete a program and its associated tables from Logicmaster memory. This is usually done after 'storing the program to a drive, or to the CPU. If the Logicmaster system is in Off-Line mode, the Clear function will also set the Scratch Pad display to its default values.

When the Clear Func (F4) key is pressed from the Load/Store/Verify menu, the Clear Memory screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LM NOTEQ CPU     LM:ONLINE   11:19:39

                C L E A R   L O G I C M A S T E R   M E M O R Y



                << PRESS ENTER TO CLEAR LOGICMASTER MEMORY >>





  LOAD    STORE  VERIFY              CONFIG  CONFIG           L/S/V
1 FUNC  2 FUNC  3 FUNC  4           5TO DSK 6TO CPU 7       8 FUNC
```

Press the Enter key to delete the entire program from Logicmaster memory. When the Clear operation is complete, the following message will be displayed at the bottom of the screen:

CLEAR COMPLETE

SECTION 6
Loading CPU Configuration Data

Use the Load CPU Configuration function to transfer configuration data from the CPU into a named file. The file name may be any "DOS" file name. The following tables are loaded: Genius Setup table, I/O configuration and assignment tables, and watchdog timer.. This section explains:

- How to display the Load CPU Configuration from CPU screen.
- How to transfer the configuration data into a named file from the CPU.

Displaying the Load CPU Configuration Screen

When you press the Config to Dsk (F5) key, the Load CPU Configuration from CPU screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LM NOTEQ CPU     LM:ONLINE   11:19:39

       L O A D   C P U   C O N F I G U R A T I O N   F R O M   C P U
                 DRIVE ID             B    (A,B)
                 FILE NAME

              << SAVE CPU CONFIGURATION DATA IN SPECIFIED FILE >>



                 << PRESS SHIFT ENTER TO START LOAD FUNCTION >>

  LOAD    STORE  VERIFY   CLEAR              CONFIG          L/S/V
1 FUNC  2 FUNC  3 FUNC  4 FUNC      5       6TO CPU 7       8 FUNC
```

CAUTION

Transfering configuration data into a named file will overwrite anv configuration data already stored there. You may wish to use a different file name each time you transfer configuration data from the CPU.

Loading Configuration Data from the CPU

To transfer configuration data from the CPU into a named file, the CPU must be in Stop mode and the Logicmaster system must be on-line.

1. With the cursor at “Drive ID,” enter the letter that represents the disk drive where the file is to be stored.
2. Move the cursor to “File Name” and enter the name of the file.
3. Press the Enter key to begin loading the CPU configuration data into the named file. The screen displays the word “BUSY” during the transfer. If the system finds any fault or inconsistency in the data, the Load operation is terminated and an error message appears. After a successful Load operation is completed, the screen will display this message:

```
COMPLETED  SUCCESSFULLY
```

SECTION 7
Storing CPU Configuration Data

The Store CPU Configuration function allows you to store the I/O assignment and configuration tables to the CPU and update the CPU to use this new assignment. This means that it will not be necessary to manually set up the operating parameters for each CPU if the configuration has already been done once and saved to diskette.

Error checking will also be performed by the CPU. If errors are found, the appropriate messages will be displayed on the screen.

This section explains:

- How to display the Store CPU Configuration screen.
- How to store configuration data to the CPU from a specified file.

Displaying the Store CPU Configuration Screen

When you press the Config to CPU (F6) key, the Store CPU Configuration to CPU screen appears:

```
CPU:RUN/ENBL/UNLOCK     CPU ID: 1   LMNOTEQ  CPU     LM:ONLINE   11:19:39

        S T O R E   C P U   C O N F I G U R A T I O N   T O   C P U
                 DRIVE ID              B   (A,B)
                 FILE NAME

       << RESTORE CPU CONFIGURATION DATA TO CPU FROM SPECIFIED FILE >>



              << PRESS SHIFT ENTER TO START STORE FUNCTION >>

  LOAD    STORE   VERIFY  CLEAR     CONFIG                  L/S/V
1 FUNC  2 FUNC  3 FUNC  4 FUNC    5TO DSK 6       7       8 FUNC
```

Storing Configuration Data to a Disk File

To transfer configuration data to the CPU from a specified file, the CPU must be in Stop mode and the Logicmaster system must be on-line.

1. With the cursor at "Drive ID," enter the letter that represents the disk drive where the file is located.

CAUTION

The CPU can only contain one configuration file at a time. If a config file is already stored in the CPU, the new data will overwrite it and the original data in the CPU will be lost.

2. Move the cursor to "File Name" and enter the name of the file.
3. Press the Enter key to begin copying the configuration data to the CPU. The screen displays the word "BUSY" during the transfer. If the system finds any fault or inconsistency in the data, the Store operation is terminated and an error message appears. After a successful Store operation is completed, the screen will display this message:

```
COMPLETED  SUCCESSFULLY
```

Chapter 10

Setup/Diagnostic Functions

The Setup and Diagnostic functions are used to specify parameters for communications, lock/unlock the CPU and, when used, change the password, select the display colors for a color monitor, and assign I/O module addresses.

This chapter contains the following sections:

Section 1. Setup/Diagnostic Functions Menu: Section 1 explains the Setup/Diagnostic Functions 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 for locking or unlocking the CPU and changing the password.

Section 4. Genius Faults: Section 4 explains the Genius I/O Faults screen, and how to display and clear this diagnostic information.

Section 5. Machine Setup Menu: Section 5 provides instructions to select display colors if you are programming on a computer with a color monitor.

Section 6. Genius Bus Controller Setup: Section 6 provides instructions for editing the Genius Bus Controller setup values.

Section 7. I/O Address Assignment: Section 7 explains I/O addressing and how to load or store these address assignments.

Section 8. I/O Bus Setup: Section 8 explains how to establish the parity retry and identify non-critical bases.

Section 9. Special Purpose Contacts and Registers: Section 9 identifies special purpose contacts and registers, which are reserved for special functions.

SECTION 1
Setup/Diagnostic Functions Menu

This section explains the Setup/Diagnostic Functions menu.

Displaying the Setup/Diagnostic Functions Menu

When the Setup & Diag (F7) key is pressed from the Supervisor menu, the Setup/Diagnostic Functions screen will appear:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE    11:19:39

                          L O G I C M A S T E R (TM)

           S E T U P   /   D I A G N O S T I C   F U N C T I O N S

         KEY #                                                   FUNCTION

         F1 -    COMM & PSWORD . . . . . Communication and Password Setup
         F2 -    GENIUS FAULTS . . . . . . . . .Genius I/O Faults Display
         F4 -    MSD FUNC . . . . . . . Display/Modify Machine Setup Data
         F5 -    GENIUS SETUP . . . . . . . . . Genius Bus Controller Setup
         F6 -    I/O ADDRESS ASSIGNMENT . . . . . . . Create/Edit I/O Map
         F7 -    I/O BUS SETUP. . . . . . .Specify Retries/Critical Bases
         F8 -    SUPERV MENU. . . . . . . . . . Return to Supervisor Menu


 COMM &  GENIUS          MSD        GENIUS  IO ADR  IO BUS  SUPERV
1PSWORD 2FAULTS 3       4 FUNC     5 SETUP 6ASSIGN 7 SETUP 8 MENU
```

Setup/Diagnostic Functions Key Summary

The Setup/Diagnostic Functions menu displays the following function keys:

Comm & Psword (F1): Select ***Communication and Password*** to set up the system parameters for communicating with the CPU.

Genius Faults (F2): Select ***Genius Faults*** to display and clear Genius I/O faults.

MSD Func (F4): Select ***MSD Functions*** to enable windowing. Windowing allows up to 10K rungs and 5K nicknames to be programmed. Also, select ***MSD Functions*** to change display colors when a color monitor is used.

Genius Setup (F5): Select ***Genius Setup*** to edit the Genius Bus Controller setup.

IO Adr Assign (F6): Select ***I/O Address Assignment*** to assign input or output references to the I/O modules in the Series Five PLC.

IO Bus Setup (F7): Select ***I/O Bus Setup*** to establish the number of parity retries and identify non-critical bases.

Superv Menu (F8): Select ***Supervisor Menu*** to return to the Logicmaster Supervisor Menu screen.

SECTION 2
Setting up Communications with the CPU

The Communications Setup menu is used to specify parameters for 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 5 system and the CPU.
- How to enable on-line changes.
- How to create a COMSET.SET file.

Displaying the Communications Setup Menu

When the Comm & Psword (F1) key is pressed from the Setup/Diagnostic Functions menu, the Communications Setup menu will appear:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE   11:19:39


              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  (1,2)

                    SELECTED CPU ID NUMBER:      1  (1-90)

                    ON-LINE CHANGES:  ENABLED







  SAVE      CPU   SELECT               SELECT   SHOW   ONLINE   SETUP
1 FILE   2PROTEC 3 PORTS 4            5CPU ID 6 ID #S 7CHNGES 8& DIAG
```

At start-up, 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 the Save File (F1) key. If you always communicate through the same port and CPU, you should save these entries. This time-saving feature will enable the system to be automatically set up at power-up.

Communications Setup Screen: Definitions

Refer to the following definitions when making changes to the Communications Setup screen:

Communication Port Number

This entry specifies the port number which will be used for CCM communications with the CPU. 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 the Select Ports (F3) key. To deselect a port, leave the work area blank and press the F3 key. A port currently selected for communications must be deselected if it is to be used for other Logicmaster 5 functions, such as printing.

The port selected must be configured to match the CCM setup in the CPU 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 CCM port configured for RS-232.

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 CCM port configured for RS-232. If it is set up for RS-422, it may be used with a CCM set up for RS-422.

Multidrop configurations (one Logicmaster 5 system connected to more than one Series Five CPU) must be done with RS-422.

Port 1 corresponds to DOS device COM1, and port 2 corresponds to DOS device COM2.

Selected CPU ID Number

Enter the ID number of the CPU (from 1 to 90 for master/slave communication) that will be communicating with the system. After entering the number, press the Select CPU ID (F5) key. The number will be entered into the field, and the system will immediately begin communicating with that CPU.

To display the IDs of the currently-available CPUs within the parentheses to the right, press the Show ID #s (F6) key. The screen will display:

```
POLLING CPU ID NUMBER:
```

plus the number of each currently-available CPU. For a network interface with more than eight CPUs, press the F6 key again, as needed, to display additional CPU IDs.

To cancel the polling of CPU IDs, press the Abort key. The screen prompts:

```
<< PRESS CONFIRM TO ABORT, ANY KEY TO CONTINUE >>
```

Press the Confirm (Shift/0) key to cancel the abort, or any other key to continue polling CPU IDs.

On-Line Changes

Press the Online Chnges (F7) key to select the ability to use the system's on-line change features. This allows you to change registers, I/O points, constants, and some instructions while the programmer is switched on-line.

Creating a COMSET.SET File

Press the Save File (F1) key 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 CPU IDs. The system will read the contents of this file at start-up.

If the COMSET.SET file is present when the Logicmaster 5 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 the default values. (Default values include: No port selected, CPU ID 1, and on-line changes enabled.)

Changing the Communications Setup Screen

Change the entries on the Communications Setup screen to describe your system. Changes are made in two ways:

1. Port Number and CPU ID Fields: Type the entry into the work area and press the appropriate function key.
2. On-Line Changes Fields: Press the appropriate function key to toggle the selections.

Canceling Entries on the Communications Setup Screen

To exit this screen and return to the values that were displayed when the screen was entered, press the Abort key. The screen displays:

```
<< PRESS CONFIRM TO ABORT, ANY KEY TO CONTINUE >>
```

Press the Confirm (Shift/0) key to exit, or press any other key to cancel the abort.

Returning to the Setup/Diagnostic Functions Menu

Press the Setup & Diag (F8) key to return to the Setup/Diagnostic Functions menu.

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 display the CPU Password Protection menu.
- When to use passwords.
- How to lock/unlock the CPU.
- How to change/enter the CPU password.

NOTE

A password of 0 disables the Password function. This is the normal mode of operation for most users.

Using Passwords

Passwords are used to protect your program from competitive viewing or stealing, and to protect the Series Five PLC from accidental or unauthorized downloading of the program or configuration data. Passwords do not, however, protect register contents, I/O forcing, or CPU configuration data. To prevent access to that data, you must physically remove the programming device or OIU from the CPU.

With a password, there is always the risk of losing or forgetting it, or having it change due to battery failure. If protection of your program or Series Five PLC is *not* absolutely essential, it is recommended that you do *not* use a password. You can still protect the program from accidental overwriting without using a password by configuring the Write Protect jumper in a RAM memory cartridge to the PROTECT position, or by using a PROM memory cartridge.

The password for your program is stored in the memory cartridge. You can clear the password (reset to 00000000, which is the same as no password) by using the Initialize CPU function; but this will also clear the user logic program and all tables as well as the CPU configuration parameters.

CAUTION

Once the memory cartridge is unlocked, anyone can enter a new password without knowing the old password and then relock the memory cartridge. To prevent unauthorized personnel from assigning new passwords, do not leave the CPU unlocked and unattended.

Once a password is entered and the memory cartridge is locked, there is no way to gain access to the user logic, except by unlocking the memory cartridge with the correct password, or by clearing the entire memory cartridge with the Initialize CPU function.

As a precautionary measure, you should:

1. Write down your password on paper, and place the paper in a secure place.
2. Make an unprotected copy of your program on a spare memory cartridge or diskette, and place that in a secure place, too.
3. You can also use a password that would only have meaning to a select group of people.

If your password changes unexpectedly, you can still recover by one of these two methods:

4. Use the Initialize CPU function to totally clear the memory cartridge. You must then reload the program from disk or memory cartridge, and re-protect the program.
5. Use your spare copy of the program with the original unchanged password, or a copy of the program which has no password.

Displaying the CPU Password Protection Menu

Press the CPU Protec (F2) key from the Communications Setup menu. The CPU Password Protection menu will appear:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE    11:19:39


          C P U   P A S S W O R D   P R O T E C T I O N   M E N U


                 CPU MEMORY PROTECT STATUS:








 UNLOCK    LOCK   CHANGE                                   COMM
1  CPU  2  CPU  3PASSWD 4          5        6        7     8SETUP
```

Unlocking the CPU

To unlock the CPU, follow these steps:

1. With the Logicmaster system in the On-Line mode only, press the Unlock CPU (F1) key from the CPU Password Protection menu. The following message will appear:

```
TYPE CPU PASSWORD (UP TO 8 DECIMAL DIGITS)
            THEN PRESS << ENTER >>
```

2. Type the current password. For security, your keystrokes are not displayed while typing the password. Then, press the Enter key. The system will attempt to unlock the CPU using your password. 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
```

3. If the password you entered is an invalid number, the CPU will remain locked. If you press the wrong key while entering the password, you cannot use the Backspace or Delete keys to correct your error. A mistake will result in a failure to unlock the CPU, and the attempted unlock must be tried again.

Locking the CPU

Before locking the CPU, it must have been previously unlocked. To lock the CPU, follow these steps:

1. With the Logicmaster system in the On-Line mode only, press the Lock CPU (F2) key from the CPU Password Protection menu. The system will attempt to 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 is zero (default password is 00000000), the CPU will remain unlocked and the following message will appear:

```
CPU CANNOT BE LOCKED, PASSWORD IS 0
```

The system will remain unlocked until you change the password.

Changing the Password

Before changing the password, the CPU must have been previously unlocked. To change the password, follow this procedure:

1. Press the Change Passwd (F3) key from the CPU Password Protection menu. The following message will appear:

```
TYPE NEW CPU PASSWORD (UP TO 8 DECIMAL DIGITS)
            THEN PRESS << ENTER >>
```

2. Type the new password (up to a maximum of 8 decimal digits). Your keystrokes will not be displayed while typing the password. Then, press the Enter key. The following message will appear:

```
RETYPE CPU PASSWORD FOR VERIFICATION
          THEN PRESS << ENTER >>
```

3. Retype your new password to verify its accuracy. Then, press the Enter key. The system will attempt to change the password. If the current password entry is not the same number entered on the first attempt, the change will not occur and the following message will be displayed:

```
CPU PASSWORD VERIFICATION FAILED, PASSWORD NOT CHANGED
```

Returning to the Communications Setup Menu

Press the Comm Setup (F8) key to return to the Communications Setup menu.

SECTION 4

Machine Setup Menu

This section explains:

- How to display the Machine Setup menu.
- What you should do before changing the Machine Setup menu.
- How to create a program with more rungs, and/or more nicknames, through the use of ''Windowing''.
- How to select windowing.
- How to change display colors if the computer you are using for programming has a color monitor.

Displaying the Machine Setup Menu

When the MSD Func (F4) key is pressed from the Setup/Diagnostic Functions menu, the Machine Setup menu will appear:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE    11:19:39
                     M A C H I N E   S E T U P   M E N U

   CURRENT MACHINE.SET FILE CONTENTS:     WINDOWING ENABLED N  DISK DRIVE

   CURRENT USER PROGRAM WINDOWING SETUP:  WINDOWING ENABLED N  DISK DRIVE


   TO INVOKE NEW USER PROGRAM WINDOWING PARAMETERS:
   1) MAKE DESIRED CHANGES IN CURRENT MACHINE.SET FILE FIELDS WITH
      F2 AND F3 SOFTKEYS.
   2) SAVE THE DESIRED VALUES TO THE DISK WITH THE F1 KEY.
   3) RE-BOOT THE LOGICMASTER SOFTWARE.

   ALTERATION OF SCREEN DISPLAY COLORS:
      PRESS F4 TO VIEW POSSIBLE FOREGROUND COLORS.
      PRESS F5 TO VIEW POSSIBLE BACKGROUND COLORS.
      PRESS F6 TO VIEW POSSIBLE BORDER COLORS.


  SAVE   TOGGLE  DISK    FORE        BACK                    SETUP
1 FILE  2WINDOW 3DRIVE  4GROUND     5GROUND 6BORDER 7       8& DIAG
```

Machine Setup Key Summary

The Machine Setup menu displays the following function keys:

Save File (F1): Color selections take effect immediately and remain active while the system is running. Press the F1 key to save the selections in the MACHINE.SET file on the start-up disk. These selections will then be used automatically whenever the system is started.

Toggle Window (F2): Use ***Toggle Window*** to select either yes or no for windowing.

Disk Drive (F3): Use ***Disk Drive*** to select the drive.

Foreground (F4): Use ***Foreground*** to select the color of the foreground (text). Each time you press the F4 key, a new foreground color will be displayed.

Background (F5): Use ***Background*** to select the color of the background. Each time the F5 function key is pressed, a new background color will be displayed. The system will prevent the selection of identical foreground and background colors.

Border (F6): If your system uses a Color Graphics Adapter (CGA), you can change the border color by pressing the F6 key. The Enhanced Graphics Adapter (EGA) will always display a black border.

Setup & Diag (F8): Press the F8 key to return to the Setup/Diagnostic Functions menu.

Editing the Machine Setup Menu

The MSD Setup menu allows you to select program windowing or to change display colors on a color monitor. This data is stored in a file named MACHINE.SET. After you change selections on the Machine Setup menu, you must re-boot the system to use the new data. Otherwise, the system will continue to use the data originally in the MACHINE.SET file. When you re-boot the system, either by pressing the Restart button, by pressing the Ctrl/Alt/Delete keys, or by cycling power to the computer, remember that:

Any program file currently in memory will be lost. Save your program before restarting the computer.

DOS must be present in the start-up drive.

Using Windowing to Increase Program Size

Program Windowing is a method that allows larger programs to be built.

	NO WINDOWING	WINDOWING
Nicknames	2048	5120
Number of Rungs	6000	10000

The disk selected for windowing should be the hard disk or RAM Disk in your computer.

NOTE

The term RAM Disk refers to the Expanded Memory card, which provides additional temporary memory space during programming.

Selecting Windowing

To select or de-select windowing, follow the instructions below:

1. Select MSD functions from the Setup/Diagnostic Functions menu. The screen displays information about the current program, and the currently-selected defaults:

```
CURRENT MACHINE.SET FILE CONTENTS:    WINDOWING ENABLED    DISK DRIVE

CURRENT USER PROGRAM WINDOWING SETUP: WINDOWING ENABLED N  DISK DRIVE
```

2. Use the Toggle Window (F2) key to select either **Y** or **N**.
3. Use the Disk Drive (F3) key to select the drive.
4. You must press the Save File (F1) key to save your entries.
5. Using DOS, re-boot the system. This is necessary to use the entries you have just made.

Loading a Program with more than 6000 Rungs

When a program that exceeds the 6000 rung non-windowing size is loaded into Logicmaster memory, windowing must be selected. Otherwise, the rungs over 6000 will be deleted from the program and from the disk if the program name is active. Therefore, before loading a program with more than 6000 rungs, you should be sure that windowing has been selected, as described on the previous page. If you attempt to load such a program when Windowing is not selected in the MACHINE.SET file, a message will appear asking whether you want to continue.

Editing a Program with more than 2K Nicknames

The total number of nicknames that can be used in a program is either 2K (2048) or 5K (5120), depending on whether windowing has been selected. Before editing nicknames in a program with more than 2K nicknames, be sure that windowing has been selected, as described on the previous page. Otherwise, the nicknames may not be stored correctly.

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 Setup/Diagnostic Functions menu.
2. Use function keys F4-F6 to toggle through the different color selections for each item. The Color Graphics Adapter (CGA) has 8 color selections, while the Enhanced Graphics Adapter (EGA) has 16 selections.
3. Press the Save File (F1) key to save your entries.

Returning to the Setup/Diagnostic Functions Menu

Press the Setup & Diag (F8) key to return to the Setup/Diagnostic Functions menu.

SECTION 5
Genius I/O Faults

The Genius I/O Faults screen displays the Genius I/O diagnostic information. This section explains how to display and clear this diagnostic information. Refer to GFK-0248, *Series Five Genius Bus Controller manual*, for more information about using Genius I/O with the Series Five PLC.

Displaying the Genius I/O Faults Screen

When the Genius Faults (F2) key is pressed from the Setup/Diagnostic Functions menu, the Genius I/O Faults screen will appear, but only if bit O2-1024 is set in the user program. If this bit is not set, an error message will be displayed.

```
                                                        LM:OFFLINE    10:47:46

                 G E N I U S   I / O   F A U L T   T A B L E

TOTAL FAULTS: 06
TOP FAULT DISPLAYED: 01

SLOT  REFERENCE  CIRC.      FAULT        FAULT      FAULT
NO.    ADDRESS   NO.       CATEGORY      TYPE    DESCRIPTION  MON DAY HR:MN:SC
------------------------------------------------------------------------------
0     I01+0009        DEVICE ADDITION                           JUN 17 08:36:51
0     I01+0001        DEVICE ADDITION                           JUN 17 08:36:52
0     I01+0145       ADDRESS CONFLICT                           JUN 17 08:36:52
0     I01+0145   08     CIRCUIT FAULT  DISCRETE  OPEN WIRE      JUN 17 08:36:52
0                         DEVICE LOSS                           JUN 17 08:44:35
0                     DEVICE ADDITION                           JUN 17 10:35:23




    NEXT     PREV   CLEAR                                     SETUP
  1 PAGE   2 PAGE  3FAULTS 4  TOP      5BOTTOM 6       7      8& DIAG
```

The CPU obtains the fault information from the Genius I/O hardware and sends it to the Logicmaster system through the register table. Each fault generates one or more display lines on the screen, depending on the number of descriptions associated with the fault.

Two static fields in the upper left corner of the screen display:

Total Faults: The current number of faults reported.

Top Fault Displayed: The fault described on line one of the display page.

Genius I/O Faults Screen: Definitions

Refer to the following definitions when making changes to the Genius I/O Faults screen:

Slot Number: The slot number is the number of the Genius bus controller reporting the fault.

Reference Address: The reference address indicates the address of the failed module. Bus error faults do not use the address field.

Circuit Number: The circuit number indicates the offset from the reference address of the failed module. This display only exists for circuit faults.

Fault Category: The fault categories include failure of a Genius bus controller, excessive bus communication errors, circuit faults reported by devices on the bus, loss of a device, addition of a device, and address conflict.

Fault Type: The fault type provides additional information about circuit faults.

Fault Description: The fault description provides additional information about fault types. Multiple descriptions may explain one fault on consecutive display lines.

Time Stamp: The CPU records the date and time it logs the fault in the fault table.

Genius I/O Faults Key Summary

The Genius I/O Faults screen displays the following function keys:

Next Page (F1): Select ***Next Page*** to scroll the diagnostic information down one screen at a time.

Prev Page (F2): Select ***Previous Page*** to scroll the diagnostic information up one screen at a time.

NOTE

The Next, Previous, and Up/Down cursor keys can also be used to scroll the fault information up and down, one fault at a time.

Clear Faults (F3): Select ***Clear Faults*** to initiate a Clear All Faults command. The CPU sends a Clear All Circuit Faults datagram to each logged-in module in the system. This will clear all faults on the Logicmaster screen and set the total faults count to zero. Devices responding to the Clear All Circuit Faults datagram will clear all internal fault indicators. Current faults will be reported again.

Top (F4): Select ***Top*** to display the first fault as the top fault on the screen.

Bottom (5): Select ***Bottom*** to display the last fault as the top fault on the screen.

Setup & Diag (F8): Select ***Setup & Diagnostics*** to return to the Setup and Diagnostic Functions menu.

Returning to the Supervisor Menu

Press the Suprv key to return to the Supervisor menu.

Genius I/O Reserved References

The Genius I/O Diagnostics function reserves certain output and register references to convey command and status information to and from the CPU. The reserved output references are O2-1019 through O2-1024. The reserved registers are R04041 through R04051, and R04057 through R04064. Another block of registers, starting at R03850, contains fault information, ten registers per fault. If the diagnostic function is not used, the block of registers starting at R03850 is available for other purposes.

Table 10-1. Reserved References for Genius I/O Faults

REFERENCE	DESCRIPTION
O2-1019	The CPU sets this bit when identifying errors in setting up the reserved references. If an error is detected, the diagnostic routine is not executed.
O2-1020	The CPU sets this bit on an overflow condition, when more faults are reported than can be accepted.
02-1021	Setting this bit causes the CPU to send a Pulse Test datagram to each logged-in device in the system.
O2-1022	Setting this bit causes the CPU to send a Clear All Faults datagram to each logged-in device in the system.
O2-1023	Setting this bit causes the addition or loss of a module to be logged as a fault condition.
O2-1024	Setting this bit enables the Genius I/O diagnostic routine.
R03850 - R03999	These registers contain the fault information for 15 faults, with each fault reserving 10 registers.
R04041	Genius bus scan time - slot 0 *
R04042	Genius bus scan time - slot 1 *
R04043	Genius bus scan time - slot 2 *
R04044	Genius bus scan time - slot 3 *
R04045	Genius bus scan time - slot 4 *
R04046	Genius bus scan time - slot 5 *
R04047	Genius bus scan time - slot 6 *
R04048	Genius bus scan time - slot 7 *
R04049	This register contains the starting register address of the fault table, initialized by the CPU on power-up to 3850. (Can be modified by the user program.)
R04050	This register contains the maximum number of faults, initialized by the CPU on power-up to 15. (Can be modified by the user program.)
R04051	This register contains the current number of faults in the fault table.
R04057	Genius bus controller slot 0 SBA conflict address/CCM RCV buffer pointer.
R04058	Genius bus controller slot 1 SBA conflict address/CCM RCV buffer pointer.
R04059	Genius bus controller slot 2 SBA conflict address/CCM RCV buffer pointer.
R04060	Genius bus controller slot 3 SBA conflict address/CCM RCV buffer pointer.
R04061	Genius bus controller slot 4 SBA conflict address/CCM RCV buffer pointer.
R04062	Genius bus controller slot 5 SBA conflict address/CCM RCV buffer pointer.
R04063	Genius bus controller slot 6 SBA conflict address/CCM RCV buffer pointer.
R04064	Genius bus controller slot 7 SBA conflict address/CCM RCV buffer pointer.

* This register is used for CCM setup purposes, if a CCM module is installed in this slot instead of a Genius bus controller.

For a more detailed description of the operation of the Genius diagnostic routine, refer to GFK-0122, *Series Five User's Manual.*

SECTION 6
Genius Bus Controller Setup

Use of a Genius Bus Controller network with the Series Five programmable controller offers:

- Compatibility with Genius I/O blocks.
- Series Five-to-Series Five communications using the Read/Write CCM instructions. This allows general-purpose communications between two Series Five PLCs at a low priority level.
- Global data sharing with other Series Five CPUs, and with other compatible GE Fanuc products, including the Series Six PLC. This allows high priority data to be transmitted to other devices on the bus automatically.
- General-purpose low priority communications with other devices which support Genius datagrams.
- Mapping of a local I/O into a remote I/O table so that the CPU can directly control I/O at a remote CPU location with no user logic in the remote CPU. (This feature will be available with a later version of software.)

The first two items listed above require no CPU setup with a revision C CPU, other than setting the bus controller's serial bus address and baud rate DIP switches.

To operate properly with the Genius network, you will need:

1. A Series Five CPU: revision B or later (revision 2.x/3.0 or later). Revision C CPU, or later, is recommended.
2. A Series Five Genius Bus Controller: revision B or later.
3. A Genius Hand Held Monitor: version 3.0 or later.
4. Logicmaster 5 software: version 2.01 or later.

Restrictions

With a version 2.x/3.0 CPU (IC655CPU500B), Genius diagnostics cannot be enabled at the same time as the Read/Write CCM instructions are active with the Genius bus controller.

In addition, for all CPU and Genius bus controller revision levels, Genius "Phase B" features cannot be used in a system containing "Phase A" Genius blocks. This means that if you have Phase A blocks in a system, you cannot use these features:

- Global Data.
- Baud rates other than 153.6K.
- Redundancy.
- Multiple controllers on the same bus.
- Datagrams (including Read/Write CCM functions).

CPU Differences between Revisions B and C

A revision B CPU defaults to the states listed below. This allows for automatic operation of global data with no user interaction.

- Read/Write CCM is allowed.
- Global data address is set in the Register table. The address depends on the serial bus address assigned to the controller (in the range of R0017 to R0080).
- Global data length is set to 8 registers.
- Serial bus address for "Output Enable Bits" is set to disabled.

A revision C CPU defaults to the states listed below. This allows for easier setup with Genius blocks, but requires that you establish setup parameters for global data if you desire to use this function.

- Read/Write CCM is allowed.
- Global data address is set to 0 to disable global data.
- Global data length is set to 0 to disable global data.
- Serial bus address for "Output Enable Bits" is set to enabled.

Installing the Genius Bus Controller Module in a Revision C CPU

In order to set up the Genius Bus Controller module in a Series Five CPU (revision C) base unit, follow this procedure:

1. Before placing the bus controller in the rack, the DIP switches on the module must first be configured. These DIP switches are set to a default configuration at the factory before shipment; the default settings are referenced in the following table. Use this table as a guide to help you configure the DIP switches.

```
DIP Switch
 Position               Serial Bus Address                                     *
                                             1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3
                         0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
      1                  - x - x - x - x - x - x - x - x - x - x - x - x - x - x - x - x
      2                  - - x x - - x x - - x x - - x x - - x x - - x x - - x x - - x x
      3                  - - - - x x x x - - - - x x x x - - - - x x x x - - - - x x x x
      4                  - - - - - - - - x x x x x x x x - - - - - - - - x x x x x x x x
      5                  - - - - - - - - - - - - - - - - x x x x x x x x x x x x x x x x

                              Baud Rate (K)
                153.6K      76.8     38.4      153.6
               Extended                        Standard *
      6            -          -        x          x
      7            -          x        -          x

                  Output Enable Bits                         NOTE
                  Enabled    Disabled *
      8              -          x              This DIP switch (8) must remain
                                               in the Output Disabled position
                                               for Genius bus controllers
                                               installed on revision B CPUs.

 * = Default settings (factory shipped)
     Serial Bus Address = 31
     Baud Rate = 153.6K baud (standard)
     Outputs Disabled (i.e., all 32 outputs enabled bits are initialized
       to "disabled".
 x = 1 (open position)       - = 0 (closed position)
```

The Serial Bus Address (SBA) is set with DIP switch positions 1 through 5. The factory default is 31, which is the address usually assigned to a bus controller. If a different serial bus address is required, configure the DIP switches accordingly.

The factory default setting for baud rate is for DIP switch positions 6 and 7 to both be open. This sets the baud rate to 153.6K baud (standard). Depending on the length of the bus and other factors, it may be desirable to change this baud rate to 76.8K, 38.4K, or 153.6K extended. For information on 153.6K baud extended, refer to GEK-90486, *Genius I/O System User's Manual.* All devices on one bus (including the bus controller and hand held monitor) must be set up for the same baud rate. However, busses connected to the Series Five PLC through other bus controllers may use different baud rates.

For use with a revision C CPU, DIP switch position 8 should be switched to the Outputs Enabled position (DIP switch in CLOSED position). This switch causes all 32 output enabled bits to be initialized to ''enabled''. For more information on output enable bits, refer to chapter 3 of GFK-0248, *Series Five Genius Bus Controller User's Manual.*

2. With power removed from the CPU rack, install the Genius Bus Controller module in any slot in the CPU rack. After the module is properly seated, tighten the two captive screw fasteners, one at the top rear and one at the bottom rear of the module. For information on wiring the serial bus, refer to GFK-90486, *Genius I/O System User's Manual.* The serial bus is connected to the bus controller through the four screw terminals on the front of the module.

3. After installing the Genius bus controller(s) into the CPU rack, it may be necessary to reset some of the "output enable" bits for each active serial bus address on each bus. If revision C CPUs are used with multiple Genius bus controllers on the same bus, some output enable bits may need to be disabled to prevent more than one CPU from controlling the same I/O.

   The output enable setup is done using either Logicmaster 5 software or the OIU. A field of 32 bits is presented for each bus controller. Each bit corresponds to the enable/disable status of one of the serial bus addresses. If the bit is set to 1, it is possible for this Genius bus controller to send outputs to the device enabled by this bit; if set to 0, it is disabled. The format of the output enable bits for Logicmaster 5 software is shown in the following example:

```
                               Output Enable Bits
                                 31  16   15  00    <---This information
To Enable SBA 1 only              0000     0002         is displayed in
To Enable SBA 1 and 2 only        0000     0006         the last column on
To Enable SBA 1 - 3, 28 - 31      F000     000E         the GBC Setup
                                                        screen. -----------+
                                                                           |
Notes:                                                                     |
1.  Block inputs will operate and report back to the CPU,                  |
    regardless of the state of the output enable bits.                     |
2.  The Hand Held Monitor serial bus address (SBA) need not be enabled.    |
                                                                           |
                                                                           |
                                                                           |
          EQUIVALENT    GLOBAL       GLOBAL      (FUTURE)       SBA        |
            STATUS       DATA         DATA       RECEIVE       OUTPUT      |
   SLOT     TABLE        LOCAL      TRANSMIT     DIRECTED    ENABLE BITS   |
  NUMBER    ADDRESS    REFERENCE     LENGTH       LENGTH     31-15  15-00  |
  -------------------------------------------------------------------      |
    0                                                             <--------+
    1
    2
    3
    4
    5
    6
    7
  -------------------------------------------------------------------
```

   Data (0-F) is entered at the cursor location, and stored to the CPU with the Store to CPU (F2) function key.

4. If global data operation is required, it must be set up. For information on global data communications, refer to the following discussion.

5. If a revision C CPU is used with Genius I/O blocks and no other controllers are on the bus, the output enable bits should be set to default to the "enable" position. No additional setup is required.

6. After enabling the desired serial bus addresses with the ouput enable bits, the following capabilities have been enabled and require no further setup:

   A. Operation with Genius I/O blocks. If used, the blocks must be configured using the Genius hand held monitor; however, no further Series Five setup is required. A block address of 1 - 1024 will map the block in the I01+ tables. A block address of 1025 - 2047 will map the block in the I02+ tables. A block address of 32768 or above, assigned with Logicmaster 5 software, will map the block into the Register table. The Hand Held Monitor (version 3.0) allows direct programming of the Register address; previous versions of the Hand Held Monitor cannot be used on the Series Five PLC.

   NOTE

   Genius I/O blocks occupy space in both I+ and O+ tables, even if the block is programmed as input only or output only. Also, analog block data is not multiplexed as it is on Series Six Genius applications.

   B. General purpose communications between Series Five CPUs using the Read/Write CCM user logic commands. (These commands can be used with the Genius Bus Controller module, as well as with the CCM Master module.) This capability provides true peer-to-peer operation under user logic control. It is normally used to exchange data which is lower priority, and does not need to be updated on each Genius bus scan.

   C. General purpose communications via the Genius datagram capability.

Enabling and Changing Global Data Values

Global data is automatically sent by the bus controller to all compatible devices on the Genius bus. The data is passed every Genius bus scan. Each bus controller receives global data and maps it into the CPU memory at the same address.

For example, if your local CPU is set up with a global data local reference of 32868 (Register 100) and a global data transmit length of 10, then registers 100 - 109 will be transmitted on each Genius bus scan to all devices on the bus capable of receiving global data transmissions. If another Series Five PLC or a Series Six PLC is active on the Genius bus, they will see R100 - R109 data from your local CPU appear in their Register tables at the same locations. Global data will be received regardless of whether it is configured to transmit global data or not.

If you also wish to transmit data from these other CPUs with global data, they must be set up to transmit a different register or I/O range.

To set up the global data communication parameters, follow this procedure:

1. Using Logicmaster 5 software, press the Genius Setup (F5) key from the Setup/Diagnostic Functions menu to access the Genius Bus Controller Setup screen.
2. For each slot containing a Genius bus controller, set the global data local reference (the starting point of the data to be transmitted). Refer to table 10-2 for valid data values.
3. After entering the local reference value, press the Calc Ref (F4) key. The equivalent status table address will be displayed in the second column on the Genius Bus Controller Setup screen.
4. Set the global data transmit length for each slot containing a Genius bus controller. This is the number of registers, or one-half the number of bytes to transmit.

5. Store the new setup values to the CPU using the Store to CPU (F2) key.

NOTE

Additional information on setting up global data communications can be found in GFK-0248, *Series Five Genius Bus Controller User's Manual.*

Notes:

1. The CPU Initialize function will reset all Genius setup parameters to zero (0), and set output enable bits to "disable".
2. The Output Enable/Disable DIP switch on the Bus Controller module is only read when a newly "registered" Genius bus controller has been detected. From that point on, the CPU uses the output enable settings which Logicmaster 5 software or the OIU has established. If a bus controller module is removed from a slot and "de-registered" with a New Config command, then it is re-installed and re-registered with another New Config command, the DIP switch will be read again at this point.
3. Note that Genius I/O blocks occupy space in both I+ and O+ tables, even if the block is programmed as input only or output only. Also, analog block data is not multiplexed as it is on Series Six Genius applications.
4. After Genius I/O blocks have had their I/O reference addresses changed, it may be necessary to power cycle the blocks to have the new addresses recognized.
5. The Genius hand held monitor does not need to have its output enable bit set to work on the bus.
6. There is no internal address conflict check between addresses to which Genius blocks have been assigned and addresses which global data is using. Be sure that incoming global data does not overwrite data coming from blocks, or that data coming from blocks does not overwrite incoming global data.

Displaying the Genius Bus Controller Setup Screen

When the Genius Setup (F5) key is pressed from the Setup/Diagnostic Functions menu, the Genius Bus Controller Setup screen will appear. Genius setup data will be loaded from the CPU if communication has been established.

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE   11:19:39

         G E N I U S   B U S   C O N T R O L L E R   S E T U P

           EQUIVALENT    GLOBAL      GLOBAL    (FUTURE)      SBA
             STATUS       DATA        DATA     RECEIVE      OUTPUT
  SLOT       TABLE        LOCAL     TRANSMIT   DIRECTED   ENABLE BITS
 NUMBER     ADDRESS     REFERENCE    LENGTH     LENGTH    31-15  15-00
 ---------------------------------------------------------------------
   0
   1
   2
   3
   4
   5
   6
   7
 ---------------------------------------------------------------------
              PRESS HELP KEY FOR LIST OF VALID RANGES

 NOTE:  FOR APPLICATIONS WITH A SINGLE CONTROLLER PER BUS, THE LOCAL
        REFERENCE, TRANSMIT, AND DIRECTED LENGTH SHOULD BE SET TO 0.


 LOAD   STORE    CLEAR   CALC                                 SETUP
1FM CPU 2TO CPU 3  CPU  4  REF       5       6       7       8& DIAG
```

Genius Bus Controller Setup Key Summary

The Genius Bus Controller Setup screen displays the following function keys:

Load fm CPU (F1): Select ***Load from CPU*** to load the Genius bus controller setup values from the CPU.

Store to CPU (F2): Select ***Store to CPU*** to store the Genius bus controller setup values to the CPU.

Clear CPU (F3): Select ***Clear CPU*** to clear the Genius bus controller setup values in the CPU.

Calc Ref (F4): Select ***Calculate Reference*** to display the CPU table addresses which correspond to the global data local references.

Setup & Diag (F8): Select ***Setup & Diagnostics*** to return to the Setup and Diagnostic Functions menu.

Setup Ranges

The following table lists the valid setup ranges of the Genius bus controller. The status table address range determines which of two address types is used. Bit addressing is used for I/O table data, and word addressing is for register data. The length is entered in bits for bit addresses (I/O table data) and words for word addresses (register data). Bit-related values (I/O addresses and lengths) will be rounded to byte boundaries when stored to the CPU.

Table 10-2. Valid Genius Bus Controller Setup Ranges

TYPE OF ADDRESS	EQUIVALENT STATUS TABLE ADDRESS	GLOBAL DATA LOCAL REFERENCE	GLOBAL DATA TRANSMIT LENGTH	RECEIVE DIRECTED LENGTH
Bit	IO1+0001 ... IO1+1024	00001 ... 01024	0000 ... 1024	0000 ... 1024
Bit	IO2+0001 ... IO2+1024	01025 ... 02048	0000 ... 1024	0000 ... 1024
Word	R00001 ... R04096 (4K REG)	32769 ... 36864	0000 ... 0064	0000 ... 0064
Word	R00001 ... R16384 (16K REG)	32769 ... 49152	0000 ... 0064	0000 ... 0064

```
where:  IO1+xxxx addresses = the I/O number.
        IO2+xxxx addresses = the I/O number + 1024.
        Reference address for registers = register number plus 32768.
```

For example, IO1+0001 corresponds to Genius Reference address 00001, and IO2+0001 corresponds to 01025. Register R00001 corresponds to 32769.

For I/O tables, the address plus each length cannot exceed the max address +1. For Registers, the address plus both lengths cannot exceed the max address +1. This is because you cannot specify a starting address and a length which goes beyond the end of the table space.

Editing the Genius Bus Controller Setup Screen

Editing may be done with the Logicmaster system in either Off-Line, Monitor, or On-Line mode. The edited values will be retained in the Logicmaster system if you leave this screen; however, unless you are in Off-Line mode, these values will be replaced by those in the CPU when you return to this screen. Store and Clear functions require that the CPU be stopped and the Logicmaster system be on-line. You must also confirm the initiation of a Load, Store, or Clear operation.

The Up, Down, Right, and Left cursor keys are used to select a field to be edited. Move the cursor to a particular field, and enter the values. All values are expressed as decimal numbers, except the Output Enable field, which is hexadecimal values. Leading zeros are not necessary.

The Clear key is used to blank the selected field, while the Delete key removes only the last digit entered. Since the addresses used are Genius Reference addresses, you can press the Calc Ref (F4) key to update the left column, which shows the corresponding CPU table addresses.

The transmission of output data can be enabled/disabled on a per serial bus address basis. The 32 output enable bits are grouped in two 16-bit words. For example: 0000 FFFF would enable the first 16 bits.

Broadcast and directed data lengths are expressed as the number of registers or I/O points to be transferred.

Range checking of the field contents is performed when a Store to CPU (F2) function is selected. If an error is found, it must be corrected and the Store to CPU function initiated again.

NOTE

Addresses and lengths of I/O points (IO1+ and IO2+ tables) are adjusted to byte boundaries when stored to the CPU.

Guidelines for Designing a Genius Network

The following guidelines will help you design a Genius network:

1. Each device on the bus must have a unique serial bus address. This number must be between 0 and 31, inclusive, with 0 usually reserved for the Genius hand held monitor.
2. Each Genius block must be programmed with a ''status table address.'' The status table address is the starting address in the CPU in both the I+ and O+ tables or in the Register table into which the Genius device will be mapped.
3. Broadcast inputs (consisting of normal inputs and global data) are reported to all Genius bus controllers on the bus. These inputs originate in blocks, or at other Genius bus controllers (those using global data). In the Series Five PLC, there is no way to turn off receipt of broadcast inputs. All Series Five bus controllers will receive all broadcast inputs on the bus. Broadcast inputs appear in the CPUs I+/O+ or Register tables and are accessable through the user logic program. Blocks will broadcast inputs regardless of whether they are output enabled or not.
4. Directed outputs, the mechanism normally used to send output data to blocks, originate only at Genius bus controllers and are directed to only one other device. These are point-to-point directed data. Directed data length and status table address are set at the receiving device. On power-up, the receiving device tells the controlling Genius bus controller what its status table address is and how much data it expects to receive from the Genius bus controller as directed outputs. A device may receive directed outputs from only one Genius bus controller. Care must be taken to ensure that only a single Genius bus controller has its ''output enabled'' to send directed outputs to any particular device on the bus.
5. It is necessary to prevent address overlap between devices on the same Genius bus, as well as on multiple buses if more than one Genius bus controller is used.

SECTION 7
I/O Address Assignment

I/O modules in the Series Five PLC are addressed by assigning unique references to each module. These references are used by the CPU to identify them with the corresponding references in your program. In addition, the CPU must be told whether to perform power-up I/O config checking between the configuration of modules currently installed in the CPU and the data stored in the memory cartridge. Normally, these configurations will be equal; however, upon initial start-up, they can be different. Refer to chapter 3, *Scratch Pad,* for more information on I/O configuration checking.

This section explains:

- Tables.
- How to display the I/O Address Assignment screen.
- How to edit the I/O Address Assignment screen.
- How to load and store I/O address assignments.

Assigning I/O References

There are two methods for assigning I/O references:

- Automatic sequential addressing of existing modules by the CPU. (This method is *not* recommended.)
- Manual addressing of all used slots using Logicmaster 5 software. (This method *is* recommended.)

It is also possible to assign references using a combination of automatic and manual assignment. The CPU will automatically assign a reference address to any module that has not been manually assigned.

Manual assignment is the recommended method of assigning I/O references. Addresses that have been manually assigned will not change until *you* change them. When I/O addresses are automatically assigned, the CPU looks at its I/O structure and assigns addresses based on what modules are actually installed. If modules are added to or deleted from the PLC system at a later time, these address assignments will change and your user logic program will need to be re-written.

Initially Assigning I/O Addresses (Manual Method)

1. Power up the CPU with all available modules installed. The CPU will flag an I/O configuration error since this I/O configuration is different than the factory default (previous configuration).
2. Using Logicmaster 5 software, create an I/O assignment map. (Refer to the information on editing the I/O Address Assignment screen later in this section.) This map should include, if possible, I/O assignments for planned modules to be added at a later date, as well as addresses for all the modules presently installed.
3. Store the new I/O assignment map to the CPU by pressing the Store to CPU (F2) key from the I/O Address Assignment screen. This will store the edited address assignment map to the CPU and also update the CPU to use these new assignments.
4. In the I/O Configuration Utilities menu (from the Scratch Pad Display screen), set the I/O Config Check mode to ENABLE for normal operation by pressing the Check I/O Configuration (F5) key. At the next power-up, the CPU will check the I/O configuration map stored in the memory cartridge against the real I/O configuration contained in its own racks.

5. Save this configuration on diskette for later reference. Refer to section 7 of chapter 9 for more information on storing configuration data to a disk file.

Adding a Module

1. Enable I/O configuration checking, if it was not enabled after the I/O assignment map was created, by pressing the Check I/O Configuration (F5) key in the I/O Configuration Utilities menu.
2. Power down the system and install the new module(s).
3. Power up the system. An I/O CONFIG CHANGED error will be displayed on the Setup/Diagnostic screen, or on the I/O Assignment screen.
4. If the new modules have previously been assigned an address, go to the I/O Configuration Utilities screen (from the Scratch Pad menu) and press the New Config (F3) key.
5. If the new module or modules have not been assigned an address, go to the I/O Assignment screen, load the present configuration if it is not displayed, and add the new addresses as required. Then, execute a Store to CPU function.

Removing a Module

1. Power down the system, and remove the module.
2. Power up the system. An I/O CONFIG CHANGED error will be displayed, if I/O Configuration checking was enabled.
3. Press the New Config (F3) key from the I/O Configuration Utilities screen to change the I/O configuration. If the module is later reinserted, you must again use the F3 function key to register the added module.

Status Table Addressing

Each I/O module in the system must be assigned a status table address. The CPU uses this starting address to send or receive I/O data from the module. Some modules (i.e., the Genius bus controller) do not use any status table addresses.

A module can be assigned an address in either the local or remote status tables.

Local Status Tables

Most modules will be assigned an address in the Local I/O status table. Valid addresses for this table are I0001 to I1024 and O0001 to O1024. The address of a module must start on an even byte boundary (i.e., I0001, I0009, O0001, O0009). The user specifies the module starting address. The starting address plus the number of bits used by the module must *not* exceed the length of the table (I1024 or O1024).

Remote Status Tables (IO1+ and IO2+)

Normally, Genius blocks will be assigned to this table; however, an I/O module can also be assigned an address in the Remote I/O status table. This is done only when the module is assigned to a remote Genius bus controller.

Output modules, which are assigned to the remote output table, can be controlled directly by a remote Genius bus controller, with no user programming required in the CPU which contains the module.

Similarly, input modules assigned to the remote input table can be read directly by a remote Genius bus controller, with no user programming required in the CPU which contains the module. (Refer to the Series Five Genius Bus Controller manual for more information.) If a module is assigned to the remote status table, the GEN (Genius) LED on the module will be on.

Valid addresses for the remote status table are I1+0001 to I1+1024, I2+0001 to I2+1024, O1+0001 to O1+1024, and O2+0001 to O2+1024. The address of a module must start on an even byte boundary *i.e., I1+0001, I1+0009, O2+0001, O2+0009). The user specifies the module starting address.

The I1+ and I2+ tables are contiguous, as are the O1+ and O2+ tables. This means, for example, that if a 16-point output module is assigned to O1+1017, its status table addresses will be from O1+1017 to O1+1024 and from O2+0001 to O2+0008. The starting address plus the number of bits used by the module must not exceed the length of the table (I2+1024 or O2+1024).

Displaying the I/O Address Assignments Screen

When the IO Adr Assign (F6) key is pressed from the Setup/Diagnostic Functions menu, the I/O Address Assignment screen will appear:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE    11:19:39

                 I / O   A D D R E S S   A S S I G N M E N T

SLOT #   0        1        2        3        4        5        6        7
---------------------------------------------------------------------------
BASE 0

     ----------------------------------------------------------------------
     1

     ----------------------------------------------------------------------
     2

     ----------------------------------------------------------------------
     3

     ----------------------------------------------------------------------



  LOAD    STORE    CLEAR   CLEAR        BASE   LED IO           SETUP
 1FM CPU 2TO CPU 3  CPU  4 FIELD     5  4-7  6 ADDR  7         8& DIAG
```

In On-Line mode, the initial value will be read from the connected CPU and displayed on the screen. In Off-Line mode, the fields displayed will be blank.

I/O Address Assignment Key Summary

The I/O Address Assignment screen displays the following function keys:

Load fm CPU (F1): Use ***Load from CPU*** to read the I/O address assignment currently stored in the CPU to the Logicmaster system. You can use this function to examine address assignments currently in the CPU, and make any reassignments necessary. This function is automatically performed upon entry to the screen and after a Store to CPU function.

Store to CPU (F2): Use ***Store to CPU*** to store the edited address assignment map to the CPU, and also to update the CPU to use these new assignments. This function is normally used after editing the I/O assignments currently displayed on the screen. The Store to CPU function automatically initiates a Load from CPU function when complete.

Clear CPU (F3): Use ***Clear CPU*** to clear the address assignments currently stored in the CPU. This function is normally not used.

Clear Field (F4): While editing the I/O assignment map, use this key to clear both I and O entries at the cursor location.

Base 4-7 (F5): Use the Base key to select which base unit map is to be displayed. The F5 function key toggles between BASE 0-3 and BASE 4-7. Its function will be whichever base unit is not currently displayed on the screen.

LED IO Addr (F6): Use ***LED I/O Address*** to toggle the LEDs of the I/O modules between displaying I/O status or the starting address of the I/O module.

Setup & Diag (F8): Press the F8 key to return to the Setup/Diagnostic Functions menu.

Editing the I/O Address Assignment Screen

The I/O Address Assignment screen displays a map of the current I/O references assigned to each module and allows you to assign input or output references to these modules. The references represent the starting address of a module in a particular slot.

CAUTION

To avoid address duplication errors, you must know the number of I/O points for each module and ensure that the reference numbers do not overlap or extend beyond the end of a table.

I/O slots can be physically empty and yet still have addresses assigned. I/O addressing does not have to be consecutive. It is recommended that addresses be assigned to empty slots where modules will be installed in the future.

To edit an address on the I/O Address Assignment screen, follow these steps:

1. Use the Up, Down, Right, and Left cursor keys to move the cursor to a particular field.
2. Using the I and O keys and the numeric keys on the numeric keypad, enter the value in the machine reference (center) line of the work area. (Or, you may use the Ctrl/I and Ctrl/O key combinations or the 0-9 keys on the ASCII keyboard to enter these values in the work area.)
3. Press the Enter key to enter the value in the selected field. The value will be accepted, rounded down to the nearest byte boundary, and displayed in the selected field.
4. To delete both the input and output entries at the cursor location, press the Clear Field (F4) key.

Loading I/O Address Assignments

This function allows you to read the I/O address assignments currently stored in the CPU to Logicmaster memory (RAM). You can also use this function to examine address assignments currently in the CPU and make changes, where appropriate. This function is performed automatically upon entry to the screen.

To read from the CPU:

1. Press the Load fm CPU (F1) key to load the assignment map into Logicmaster memory.
2. Press the Confirm (Shift/0) key to proceed.

Storing I/O Address Assignments

This function allows you to store the edited address assignments to the CPU, and also update the CPU to use the new assignments. Error checking will also be performed by the CPU. This function is normally used after editing the screen that represents the desired I/O assignments. If any error exists, error messages will be displayed on the screen.

NOTE

To store I/O address assignments to a diskette, refer to chapter 9, *Load/Store/Verify*, in this manual.

It is recommended that you assign an address to all the I/O modules currently in the system, and, if possible, to slots which will eventually have modules installed. If a module is physically installed, but has not been assigned an address before using this function, the CPU will assign the module an address starting at reference I0001 or O0001.

The values displayed on the I/O Address Assignment screen will not be stored to the CPU until you request the Store to CPU function.

To store to the CPU:

1. Press the Store to CPU (F2) key.
2. Press the Confirm (Shift/0) key to proceed.

Clearing I/O Address Assignments

The Clear CPU function allows you to clear the address assignments currently stored in the CPU. However, this function is not used very often.

After clearing the assignments in the CPU, you should assign new addresses unless you want the CPU to perform this function.

To clear the CPU, follow these steps:

1. Press the Clear CPU (F3) key.
2. Press the Confirm (Shift/0) key to proceed.

Displaying the I/O LED Mode

The LEDs on the CPU I/O modules can display either the status of the Input/Output points on the module, or the address of that module. Logicmaster software allows you to toggle between these two modes. The function of the F6 key will be the opposite of the current mode displayed. If the status of the I/O points on the module is currently displayed, the function of the F6 key will be "address." If the LEDs display the address of that module, the function of the F6 key will be "status." (Refer to section 2, chapter 3 for more information.)

Returning to the Setup/Diagnostic Functions Menu

Press the Setup & Diag (F8) key to return to the Setup/Diagnostic Functions menu.

SECTION 8
I/O Bus Setup

The I/O Bus Setup menu is used to establish parity retry and specify the critical I/O bases. This section explains:

- How to display the I/O Bus Setup menu.
- How to use the Parity Retry function.
- How to specify critical I/O bases.

Displaying the I/O Bus Setup Menu

When the IO Bus Setup (F7) key is pressed from the Supervisor Functions menu, the I/O Bus Setup Functions menu appears:

```
CPU:RUN/ENBL/UNLOCKED     CPU ID: 1     LM NOTEQ CPU     LM:ONLINE   11:19:39

                        L O G I C M A S T E R (TM)

                I / O   B U S   S E T U P   F U N C T I O N S

       KEY #                                              FUNCTION

       F1 -  PARITY RETRY . . . . . . . . . .Specify Number of Retries
       F2 -  SPECIFY CRITCL . . . . . . . . . Specify Non-Critical Bases
       F3 -  SETUP & DIA . . . . . . . . . . . Setup/Diagnostic Functions











 PARITY  SPECFY                                                  SETUP
1 RETRY 2CRITCL 3      4           5        6       7        8& DIAG
```

I/O Bus Setup Functions Key Summary

The I/O Bus Setup Functions menu displays the following function keys:

Parity Retry (F1): Select ***Parity Retry*** to set the number of unsuccessful communication attempts that will be allowed before an I/O parity error occurs.

Specfy Critcl (F2): Select ***Specify Critical*** to identify critical and non-critical bases.

Setup & Diag (F8): Select ***Setup & Diagnostics*** to return to the Setup/Diagnostic Functions menu.

Setting Parity Retry

After a pre-determined number (default = 3) of unsuccessful attempts to read or write a byte of I/O data, the CPU reports an I/O parity error. This pre-determined number can be specified up to 15 by selecting a number from 0 to F (Hexadecimal).

The CPU normally stops when an I/O parity error is reported. If you want the CPU to continue running after repeated failures, you must set the most significant bit of the byte entered in the work area to 1. For example, the data entry 0A (Hexadecimal) specifies that the CPU will stop after 10 unsuccessful retries. The data entry 8A (Hexadecimal) means that after 10 unsuccessful retries, the CPU should continue I/O scanning, resuming at the next address.

To select the number of communication attempts desired, follow these steps:

1. The CPU must first be stopped, and the Logicmaster system must be on-line with communications established.
2. Using the numeric keypad, enter a number in the data value (bottom) line of the work area. (The work area defaults to Hexadecimal.) Legal byte values are 0 to F (Hexadecimal).
3. Press the Parity Retry (F1) key.
4. The system will prompt you to confirm this request. Press the Confirm (Shift/0) keys to complete this procedure. The changes will be effective on the next stop-to-run transition by the CPU.

Specifying Critical Bases

If a serious I/O error occurs in any rack or if power is lost from any rack, the CPU halts in STOP mode with a diagnostic and/or I/O error. It may be desirable, however, for the CPU to continue running in spite of problems with certain non-critical bases.

Using the Critical Rack function, you can tell the CPU *not* to stop if only non-critical racks are affected. This would allow the critical part of the process to continue until the whole system can be safely shut down for debug and repair.

Initially, all bases are critical. To specify the non-critical bases, enter a byte value in the work area in which a "1" in bit position x indicates that base x is non-critical. For example, the data entry 1C (Hexadecimal) corresponds to 00011100 (Binary), meaning that base units 2, 3, and 4 are non-critical; all others (0, 1, 5, 6, 7) are critical.

To select the number of non-critical bases, follow these steps:

1. The CPU must first be stopped, and the Logicmaster system must be on-line with communications established.
2. Using the numeric keypad, enter a number in the data value (bottom) line of the work area. (The work area defaults to hex.) Legal byte values are 00-FF (hex).
3. Press the Parity Retry (F1) key.
4. The system will prompt you to confirm this request. Press the Confirm (Shift/0) key to complete this procedure. The changes will be effective on the next stop-to-run transition by the CPU.

Returning to the Setup/Diagnostic Functions Menu

Press the Setup & Diag (F8) key to return to the Setup/Diagnostics Functions menu. You may also press the Suprv key to return to the Supervisor menu.

SECTION 9
Special Purpose Contacts and Registers

The Series Five PLC has several areas of memory that provide either special functions, system status information, or error reporting information. This section explains special purpose contacts and dedicated registers.

Special Purpose Contacts

Special purpose contacts consist of a group of 512 internal contacts with special system meaning. Some of these contacts provide special functions, such as a clock having a specific pulse width or time duration, while others provide system error information.

These contacts are not available as real world inputs, but can be used within your program as needed. References for these contacts are I1-0001 through I1-0512. Special purpose contacts listed as not used or for internal use by the CPU are not available.

NOTE

A 1 in the Definition column of the following table indicates a logic 1 (contact ON).

Table 10-3. Special Purpose Contacts (I1-0001 thru I1-0080)

REFERENCE	PURPOSE	DEFINITION
I1-0001	Initial Reset	On in Stop mode and for first scan after going to Run.
I1-0002	Always On	Used as an "always on" conditional contact.
I1-0003	Not used	Not available for program use
I1-0004	1 Minute Clock	Provides a pulse 30 seconds off, 30 seconds on.
I1-0005	1 Second Clock	Provides a pulse .5 seconds off, .5 seconds on.
I1-0006	100 ms Clock	Provides a pulse 50 ms off, 50 ms on.
I1-0007	50 ms Clock	Provides a pulse 24 ms off, 26 ms on.
I1-0008	Scan Time Clock	Provides a pulse on for 1 scan, off for 1 scan.
I1-0009	Not used	Not available for program use
I1-0010	Forced RUN	1 = running, CPU keyswitch in the RUN position.
I1-0011	OIU RUN	1 = running, CPU keyswitch in the OIU position.
I1-0012	Internal use	Not available for program use
I1-0013	Internal use	Not available for program use
I1-0014	Internal use	Not available for program use
I1-0015	OIU Stop	1 = CPU stopped, keyswitch in the OIU position.
I1-0016	Forced Stop	1 = CPU stopped by keyswitch in STOP position or by an error.
I1-0018	Internal use	Not available for program use
I1-0019	Internal use	Not available for program use
I1-0020	Suspend I/O	1 = I/O is suspended.
I1-0033	Critical System Error	1 = error, CPU goes to STOP mode.
I1-0034	Non-Critical System Error	1 = error, CPU remains in RUN mode.
I1-0035	Diagnostic Error	1 = error detected.
I1-0036	Battery Not Normal	1 = CPU or memory cartridge battery voltage low.
I1-0037	Memory Error	1 = latches if a memory cartridge error occurs.
I1-0038	I/O Error	1 = latches if I/O bus error is detected.

Table 10-3. Special Purpose Contacts (I1-0001 thru I1-0080) - Continued

REFERENCE	PURPOSE	DEFINITION
I1-0039	Communications Error	1 = turned ON by a CCM error. Next successful communications will turn it off.
I1-0040	I/O Configuration Error	1 = error detected, I/O configuration has changed since last power-up.
I1-0041	Internal use	Not available for program use
I1-0042	Watchdog Timeout	1 = Watchdog timer has timed out.
I1-0043	Internal Program Error	1 = Error.
I1-0044	Internal Math Error	1 = Error
I1-0045	Smart Module Comm. Error	1 = Error
I1-0046 to I1-0076	Internal Use	Not available for program use
I1-0077	RD CCM	1 = RD CCM thru CPU is busy; 0 = not busy.
I1-0078	RD CCM	1 = RD CCM thru CPU had error (see below); 0 = no error.
I1-0079	WR CCM	1 = WR CCM thru CPU is busy; 0 = not busy.
I1-0080	WR CCM	1 = WR CCM thru CPU had error (see below); 0 = no error.

Possible causes of the Read or Write CCM thru CPU error, listed in the table above, include the following:

1. The port is already in use by OIU.
2. The data length of the Read or Write command is less than 1 or greater than 128 bytes.
3. Trap mode, which is only legal for the Read CCM function, is specified for the Write CCM function.
4. Framing, parity or overrun error detected during read.
5. An illegeal register is specified as the operand.

Table 10-4. Special Purpose Contacts Smart Module Communications Status

SLOT	RACK 0	RACK 1	RACK 2	RACK 3	RACK 4	RACK 5	RACK 6	RACK 7
0	I1-81 I1-82	I1-97 I1-98	I1-113 I1-114	I1-129 I1-130	I1-145 I1-146	I1-161 I1-162	I1-177 I1-178	I1-193 I1-194
1	I1-83 I1-84	I1-99 I1-100	I1-115 I1-116	I1-131 I1-132	I1-147 I1-148	I1-163 I1-164	I1-179 I1-180	I1-195 I1-196
2	I1-85 I1-86	I1-101 I1-102	I1-117 I1-118	I1-133 I1-134	I1-149 I1-150	I1-165 I1-166	I1-181 I1-182	I1-197 I1-198
3	I1-87 I1-88	I1-103 I1-104	I1-119 I1-120	I1-135 I1-136	I1-151 I1-152	I1-167 I1-168	I1-183 I1-184	I1-199 I1-200
4	I1-89 I1-90	I1-105 I1-106	I1-121 I1-122	I1-137 I1-138	I1-153 I1-154	I1-169 I1-170	I1-185 I1-186	I1-201 I1-202
5	I1-91 I1-92	I1-107 I1-108	I1-123 I1-124	I1-139 I1-140	I1-155 I1-156	I1-171 I1-172	I1-187 I1-188	I1-203 I1-204
6	I1-93 I1-94	I1-109 I1-110	I1-125 I1-126	I1-141 I1-142	I1-157 I1-158	I1-173 I1-174	I1-189 I1-190	I1-205 I1-206
7	I1-95 I1-96	I1-111 I1-112	I1-127 I1-128	I1-143 I1-144	I1-159 I1-160	I1-175 I1-176	I1-191 I1-192	I1-207 I1-208

There are two special purpose contact references for each slot in each rack, as shown in the table above. Each reference is a status bit for smart module communications status, if a smart module is installed in that slot. Each reference has two conditions: 1 (ON) and 0 (OFF).

The status definition for the first refrence (i.e., I1-81) is:

```
0 = not executing
1 = executing
```

The status definition for the second reference (i.e., I1-82) is:

```
0 = no error
1 = error
```

Internal Coils with Special Meaning

A group of bits in the 02- internal output status table has special meaning for system use. These internal outputs are references O2-1000 through O2-1024, and are defined in the following table.

Table 10-5. Special Purpose Internal Coils

REFERENCE *	PURPOSE/DEFINITION
O2-1000	1 = OIU Escape key locked; 0 = unlocked
O2-1001	1 = OIU bell on; 0 = bell off
O2-1002	1 = OIU key click on; 0 = key click off
O2-1003	1 = OIU backlight on; 0 = backlight off
O2-1004	Printer output start: 1 = set by program; 0 = ready (set by OIU)
O2-1005	Printer error (set by OIU): 1 = error; 0 = no error
O2-1006	Transfer cartridge ID: 1 = set by program; 0 = set by OIU
O2-1007	Transfer command, OIU to CPU: 1 = set by program; 0 = set by OIU
O2-1008	Transfer command, CPU to OIU: 1 = set by program; 0 = set by OIU
O2-1009	Clear memory cartridge: 1 = set by program; 0 = set by OIU
O2-1010	1 = memory cartridge error; 0 = no error
O2-1011 to O2-1018	Reserved for future use
O2-1019	Genius Setup Error
O2-1020	Genius Fault Table Overflow
O2-1021	Genius Pulse Test
O2-1022	Genius Clear All Faults
O2-1023	Report Add or Loss of Device (except Hand Held Monitor)
O2-1024	Enable Genius Diagnostics

* For more information on O2-1000 thru O2-1010, refer to GFK-0181A, *Series Five Operator Interface User's Manual.*

Special Registers

Registers 3848 through 4096 are reserved by the system and the data to be stored in them has special meaning, as listed below. Some of the registers contain valuable information pertaining to various system errors. For example, when certain system errors or conditions occur, information relative to the error or condition is stored in specified registers, and is available for user intervention. These registers should not be used as general purpose registers for data storage or data manipulation.

Table 10-6. Special Register Definitions (R4000 thru R4096)

REGISTER REFERENCE	DEFINITION - CONTENTS OF REGISTER	DATA * FORMAT
R03848 - R03999	Default Genius diagnostics faults	Binary
R04000	OIU Data Transfer register	Binary
R04001	OIU Printer register	Binary
R04002	OIU Display register	Binary
R04003 - R04040	Reserved for future use	n/a
R04041	Genius bus scan time (slot 0)	Binary
R04042	Genius bus scan time (slot 1)	Binary
R04043	Genius bus scan time (slot 2)	Binary
R04044	Genius bus scan time (slot 3)	Binary
R04045	Genius bus scan time (slot 4)	Binary
R04046	Genius bus scan time (slot 5)	Binary
R04047	Genius bus scan time (slot 6)	Binary
R04048	Genius bus scan time (slot 7)	Binary
R04049	Genius diag - starting register for fault table (DEF=R03850)**	Binary
R04050	Genius diag - number of faults to be registered (DEF=15 max)**	Binary
R04051	Genius diagnostics - number of actual faults	Binary
R04052 - R04056	Reserved for future use	n/a
R04057	Genius bus controller slot 0 SBA conflict address/CCM RCV buffer pointer	Binary
R04058	Genius bus controller slot 1 SBA conflict address/CCM RCV buffer pointer	Binary
R04059	Genius bus controller slot 2 SBA conflict address/CCM RCV buffer pointer	Binary
R04060	Genius bus controller slot 3 SBA conflict address/CCM RCV buffer pointer	Binary
R04061	Genius bus controller slot 4 SBA conflict address/CCM RCV buffer pointer	Binary
R04062	Genius bus controller slot 5 SBA conflict address/CCM RCV buffer pointer	Binary
R04063	Genius bus controller slot 6 SBA conflict address/CCM RCV buffer pointer	Binary
R04064	Genius bus controller slot 7 SBA conflict address/CCM RCV buffer pointer	Binary
R04065	For OIU use - Start address of timer register area	Binary
R04066	For OIU use - Number of timers	Binary
R04067	For OIU use - Start address of counter register area	Binary
R04068	For OIU use - Number of counters	Binary
R04069	For OIU use - Message pointer for ASCII display (lower line)	Binary
R04070	For OIU use - Key code buffer for operator key entry	Binary
R04071	For OIU use - Message pointer for ASCII display (upper line)	Binary
R04072	OIU mode register	Binary
R04073	Address of math error	Binary
R04074	Not used	BCD
R04075	Current ID of module - I/O Config error	Binary
R04076	Previous ID of module - I/O Config error	Binary
R04077	Rack and Slot numbers - I/O Config error	BCD
R04078	Critical system error; e.g., no memory cartridge, CPU stops	BCD
R04079	Somewhat critical system error; e.g., blown fuse. CPU continues running.	BCD
R04080	System error - not serious; e.g., battery voltage low. CPU continues running.	BCD
R04081	Error Code - Module error	BCD
R04082	Circuit number - Module error	BCD
R04083	Rack and Slot number - Module error	BCD
R04084 - R04085	Reserved for future use	n/a
R04086	Scan counter	Binary
R04087	Seconds - calendar/clock	BCD
R04088	Minutes - calendar/clock	BCD
R04089	Hour - calendar/clock	BCD
R04090	Day of Week - calendar/clock (For day of week display on programmer: 0 = Sun, 1 = Mon, 2 = Tues, 3 = Wed, 4 = Thurs, 5 = Fri, 6 = Sat)	BCD
R04091	Day - calendar/clock	BCD
R04092	Month - calendar/clock	BCD
R04093	Year - calendar/clock	BCD
R04094	Last scan time (in milliseconds)	Binary
R04095	Minimum scan time (in milliseconds)	Binary
R04096	Maximum scan time (in milliseconds)	Binary

* View BCD data format in Hexadecimal mode.

** Initialized by the CPU on powerup; may be modified by the user program.

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 sections.

Section 1. 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 instructions to duplicate the original Logicmaster 5 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
Utilities Menu

This section explains:

- How to display the Utilities menu.
- The definitions of the Utilities function keys.

Displaying the Utilities Menu

To use the Utilities functions, press the Utilty Func (F8) key from the Supervisor menu. The Utility Function menu will appear:

```
                                                LM:OFFLINE   11:19:39


                 U T I L I T Y   F U N C T I O N   M E N U

   KEY #                                                     FUNCTION

   F1 -    DUPLIC MASTER. . . . . . . . .Duplicate Master Software
   F2 -    COPY FILE. . . . . . . . . . . . . . . . . . .Copy File
   F3 -    DELETE FILE. . . . . . . . . . . . . . . . .Delete File
   F4 -    DIR FILES. . . . . . . . . . . . . . . Directory of Files
   F6 -    PORT SETUP . . . . . . . . . . . . . . .Serial Port Setup
   F8 -    SUPERV MENU. . . . . . . . . .Return to Supervisor Menu





 DUPLIC    COPY   DELETE   DIR                 PORT            SUPERV
1MASTER 2 FILE   3 FILE  4FILES      5       6 SETUP 7         8 MENU
```

Utilities Function Key Summary

The Utility Function menu displays the following function keys:

Duplic Master (F1): Select ***Duplicate Master*** to make copies of the master diskette.

Copy File (F2): Select ***Copy File*** to copy one or more files.

Delete File (F3): Select ***Delete File*** to delete one or more files.

Dir Files (F4): Select ***Directory of Files*** 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 on-line to the system.

Port Setup (F6): Select ***Port Setup*** to specify the parameters of the serial port(s).

Superv Menu (F8): Select ***Supervisor Menu*** to return to the Logicmaster Supervisor Menu screen.

SECTION 2
Duplicating the Master Software

Use the Duplicate Master Software utility to copy the Logicmaster 5 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

To make a copy of each master software diskette using the Duplicate Master Software utility, follow these steps:

1. Format the diskette using DOS. (You must start with a newly formatted diskette.) For instructions on formatting diskettes and making bootable disks, refer to chapter 2.
2. Use the Duplicate Master utility to copy the Logicmaster 5 system files onto the formatted diskette. *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 Logicmaster 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 try to reload the program (including the .NAM file) from disk when you return to the Supervisor menu, overwriting the program currently stored in Logicmaster memory.

Duplicate Master Software: Single Diskette Drive System

Follow these instructions for a single-drive system:

1. Press the Duplic Master (F1) key from the Utilities menu. The Duplicate Master Software screen will appear:

```
                                                          LM:OFFLINE   11:19:39


                    D U P L I C A T E   M A S T E R   S O F T W A R E

                         DUPLICATE FROM :     DRIVE ID   A (A)

                         DUPLICATE TO   :     DRIVE ID   A (A)



                      << INSERT MASTER DISKETTE - PRESS ENTER >>

          WARNING :   -DESTINATION DISKETTE MUST PREVIOUSLY BE FORMATTED.
                      -DUPLICATE MASTER OVERWRITES USER PROGRAM MEMORY.
                       LOGICMASTER WILL ATTEMPT TO RELOAD PROGRAM FROM
                       DISK UPON RETURN TO SUPERVISOR.

                                                              UTILTY
 1        2        3        4           5        6        7        8 MENU
```

2. If the master software diskette (not a copy) is not presently installed, place it into the disk drive.
3. Press the Enter key. When prompted, remove the master diskette.
4. Insert a formatted diskette in the drive. Press the Enter key. *Once the Enter key is pressed, you may stop the Duplication process by pressing the Abort Duplic (F4) key.*
5. After some of the program has been placed on the diskette, a prompt will appear. In response to the prompt, 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 screen will display this message:

   ```
   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 Logicmaster 5 software.

The next return to the Supervisor level causes the system to search for the nickname file that was used last. The system will try to reload the program (including the .NAM file) from disk if there is an active file name.

Duplicate Master Software: Multiple Diskette Drive System

Follow these instructions for a multiple-drive system:

1. Press the Duplic Master (F1) key from the Utilities menu. The Duplicate Master Software screen will appear:

```
                                                    LM:OFFLINE    11:19:39


                D U P L I C A T E   M A S T E R   S O F T W A R E

                     DUPLICATE FROM :     DRIVE ID  A (A,B)

                     DUPLICATE TO   :     DRIVE ID  B (A,B)



                  << INSERT MASTER DISKETTE - PRESS ENTER >>

        WARNING :   -DESTINATION DISKETTE MUST PREVIOUSLY BE FORMATTED.
                    -DUPLICATE MASTER OVERWRITES USER PROGRAM MEMORY.
                     LOGICMASTER WILL ATTEMPT TO RELOAD PROGRAM FROM
                     DISK UPON RETURN TO SUPERVISOR.

                                                            UTILTY
 1       2       3       4          5       6       7       8 MENU
```

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 are displayed beside the prompt.
5. Press the Enter key. *Once the Enter key is pressed, you may stop the Duplication process by pressing the Abort Duplic (F4) key.*
6. The system begins copying the software onto the diskette. When the copying is complete, the screen will display this message:

   ```
   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 Logicmaster 5 software.

The next return to the Supervisor level causes the system to search for the nickname file that was used last. The system will try to reload the program (including the .NAM file) from disk if there is an active 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 the Duplic Master (F1) key from the Utilities menu. The Duplicate Master Software screen will appear:

```
                                                          LM:OFFLINE   11:19:39


                 D U P L I C A T E   M A S T E R   S O F T W A R E

                     DUPLICATE FROM :    DRIVE ID    (A,B,C)

                     DUPLICATE TO   :    DRIVE ID    (A,B,C)



                   << INSERT MASTER DISKETTE - PRESS ENTER >>

          WARNING :  -LOGICMASTER 5 SOFTWARE ON DISK WILL BE REPLACED.
                     -DUPLICATE MASTER OVERWRITES USER PROGRAM MEMORY.
                      LOGICMASTER WILL ATTEMPT TO RELOAD PROGRAM FROM
                      DISK UPON RETURN TO SUPERVISOR.

                                                                UTILTY
  1      2      3      4         5      6      7               8 MENU
```

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 the Enter key. *Once the Enter key is pressed, you may stop the Duplication process by pressing the Abort Duplic (F4) key.*
6. If not already present, the utility creates the directory /LM5 on the hard disk. System files are then copied into the LM5 subdirectory. When the copying is complete, the screen will display this message:

   ```
   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 Logicmaster 5 software.

The next return to the Supervisor level causes the system to search for the nickname file that was used last. The system will try to reload the program (including the .NAM file) from disk if there is an active 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: CON, AUX, COM1, COM2, PRN, LPT1, LPT2, LPT3, or NUL. These have special meaning to the system.

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:

Table 11-1. Wildcard Characters

CHARACTER	DESCRIPTION
*	The asterisk 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 of the same file name (PROGRAM1.*).
?	The question mark can be used to represent one character in a file name. For example, PROGRAM?.LAD and PROGRAM1.L??.

Both wildcard characters can be used together. For example, PROGRAM?.* means all files beginning with PROGRAM.

NOTE

When using wildcard 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 table defines the file name extensions used by the system.

Table 11-2. Program File Name Extensions

EXTENSION NAME	DESCRIPTION
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, Overrides, 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	The .LBU file contains a copy of the .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, this 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 generated 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.

In addition to the program files, other files of interest are:

Table 11-3. Miscellaneous Files

FILE NAME	DESCRIPTION
Fx.DEF	where x = 1-8. 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 File (F1) key is pressed from the Communications Setup menu.
PRINTER.SET	The Printer Setup file contains the printer data. This file is created or updated when the Save File (F5) key is pressed from the Define Printer screen.
PORT.PSU	The PORT1.PSU or PORT2.PSU file contains the serial port setup information entered with the Setup Serial Port utility. This file is created or updated when the Save File (F2) key is pressed from the Port Setup menu.
MACHINE.SET	The Machine Setup file sets up program windowing and color monitor default colors. This file is created or updated when the Save File (F1) key is pressed from the MSD Functions screen.

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 Logicmaster 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 try to reload the program (including the .NAM file) from disk when you return to the Supervisor menu, overwriting the program currently stored in Logicmaster memory.

To copy files, press the Copy File (F2) key from the Utilities menu. The Copy File screen will appear:

```
                                                        LM:OFFLINE   11:19:39

                                  C O P Y   F I L E

            COPY FROM :  SERIAL PORT/DRIVE ID      A     (2/A,B)
                         FILE NAME

            COPY TO   :  SERIAL PORT/DRIVE ID      B     (2/A,B)
                         FILE NAME

                        << PRESS ENTER TO COPY FILES >>


     NOTE:  USER PROGRAM MAY NEED TO BE RELOADED UPON RETURN TO SUPERVISOR




                                                                  UTILTY
 1       2       3       4               5       6       7       8 MENU
```

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 wildcard 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 information on wildcards, refer to ''Using Wildcards to Represent Parts of File Names''.

   To copy the primary program files (.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 an old file with the same name, and the old file will be lost.

5. Press the Enter key. If the entries for source and destination are correct, the copy begins. To stop the Copy File procedure in progress, press the Abort Copy (F4) key.
6. Respond to any prompts to insert and remove diskettes. When the copying is complete, the screen will display this message:

```
FILE COPY COMPLETED
```

If multiple files were copied using wildcard characters, the names of the files will appear 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 logic	program.LAD	program.LBU
Rung explanations & 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. To delete files, press the Delete File (F3) key from the Utilities menu. The Delete File screen will appear:

```
                                                LM:OFFLINE    11:19:39

                          D E L E T E   F I L E

                          DRIVE ID     B    (A,B)
                          FILE NAME

                     << PRESS ENTER TO DELETE FILES >>




                                                        UTILTY
 1      2      3      4        5      6      7       8 MENU
```

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 File Names''.

   To delete the primary program files (.LAD, .RDF, .NAM, and .EXP files), enter just the file name without an extension.

3. Press 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 (no). Use this option with care. After the last file is found and deleted, the screen will display this message:

```
DELETIONS COMPLETED
```

To stop the Delete File procedure in progress, press the Abort Delete (F4) key.

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.

When the Dir Files (F4) key is pressed from the Utilities menu, the following screen appears:

```
                                              LM:OFFLINE    11:19:39

                     D I R E C T O R Y   O F   F I L E S

                        DRIVE ID         B  (A,B)
                        FILE NAME
                        PRINTER PORT        (2,3)

                     << PRESS ENTER TO LIST FILES >>




                                                           UTILTY
 1    2    3    4         5    6    7    8 MENU
```

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 File Names''.
3. To print a copy of the listing, enter the number of the printer port.

4. Press the Enter key. A listing of files appears on the directory screen. The listing has the following format:

```
    FILE            NUMBER OF              LAST MODIFIED
    NAME              BYTES           DATE                 TIME

PROGRAM1.LAD          3078          01-15-88             13:19:29
PROGRAM1.LBU          3016          01-15-88             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 Scrolling 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 Dir (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 the Abort/Dir (F4) key. Press the Enter key to start the Directory from the beginning.

To return to the Utilities menu, press the Utilty Menu (F8) key.

SECTION 4
Setting up the Serial Ports

The serial ports in the system (designated 1 and 2) can be used for serial printers or CCM RS-232/422 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:

- The default settings for the serial ports.
- 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

When the Port Setup (F6) key is pressed from the Utilities menu, the Serial Port Setup screen will appear:

```
                                                LM:OFFLINE   11:19:39


                         S E R I A L   P O R T   S E T U P

          PORT NUMBER     1    (1,2) -- PORT TO BE SETUP 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)




   SETUP    SAVE    SHOW    SHOW                                UTILTY
  1 PORT  2 FILE  3 PORT  4 FILE     5       6       7        8 MENU
```

The screen shows the characteristics for a port. The bottom of the screen shows these function key assignments:

Setup Port (F1): Select ***Setup Port*** to implement the parameters.

Save File (F2): Select ***Save File*** to create a Port Setup file.

Show Port (F3): Select ***Show Port*** to display the present port parameters.

Show File (F4): Select ***Show File*** to display the port parameters from a file.

Utilty Menu (F8): Select ***Utility Menu*** to return to the Utility menu screen.

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 the Show Port (F3) key.

Displaying Parameters in a Port Setup File

Port Setup values may be stored in a program file with the file name extension .PSU. To determine the current values contained in a Port Setup 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 the Show File (F4) key. The current setup 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 CPU, the parameters set up must match those of the CPU port. It is also necessary to configure the hardware, as described in appendix A.

Default settings are provided for ports 1 and 2. (These ports correspond to DOS devices COM1 and COM2, respectively.) The defaults match the factory settings of the serial port on the CPU. The default serial port settings are shown below in parentheses.

1. Enter the following information about the device that will be using the serial port:

   A. **Baud Rate:** The communications rate, in bits per second. (Default = 19200)

   B. **Stop Bits:** All CPU communications use one stop bit. Slower devices may use two stop bits. (Default = 1)

   C. **Parity:** 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. (Default = none. Setting parity to NONE will ensure compatibility with modems which do not support ODD parity.)

   D. **Data Bits:** Specify whether the device recognizes 7 or 8 bit words. (Default = 8)

   E. **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). (Default = N)

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, begin this setup procedure with step 2.

   If this setup is intended only until power is removed from the system, or until new setup information is entered, press the Setup Port (F1) key to execute the setup.
4. If this setup will be stored in a file, place the system diskette in a drive, and enter the letter designation of the drive. The setup 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 \LM5 subdirectory.
5. Enter the file name PORT1.PSU or PORT2.PSU, depending on whether you are setting up port 1 or 2. The file may be stored as any file name.PSU, but must be renamed to either PORT1.PSU or PORT2.PSU, depending on whether you want to set up port 1 or port 2 automatically at power-up.
6. Press the Save File (F2) key. The setup file will be placed on the Logicmaster 5 system diskette. However, the setup information in the file will not be used until the file is loaded into Logicmaster memory during the next power-up. To activate the setup during the current session, press the Setup Port (F1) key to execute the setup.

Chapter 12
Programming

Chapters 1 through 11 of this manual describe the features and use of Logicmaster 5 software.

Chapters 12 and 13 are about programming the Series Five PLC. This chapter presents general programming concepts. Chapter 13 describes the specific programming instructions for the Series Five PLC.

This chapter consists of the following sections:

Section 1. Ladder Logic Programs: Section 1 describes the CPU scan, the format of a program, elements of a program, and program references.

Section 2. CPU Tables and Memories: Section 2 describes the ways the Series Five CPU stores discrete and register references in memory. You will need this information to assign program references.

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 Five CPU executes the ladder program as part of its regular scanning cycle.

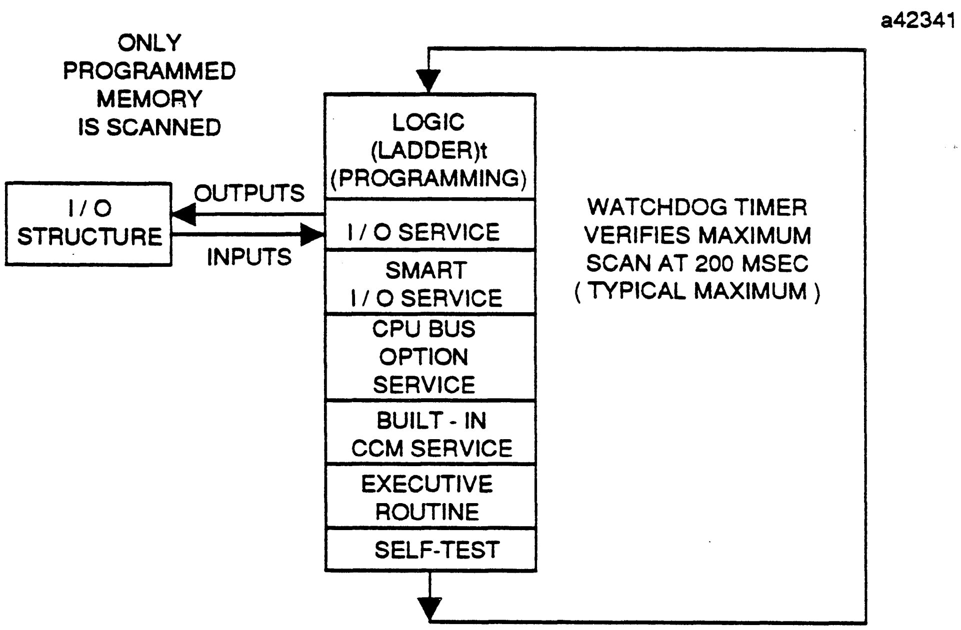


Figure 12-1. CPU Scanning Cycle

The CPU begins executing the logic at the first function in memory. It proceeds sequentially through all the memory addresses until it reaches 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 services the I/O connected to the system. The CPU transfers output status to output modules, and reads the status of input modules.

The CPU also services other devices, such as the built-in CCM port, Intelligent I/O modules, and CPU Bus option modules.

The CPU then performs a check of its internal hardware and resets the watchdog timer. The watchdog timer is a hardware timer which ensures that memory or internal circuit faults do not cause the CPU to enter an endless loop because of hardware failure. The watchdog timer value is user selectable (through the Scratch Pad function of Logicmaster 5 software. Valid values for the watchdog timer are 20 to 998 ms. The factory default setting is 200 ms. If the watchdog timer expires before the sweep completes, then the CPU will go to Stop mode.

After successfully completing the internal checks, the CPU begins the next scan. This repetitive scanning operation is performed continuously while the CPU is in the Run mode.

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.

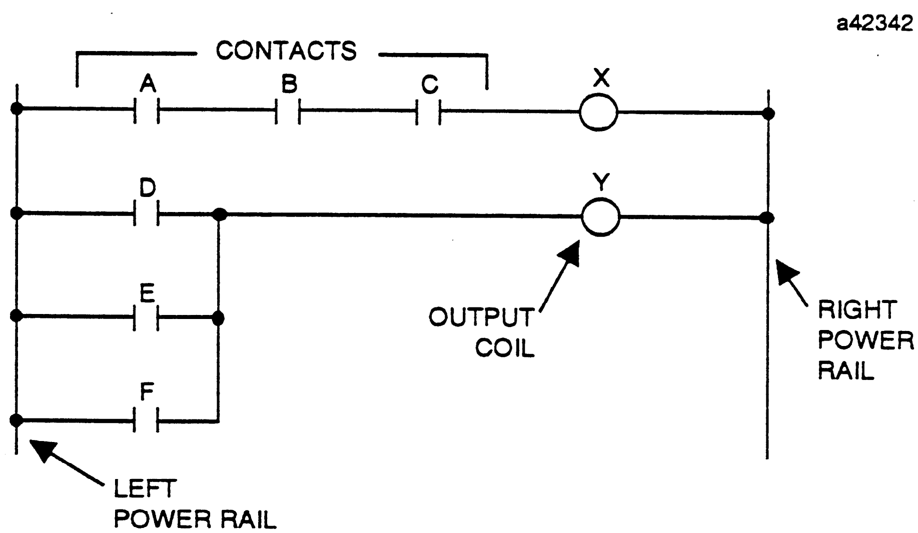


Figure 12-2. Ladder Diagram Format

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.

A single rung should be limited to nine contacts in series plus a coil. A rung can have as many as eight contacts in parallel. Logicmaster 5 software can display seven parallel contacts on the screen at one time. If there are eight parallel branches in the rung being displayed, you can use the Up and Down cursor keys to display the first seven lines of logic, or the second through eighth lines of logic.

Elements of a Ladder Diagram

A ladder program consists of a sequence of linked "rungs". Each rung begins at the left side, which is called a rail. Each rung can include up to 8 parallel lines of logic. However, each logic rung may have only one connection to the right rail.

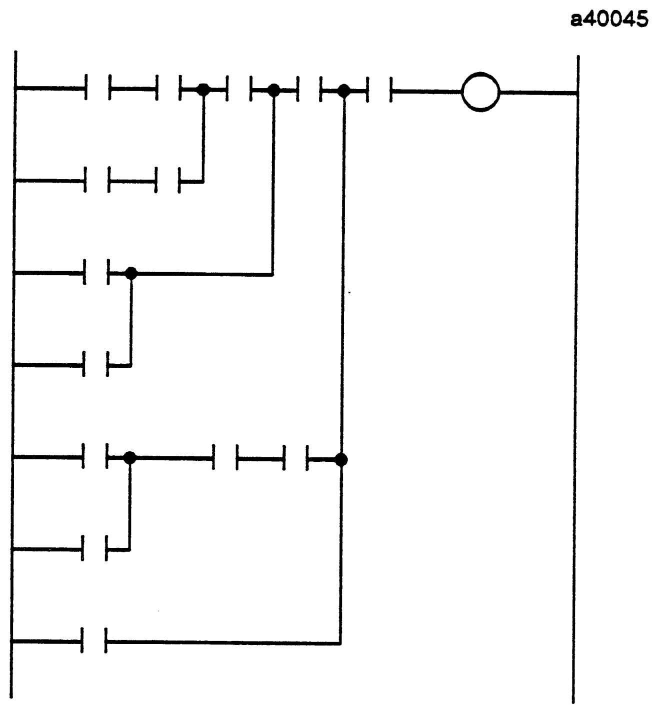


Figure 12-3. Ladder Diagram With Parallel Lines Of Logic

Each line of a rung may consist of up to nine program elements (instructions) entered in series and an output. Vertical connections can be made between two parallel lines of logic in positions (columns) 1 through 9.

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.

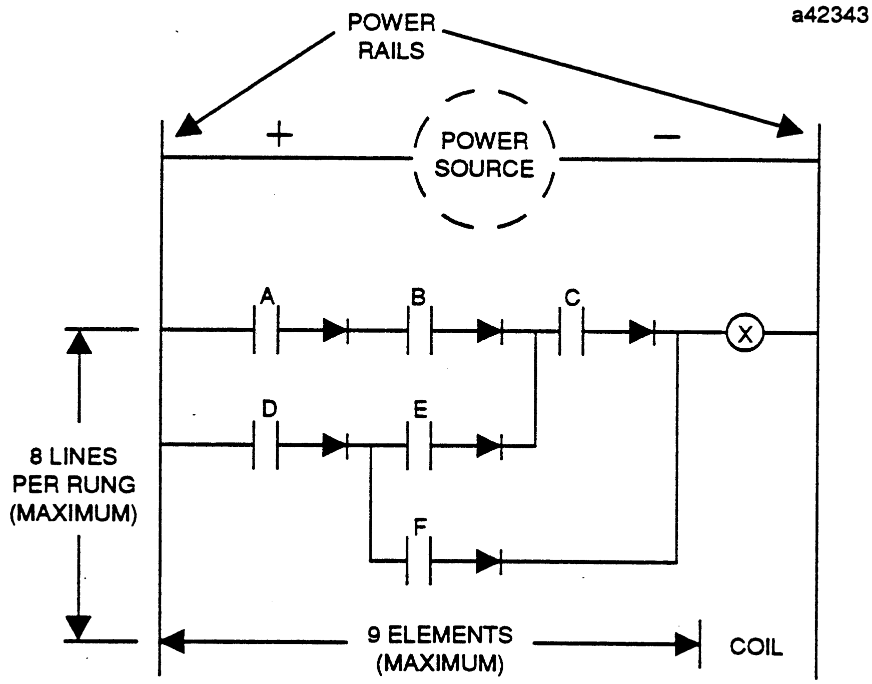


Figure 12-4. Sample Diagram Showing Flow Of Power

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: Nothing allowed in parallel with a mnemonic.

```
+--|  |--+--|  |--+--|  |--+--|  |--+--|  |--+|xxxxx|+-------+-------+--( )--+
                                             |       |
                                             +--| |--+
```

Illegal Rung: More than nine series contacts.

```
+--| |--+--| |--+              +--| |--+--| |--+--| |--+--| |--+--| |--( )-+
                |              |
                |              |
                +              +--------+
                |                       |
                |                       |
                +--| |--+--| |--+--| |--+
```

Illegal Rung: Starting a branch within a branch.

```
    A         B         C
+--| |--+--| |--+--| |--+-------+-------+-------+-------+-------+-------+-( )-+
        |                 |
        |     D         E |
        +--| |--+--| |--+
                |
    F           |
+--| |--+-------+
```

Format of a Ladder Diagram Function

Whether simple or complex, the functions that make up a line of logic have a similar format.

```
  |_______   Reference (input)
  I0145
---| |---
     |
     |____   Function (contact)

  |_______   Reference (output)
  00001
---(  )
     |
     |____   Function (relay coil)

  |_______   Reference (register)
  R00004
--|ACC|--
     |
     |____   Function (mnemonic instruction)
```

Each function is represented by a symbol or ''mnemonic''. For example:

```
---|/|---              symbol for a normally-closed contact.

-|  BIN TO BCD  |-     mnemonic for Binary-to-BCD Conversion function.
```

Types of References

The values used by the functions in a program are either constants, registers, or I/O table references. During programming, the place for the reference 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.

A reference may be an I/O address or a register. Some functions use a sequence of adjacent memory locations to store data. Only the first reference is entered into the ladder diagram. This is called an ''explicit reference''. The other addresses that are used by the function, but do not appear in the ladder diagram, are called ''implicit references''.

SECTION 2
CPU Tables and Memories

Each I/O module in the system must be assigned a status table address. The CPU uses this starting address to send or receive I/O data from the module. Some modules (i.e., the Genius bus controller) do not use any status table addresses.

A module can be assigned an address in either the local or remote status tables. This section describes where the Series Five CPU stores discrete and register references in memory. You will need this information to assign program references.

Refer to the appropriate heading:

- Local Input table.
- Local Output table.
- Override table.
- Register Memory.
- Remote Input tables.
- Remote Output tables.

Many of the functions in a program can reference the input and output status tables and register memory in the CPU. Certain hardware (CPU) tables are also used by the functions. These tables and the various memories are summarized below. All tables are retained during power failure.

Local Input Table

In a program, inputs are used to represent contacts activated by devices (pushbuttons, limit switches, analog sensors, or relay contacts). Inputs that represent actual hardware devices are called "real" inputs.

Inputs also represent contacts operated by output coils of program functions (relays, counters, timers, latches, and one-shots). Input references that do not represent actual hardware inputs are called "internal" inputs.

Most modules will be assigned an address in either the Local Input or Output status table. There are 1024 local inputs available, numbered from 1 to 1024. The address of a module must start on an even byte boundary (i.e., I0001, I0009). The user specifies the module starting address. The starting address plus the number of bits used by the module must *not* exceed the length of the table (I1024).

Local Output Table

In a program, outputs are used to represent the coils of relays, counters, timers, latches, and one-shots. Like inputs, there are also real and internal outputs.

There are 1024 outputs available, numbered from 1 to 1024. As in the Input table, the address of a module must start on an even byte boundary (i.e., O0001, O0009). The user specifies the module starting address. The starting address plus the number of bits used by the module must *not* exceed the length of the table (O1024).

Override Table

The Override table is divided into four parts: the Input Override table, Output Override table, Channeled Input Override table, and Channeled Output Override table. Override tables are used by the following functions: relay contacts and outputs, counters, timers, latches, and one-shots. *Mnemonic functions ignore the Override table when operating on the Input and Output tables.*

When a bit in the Input, Output, Channeled Input, or Channeled Output table is overridden, it is maintained in the state (ON or OFF) it was in when the override was applied. This state remains the same until the override is removed or its state is changed. *Overridden bits can be changed by the mnemonic functions.*

Local Inputs and Outputs, and Channeled Inputs and Outputs can be overridden as described in chapter 7, *Display Reference Tables.*

Register Memory

The term ''register'' refers to a group of 16 consecutive bits located in register memory. The structure of these registers is fixed. Each register is numbered, beginning at 0001.

```
Registers        0001 |____________|
                 0002 |____________|
                 0003 |____________|
                   .  |____________|
                   .  |____________|
                   .  |____________|
            4K or 16K |____________|
```

Register memory consists of 4K or 16K consecutive 16-bit storage locations, depending on the CPU. Some of the mnemonic functions refer to locations in the Register memory and use those locations for data manipulation when specifying lists, storing results of arithmetic operations, data tables, data moves, and matrices.

Remote I/O Addressing

An I/O module can be assigned an address in the Remote I/O Status table. This is normally done only when the module is assigned to a remote Genius bus controller.

Output modules, which are assigned to the Remote Output table, can be controlled directly by a remote Genius bus controller, with no user programming required in the CPU which contains the module.

Similarly, input modules assigned to the Remote Input table can be read directly by a remote Genius bus controller, with no user programming required in the CPU which contains the module. If a module is assigned to the Remote Status table, the GEN (Genius) LED on the module will be on.

There are four Remote I/O tables, each 1K (1024 bits) long. Valid addresses for these tables are:

- I1+0001 to I1+1024.
- I2+0001 to I2+1024.
- O1+0001 to O1+1024.
- O2+0001 to O2+1024.

The address of a module must start on an even byte boundary (i.e., I1+0001, I1+0009, O2+0001, O2+0009). The user specifies the module starting address. The I1+ and I2+ tables are contiguous, as are the O1+ and O2+ tables. This means, for example, that if a 16-point output module is assigned to O1+1017, its status table addresses will be from O1+1027 to O1+1024 and from O2+0001 to O2+0008. The starting address plus the number of bits used by the module must not exceed the length of the table (I2+1024 or O2+1024).

Format for Addressing Remote I/O

The format for addressing Remote I/O must include:

- Either an Input (I) or Output (O) reference identifier.
- Channel number: 1 or 2.
- Point type: plus (+) or minus (-).
- The I/O reference number.

This format is shown in the example below:

```
                              I1 + 0022
                              ||   |   |
          I = Input ___________|   |   |__  I/O Reference Number
          O = Output           |   |
                               |   |_____   + = I/O Reference State (Remote I/O)
Channel Number (1-2) __________|            - = I/O Reference Status (Internal I/O)
```

Thus, the format for real world I/O points for table 1 is I1+0001 to I1+1024 for inputs and O1+0001 to O1+1024 for outputs.

When referencing an I/O point in a program, a prefix must properly address the applicable I/O table. Remote references for tables 1 to 2 are referenced in the following example: I1+0101, O2+0101, I1+0234, or O2+0567.

Entering Channeled I/O References

To enter a Channeled I/O reference, follow these steps:

1. In the *center* line of the work area, enter an I for an Input or O for an Output. This can be done using the I or O key on the numeric keypad, or by using the Ctrl/I or Ctrl/O key combinations, as described in chapter 2.
2. Press and hold the Ctrl key. At the same time, press either number 1 or 2 on the numeric keypad to enter table 1 or 2.

NOTE

Pressing the Ctrl/Clear keys removes the table number and the ± sign from the reference line of the work area. If you are using a PC keyboard, refer to the Alternate and Control key functions described in chapter 2.

3. Press the Shift and ±2 keys to toggle the sign field. Enter a plus (+) or minus (-) sign, depending upon whether the I/O is real (+) or internal (-). You may also use the Ctrl/= keys to toggle between the plus and minus sign in the work area.
4. Enter the point address, which is a number from 0001 to 1024.

Chapter 13
Series Five Function Set

The Series Five function set includes relays, timers, counters, latches, one-shots, BCD conversion, special control functions, math and data manipulation functions, table move functions, list functions, matrix functions, subroutines, and functions that control I/O servicing.

Chapter 5, *Edit Program*, explains how to perform the editing involved in creating a program. This chapter defines the functions that can be included in a program.

Use this chapter as a reference guide. Within the chapter, functions are grouped into sections that correspond to the function key assignments used during programming.

NOTE

A complete listing of the contents of this chapter appears on the next page. The page numbers provided in this listing will help you to quickly locate a detailed description of each instruction.

Within a section, each function is explained separately. Step-by-step instructions for entering the functions in a rung are included at the beginning of each section, along with a table listing the reference ranges for those functions in that section.

The following notation is used throughout this chapter:

```
******  =  Address
   ddd  =  Decimal
 ddddd  =  Decimal
-ddddd  =  Signed Decimal
  hhhh  =  Hexadecimal
     D  =  Double Precision Signed Decimal
    Rs  =  Register size:    4,096 for 4K register systems
                              16,384 for 16K register systems
     I  =  Local Input
   I1+  =  Remote Input
   I2+  =  Remote Input
   I1-  =  Internal Status Input
     O  =  Local Output
   O1+  =  Remote Output
   O2+  =  Remote Output
   O1-  =  Internal Output
   O2-  =  Internal Output
     R  =  Register
     C  =  Constant
```

Configuring Scratch Pad

Before programming, you should configure the Scratch Pad in Off-Line mode to match the capabilities of the CPU that will receive the program. Specify the amount of CPU register memory that is available. After these selections are made, the Logicmaster 5 software will prevent the entry of references that are incompatible with the register memory of the CPU.

Table 13-1. Series Five Function Set

FUNCTION	DESCRIPTION	PAGE
Relay Functions	Normally Open Contacts Normally Closed Contacts Coils (Relay, One-Shot, and Latch)	13-7 13-7 13-8
Timers and Counters	Timer Preset and Accumulate Counter Preset and Accumulate	13-14 13-12
Shift/Move Functions	Binary-to-BCD Conversion BCD-to-Binary Conversion	13-18 13-19
Special Functions	Master Control Relay (MCR) Skip No Operation End Sweep Read/Write CCM Read/Write Device Transfer	13-21 13-22 13-23 13-23 13-23 13-28 13-31
Data Move Functions	Move A to B Move Left 8 Bits Move Right 8 Bits Block Move	13-35 13-35 13-36 13-36
Arithmetic Functions	Signed Addition Signed Subtraction Signed Multiplication Signed Division Double Precision Addition Double Precision Subtraction Greater Than Equal	13-41 13-41 13-43 13-44 13-42 13-42 13-45 13-45
Table Move Functions	Source to Table Move Table to Destination Move Move Table	13-48 13-49 13-50
List Functions	Add to Top Remove from Bottom Remove from Top	13-54 13-54 13-55
Matrix Functions	Logical AND Logical Inclusive OR Logical Exclusive OR Logical Invert Bit Set Bit Clear Bit Sense Shift Right Shift Left	13-59 13-59 13-60 13-61 13-62 13-63 13-64 13-65 13-66
Control Functions	Do Subroutine Return from Subroutine Suspend I/O Do I/O	13-68 13-70 13-70 13-71

SECTION 1
Series Five Function Set

The Series Five function set contains some instructions that are also found in the Series Six expanded instruction set. In most cases, these instructions operate in a way that is compatible with the Series Six instruction set. The differences between these instruction sets are summarized below.

Functions Not Implemented

The Series Five function set does not use auxiliary references like those used with the Series Six instruction set, so auxiliary contacts and outputs cannot be programmed.

The Series Five function set also does not support Series Six floating point math functions.

Some of the Series Six basic instruction set op codes, such as ADD and SUB, are not present in the Series Five function set. In most of these cases, a more advanced instruction from the Series Six advanced or expanded instruction set is available to perform the function (such as ADDX or SUBX, in this case).

Several instructions not in the Series Six instruction set have been included in the Series Five function set.

General Differences in Operand Types and Ranges

The Series Five Local I/O supports 1024 input and 1024 output points. All 1024 points can be used for physical I/O. (Series Six Local I/O supports only 1000 I/O.) Channeled I/O consists of:

- 2048 remote inputs and 2048 remote outputs.
- 2048 internal outputs.
- 512 internal status inputs.

None of these tables are mapped into the register space, and all have override bits, except for the 512 internal status inputs.

For programming purposes, all mnemonic references to tables must be on even *word* boundaries (i.e., I0001, O0017). The I1- table, which contains the internal status bits, is *read* only. Logicmaster 5 software will not allow the I1- table to be used as the destination field in an instruction.

Registers in the range 3850-3999 should not be used if compatibility with Genius diagnostics is desired.

All registers in the range R04000-R04096 are reserved locations. These registers are used to store error information, real time clock, scan time, and other system data. Therefore, to avoid compatibility problems, these registers should not be used as general purpose registers.

Some of the registers in the range R04000-R04096 are written by the CPU, so all of these registers should be treated as read only registers. If your program does write to these registers, the data will be overwritten by the CPU.

Differences in Programming

A few Series Five instructions differ slightly from their Series Six counterparts. These differences are summarized below:

Equal: The Series Six Expanded Compare instruction allows either or both of the references in this instruction to be a constant. In the Series Five Equal instruction, only reference A can be a constant.

Do I/O and Suspend I/O: These instructions work for both the local I/O and Remote (Genius) I/O. The DO I/O instruction is programmed using operands from 1 to 3072. Values from 1 to 1024 correspond to Local Input and Local Output tables. The range 1025 to 2048 corresponds to the I1+ and O1+ tables, and values from 2049-3072 relate to the I2+ and O2+ tables.

DOSUB: There are 32 subroutines available in the Series Five instruction set, so valid subroutine numbers are 1-32.

Timer/Counter Preset: When a constant is used, the valid range is now 0 to 65,535. (In the Series Six instruction set, the range is 0 to 999.)

Differences in Execution

There are a few execution differences between the Series Five and Series Six instruction sets.

Bit Set and Bit Clear: The Series Five instructions perform the Set and Clear functions, respectively, but do not perform the Sense function when there is no input power flow. A separate Bit Sense instruction performs the Sense function (see next page).

Matrix Operations: The Series Five instruction set uses a separate buffer to store the results of Matrix operations. After the instruction is completed, the buffer is written to the result matrix. As a result, matrix calculations are not order sensitive, as they are in the Series Six instruction set.

For example, using the AND matrix Series Six instruction, if the operands were R1, R1, and the result was stored in R2, with a length of 5; incorrect results would be obtained. Operands R2, R2, and R1 would work, however, since the result does not overwrite the input matrix. In the Series Five instruction set, either of these schemes is acceptable.

New Instructions

Several new instructions are included in the Series Five instruction set. They are briefly described below.

Transfer: The Series Five Transfer instruction is a general-purpose data move type instruction which can move data between memory located anywhere in the system. The instruction contains a single register operand which specifies the starting address of a block of five registers. These registers contain the source address, destination address, and length of data to be transferred.

NOTE

The Transfer instruction is provided to support future Series Five options and functions. Further documentation on this instruction will be provided in the future, as required. This instruction should not be used at this time, except as specified by GE Fanuc in an application note or other publication.

Read/Write CCM: These Series Five instructions are used to move data from/to the CCM master module. These instructions contain a single register operand which specifies the starting address of a block of five registers. The registers contain the base and slot number of the CCM Communications module, the starting address within the target device, the length of the data transfer, and the starting register in the CPU which contains data to transmit or which will receive data.

Read/Write Device: These instructions are used to move data from/to the High Speed Counter module, and possibly to other future smart modules. These instructions contain a single register operand which specifies the starting address of a block of five registers. The registers contain the base and slot number of the smart module, the starting address within the target device, the length of the data transfer, and the starting register in the CPU.

Bit Sense: In the Series Six instruction set, the Bit Sense function is performed by the Bit Set and Bit Clear instructions when there is no input power flow. The Series Five instruction set provides a separate instruction for this purpose. The format of Bit Sense is similar to the Bit Set and Bit Clear instructions. The operation is as follows:

- When the input power flow state is OFF, the instruction does not execute and the output power flow state is OFF.
- When the input power flow state is ON, the output power flow state is equal to the state of the bit specified by reference BIT. If reference BIT is zero or greater than LEN, the output power flow state is OFF.

SECTION 2

Relays

This section is a reference to the Relay functions:

- Normally-Open Contact
- Normally-Closed Contact
- Relay Coil
- One-Shot Coil
- Latch Coil

Entering Relay Functions

To enter a Relay function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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 Relay (F1) to display the Relay function keys at the bottom of the screen.

5. At this point, the cursor should be at the position where you wish to enter a Relay function. Press the appropriate key for the Relay function you wish to select:

   F1 = Normally-Open Contact
   F2 = Normally-Closed Contact
   F3 = Shunt
   F7 = Coil

6. If you press the F7 function key, the Coil function keys will be displayed at the bottom of the screen. You can then select one of these functions:

   F4 = Vertical Connection
   F5 = Latch Coil
   F6 = One-Shot Coil
   F7 = Relay Coil

   NOTE

   Refer to the following pages in this section for more information on these functions.

7. Using the numeric keypad, type in a reference for the contact. Refer to the following table for the reference ranges of each function.

8. After entering the reference, press the Enter key.

9. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Table 13-2. Reference Ranges for Relay Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Normally-Open or Normally-Closed Contact	Input or Output	I or O= 1-1024 I1+ or O1+= 1-1024 I2+ or O2+= 1-1024 I1-= 1-512 O1- or O2-= 1-1024		
Coil or Latch	Output	O= 1-1024 O1+ or O2+= 1-1024 O1- or O2-= 1-1024		
One-Shot	Output	O= 1-1024		

Normally-Open Contact

A Normally-Open Contact passes power flow to the right if the contact status is ON (equal to 1). If the contact status is OFF (equal to zero), power flow is not passed to the right.

Symbology:

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

Operation:

```
ON  = Passes power flow.
OFF = Does not pass power flow.
```

A Normally-Open Contact can be placed anywhere in the first 9 columns and 8 lines of a rung. If more than nine contacts are needed in series, enter the first nine and assign an output coil reference to a coil in position 10. Use a contact from that coil as the first contact in the next rung of logic. In this way, as many contacts as needed can be placed in series.

Normally-Closed Contact

A Normally-Closed Contact passes power flow to the right if the contact status is OFF (equal to zero). If the contact status is ON (equal to 1), power flow is not passed to the right.

Symbology:

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

Operation:

```
ON  = Does not pass power flow.
OFF = Passes power flow.
```

A Normally-Closed Contact can be placed anywhere in the first 9 columns and 8 lines of a rung. If more than nine contacts are needed in series, enter the first nine and assign an output coil reference to a coil in position 10. Use a contact from that coil as the first contact in the next rung of logic. In this way, as many contacts as needed can be placed in series.

Coil

A Relay Coil represents an output device that is on when power is received. Coil references can be used as often as necessary in a program; however, a coil can only be placed in the tenth column of the first line of a rung. It is the last state of the coil that is transmitted to the output hardware at the end of the scan.

Symbology:

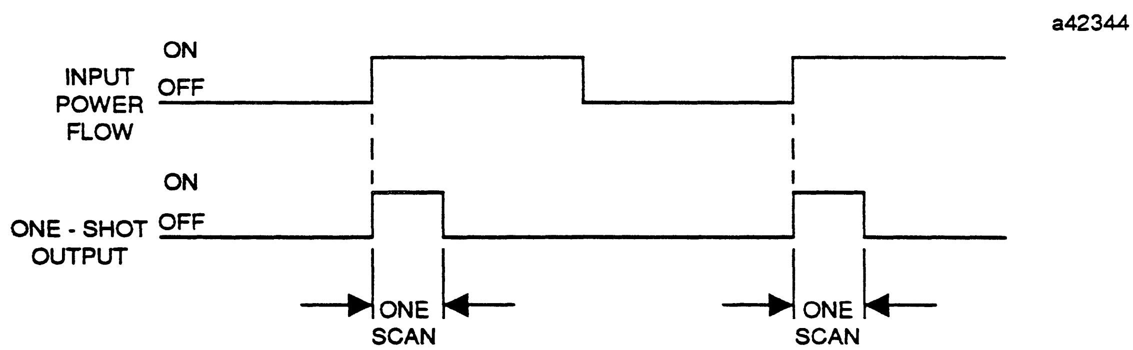
```
 *******
---(   )
```

Operation:

```
ON  = Receiving power flow.
OFF = Not receiving power flow.
```

One-Shot

A One-Shot is a positive edge-triggered output, which stays on for one scan *only*. One-shot coils will output power flow for one scan when an OFF-to-ON transition occurs. This function is useful for controlling operations having a short duration, such as start commands or data sampling.



Symbology:

```
 *****
---(OS)
```

Operation:

The coil turns on for one scan when an OFF-to-ON transition occurs. The input to the one-shot must turn off before the one-shot can be retriggered. A Coil can only be placed in the tenth column of the first line of a rung.

Latch

Two lines of logic are used to control the latch coil. The top line of logic is the latch input. The bottom line is the unlatch input. The latch is a retentive coil. This means that if both inputs to the latch are off, the output state will be maintained, even during a power cycle.

```
|
|---| |---| |-+-| | -+-|/|-----------------------------------|LATCH|---( L)
|             |       |                                               (  )
|---| |---| |-+       |                                               (  )
|                     |                                               (  )
|---| |---------------+                                               (  )
|                                                                     (  )
|---| |-+-| |---------------------------------------------------------(UL)
|         |
|---| |-+
|
```

Symbology:

```
                   *******
---|LATCH|---( L)
             (  )
             (  )
-------------(UL)
```

Operation:

When power flows to the coil from the top line of logic, the coil is turned on. This ''sets'' the latch. When power flows to the coil from the second line of logic, the coil is turned off. This resets the latch. If both lines supply power to the coil at the same time, the coil is turned off. If both the lines are off, then the latch output maintains its previous state.

LATCH INPUT	UNLATCH INPUT	PRESENT OUTPUT STATE	NEXT OUTPUT STATE
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

A latch output uses the ninths and tenths columns of the upper line of logic. Parallel logic may be used, with up to 8 total lines in the rung. Contacts cannot be placed in parallel with the Latch function in the ninth column of the first line of logic.

A latch is unlatched by an active MCR if the latch is within the scope of the MCR.

SECTION 3
Timer and Counter Functions

This section is a reference to the Timer and Counter functions:

- Up Counter
- Down Counter
- Seconds Timer
- Tenths Timer
- Hundredths Timer

Using Logic in the Reset Rung of a Timer or Counter

The first element in the reset line of a counter or timer must be a contact. Timers and counters will not operate correctly if a mnemonic instruction is the first element in the reset line. For example, this counter will not execute correctly:

```
|
| I0001                                                         Const     00001
|--| |---------------------------------------------------------| PRE |----(CU)
|                                                               +00025     (  )
| *******            *******                                   R00001     (  )
|-| A        EQUAL         B     |-----------------------------| ACC |----( R)
|                                                               00000
|
```

However, a contact placed at the left rail will cause the counter to execute correctly. This same example would look like this:

```
|
| I0001                                                         Const     00001
|--| |---------------------------------------------------------| PRE |----(CU)
|                                                               +00025     (  )
| I1-0002  *******            *******                          R00001     (  )
|--| |-----| A        EQUAL         B     |--------------------| ACC |----( R)
|                                                               00000
|
```

Now, the A Equal to B function, which controls power flow to the reset, will execute every time the normally-open contact passes power flow. The counter will be reset when I0002 is ON and A=B.

To conserve I/O points, the "always on" internal input I1-0002 can be used to always enable power flow to a mnemonic instruction.

Entering Timer and Counter Functions

To enter a Timer or Counter function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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 for the upper part of the rung, leading to the preset in column 9.
4. Select Timer/Countr (F2) and then Preset (F1). The cursor moves to the ninth column, and the screen displays the following new function key assignments:

```
                                  rung                T/C     EDIT
1 PRE   2ACCUML 3        4          # 5      6      7 COIL  8 MENU
```

5. To enter the preset, press the Pre (F1) key.
6. To enter a reference for the preset, enter any valid register reference or any constant up to 16,383. After entering the reference, press the Enter key.
7. After the preset is entered, the cursor moves to column 10. The screen displays the following new function key assignments:

```
                   +-(CU)  +-(CD)  rung  +-(TS)  +-(TT)  +-(TH)   EDIT
1PRESET 2ACCUML 3  UP    4 DOWN     # 5 SEC  61/10 S 71/100S 8 MENU
```

8. Select the type of timer or counter by pressing the appropriate function key. The coil display appears in column 10. For example, this is the display for an Up Counter:

```
     ******  *****
---| PRE  |---(CU)
     ddddd    (  )
    R*****    (  )
---| ACC  |---( R)
     ddddd
```

NOTE

Refer to the following pages in this section for more information on timers and counters.

9. Using the numeric keypad, type in a reference for the coil. Refer to the following table for the reference ranges of each function.
10. After entering the reference, press the Enter key.
11. If you have not already done so, enter the logic to reset the accumulate register now. When this logic is complete, select Accuml (F2) to enter the Accumulate Register. The Accumulate display appears in column 9 of the reset line:

```
    R*****
---| ACC  |---( R)
     ddddd
```

12. Using the numeric keypad, type in the reference for the Accumulate Register. Refer to the following table for the reference ranges of each function. After entering the reference, press the Enter key.
13. Complete the logic for the rung; then press the Accept key. The Edit key functions reappear at the bottom of the screen.

NOTE

Parallel logic may be used, with up to 8 total lines in the rung. It is not legal to place contacts in parallel with the PRE or ACC instructions. Logicmaster 5 software will prevent parallel contacts from being entered in these locations.

Table 13-3. Reference Ranges for Timer and Counter Functions

FUNCTION	TYPE	PRESET	ACCUMULATE	OUTPUT
Timer	Output			O= 1-1024
			O1+ or O2+= 1-1024	O1+ or O2+= 1-1024
			O1- or O2-= 1-1024	O1- or O2-= 1-1024
	Register	R= 1-Rs	R= 1-Rs	
	Constant	C= 0-16,383		
Counter	Output			O= 1-1024
	Register	R= 1-Rs	R= 1-Rs	
	Constant	C= 0-16,383		

Counters

There are two types of counters: Up Counters and Down Counters. Both store the preset value in a register or constant and the current value of the counter in an accumulate register. Counters increment or decrement upon detecting a transition in power flow from OFF to ON (positive edge triggered).

Symbology:

```
        ******   *****
    ---| PRE |---(CU)         For R:
        ddddd     ( )         ddddd = 0 to 65,535
       R*****     ( )             C = 0 to 16,383
    ---| ACC |---( R)
        ddddd
```

Up Counters

The Up Counter contains two lines of logic. The top line is the count line. An OFF to ON transition on this line will cause the accumulate value to increment by one if the reset line is off. The bottom line of logic is the reset line. If this line is on, the accumulate value will be set to zero. The reset line takes precedence over the count line, and the counter will stay reset as long as the reset line is on. If both the count and reset lines are off, the counter maintains its current state. The output will be on if the accumulate value is greater than or equal to the preset value. The counter will accumulate counts until the count reaches 65,535, at which point OFF to ON transitions of the count line have no effect on the accumulate value.

Down Counters

The Down Counter contains two lines of logic. The top line is the count line. An OFF to ON transition on this line will cause the accumulate value to decrement by one if the reset line is off. The bottom line of logic is the reset line. If this line is on, the accumulate value will be set to the preset value. The reset line takes precedence over the count line, and the counter will stay reset as long as the reset line is ON. If both the count and reset lines are off, the counter maintains its current state. The output will be on if the accumulate value is equal to zero. When the accumulate value reaches zero, OFF to ON transitions of the count line have no effect on the accumulate value.

Displaying Preset and Accumulate Values

The Operator Interface Unit (OIU) allows you to display the preset and accumulate values for timers and counters. In order to use this feature, however, you must specify the preset and accumulate registers in a specific order.

If the counter access function of the OIU is to be used, the counter presets and accumulates should be programmed as follows:

Counter presets and accumulates are located in a contiguous block of registers. The first register of the block is the accumulate register for counter 1; the next register is the preset register for counter 1. The next two registers contain the accumulate and preset registers, respectively, for counter 2, and so on.

Register 4067 contains the starting register number of the counter accumulate and preset values (that is, the register number for counter 1 accumulate value). Register 4068 contains the number of counters to be displayed by the OIT (range is 1 to 999). The user program should write the proper values into R4067 and R4068. Refer to the OIT User's manual for more detailed information on the display of timer/counter registers.

The illustration below shows a sample program using a timer and two counters programmed as a 24-hour clock.

```
 O0001                                                              Const   O0001
--|/|---------------------------------------------------------------| PRE |---(TS)
                                                                    +00060    (  )
 00001                                                              R00001    (  )
--| |---------------------------------------------------------------| ACC |---( R)
                                                                     00000

 O0001                                                              Const   00002
--| |---------------------------------------------------------------| PRE |---(CU)
                                                                    +00060    (  )
 O0002                                                              R00002    (  )
--| |---------------------------------------------------------------| ACC |---( R)
                                                                     00000

 00002                                                              Const   00003
--| |---------------------------------------------------------------| PRE |---(CU)
                                                                    +00024    (  )
 00003                                                              R00003    (  )
--| |---------------------------------------------------------------| ACC |---( R)
                                                                     00000

-|ENDSW|-

-|ENDSW|-
```

```
Notes:   R00001  =  Time in seconds.
         R00002  =  Time in minutes.
         R00003  =  Time in hours.
         00001   =  ON for one scan every minute.
         00002   =  ON for one scan every hour.
         00003   =  ON for one scan every day.
```

Timers

A Timer accumulates elapsed time. Timers accumulate time in one of three increments:

- Seconds (TS).
- Tenths of seconds (1/10 S or TT).
- Hundredths of seconds (1/100 S or TH).

Symbology :

```
       ******   *****
---| PRE |---(TH)            For R:
     ddddd     (  )          ddddd = 0 to 65,535
    R*****     (  )              C = 0 to 16,383
---| ACC |---( R)
     ddddd
```

Displaying Preset and Accumulate Values

The Operator Interface Unit (OIU) allows you to display the preset and accumulate values for timers and counters. In order to use this feature, however, you must specify the preset and accumulate registers in a specific order.

If the timer access function of the OIU is to be used, the timer presets and accumulates should be programmed as follows:

Timer presets and accumulates are located in a contiguous block of registers. The first register of the block is the accumulate register for timer 1; the next register is the preset register for timer 1. The next two registers contain the accumulate and preset registers, respectively, for timer 2, and so on.

Register **4065** contains the starting register number of the timer accumulate and preset values (that is, the register number for timer 1 accumulate value). Register 4066 contains the number of timers to be displayed by the OIT (range is 1 to **999). The** user program should write the proper values into R4065 and R4066. Refer to the OIT User's manual for more detailed information on the display of timer/counter registers.

Typical Timer

The upper line of logic for the rung contains the preset, which may be a constant or a register. The preset determines the maximum value for the timer. The maximum value of a constant preset is 16,383. If a register is used as the reference for a timer, the maximum value it may contain is 65,535.

When power flows only through the top line, the timer is enabled and begins to accumulate time in the selected increments. If power flow to the top of the rung is interrupted, the timer stops accumulating time. When power flow is restored, the timer resumes timing from the accumulate value. **When the** value in the accumulate register equals or exceeds the preset value, the coil turns on.

The lower line of logic for the rung contains the accumulate register. When power flows to the bottom line of a timer, the value in the accumulate register is reset to zero, the coil is de-energized, and timing is disabled. The reset input takes precedence over the timer input. As long as the reset input is on, the timer will be reset.

All timers are based on the crystal in the CPU. Long-term accuracy is +0.01 percent. Short-term accuracy is minus the time increment plus the scan time.

Cascaded Timer

If longer periods must be timed, timers can be cascaded to increase their range while maintaining their accuracy. The example below shows a timer (O0002) that turns on after 24 hours (86,400 seconds) have elapsed. The first timer (O0001) turns on after 60,000 seconds. This enables the second timer (O0002), which turns on after 26,400 seconds. I0001 starts the clock, and I0002 resets it.

```
|
|  I0001                                                        R00001    O0001
|---| |--------------------------------------------------------| PRE |---(TS)
|                                                               +60000     (  )
|  I0002                                                        R00002     (  )
|---| |--------------------------------------------------------| ACC |---( R)
|                                                                00000
|
| O0001                                                         R00003    O0002
|--| |---------------------------------------------------------| PRE |---(TS)
|                                                               +26400     (  )
| I0002                                                         R00004     (  )
|--| |---------------------------------------------------------| ACC |---( R)
|                                                                00000
```

Master Timer

Greater range can also be obtained by the use of a master timer. A master timer establishes the basic accuracy, and counters are slaved from it. The example below shows a counter (O0002) that turns on after 24 hours have elapsed. The timer (O0001) turns on after 1 hour (3,600 seconds) has elapsed. When the timer turns on, the counter is incremented. The counter will turn on after 24 hours. I0001 starts the clock, and I0002 resets it.

```
|
| I0001                                                          Const    O0001
|--| |---------------------------------------------------------| PRE |---(TS)
|                                                               +03600     (  )
| I0002                                                         R00002     (  )
|--| |---+-----------------------------------------------------| ACC |---( R)
|        |                                                       00000
| O0001  |
|--| |---+
|
| O0001                                                          Const    O0002
|--| |---------------------------------------------------------| PRE |---(CU)
|                                                               +00024     (  )
| I0002                                                         R00004     (  )
|--| |---------------------------------------------------------| ACC |---( R)
|                                                                00000
```

SECTION 4
Shift/Move Functions

This section is a reference to the Shift/Move functions:

- Binary-to-BCD Conversion
- BCD-to-Binary Conversion

Entering Shift/Move Functions

To enter a Shift/Move function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select Shift/Move (F3) to display the Shift/Move function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Shift/Move function. Press the appropriate key for the Shift/Move function you wish to select:

   F5 = Binary to BCD Convert
   F6 = BCD to Binary Convert

   NOTE

   Refer to the following pages in this section for more information on these functions.

6. As the cursor moves to each value within the Shift/Move function, use the numeric keypad to type in a address reference for each BCD and BIN value. Refer to the following table for the reference ranges of each function.
7. After entering a reference, press the Enter key. The cursor will then move to the next value.
8. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

NOTE

A Binary-to-BCD or BCD-to-Binary instruction can be placed in columns 1 to 8 of the top line of a rung, or the reset line.

Logicmaster 5 software will automatically change an I/O address down to the first bit contained in the word. For example, if the addresses 10018 through 10032 are entered, the software will change the reference to 10017.

Table 13-4. Reference Ranges for Shift/Move Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Bin to BCD	Input output Register	R= l-1024	I= l-1009 o= l-1009	
BCD to Bin	Input output Register	I= l-1009 o= l-1009	R= l-1024	

Convert Binary to BCD

Binary-to-BCD-conversion takes binary data from a register and provides it to the I/O structure in BCD format. Binary-to-BCD conversion can be used to drive to BCD encoded LED displays or presets to external devices such as high-speed counters,

Symbology:

```
   R****   *****          hhhh  = 0 to FFFF
-|  BIN TO BCD |-         ddddd = 0 to 65,535
   ddddd   hhhh
```

Operation:

The source of the binary data can be a register from 1 to 1024. Converted data is stored in a word of the input or output table. Words of the I/O table are addressed on multiples of 16 plus one (for example, I0017, I0065, 00129). Because 16 references are required, the maximum point number of the second reference is either 11009 or 01009.

Every scan that power flows to the BIN/BCD function, the program converts the 16 bits of binary data beginning in the first reference into a BCD pattern. If the value in the register is greater than 9999, only the lower four digits are placed in the I/O and output power flow is generated to indicate an error.

If inactive (no power flow), all references remain unchanged and the output is off.

Convert BCD to Binary

The BCD-to-Binary function converts BCD data from the I/O structure into binary data and stores it in register memory. BCD/Binary conversion can be used to interface to BCD thumbwheels or external BCD electronics, such as high-speed counters or position encoders.

Binary Coded Decimal (BCD) uses 10 of the 16 possible states of 4 bits of the I/O table to represent the decimal digits O-9. The chart below shows how the binary values of four I/O bits are used to encode the decimal values.

DECIMAL DIGIT	BCD REPRESENTATIONS			
	BIT NUMBER 3, WEIGHT 8	BIT NUMBER 2, WEIGHT 4	BIT NUMBER 1, WEIGHT 2	BIT NUMBER 0, WEIGHT 1
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
A B C D E F	ILLEGAL VALUES NOT USED.			

Symbology :

```
        *****  R****           hhhh = 0 to FFFF
   -I   BCD TO BIN |-          ddddd = 0 to 65,535
        hhhh  ddddd
```

Operation:

Every scan that power flows to the BCD/BIN function, it converts the BCD values represented by the 16 I/O references (4 digits) starting at the first reference into a single binary number from 0000 - 9999. The binary number is then stored in the second reference.

If the selected I/O reference contains illegal BCD digits, then the result will be computed as the binary sum of the BCD weights of the bits in the word. Output power flow will be generated to indicate an error.

If inactive (no power flow), all references remain unchanged and the output is off.

SECTION 5
Special Functions

This section is a reference to these Special functions:

- Master Control Relay (MCR)
- skip
- No Operation
- End Sweep
- Read/Write CCM
- Read/Write Device
- Transfer

NOTE

The Read/Write CCM, Read/Write Device, and Transfer functions are accessed through the Control Function keys.

Entering Special Functions

To enter a Special function, follow the procedure described below.

NOTE

For the entry procedures of the Read/Write CCM, Read/Write Device, and Transfer functions, refer to the detailed information on these functions provided later in this section.

1. From the Supervisor menu, select Edit Prog (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 for the rung, leading to where you wish to enter the Special function. Logic located before the Special function will execute normally, and will not be affected by the Special function.
4. Select Spec Func (F5) to display the Special function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Special function. Press the appropriate key for the Special function you wish to select:

F1 =MCR
F2 = skip
F3 = No operation
F4 = End Sweep

NOTE

Refer to the following pages in this section for more information on these functions.

6. Using the numeric keypad, enter the number of referenced coils to be bypassed during an MCR or Skip function. It must be a constant from 0 to **255.** Enter 0 to have the MCR active to the next Return or End Sweep function. After entering the number, press the Enter key.

NOTE

The No Operation and End Sweep functions have no references to be entered.

7. When the rung is complete, press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Master Control Relay

Every scan that power is received, a Master Control Relay (MCR) function causes a portion of the program after the MCR to be bypassed. All coils associated with the rungs that are skipped will be forced off, unless overridden. Program execution resumes after the specified number of rungs, or at the next Return or End Sweep command.

```
| 01000    Const
|--| |--+| MCR |
|        |  +002
| 10001  |
|--| |--+
|        |
| I0002  |
|--| |--+
|
|
| 10009                                                    Const    00101
|--| |--------------------------------------------------| PRE |---(TS)
|                                                       +03600     ( )
| 10100                                                 R00002     ( )     |
|--| |--------------------------------------------------| ACC |---( R)     |
|                                                        00000             |
|                                                                          |
| 10101    R00513 R00129  Const                                        Span of
|--| |---| SRC-TO-TABLE     LEN|-----------------------------------( )   Control
|                           050                                            |
|                                                                          |
| 00056    10997                                                   00102   |
|--| |--+--| |------------------------------------------------------ ()    |
|        |
| 10100  |
|--| |--+
|
|
| 00057    00058    10100                                          00103
|--|/|-----| |-----|/|---------------------------------------------- ( )
```

Symbology :

```
       Const                 ddd = 0 to 255
     -| MCR |-
        ddd
```

Operation:

When the MCR is active, all of the outputs associated with the timers, counters, one-shots, latches, or relays within its scope are turned off. These coils cannot be changed with an on-line change or overrides.

If inactive (no power flow), all references remain unchanged and the output is off.

Only coils with output references are included in determining the area to be skipped. Rungs that end in mnemonics can have dummy coils without references. The execution of these rungs is also skipped, but they do not count toward the total number of rungs to be skipped. If the number 0 is entered for the MCR, all logic to the next Return or End Sweep instruction is controlled by the MCR.

Master Control Relays and Skips (see below) can be used in building shift registers, stepping switches, and other logic functions.

A Master Control Relay instruction can be placed in columns 1 through 9 of the top line of a rung, or the reset line.

Skip

A Skip function is similar to a Master Control Relay, except that coils are nor turned off. They remain in their pre-Skip condition until power flow is removed from the Skip. Program execution resumes after the specified number of rungs, or at the next Return or End Sweep instruction.

Symbology :

```
       Const                 ddd = 0 to 255
     -|SKIP |-
        ddd
```

Operation:

When the Skip is active, all of the outputs associated with the timers, counters, one-shots, latches, or relays within its scope are frozen unless overridden or changed from an outside source (not the user logic program).

If inactive (no power flow), all references remain unchanged and the output is off.

Only coils with valid output references are included in determining the area to be skipped. Rungs that end in mnemonics can have dummy coils without references. The execution of these rungs is also skipped, but they do not count toward the total number of rungs to be skipped. If the number 0 is entered for the Skip, all logic to the next Return or End Sweep instruction is controlled by the Skip.

A Skip instruction can be placed in columns 1 through 9 of the top line of a rung, or the reset line.

No Op

Program a No Operation (No Op) function to occupy memory that will later be used for a real function. A No Op function can also be used to form a break between areas of logic.

Symbology:

```
-(NO OP|-
```

Operation:

No action. Passes power flow when active.

A No Operation instruction can be placed in columns 1 through **9** of the top line of a rung, or the reset line.

End Sweep

An End Sweep function separates the main program from subroutine logic. The system places an End Sweep function at the end of the main program. Instructions which follow a single End Sweep are part of subroutines. An End Sweep can only appear in column 1 of the top row and must appear on a line by itself; nothing is allowed in series with this function.

Two End Sweep instructions indicate the end of the entire ladder logic program.

Symbology:

```
-|ENDSW|-
```

Read/Write CCM

The Read CCM and Write CCM instructions move data to and from the CCM Master module or Genius bus controller. You can use the READ CCM instruction to request data from a remote device through the CCM Master module or the Genius bus controller to a data register buffer in the local CPU. With the Write CCM instruction, you can send data from the local CPU through the CCM Master module to a remote CCM compatible device, or to a remote CPU with a Genius bus controller. Each of these instructions has a single register operand which specifies the starting address of a block of six registers containing the following information:

- Slot number of the local CCM Master module or Genius bus controller.
- Target CCM ID or serial bus address.
- Target memory type.
- Starting address within the memory type of the remote target device.
- Length of the data to be transferred.
- Starting register in the local CPU for the data buffer.

Symbology :

```
 R*****             R*****
-|RDCCM|-    or    -|WRCCM|-
```

Operation:

Before execution, the following registers must contain the data listed below. (Refer to the table which follows for information on CCM/CPU mapping.)

Read CCM:

```
R***** = Slot number of local CCM Master module or Genius bus controller.
   + 1 = Target CCM ID or serial bus address of Genius bus controller.
   + 2 = CCM memory type to read from (see table below).
   + 3 = Start address in target.
   + 4 = Length to read (registers).  The maximum length allowed is 64.
   + 5 = First register in local receive buffer.
```

Write CCM:

```
R***** = Slot number of local CCM Master module or Genius bus controller.
   + 1 = Destination CCM ID or serial bus address of Genius bus controller.
   + 2 = CCM memory type to write to (see table below).
   + 3 = Start address in target.
   + 4 = Length to write (registers).  The maximum length allowed is 64.
   + 5 = First register in local transmit buffer.
```

After execution, the register data buffer pointed to by R***** +5 will contain the data from the remote device.

Special internal bits affected are I1-0081 to I1-0204 and I1-0045 for the CCM Master module and Genius bus controller.

Table 134. CCM/CPU Mapping

Table Name	Range and Reference Numbers	Offset Values	Target Memory Type for Table	Target Memory Type for Override	Data Format
Registers	R00001-R16384 (for 16k reg)	0001H-4000H	1	N/A	2 Bytes/Register
	R00001-R04096 (for 4k reg)	0001H-1000H	1	N/A	2 Bytes/Register
I1+ Inputs	I1+0001-I1+1024	0001H-0080H	2	4	8 Inputs/Byte
I2+ Inputs	I2+0001-I2+1024	0081H-0100H	2	4	8 Inputs/Byte
Local Inputs	10001-11024	0101H-0180H	2	4	8 Inputs/Byte
special Inputs	11-0001-11-0512	0181H-01C0H	2	N/A	8 Inputs/Byte
O1+ outputs	O1+0000-O1+1024	0001H-0080H	3	5	8 Outputs/Byte
O2+ outputs	O2+0000-O2+1024	0081H-0100H	3	5	8 Outputs/Byte
Local outputs	00001-01024	0101H-0180H	3	5	8 Outputs/Byte
Internal coils	02-0001-02-1024	0201H-0280H	3	5	8 Outputs/Byte
Scratch Pad *	0000-0900H	0000-0900H	6	N/A	1 Byte/Byte
user Logic	OOOO-16,383	0000-3FFFH	7	N/A	2 Bytes/Word
CCM Diagnostics	0000-0009	0000-0009	9	N/A	1 Byte/Byte

Notes: H = Hexadecimal.
* Extreme care must be used when **writing** to any Scratch Pad location area. It is recommended that you consult GE Fanuc **before doing this.**

Entry:

1. From the Supervisor menu, select Edit Prog (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 Advncd Mn Gr (F7), Contrl Func (F6), Read Write (F5), and then Read CCM (F1) or Write CCM (F2). The Read/Write CCM display will appear.
5. Using the numeric keypad, type in the reference for the transfer.
6. After entering the reference, press the Enter key.
7. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Example of Reading from a Remote Device:

1. Read inputs 10017-10048 from the remote Series Five CPU/CCM Master module with CCM ID number 20H.
2. Load the data into registers R00200-R00201. Assume that the local CCM module is in slot 5.
3. Preset the registers with the following data:

```
R01001 = 05    (slot number of local CCM Master module).
R01002 = 20H   (CCM ID of remote CPU).
R01003 = 02    (memory type = input table).
R01004 = 103H  (start address for input table, 10017).
R01005 = 02    (number of words to fetch; also, length of data buffer).
R01006 = 0200  (data buffer to start at register R0200).
```

4. Execute the following:

```
      R01001
    -|RDCCM|-
```

5. During execution, status bit I1-0091 will indicate the transfer status:

```
0 = done.
1 = executing for slot 5.
```

Status bit I1-0092 will indicate the error status:

```
0 = OK.
1 = error for slot 5.
```

The data buffer for this example will contain the following data:

```
R00200 = 0002  (inputs 17, 19-32 are 0, input 0018 is 1).
R00201 = 0004  (inputs 33, 34, 36-48 are 0, input 35 = 1).
```

Example of Writing to a Remote CCM Device:

1. Write data buffer (R00220-00222) to outputs 1-48 in a remote Series Five CPU/CCM master module with CCM ID number 4. The local CCM master module is in slot 2.

2. Preset the registers as follows:

```
        R00501 = 02     (lock CCM master module is in slot 2).
        R00502 = 04     (target CCM ID).
        R00503 = 03     (target memory type = output table).
        R00504 = 0101H  (starting address for outputs l-48).
        R00505 = 03     (number of words to send).
        R00506 = 220    (start data buffer at register 220).
 R00220-R00222 = data to send.
```

3. Execute the following:

```
  R00501
 -|WRCCM|-
```

4. During execution, status bit I1-0085 will indicate the transfer status:

```
0 = done.
1 = executing for slot 2.
```

Status bit I1-0086 will indicate the error status:

```
0 = OK.
1 = error for slot 2.
```

Read/Write CCM through the CPU Port (CPU version 3.1 or later)

The Read CCM and Write CCM instructions can be used to read and write unformatted data through the 25-pin port in the Series Five CPU. This enables the CPU to directly output register data to a printer, or to an operator display. Also, it is easy to implement operator input or output via a serial data terminal.

The Write CCM instruction sends unformatted register data out the port. The Read CCM instruction can be used in two ways: by reading a known number of characters, or by continuing to read characters until a known character string is received.

Data is transmitted from (or written to) the Series Five Register table at a user-specified address. Internal status contacts are used to indicate busy/done status and error status. These contacts are used in the user logic program to interlock consecutive Read/Write CCM requests, and to know the validity of the data received.

The format for using the Read CCM request through the CPU port is shown below:

```
    10001    I1-77          R****
|-----] [-----] [----------[  RD CCM  ]-----|

R**** = CPU slot (must be 13 decimal).
   +1 = 0 = Length mode; 1 = Trap mode.
   +2 = Don't care for Length mode; trap sequence for Trap mode.
   +3 = Don't care for Length mode; trap sequence for Trap mode.
   +4 = Length mode:  number of registers to fill (1 to 64).
        Trap mode:  maximum number of registers to fill before abort.
   +5 = First register to fill.
```

The format for using the Write CCM request through the CPU port is shown below:

```
     10001  I1-79           R****
|----- 1 I ----- 1 [ ----------[  WR CCM  ]-----I

R**** = CPU slot (must be 13 decimal).
   +1 = Don't care.
   +2 = Don't care.
   +3 = Don't care.
   +4 = Number of consecutive registers to write (1 to 64).
   +5 = First register to write from.
```

Example: Write CCM Request

```
     10001   11-79           R0010
|----- 1 [ ----- 1 [ ----------[  WR CCM  ]-_--_I

R0010 = 00013 (13 = CPU's slot number)
R0011 = 00000 (Don't care)
R0012 = 00000 (Don't care)
R0013 = 00000 (Don't care)
R0014 = 00004 (Write 4 registers of data -- 8 bytes)
R0015 = 02050 (First register to write is R2050)

R2050 = 3231H ("21")
R2051 = 3433H ("43")
R2052 = 4241H ("BA")
R2053 = 4443H ("DC")
```

When the Write CCM request executes, "1234ABCD" is transmitted from the port. From the time the Write. CCM request is initiated until the last byte is transmitted, I1-79 will be on (indicating busy). If an error is detected in the data format, then I1-80 will turn on.

Example: Read CCM Request through the CPU Port (Fixed Length mode)

```
     10001  I1-77            R1234
|-----   1 [ ----- 1 [ ----------[  RD CCM  ]-----I

R1234 = 00013 (13 = CPU's slot number)
R1235 = 00000 (0 = Length mode)
R1236 = 00000 (Don't care)
R1237 = 00000 (Don't care)
R1238 = 00004 (Fill 4 registers with data; then quit)
R1239 = 03456 (First register to fill is R3456)
```

If the Read CCM request executes and the data coming in the port is A B C D 1 2 3 4, then the registers would fill up as:

```
R3456 = 4241H ("BA")
R3457 = 4443H ("DC")
R3458 = 3231H ("21")
R3459 = 3433H ("43")
```

Special contact I1-77 will be off until the Read CCM request is initiated; then it will go on. When the eighth byte of data has been received, I1-77 goes off and the received data is transferred to R3456-R3459. I1-78 will be off until the instruction executes. If an error is detected, then I1-78 will turn on.

Example: Read CCM Request through the CPU Port (Trap mode)

Instead of waiting for a specified number of characters to be received, data is stored to the specified registers (up to a specified maximum) until a specific data sequence is encountered (normally CR LF), as shown below:

```
     I0001   I1-77          R1234
|-----1 I-----1 [----------[  RD  CCM  ]-----|

R1234 = 00013 (13 = CPU's slot number)
R1235 = 00000 (1 = Trap mode)
R1236 = OAODH (Stop receiving on CR LF . . . . . .
R1237 = 003EH    .....  ">" sequence)
R1238 = 00004 (If trap sequence is not received, fill 4 registers mar,)
R1239 = 03456 (First register to fill is R3456)
```

If the Read CCM request executes and the data coming in the port is B C D CR LF >, then the registers would fill up as:

```
R3456 = 424lH ("BC")
R3457 = 0044H ("D")
R3458 = 00000 (CR LF > is not stored since it is the trap sequence)
R3459 = 00000
```

Special contact I1-77 will be off until the Read CCM request is initiated; then it will go on. When the last byte of the trap sequence has been received, I1-77 goes off and the received data is transferred to R3456-R3459. I1-78 will be off until the instruction executes. If an error is detected, then I1-78 will tum on.

The trap sequence must be received exactly as specified. For example, if the sequence A B CR LF V < is received, the sequence will not be trapped. If four maximum registers have been specified and the sequence A B CR LF **V c** 1 2 3 4 5 6 is received, the first 8 bytes of data are stored in the registers.

The trap sequence may consist of up to four non-0 ASCII characters (1-FFH).

Read/Write Device

The Read Device and Write Device instructions move data from and to the High Speed Counter module, Axis Positioning Module (APM), or other Smart module, such as the Analog I/O module. Each of these instructions has a single register operand which specifies the starting address of a block of five registers. These five registers contain the following information:

- Base number of the High Speed Counter, or other intelligent module.
- Slot number of the High Speed Counter, or other intelligent module.
- Starting address within the module which receives or sends the data.
- Length of the data to be transferred.
- Starting register in the CPU for the data buffer.

NOTE

Refer to the manual provided with each individual module for more information on the operation of that particular module.

Symbology :

```
     R*****              R*****
   -|RDDEV|-     or    -|WRDEV|-
```

Operation:

Before execution, the following registers must contain the data listed below:

```
R***** = Base number of the intelligent module (0-7).
   + 1 = Slot number of the intelligent module (0-7).
   + 2 = Starting address within the module.  (Refer to the module
         specifications for the High Speed Counter, IC655APU510, in
         GFK-0123, I/O Module Specifications, or others as required.
   + 3 = Length (bytes) to read or write, beginning with the start
         address.  This length divided by 2 equals the number of registers
         used in the data buffer.
   + 4 = The contents define the beginning register of the data buffer
         which will contain the data to read from, or to write to, the
         module.
```

Special internal bits affected are I1-0081 to 11-0204.

Entry:

1. From the Supervisor menu, select Edit Prog (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 Advncd Mn Gr (F7), Contrl Func (F6), Read Write (F5), and then Read Device (F3) or Write Device (F4). The Read/Write device will appear.
5. Using the numeric keypad, type in the reference for the transfer.
6. After entering the reference, press the Enter key.
7. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Example of Reading from a Device:

1. Read the count value from the High Speed Counter module located in base 0 slot 6. Assume that the count is 12345678 at the time it is read.
2. Load Series Five CPU registers with the following data:

```
R01000 =0000 (base 0).
R01001 = 0006 (slot number 6).
R01002 = 0000 (start address within the High Speed Counter module = 0000).
R01003 = 0004 (read 4 bytes of data from the High Speed Counter).
R01004 = 1100  (start the data buffer at R1100).
```

3. Execute the following:

```
 R01000
-|RDDEV|-
```

4. During execution, status bit I1-0093 will indicate the transfer status:

```
0 = done.
1 = executing for slot 6.
```

Status bit II-0094 will indicate error status:

```
0 = OK.
1 = error for slot 6.
```

The data buffer will contain the following data:

```
R01100 = 5678H
R01101 = 1234H
```

Example of Writing to a Device:

1. With the High Speed Counter module located in slot **6,** write 00001234 to the High Speed Counter accumulate register, and write 23456789 to the High Speed Counter preset register.
2. Load Series Five CPU registers with the following data:

```
R00100 = 0000 (base number).
R00101 = 0006 (slot number 6).
R00102 = 0004 (start address within the High Speed Counter module).
R00103 = 0004 (number of bytes to write).
R00104 = 0200 (R0200 = start of data buffer).
R00200 = 1234H (BCD least significant data to write to accumulate register).
R00201 = 0000H (BCD most significant data to write to accumulate register).
```

3. Execute the following:

```
 R00100
-|WRDEV|-
```

This writes 00001234 to the accumulate register in the High Speed Counter module.

4. During execution, status bit I1-0093 will indicate the transfer status:

```
0 = done.
1 = executing for slot 6.
```

Status bit II-0094 will indicate the error status:

```
0 = OK.
1 = error for slot 6.
```

5. Next, load the Series Five CPU registers as follows:

```
R00300 = 0000 (base 0).
R00301 = 0006 (slot number 6).
R00302 = 0008 (start address of the preset register in the High Speed Counter
                module).
R00303 = 0004 (number of bytes to write).
R00304 = 0400 (start of the data buffer at R0400).
R00400 = 6789H
R00401 = 2345H
```

6. Execute the following:

```
 R00300
-|WRDEV|-
```

7. During execution, status bit I1-0093 will indicate the transfer status:

```
0 = done.
1 = executing for slot 6.
```

Status bit I1-0094 will indicate the error status:

```
0 = OK.
1 = error for slot 6.
```

This writes 2345678 to the preset register in the High Speed Counter module.

Transfer

The Transfer instruction is a general-purpose data move instruction which moves data between memory located anywhere in the system. This instruction has a single register operand which specifies the starting address of a block of five registers. The registers contain the following information:

- Source address.
- Destination address.
- Length of the data to be transferred.

Symbology:

```
          R*****
-|  TRANSFER  |-
```

Operation:

An active Transfer instruction is executed immediately during the CPU sweep. The maximum amount of data that can be transferred by a single Transfer instruction is 256 bytes. Multiple Transfer instructions can be used to move larger amounts of data.

NOTE

> The Transfer instruction is provided to support future Series Five options and functions. Further documentation on this instruction will be provided in the future, as required. This instruction should not be used at this time, except as specified by GE Fanuc in an application note or other publication.

Entry:

1. From the Supervisor menu, select Edit Prog (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 Advncd Mn Gr (F7), Contrl Func (F6), Read Write (F5), and then Transf (F7). The Transfer display will appear.
5. Using the numeric keypad, type in the reference for the transfer.
6. After entering the reference, press the Enter key.
7. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Example:

The Transfer instruction can be used in a variety of ways. The following example illustrates how the Transfer instruction can be used to change the Run/Stop mode of the CPU through user logic control.

For this example, load the Series Five CPU registers as follows:

```
R0001 = 0080H to stop the CPU
      = 0083H to put the CPU in Run Disable mode
      = 0001H to go to Run Enable mode
R0100 = 8005H MSB address for data register ROOOl
R0101 = OOOOH LSB address for data register ROOOl
R0102 = 8000H MSB address for CPU Scratch Pad Run/Stop mode byte
R0103 = 0300H LSB address for CPU Scratch Pad Run/Stop mode byte
R0104 = 0001H Number of bytes to transfer (the LSB of ROOOl in this
              example)
```

When the following rung is executed, the CPU will go to the mode specified by the data in ROOOl. **If you go** to Stop mode, you will need to manually go back to Run mode.

```
|      10001              R00100  (start of the Transfer)
|-------1 [--------[  TRANSFER ]------------------------(  )-|
|
```

SECTION 6
Data Move Functions

Data Move functions are used to transfer data in memory. The specified data is copied from one location to another. It exists unchanged in the original location, and writes over any data already stored in the specified location.

Use this section as a reference to the Data Move functions:

- A **Move** A **to B** function copies 16 bits of data from one location to another location.
- A **Move Left 8 Bits** function copies the upper byte from one location into the upper byte of another location.
- A **Move Right 8 Bits** function copies the lower byte from one location into the lower byte of another location.
- A **Block Move** function loads 7 values from the program into a specified destination.

Entering Data Move Functions

To enter a Data Move Function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it* **will** *execute unconditionally every sweep.*
4. Select Advncd Mn Gr (F7) and then Data Move (F1). The Data Move function keys will be displayed at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Data Move function. Press the appropriate key for the Data Move function you wish to select:

   F1 = Move A to B
   F2 = Move Left 8
   F3 = Move Right 8
   F4 = Block Move

   NOTE

   Refer to the following pages in this section for more information on these functions.

6. As the cursor moves to each value with the Data Move function, use the numeric keypad to type in a reference for each value. Refer to the following table for the reference ranges of each function.
7. After entering a reference, press the Enter key. The cursor will then move to the next value.
8. ***For the Block** Move **function only,*** follow this procedure:

   A. **When the** Block Move **function** is displayed on the screen, **use the** numeric keypad to type in the **destination** of the data from the program. This destination must be the first of seven consecutive **storage locations.** Refer to the following table for the reference ranges.

B. After entering the reference, press the Enter key. The cursor automatically moves one position to the right, which is the location of the first constant value.

C. Press the Select key to move the work area banner to the bottom (value) line. Using the numeric keypad, type in the first constant value. Constant values used with this function must be between -32,768 and +32,767. Then, press the Enter key to place it in the rung.

D. Move the cursor to the next value location. Type the next value into the work area. Press the Enter key to place it in the rung.

9. Complete the logic for the rung; then press the Accept key. The Edit key functions will **reappear** at the bottom of the screen.

NOTE

Data Move functions can be placed in columns 1 through 8 of the top line of a rung, or the reset line.

Table 13-6. Reference Ranges for Data Move Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Move A to B	Input or output Register Constant	I or 0= l-1009 I1+ or O1+= l-1009 I2+ or O2+= l-1009 I1-= l-497 O1- or O2-= l-1009 R= 1-Rs c= -16,384 to +16,383	I or 0= l-1009 I1+ or O1+= l-1009 I2+ or O2+= l-1009 O1- or O2-= l-1009 R= 1-Rs	
Move Left or Right 8 Bits	Input or output Register constant	I or 0= l-1009 I1+ or O1+= l-1009 I2+ or O2+= l-1009 I1-= l-497 O1- or O2-= l-1009 R= 1-Rs C= -16,384 to +16,383	I or 0= l-1009 I1+ or O1+= l-1009 I2+ or O2+= l-1009 O1- or O2-= l-1009 R= 1-Rs	
Block Move	Input or output Register	I or 0= 1-913 I1+ or O1+= 1-913 I2+ or O2+= l-913 O1- or O2-= l-913 R= 1-(Rs-6)		

Move A to B

The Move A to B function copies the content of one 16-bit storage location to another location.

Symbology:

```
 *******        *******           For I, 0, or R:
-| A    MOVE       B |-          -ddddd = -32,768 to +32,767
 -ddddd         -ddddd                C = -16,384 to +16,383
```

Operation:

Every scan that power flows to the Move A to B function, the data is copied from reference A to reference B. The data in A is retained, and the previous value of B is overwritten. Power flow is generated whenever the function is active.

If inactive (no power flow), all references remain unchanged and the output is off.

Move Left 8 Bits

The Move Left 8 Bits function copies the upper byte from one location into the upper byte of another location.

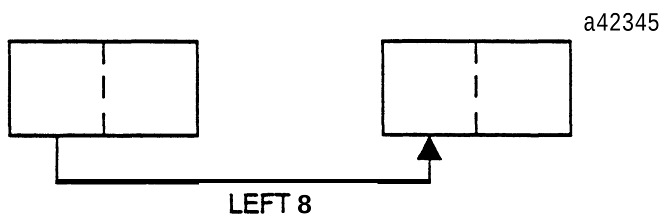
Symbology :

```
 *******          *******         hhhh = 0 to FFFF
-| MOVE LEFT  8  BITS |-             C = -16,384 to +16,383
  hhhh            hhhh
```

Operation:

Every scan that power flows to a Move 8 Bits function, the specified 8 bits of data is copied from reference A to reference B. The data in reference A is retained, and the previous content of the corresponding 8 bits of reference B is lost. Power flow is generated whenever the function is active.

If inactive (no power flow), all references remain unchanged and the output is off.



Restrictions apply when using the Move Left 8 bits function to copy the 8 high-order bits of a constant value. Constant values from 0000 to 3FFF hex and from 8000 to FFFF hex will operate as expected. Values from 4000 to 7FFF hex cannot be entered.

Move Right 8 Bits

The Move Right **8** Bits function copies the lower byte from one location into the lower byte of another location.

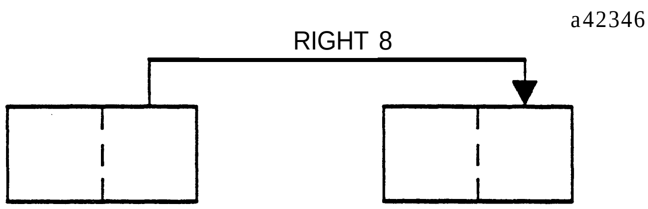
Symbology:

```
 *******          *******           hhhh = 0 to FFFF
-|  MOVE   RIGHT  8 BITS|-             C - -16,384 to  +16,383
  hhhh             hhhh
```

Operation:

Every scan that power flows to a Move 8 Bits function, the specified **8** bits of data is copied from reference A to reference B. The data in reference A is retained, and the previous content of the corresponding 8 bits of reference B is lost. Power flow is generated whenever the function is active.

If inactive (no power flow), all references remain unchanged and the output is off,



Block Move

The Block Move function loads 7 constant values directly from the program into a specified destination.

Symbology:

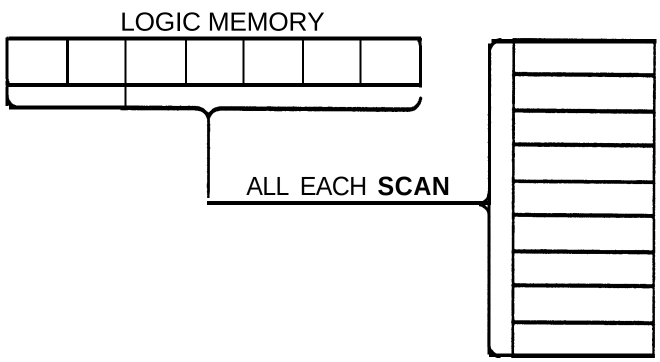
```
                                        -ddddd = -32,768 to +32,767
 *******
-|                                BLOCK  MOVE                          |-
          +ooooo  +ooooo  +ooooo  +ooooo  +ooooo  +ooooo  +00000
```

Operation:

The Block Move function generates power flow and moves data whenever it is active. Enter one contact if required to control execution of the Block Move function. If the function is placed at the left rail, it will execute unconditionally every sweep.

If inactive (no power flow), all references remain unchanged and the output is off.

a40033



SECTION 7
Arithmetic Functions

This section is a reference to the Arithmetic functions. It explains:

- How Arithmetic functions are stored, and the values that may be used.
- Signed Addition.
- Signed Subtraction.
- Signed Multiplication.
- Signed Division.
- Double Precision Arithmetic Functions:
  - Signed Double Precision Addition
  - Signed Double Precision Subtraction
  - Greater Than
- Equal

How Arithmetic Functions are Stored

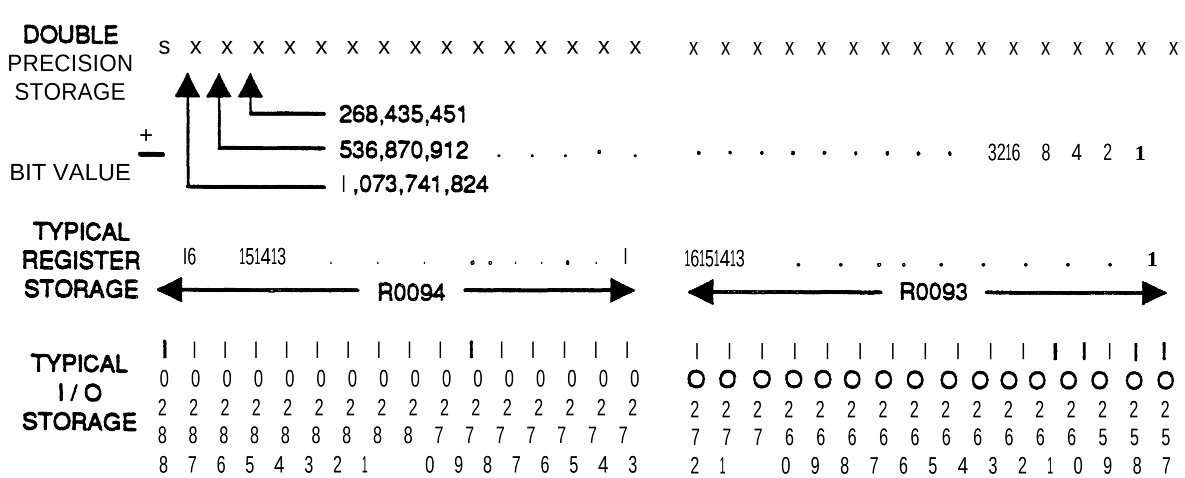
All advanced mathematical functions use signed 2's complement arithmetic. These are stored in 16 contiguous bits of memory, with the leftmost bit used as the sign bit. Single precision signed values can range from -32,768 to +32,767.

Constants are allowed by most advanced math functions, but not in all positions.

Double precision values use two registers or 32 I/O points. Double precision values are always signed 2's complement. Valid range for double precision values is -2,147,483,648 to +2,147,483,647.

The illustration below shows how double precision values are stored. The lower part of the illustration shows how the double precision value could be stored in 32 consecutive I/O references. The I/O references shown are an example only.

a42347



Entering Arithmetic Functions

To enter an Arithmetic function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select Advncd Mn Gr (F7) and then Arith Func (F2). The Arithmetic function keys will be displayed at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter an Arithmetic function. Press the appropriate key for the Arithmetic function you wish to select:

   F1 = Signed Addition
   F2 = Signed Subtraction
   F3 = Signed Multiply
   F4 = Signed Divide
   F5 = Double Precision Arithmetic
   F7 = Equal

6. If you press the F5 function key, the Double Precision Arithmetic function keys will be displayed at the bottom of the screen. You can then select one of these functions:

   F1 = Signed Double Precision Addition
   F2 = Signed Double Precision Subtraction
   F3 = Greater Than

NOTE

Refer to the following pages in this section for more information on these functions.

7. As the cursor moves to each value within the Arithmetic function, use the numeric keypad to type in a reference for each value. Refer to the following table for the reference ranges of each function.
8. After entering a reference, press the Enter key. The cursor will then move to the next value.
9. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Table 13-7. Reference Ranges for Arithmetic Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
ADDX **or** **SUBX**	Input or Output Register Constant	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs
DPADD **or** **DPSUB**	Input or Output Register Constant	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 I1-= 1-481 O1- or O2-= 1-993 R= 1-(Rs-1) C= -1073741824 to +1073741823	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 I1-= 1-481 O1- or O2-= 1-993 R= 1-(Rs-1) C= -1073741824 to +1073741823	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-993 R= 1-(Rs-1)
MPY	Input or Output Register Constant	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-993 R= 1-(Rs-1)
DVD	Input or Output Register Constant	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 I1-= 1-481 O1- or O2-= 1-993 R= 1-(Rs-1) C= -1073741824 to +1073741823	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs
Greater **Than**	Input or Output Register Constant	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 I1-= 1-481 O1- or O2-= 1-993 R= 1-(Rs-1) C= -1073741824 to +1073741823	I or O= 1-993 I1+ or O2+= 1-993 I2+ or O2+= 1-993 I1-= 1-481 O1- or O2-= 1-993 R= 1-(Rs-1) C= -1073741824 to +1073741823	
Equal	Input or Output Register Constant	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= -16,384 to +16,383	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	

Signed Addition (ADDX)

The Signed Addition function adds the value in one reference to the value in another reference and place the result in a third reference.

Symbology:

```
 ******* ******* *******       -ddddd = -32,768 to +32,767
-|   A ADDX  B  =    C |-      If A or B is a constant, then
 -ddddd  -ddddd  -ddddd        -ddddd = -16,384 to +16,383
```

Operation:

Every scan that power flows to the ADDX function, the program adds the content of reference A to the content of reference B and places the result in reference C. Only the content of reference C is altered by this function. If the sum is less than -32,768 or greater than +32,767, the function supplies power flow and the value -32,768 or +32,767 is placed in reference C.

If inactive (no power flow), all references remain unchanged and the output is off.

REFERENCE A		REFERENCE B		REFERENCE C
-4511	+	+0018	=	-4493

The Signed Addition function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

Signed Subtraction (SUBX)

The Signed Subtraction function subtracts the value in one reference from the value in another reference and place the result in a third reference.

Symbology:

```
 ******* ******* *******        -ddddd = -32,768 to +32,767
-|   A SUBX  B  =    C |-      If A or B is a constant, then
 -ddddd  -ddddd  -ddddd         -ddddd = -16,384 to +16,383
```

Operation:

Every scan that power flows to the SUBX function, the program subtracts the content of reference B from the content of reference A and places the result in reference C. Only the content of reference C is altered by this function. The function supplies power flow only if the value is 0 or less.

If inactive (no power flow), all references remain unchanged and the output is off.

REFERENCE A		REFERENCE B		REFERENCE C
-4511	-	+0018	=	-4529

The Signed Subtraction function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

Double Precision Addition (DPADD)

Double Precision Addition adds two 32-bit values and places the result in a third reference.

Symbology:

```
      *******            *******     *******      D = -2,147,483,648 to
  -|     A      DPADD       B     =     C |-           +2,147,483,647
         D                  D           D       If A or B is a constant, then
                                                  D = -1,073,741,824 to
                                                       +1,073,741,823
```

Operation:

Every scan that power flows to the DPADD function, the program adds the content of reference A to the content of reference B and places the result in reference C. Automatic carries are performed between the two registers or groups of I/O, if necessary. Only the content of reference C is altered by this function.

The function outputs power flow if the addition results in a 2's complement overflow. The value +2,147,483,647 or -2,147,483,648 (depending on whether the overflow is in the positive or negative direction) is placed in the result location.

If inactive (no power flow), all references remain unchanged and the output is off.

The Double Precision Addition function can be placed in columns 1 to 4 of the top line of a rung, or the reset line.

Double Precision Subtraction (DPSUB)

Double Precision Subtraction subtracts two 32-bit values and places the result in a third reference.

Symbology:

```
      *******            *******     *******      D = -2,147,483,648 to
  -|     A      DPSUB       B     =     C |-           +2,147,483,647
         D                  D           D       If A or B is a constant, then
                                                  D = -1,073,741,824 to
                                                       +1,073,741,823
```

Operation:

Every scan that power flows to the DPSUB function, the program subtracts the content of reference B from the content of reference A and places the result in reference C. Only the content of reference C is altered by this function.

The Double Precision Subtraction function outputs power flow if the subtraction results in a 2;s complement overflow. The value +2,147,483,647 or -2,147,483,648 (depending on whether the overflow is in the positive or negative direction) is placed in the result location.

If inactive (no power flow), all references remain unchanged and the output is off.

The Double Precision Subtraction function can be placed in columns 1 to 4 of the top line of a rung, or the reset line.

Signed Multiplication (MPY)

Signed Multiplication multiplies two single precision numbers and places the double precision result in a third reference.

Symbology:

```
 ******* ******* *******          -ddddd = -32,768 to +32,767
-|   A MPY   B  =    C |-          If A or B is a constant, then
  -ddddd  -ddddd     D             D = -2,147,483,648 to +2,147,483,647
```

Operation:

Every scan that power flows to the function, the system multiplies the value in reference A by the value in reference B and places the signed result in reference C. The possible sign of the result is shown below.

REFERENCE A	REFERENCE B	REFERENCE C
+	+	+
+	-	-
-	+	-
-	-	+

There are no error conditions; the Signed Multiplication function always outputs power flow when active.

If inactive (no power flow), all references remain unchanged and the output is off.

The Signed Multiplication function can be placed in columns 1 to 6 of the top line of a rung, or the reset line.

Signed Division (DVD)

Signed Division divides a double precision number by a single precision number and obtains a single precision quotient and a single precision remainder.

Symbology:

```
   *******          ******* ******* *******       D = -2,147,483,648 to
 -|   A    DVD         B      QUO     REM |-          +2,147,483,647
      D             -ddddd -ddddd  -ddddd           If A is a constant, then
                                                      D = -1,073,741,824 to
                                                          +1,073,741,823
                                                   -ddddd = -32,768 to +32,767
                                                    If -ddddd is a constant, then
                                                   -ddddd = -16,384 to +16,383
```

Operation:

Every scan that power flows to the function, the system divides the content of reference A by the content of reference B. The quotient is placed in QUO and the whole number remainder is placed in REM. The possible signs are shown below.

REFERENCE A	REFERENCE B	QUOTIENT	REMAINDER
+	+	+	+
+	-	-	+
-	+	-	-
-	-	+	-

If the division results in a 2's complement overflow (including division by zero), the Signed Division function outputs power flow, and the divide operation is not performed.

If inactive (no power flow), all references remain unchanged and the output is off.

The Signed Division function can be placed in columns 1 to 5 of the top line of a rung, or the reset line.

Greater Than

The Greater Than function compares two double precision values.

Symbology:

```
   *******          *******              D = -2,147,483,648 to
-|   A GREATER THAN   B     |-               +2,147,483,647
     D                D                  If A or B is constant, then
                                         D = -1,073,741,824 to
                                             +1,073,741,823
```

Operation:

Every scan that power flows to the Greater Than function, the program compares the content of reference A to the content of reference B. Comparison is based on the double precision signed values of the contents.

Power flows only if the first value (A) is larger than the second. Some example comparisons are shown below:

REFERENCE A	REFERENCE B	POWER FLOW ?
+57,001	+57,000	yes
+57,000	+57,001	no
+225	+225	no
-500	-600	yes
-600	-500	no

If inactive (no power flow), all references remain unchanged and the output is off.

The Greater Than function can be placed in columns 1 to 6 of the top line of a rung, or the reset line.

Equal

The Equal function compares the values of the two operands. The addressing range includes all Local I/O and Channeled I/O, constants, and registers from 1K to 16K. However, operand B cannot be a constant.

Symbology:

```
   ******* *******          ddddd = -32,768 to +32,767
-|  A EQUAL B  |-           If A or B equals constant,
  ddddd    ddddd            ddddd = -16,384 to +16,383
```

Operation:

Every scan that power flows to the Equal function, the program compares the content of reference A to the content of reference B. Power flows only if the two values are equal.

If inactive, (no power flow), all references remain unchanged and the output is off.

The Equal function can be placed in columns 1 to 8 of the top line of a rung, or the reset line.

SECTION 8
Table Move Functions

Table Move functions are used to transfer data from a source location to a destination location. The data remains unchanged in the source location, and writes over any data already stored in the destination location.

This section describes the following Table Move functions:

- A **Source to Table Move** function copies data into a table, one word (16 bits) at a time.
- A **Table to Destination Move** function copies data from a table to a specified location, one word (16 bits) at a time.
- A **Move Table** function copies the contents of one table into another table.

A table is a contiguous group of 16-bit data storage locations, and can be located in registers or I/O tables. The data in a table is retained upon power failure. The starting address of the table contains the pointer. In addition to the pointer, the table may contain from 1 to 255 data locations, which are specified by the reference LEN (length).

Entering Table Move Functions

To enter a Table Move function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select you Advncd Mn Gr (F7) and then Table Move (F3) to display the Table Move function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Table Move function. Press the appropriate key for the Table Move function you wish to select:

   F1 = Source to Table Move
   F2 = Table to Destination Move
   F4 = Move Table

   NOTE

   Refer to the following pages in this section for more information on these functions.

6. Using the numeric keypad, type in a reference for the contact. Refer to the following table for the reference ranges of each function.

   NOTE

   To use indirect references, first press the A/Bin key and then the R/+ address key on the numeric keypad. Then, enter the beginning address of the table where the addresses for the data will be stored.

7. After entering the reference, press the Enter key.
8. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Table 13-8. Reference Ranges for Table Move Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Source to Table Move	Input or Output Register	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-993 R= 1-(Rs-1)	
Table to Dest Move	Input or Output Register	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-993 R= 1-(Rs-1)	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or 02-= 1-1009 R= 1-Rs	
Move Table	Input or Output Register Constant	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs IR= 1-Rs	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs IR= 1-Rs	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= 1-255

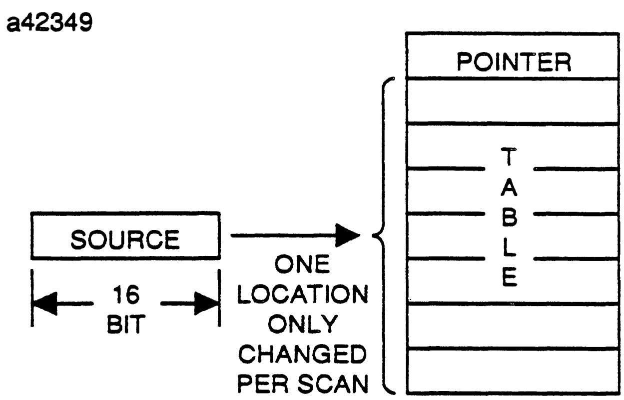
Source to Table Move

Source to Table Move copies successive 16-bit values from a source location into a table.

Symbology:

```
******* ******* Const        ddddd = 0 to 65,535
-| SRC-TO-TABLE    LEN|-    -ddddd = -32,768 to +32,767
-ddddd     ddddd   ddd         ddd = 1 to 255
                            If SRC or TABLE is I+, I-, O+,
                            or O-, then ddd = 1 to 63
```

Operation:



The least significant half of the contents of reference TABLE is a pointer to one of the items in the table (8-bit unsigned binary). The most significant half is not affected by the instruction.

If active, the pointer is incremented by one. If the result is equal to reference LEN, the output is turned on. Otherwise, it is turned off. If the incrementation results in a number greater than reference LEN, the pointer is set to one. After the pointer is incremented, the data located in reference SRC is copied into the location in the table specified by the pointer.

If inactive (no power flow), all references remain unchanged and the output is off.

For example, if the address of the pointer is R00360, and the value contained in the pointer (after incrementing) is 5, the data will be loaded into table location R00365.

If I/O addresses are used, multiply the value in the pointer by 16 to determine the location of the data.

For example, if the address of the pointer is I0721, and the value contained in the pointer is 5, multiplying 5 x 16 = 80. The location of the data will be I0801 to I0816.

To load values into a single location in the table, power flow should operate for only one scan. This may be done with a one-shot coil.

If the value of the pointer is equal to the table length, the Source to Table Move function supplies power flow.

The Source to Table Move function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

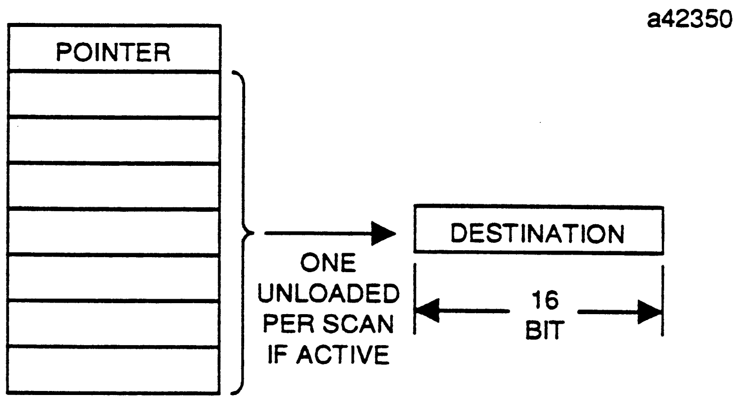
Table to Destination Move

Table to Destination Move copies successive 16-bit values from a table to a destination location.

Symbology:

```
 ******* ******* Const         ddddd = 0 to 65,535
-|TABLE-TO-DEST     LEN|-     -ddddd = -32,768 to +32,767
  ddddd   -ddddd    ddd          ddd = 1 to 255
                              If TABLE or DEST is I+, I-,
                              O+, or O-, then ddd = 1 to 63
```

Operation:



The least significant half of the contents of reference TABLE is a pointer to one of the items in the table (8-bit unsigned binary). The most significant half is not affected by the instruction.

If active, the pointer is incremented by one. If the result is equal to reference LEN, the output is turned on. Otherwise, it is turned off. If the incrementation results in a number greater than reference LEN, the pointer is set to one. After incrementation, the content of the location in the table specified by the pointer is copied into reference DEST.

If inactive (no power flow), all references remain unchanged and the output is off.

For example, if the address of the pointer is R00753, and the value contained in the pointer is 33 after incrementing, the data will be supplied by table location R00786.

If the pointer is pointing to the last location in the table, the next execution of the instruction will set the pointer to one which will move the top (first) item in the table to the location specified by DEST.

Unless controlled by a one-shot coil or similar logic, at every scan the next value in the table is copied to the destination. Therefore, the content of the destination will change with every scan.

The Table to Destination Move function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

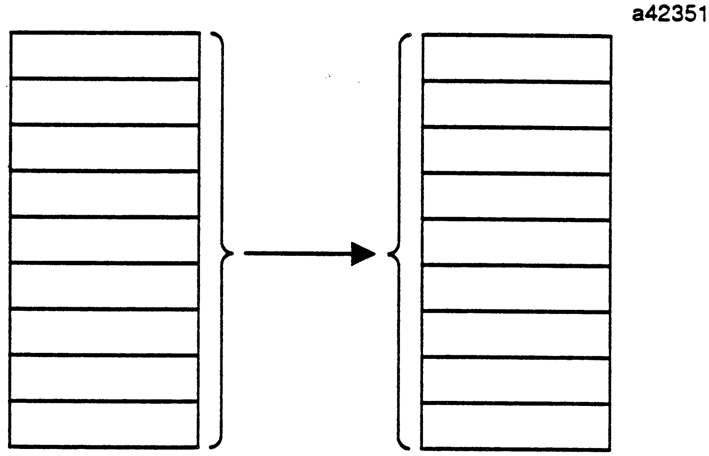
Move Table

Move Table copies data from one table to another table.

Symbology:

```
 *******              ******* *******       ddddd = 0 to 65,535
-|   A    MOVE TABLE    B     LEN |-     If LEN is constant,
  ddddd               ddddd  ddddd         ddddd = 1 to 255
                                        If A or B is I+, I-, O+,
                                        or O- and LEN is constant,
                                        then ddddd = 1 to 64
```

Operation:



The Move Table function copies a block of data from one location to another in a single sweep. Register data can be copied to either register or I/O locations, or vice versa. The Move Table function does not use a pointer. Every scan power is received, the entire table specified by reference A is copied to the destination table specified by reference B. Power flow is generated whenever power is received.

If inactive (no power flow), all references remain unchanged and the output is off.

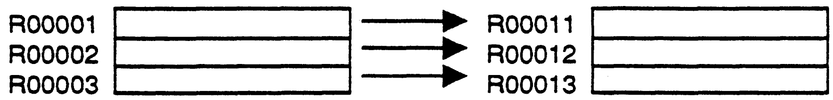
Indirect Table Moves

The Move Table function can also be used with indirect references. Indirect referencing means that instead of containing actual data, one or both of the tables contain register addresses which ''point'' to the data. This is best shown in an illustration:

Example A:

```
 R00001              R00011  Const
-|   A   MOVE TABLE    B     LEN |-
                             003
```

a42426



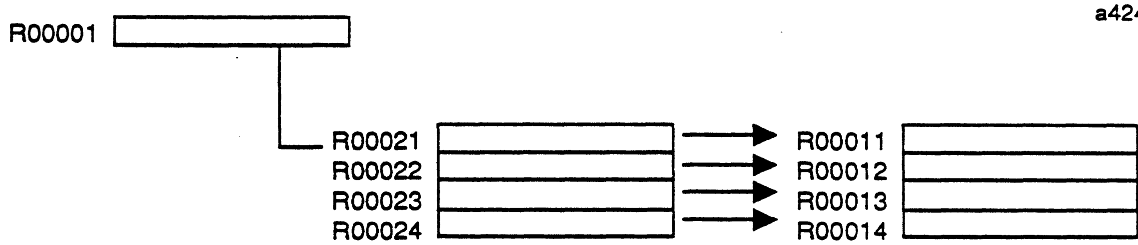
In this case, data in R00001-R00003 is copied into R00011-R00013, respectively.

Example B:

```
   R00001            R00011  Const
  -|  A   MOVE TABLE    B   LEN |-
                             004
```

Suppose that indirect reference R1 contains the value 21. Then, R00020 is the starting address of the table to be moved. The data in R00021-R00024 is copied to R00011-R00014.

a42427



In this case, data in R00021-R00024 is copied into R00011-R00014, respectively.

This powerful function allows the source and/or destination table to be dynamically programmed, to fit the requirements of the application.

The Move Table function can be placed in columns 1 to 5 of the top line of a rung, or the reset line.

SECTION 9
List Functions

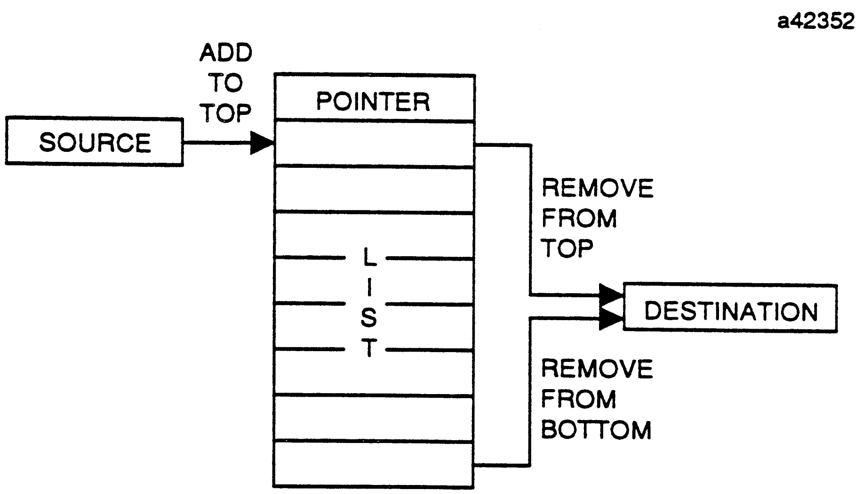
Use this section as a reference to the List functions:

- An **Add to Top** function copies 16 bits of data from a source location to the first position of a list. The rest of the list moves down one position to make room for the new entry. When the list contains the specified number of entries, no more data can be added.
- A **Remove from Bottom** function copies the last entry in a list into a destination address. Using this function with Add to Top creates a FIFO (First In/First Out) queue.
- A **Remove from Top** function removes the first entry in a list and copies it into a destination address. The rest of the entries in the list move up one position. Using this function with Add to Top creates a LIFO (Last In/First Out) stack.

List functions are used to transfer data in memory. Adding or removing data to or from a list alters its makeup. The LEN parameter defines the maximum size of the list. Unlike a table, a list may not be completely full. Valid list elements are specified by the pointer, which is incremented or decremented when items are added or removed from the list.

A list consists of a pointer followed by a sequence of adjacent 16-bit data storage locations. The list pointer specifies the number of entries currently in the list. It does not, however, control the location of the stored data. Data may only be written to the first location of a list, or read from the first or last location.

The pointer is not part of the list. The location of the pointer is specified by the reference LIST. The list itself follows the pointer and contains the number of entries specified by the contents of the pointer. The number of elements in a list will always be less than or equal to the value of the reference LEN.



Entering List Functions

To enter a List function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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 runction. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select Advncd Mn Gr (F7) and then List Func (F4) to display the List function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a List function. Press the appropriate key for the List function you wish to select:

   F1 = Add to Top
   F2 = Remove from Bottom
   F3 = Remove from Top

   NOTE

   Refer to the following pages in this section for more information on these functions.

6. As the cursor moves to each value within the List function, use the numeric keypad to type in a reference for each value. Refer to the following tables for the reference ranges of each function.
7. After entering a reference, press the Enter key. The cursor will then move to the next value.
8. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

NOTE

List functions can be placed in columns 1 to 6 of the top line of a rung, or the reset line.

Table 13-9. Reference Ranges for List Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Add to Top	Input or Output Register	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-99 R= 1-(Rs-1)	
Remove from Top or Bottom	Input or Output Register	I or O= 1-993 I1+ or O1+= 1-993 I2+ or O2+= 1-993 O1- or O2-= 1-993 R= 1-(Rs-1)	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs	

Add to Top

Add to Top copies data from the specified source to the first location in a list. The top of the list is the address immediately after the pointer.

Symbology:

```
*******           ******* Const        -ddddd = -32,768 to +32,767
+| SRC ADD-TO-TOP  LIST    LEN|-         ddddd = 0 to 65,535
 -ddddd           ddddd   ddd              ddd = 1 to 255
                                        If SRC or LIST is I+, I-,
                                        O+, or O-, then ddd = 1 to 63
```

Operation:

The least significant half of the contents of reference LIST is a pointer to the bottom of the list (8-bit unsigned binary), which also represents the number of items in the list. The most significant half is not affected by the function.

If active and the pointer is equal to or greater than reference LEN, the pointer is set to the value of reference LEN, the output is turned on, and no further action takes place.

If active but the pointer is less than reference LEN, each item in the list is moved down one slot, reference SRC is copied into the first slot, and the pointer is incremented by one. If the incrementation results in the pointer becoming equal to reference LEN, the output is turned on. Otherwise, the output is turned off.

If inactive (no power flow), all references remain unchanged and the output is off.

Remove from Bottom

Remove from Bottom copies data from the last location in a list to a specified destination. When this function is used on a list filled with the Add to Top function, the result is a first in/first out stack. This function is frequently used to track items on a conveyor, where the first item on the conveyor is the first one to come off.

Symbology:

```
*******           ******* Const        -ddddd = -32,768 to +32,767
-| LIST REM-FM-BOT DEST    LEN|-         ddddd = 0 to 65,535
  ddddd           -ddddd   ddd              ddd = 1 to 255
                                        If LIST or DEST is I+, O+, or
                                        O-, then ddd = 1 to 63
```

Operation:

The least significant half of the contents of reference LIST is a pointer to the bottom of the list (8-bit unsigned binary), which also represents the number of items in the list. The most significant half is not affected by the function.

If active and the pointer is equal to zero or greater than reference LEN, the output is turned on and no further action takes place.

If active but the pointer is greater than zero and equal to or less than reference LEN, the last item in the list (bottom of list) is copied into reference DEST and the pointer is decremented by one. If this results in the pointer becoming zero, the output is turned on. Otherwise, the output is turned off.

If inactive (no power flow), all references remain unchanged and the output is off.

Remove from Top

Remove from Top copies data from the first location in a list to a specified destination. When this function is used on a list filled with the Add to Top function, the result is a last in/first out stack.

Symbology:

```
   *******          ******* Const       -ddddd = -32,768 to +32,767
  -| LIST REM-FM-TOP DEST    LEN|-        ddddd = 0 to 65,535
   ddddd            -ddddd   ddd            ddd = 1 to 255
                                          If LIST or DEST is I+, O+, or
                                          O-, then ddd = 1 to 63
```

Operation:

The least significant half of the contents of reference LIST is a pointer to the bottom of the list (8-bit unsigned binary), which also represents the number of items in the list. The most significant half is not affected by the function.

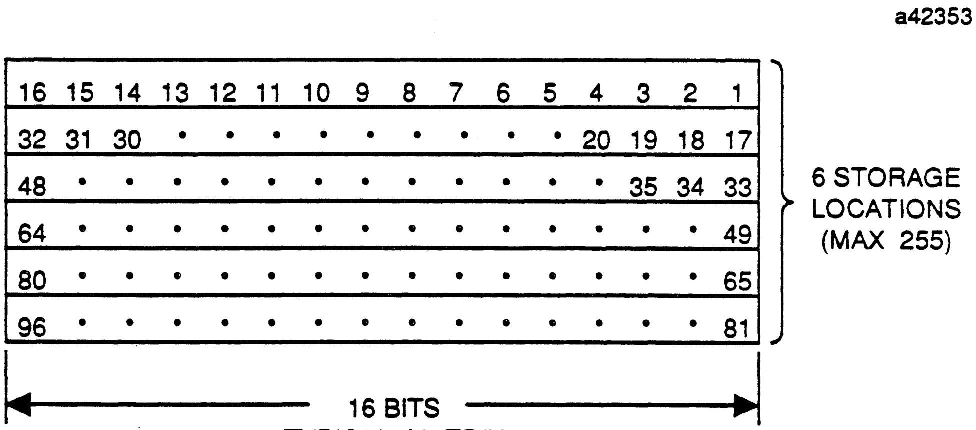
If active and the pointer is zero or greater than reference LEN, the output is turned on and no further action takes place.

If active and the pointer is greater than zero and equal to or less than reference LEN, the first item in the list (top of list) is copied into reference DEST and the pointer is decremented by one. If the decrementation did not result in zero, each item (starting with the second and ending with the last) is copied into the slot above it. If the pointer is zero, the output is turned on; otherwise, the output is turned off.

If inactive (no power flow), all references remain unchanged and the output is off.

SECTION 10
Matrix Functions

A matrix consists of one or more adjacent 16-bit storage locations. Either registers or I/O can be assigned to matrices.



TYPICAL MATRIX

A matrix may contain as many as 255 storage locations, each with 16 bits. Therefore, one matrix may contain from 16 to 4080 bits.

If a matrix is built in the I/O area, functions performed on the matrix will ignore the override status of any references contained in the matrix.

All matrices are retentive during power failure or scan interruption.

Matrix operations are performed in a buffer area. After the operation is complete, the buffer is copied to a result matrix. For this reason, the matrix instructions are not sensitive to the order of the operands (as they are with Series Six instructions) and will work correctly if the destination matrix overlaps a source matrix.

Use this section as a reference to the Matrix functions:

- A **Logical AND** function compares each bit in matrix A with the corresponding bit in matrix B. When both are 1, a 1 is placed in matrix C in the same relative position.
- A **Logical IOR** function compares each bit in matrix A with the corresponding bit in matrix B. When either is 1, a 1 is placed in matrix C in the same relative position.
- A **Logical EOR** function compares each bit in matrix A with the corresponding bit in matrix B. If one is 1 and the other is 0, a 1 is placed in matrix C in the same relative position.
- A **Logical Invert** function sets each bit in matrix B to be the opposite of the corresponding bit in matrix A.
- A **Bit Set** function makes the matrix bit that is indicated by the pointer into a 1.
- A **Bit Clear** function makes the matrix bit that is indicated by the pointer into a 0.
- A **Bit Sense** function outputs the state of the bit specified by the pointer.
- A **Bit Shift** function shifts all bits in a matrix left or right by the specified number of positions.

Entering Matrix Functions

To enter a Matrix function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select Advncd Mn Gr (F7) and then Matrix Func (F5) to display the Matrix function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Matrix function. Press the appropriate key for the Matrix function you wish to select:

   F1 = Logical AND
   F2 = Logical Inclusive OR
   F3 = Logical Exclusive OR
   F4 = Logical Invert
   F6 = Bit Matrix Group

6. If you press the F6 function key, the Bit Matrix Group function keys will be displayed at the bottom of the screen. You can then select one of these functions:

   F1 = Bit Set
   F2 = Bit Clear
   F3 = Bit Shift Left
   F4 = Bit Shift Right
   F6 = Bit Sense

NOTE

Refer to the following pages in this section for more information on these functions.

7. As the cursor moves to each value within the Matrix function, use the numeric keypad to type in a reference for each value. Refer to the following table for the reference ranges of each function.
8. After entering a reference, press the Enter key. The cursor will then move to the next value.
9. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

NOTE

The Matrix functions can be placed in columns 1 to 6 of the top line of a rung, or the reset line.

Table 13-10. Reference Ranges for Matrix Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Logical AND **or** **Logical IOR** **or** **Logical EOR**	Input or Output Register	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or 02-= 1-1009 R= 1-Rs	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs
Logical **Invert**	Input or Output Register	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs	
Bit Set **or** **Bit Clear**	Input or Output Register	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs	
Bit Sense **or** **Shift Right** **or** **Shift Left**	Input or Output Register	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs	I or O= 1-1009 I1+ or I2+= 1-1009 I2+ or O2+= 1-1009 O1- or O2-= 1-1009 R= 1-Rs	

Logical AND

The Logical AND function is useful to build masks or screens, where only certain bits are passed through (those that are opposite a 1 in the mask), and all other bits are set to 0.

Symbology:

```
 ******* ******* ******* Const      hhhh = 0 to FFFF
-|  A  AND  B   =   C     LEN |-     ddd = 1 to 255
   hhhh     hhhh    hhhh    ddd      If A, B, or C is I+, I-, O+,
                                      or O-, then ddd = 1 to 64
```

Operation:

Each scan that power is received, the Logical AND function ANDs each bit in matrix A with the corresponding bit in matrix B and places the result in matrix C. If both bits are 1, then a 1 is placed in matrix C. If either or both bits is a 0, then a 0 is placed in matrix C.

BIT IN MATRIX A	AND	BIT IN MATRIX B	RESULT IN MATRIX C
0		0	0
0		1	0
1		0	0
1		1	1

Matrices A, B, and C can overlap either partially or completely.

The Logical AND function passes power flow to the right only when matrix C is all 0s. (No corresponding bits in matrix A and matrix B are 1 at the same time.)

If inactive (no power flow), all references remain unchanged and the output is off.

Logical IOR

The contents of matrix A are logically inclusive ORed bit by bit with the contents of matrix B, and the result is placed in matrix C.

Symbology:

```
 ******* ******* ******* Const      hhhh = 0 to FFFF
-|  A  IOR  B   =   C     LEN |-     ddd = 1 to 255
   hhhh     hhhh    hhhh    ddd      If A, B, or C is I+, I-, O+,
                                      or O-, then ddd = 1 to 64
```

Operation:

Each scan that power is received, the Logical IOR function ORs each bit in matrix A with the corresponding bit in matrix B, and places the result in matrix C. If either bit is 1 or both bits are 1, then a 1 is placed in matrix C.

BIT IN MATRIX A	IOR	BIT IN MATRIX B	RESULT IN MATRIX C
0		0	0
0		1	1
1		0	1
1		1	1

Matrices A, B, and C can overlap either partially or completely.

The Logical IOR function passes power flow whenever power is received.

If inactive (no power flow), all references remain unchanged and the output is off.

Logical EOR

The Logical EOR function is useful to quickly compare two matrices. Exclusive ORing a matrix with itself will clear all the bits in the matrix.

Symbology:

```
 ******* ******* ******* Const       hhhh = 0 to FFFF
-|  A   EOR  B   =   C    LEN |-      ddd = 1 to 255
  hhhh    hhhh    hhhh    ddd        If A, B, or C is I+, I-, O+,
                                      or O-, then ddd = 1 to 64.
```

Operation:

Each scan that power is received, the Logical EOR function exclusive ORs each bit in matrix A with the corresponding bit in matrix B, and places the result in the corresponding bit of matrix C. If either bit, but not both, is 1, then a 1 is placed in matrix C.

BIT IN MATRIX A	EOR	BIT IN MATRIX B	RESULT IN MATRIX C
0		0	0
0		1	1
1		0	1
1		1	0

The Logical EOR function passes power flow only when all bits in matrix C are zeros, indicating that all bits in matrix B are the same as all bits in matrix A.

If inactive (no power flow), all references remain unchanged and the output is off.

Logical Invert

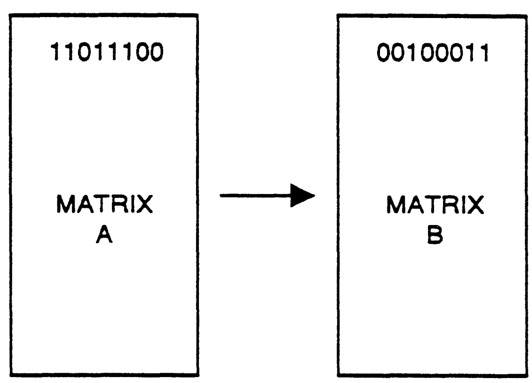
Symbology:

```
     ******* ******* Const        hhhh = 0 to FFFF
   -|  A INV    B     LEN |-       ddd = 1 to 255
      hhhh    hhhh   ddd          If A or B is I+, I-, O, O+, or
                                   O-, then ddd = 1 to 64
```

Operation:

Each scan that power is received, the Logical Invert function sets each bit in matrix B to the opposite of the state of the corresponding bit in matrix A.

a42354



All bits are altered on each scan that power is received, making matrix B a mirror image of matrix A. The Logical Invert function passes power flow whenever power is received.

If inactive (no power flow), all references remain unchanged and the output is off.

Bit Set

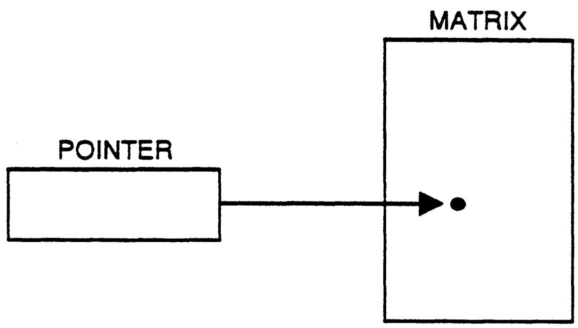
Symbology:

```
 *******        ******* Const        ddddd = 0 to 65,535
-| BIT  SET    MATRIX     LEN|-       If a constant, then
 ddddd            hhhh     ddd        ddddd = 0 to 32,767
                                       hhhh = 0 to FFFF
                                        ddd = 1 to 255
                                     If BIT or MATRIX is I, I+, I-, O,
                                     O+ or O-, then ddd = 1 to 64
```

Operation:

Every scan that the instruction is active, the Bit Set function sets the bit designated by the reference BIT with a matrix. The number of the bit must be greater than zero and within the total size in bits of the matrix (matrix length x 16). The bits of the matrix are organized as shown in the illustration at the beginning of Section 10 of this chapter.

a42355



If the reference BIT is within the matrix (BIT greater than zero and less than or equal to LEN x 16), then power flow is output and the specified bit is SET when active. If reference BIT is not within the matrix, no power flow is output and the instruction is not executed when active.

If inactive (no power flow), all references remain unchanged and the output is off.

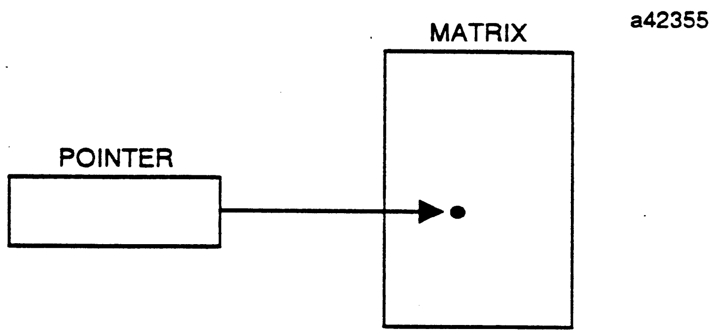
Bit Clear

Symbology:

```
     *******           ******* Const        ddddd = 0 to 65,535
   -| BIT  CLEAR     MATRIX      LEN|+      If a constant, then
        ddddd         hhhh       ddd        ddddd = 0 to 32,767
                                             hhhh = 0 to FFFF
                                              ddd = 1 to 255
                                         If BIT or MATRIX is I, I+, I-, O
                                         or O-, then ddd = 1 to 64
```

Operation:

Every scan that the instruction is active, the Bit Clear function clears the bit designated by the reference BIT within a matrix. The number of the bit must be greater than zero and within the total size in bits of the matrix (matrix length x 16).



If the reference BIT is within the matrix (BIT greater than zero and less than or equal to LEN x 16), then power flow is not output and the specified bit is cleared when active. If reference BIT is not within the matrix, power flow is output and the instruction is not executed when active.

If inactive (no power flow), all references remain unchanged and the output is off.

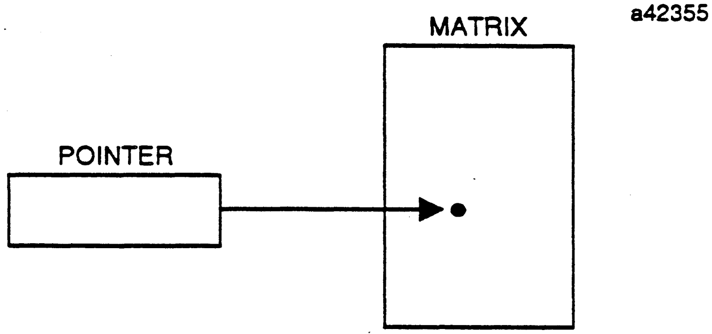
Bit Sense

Symbology:

```
 *******            ******* Const           ddddd = 0 to 65,535
-| BIT   SENSE     MATRIX      LEN|-       If a constant, then
  ddddd              hhhh       ddd          ddddd = 0 to 32,767
                                               hhhh = 0 to FFFF
                                                ddd = 1 to 255
                                          If BIT or MATRIX is I, I+, I-, O,
                                          O+ or O-, then ddd = 1 to 64
```

Operation:

Every scan that the instruction is active, the Bit Sense function outputs the state (ON or OFF) of the bit designated by the reference BIT with a matrix. The number of the bit must be greater than zero and within the total size in bits of the matrix (matrix length x 16).



If the reference BIT is within the matrix (BIT greater than zero and less than or equal to LEN x 16), then the output power flow is determined by the state of reference BIT when active. (Power flow is output if the specified bit is a 1; power flow is not output if the specified bit is a 0.) All references remain unchanged. If reference BIT is not within the matrix, no power flow is output and the instruction is not executed.

If inactive (no power flow), all references remain unchanged and the output is off.

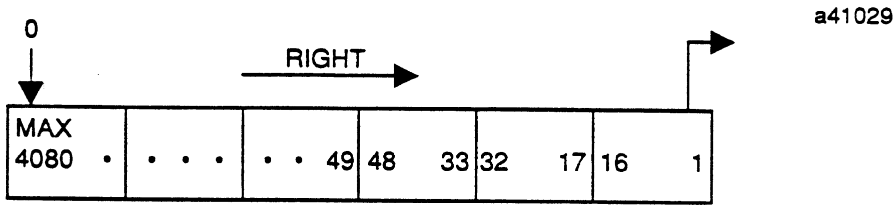
Shift Right

Symbology:

```
           ******* ******* Const         ddddd = 0 to 65,535
-| SHIFT RT   N    MATRIX   LEN |-       If a constant, then
            ddddd   hhhh    ddd           ddddd = 0 to 32,767
                                          hhhh = 0 to FFFF
                                           ddd = 1 to 255
                                        If N or MATRIX is I, I+, I-, O
                                        O+, or O-, then ddd = 1 to 64
```

Operation:

Every scan that power is received, the Shift Right function shifts all the bits in a matrix a specified number of places to the right (that is, toward less-significant bit locations). The number of bits to be shifted is specified by the content of reference N.



The number of places specified for the shift must be greater than 0 and within the total size in bits of the matrix (matrix length x 16). Otherwise, no shift occurs and no power flow is generated.

When the shift occurs, the specified number of bits is shifted out of the matrix. As bits are shifted out of the low end of the matrix, zeros are loaded in from the most significant bit of the last word in the matrix. Power flow is passed to the right only if the last bit that is shifted out of the matrix is a 1.

If inactive (no power flow), all references remain unchanged and the output is off.

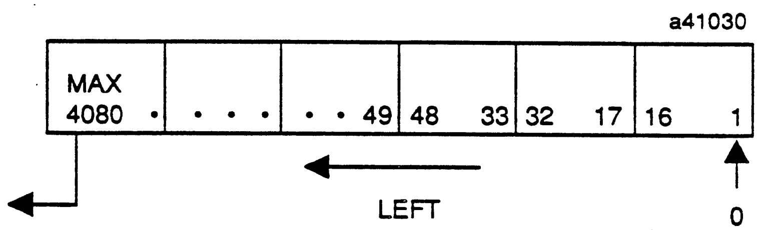
Shift Left

Symbology:

```
             ******* ******* Const       ddddd = 0 to 65,535
-| SHIFT LEFT N    MATRIX  LEN |-       If a constant, then
               ddddd  hhhh    ddd       ddddd = 0 to 32,767
                                          hhhh = 0 to FFFF
                                           ddd = 1 to 255
                                     If N or MATRIX is I, I+, I-, O
                                     O+, or O-, then ddd = 1 to 64
```

Operation:

Every scan that power is received, the Shift Left function shifts all the bits in a matrix a specified number of places to the left (that is, toward more-significant bit locations). The number of bits to be shifted is specified by the content of reference N.



The number of places specified for the shift must be greater than 0 and within the total size in bits of the matrix (matrix length x 16). Otherwise, no shift occurs and no power flow is generated.

When the shift occurs, the specified number of bits is shifted out of the matrix. As bits are shifted out of the high end of the matrix, zeros are loaded in from the least significant bit of the first word in the matrix. Power flow is passed to the right only if the last bit that is shifted out of the matrix is a 1.

If inactive (no power flow), all references remain unchanged and the output is off.

SECTION 11
Control Functions

The Control Functions are used to alter or control the normal sequence of logic operations.

Use this section as a reference to the Control functions:

- A **Do Sub** function causes a subroutine to be executed.
- A **Return from Subroutine** function returns control to the main program, at a point following the Do Sub instruction.
- A **Suspend I/O** function causes the CPU to suspend I/O servicing.
- A **Do I/O** function causes specified I/O points to be serviced immediately.

Entering Control Functions

To enter a Control function, follow this procedure:

1. From the Supervisor menu, select Edit Prog (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. *If the function is placed at the left rail, it will execute unconditionally every sweep.*
4. Select Advncd Mn Gr (F7) and then Ctrl Func (F6) to display the Control function keys at the bottom of the screen.
5. At this point, the cursor should be at the position where you wish to enter a Control function. Press the appropriate key for the Control function you wish to select:

   F1 = Do Subroutine
   F2 = Return from Subroutine
   F3 = Suspend I/O
   F4 = Do I/O
   F5 = Read/Write

   NOTE

   Refer to the following pages in this section for more information on these functions.

6. Using the numeric keypad, type in a reference for the contact. Refer to the following table for the reference ranges of each function.

   NOTE

   The Return and Suspend I/O functions have no references to be entered.

7. After entering the reference, press the Enter key.
8. Complete the logic for the rung; then press the Accept key. The Edit key functions will reappear at the bottom of the screen.

Table 13-11. Reference Ranges for Matrix Functions

FUNCTION	TYPE	1ST OPERAND	2ND OPERAND	3RD OPERAND
Do Subroutine	Input or Output Register	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs		
Do I/O	Input or Output Register Constant	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= 1 to 3072	I or O= 1-1009 I1+ or O1+= 1-1009 I2+ or O2+= 1-1009 I1-= 1-497 O1- or O2-= 1-1009 R= 1-Rs C= 1 to 3072	

Do Subroutine

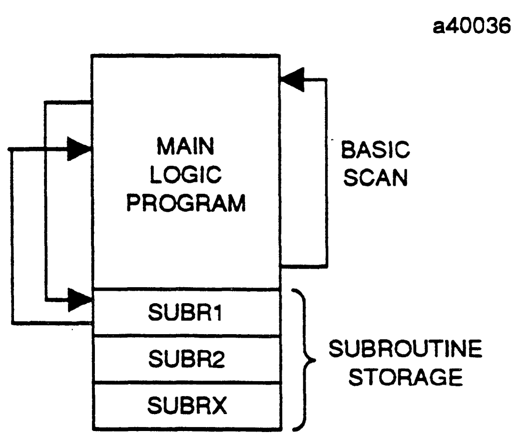
Symbology:

```
                Const   *******            ddd = 1 to 32
-| DO SUB         N      REPS |-         ddddd = 0 to 65,535
                 ddd    ddddd
```

Operation:

Each scan that power is received, the Do Subroutine function causes the subroutine specified by the reference N to be executed the number of times specified by the reference REPS. After the subroutine has executed the specified number of times, control returns to the main body of the program to the instruction following the DO SUB instruction.

If inactive (no power flow), all references remain unchanged and the output is off.



A subroutine is a segment of ladder logic. It is just like the rest of the program, except that it cannot contain a Do Subroutine function.

As many as 32 subroutines can be created, and stored directly after the main program. The format of a program using subroutines is shown below:

```
Main Ladder Diagram Program
          END-OF-SWEEP
          Subroutine 1
             RETURN
          Subroutine 2
             RETURN
          Subroutine 32
             RETURN
           END-OF-SWEEP
           END-OF-SWEEP
```

A single End Sweep function at the end of the main program separates it from any subroutines that follow. Each subroutine ends with a Return function. The system places two End Sweep functions together at the end of the entire program.

The Return function causes the scan to return to the main program, and power flow passes to the right of the Do Subroutine function.

Because subroutines are located outside the main program, they are executed only when called by DOSUB instructions. A subroutine is scanned only if called by a Do Subroutine function. There is no limit to the number of Do Subroutine instructions that may be included in a program.

NOTE

An excessive number of subroutine calls and subroutine repetitions may cause the watchdog timer to exceed its nominal value of 200 ms per scan and shut down the CPU. In this event, the program should be modified, or the watchdog timer setting should be increased.

The content of the register that controls the number of repetitions can be changed by the program, but must always be within the range 1 to 255. If the reference contains the value zero when power is received by the function, the subroutine does not execute. The reference may be any valid register or an I/O reference beginning on a word boundary. After entering the reference, press the Enter key.

NOTE

Enter a Do Subroutine function at each location in the main program where control should jump to the subroutine.

The Do Subroutine function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

Return

A Return function must always be located at the end of a subroutine (and may never be included in a main program).

Symbology:

```
-| Return |-
```

Operation:

A Return instruction must be placed at the end of each subroutine. It can be entered only in column 1 of a rung and occupies a rung by itself. When the Return instruction is executed, there are two possible actions:

1. If the subroutine has been executed the number of times specified by reference REPs in the calling DOSUB instruction, the program continues execution at the instruction following the DOSUB.
2. If the number of subroutine executions is less than reference REPS, then the program continues execution at the first instruction in the subroutine.

Suspend I/O

Symbology:

```
-| SUSPEND I/O |-
```

Operation:

Each scan that power is received, the Suspend I/O function causes the CPU to skip all I/O servicing at the end of that scan. All local output devices are held in their last state, and all Genius blocks go to their default states. The Suspend I/O instruction stops the scanning of both local and remote I/O.

If the program contains more than one Suspend I/O functions, only one must be active for I/O service to be suspended.

The Suspend I/O function passes power to the right on each scan that the function is active.

If inactive (no power flow), all references remain unchanged and the output is off.

The Suspend I/O function can be placed in columns 1 to 8 of the top line of a rung, or the reset line.

DO I/O

The Do I/O function causes an I/O scan for the specified range of I/O points to be executed immediately. It can also be used to rapidly service just the I/O pertinent to the program. It can be used in conjunction with the Suspend I/O function, which eliminates the I/O servicing at the end of a scan.

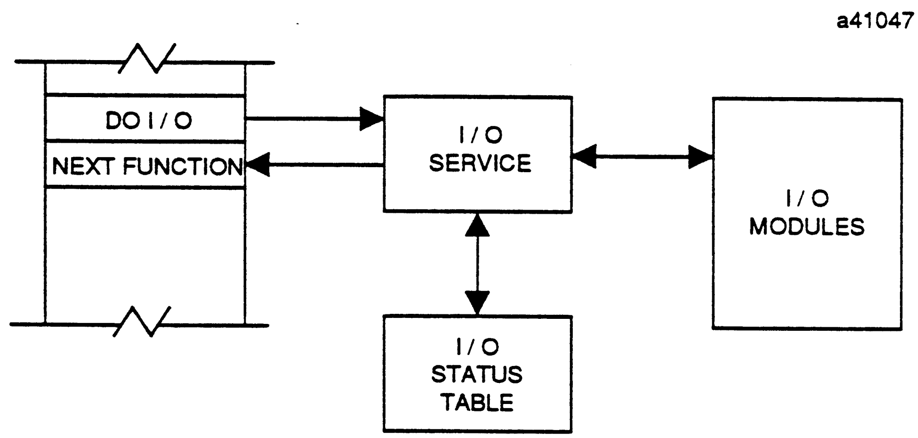
Symbology:

```
             ******* *******        ddddd = 1 to 3072
 -| DO I/O START     END |-         If a constant, then
             ddddd   ddddd          ddddd = 1 to 3072
```

Operation:

Each scan that power is received, the Do I/O function causes the CPU to service selected I/O. This is in addition to the I/O servicing at the end of the scan.

The I/O is serviced in bytes. The I/O points scanned include the byte containing the reference START through and including the byte containing the reference END. Both inputs and outputs are scanned.



When the Do I/O function receives power, the values entered as the starting and ending references are compared. If the start reference is less than the end reference, and both values are between 1 and 3072, the I/O whose addresses are contained in the references are serviced and power flow is passed to the right.

If the reference start is greater than the reference end, or outside the range 1 to 3072, the I/O are not serviced, and power is not passed to the right.

If inactive (no power flow), all references remain unchanged and the output is off.

The Do I/O function can be placed in columns 1 to 7 of the top line of a rung, or the reset line.

Referencing I/O Points with the DO I/O Instruction

The Do I/O instruction uses two operands, START and END. The START operand value is the first byte of I/O to be scanned, and the END operand contains the address of the last byte to be scanned. Valid values for START and END are 1 to 3072. The START and END values map into the I/O tables, as shown below:

I/O POINT	START OR END VALUE	TO CALCULATE
I0001 - I1024 O0001 - O1024	1024 - 1024	Same as I/O point number
I1+0001 - I1+1024 O1+0001 - O1+1024	1025 - 2048	Same as I/O point number + 1024
I2+0001 - I2+1024 O2+0001 - O2+1024	2049 - 3072	Same as I/O point number + 2048

Examples:

```
           Const  Const
-| DO I/O START   END |-
          +00001 +01024
```

Will scan all 1K local I/O.

```
           Const  Const
-| DO I/O START   END |-
          +00002 +00005
```

Will scan the first byte of local I/O.

```
           Const  Const
-| DO I/O START   END |-
          +00513 +01537
```

Will scan the upper 512 bits of local I/O and the first 512 bits of remote I/O (I1+0001 - I1+0512, O1+0001 - O1+0512).

```
           Const  Const
-| DO I/O START   END |-
          +00001 +03072
```

Will scan all 3K inputs and 3K outputs of local and remote I/O.

Appendix A
Setup Information

This appendix describes the setup information required in order to use Logicmaster 5 software:

- Configuring the communication port.
- Connecting to a Workmaster or Cimstar I industrial computer.
- Using modems.
- Installing optional boards:
  - Expanded Memory (RAM Disk) card.
  - Enhanced Graphics Adapter card,.
  - Diskette Drive Adapter card.
  - Color Graphics/Monitor Adapter card.
- Printer Protocol and Cable Diagrams.

Configuring the Communication Port

The CCM port on the CPU module in the Series Five PLC is connected by cable to port 1 (COM1) or port 2 (COM2) on the Logicmaster host computer. The CCM port provides either RS-232 or RS-422 communications. RS-232 is used for direct connections up to 50 feet (15 meters); and RS-422, for direct connections up to 4000 feet (1200 meters).

NOTE

Follow the instructions provided with your computer to configure the port you want to use for communications.

Logicmaster 5 communications use interrupt-driven I/O. When you configure the communications port, be sure to use the correct interrupt request line for the selected port:

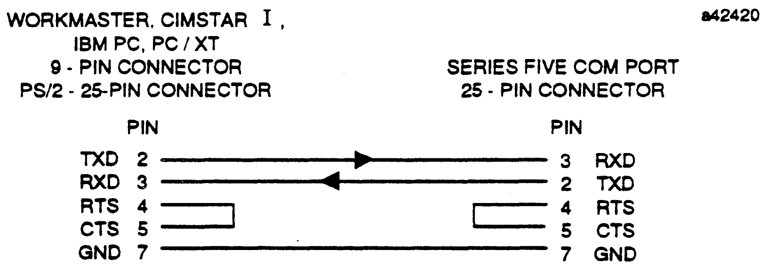
- Port COM1 (I/O addresses 3F8-3FF) uses interrupt request IRQ4.
- Port COM2 (I/O addresses 2F8-2FF) uses interrupt request IRQ3.

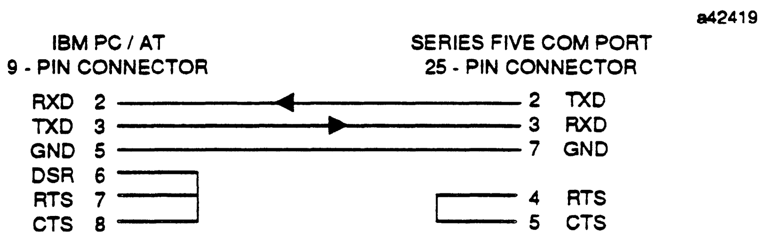
These are IBM-standard request line assignments.

On serial adapter cards from IBM, the interrupt request line and port address selections are coupled together to enforce these assignments. On cards from other vendors (such as Tecmar or AST), however, the ID number and interrupt request line may be assigned independently. *Make sure that you use IRQ4 for COM1 and IRQ3 for COM2.*

For direct communication to a Series Five PLC, use the RS-232 line interface standard and master/slave CCM protocol. RS-232 is especially convenient since all Workmaster and Cimstar I computers have an RS-232 port, and many IBM PC-XT and PC-AT systems have at least one RS-232 port which may be used by the Logicmaster 5 software.

For direct RS-232 communications without a modem, use one of the cables shown below. Note that the IBM PC-AT pinouts are different from the PC-XT pinouts. If you are not using a GE Fanuc serial port, you should use the signal names rather than the pin numbers to make your cable. Some serial ports are not AT or XT pinout compatible.





NOTE

If you are using a Workmaster industrial computer with a Combination Adapter card, refer to the wiring diagram on page A-7. Additional jumpers may be required.

Configuration Selections

The CCM communications port uses a 25-pin male connector. Communications characteristics are set up in the hardware.

Default settings are provided for ports 1 and 2. These ports correspond to DOS devices COM1 and COM2, respectively. The defaults match the factory settings of the serial port on the CPU. Brief definitions of the configuration selections are given below:

Baud Rate: The communications rate, in bits per second. (Default = 19200 bps)

Protocol: Protocol must be master/slave. In this mode, up to 8 CPUs may be connected to one computer.

RS-232: used for direct connections up to 50 feet (15 meters).

RS-422: used for direct connections up to 4000 feet (1200 meters).

Parity: The CCM port uses the serial data format shown below:

```
| START | 1   2   3   4   5   6   7   8   | PARITY | STOP
|   0   | LSB                         MSB |        |  1

         <--------- Direction of data flow.
```

Data is divided into 8-bit bytes and transferred using an asynchronous format. This format consists of one start bit, 8 data bits, one parity bit, and one stop bit.

The parity bit can be enabled or disabled. When enabled via the OIU, the format is odd parity. When disabled (default = none), the parity bit is not transmitted. Setting the parity to "NONE" will insure compatibility with modems which do not support ODD parity.

Communications Ports

Two connectors on the CPU module provide communications ports for external devices communicating with the CPU:

- The top port uses a 15-pin D connector, and is used to interface to the Series Five Operator Interface Unit (OIU).
- The lower port provides both RS-232 and RS-422 signals for communications purposes and is used for general communications networks. This port is accessed through a 25-pin D connector. It is used to interface the CPU to devices capable of communicating via the CCM protocol, such as host computers and Logicmaster 5 software.

NOTE

The lower port is the port used for programming with Logicmaster 5 software. The Workmaster computer, or other programming device, should be connected to this port.

There is only one logical port as far as the CPU is concerned, since both are connected to the same internal circuitry. However, the 15-pin port takes priority if the OIU is in the On-Line mode.

For example, if the 25-pin port is communicating with some device and an OIU is connected to the 15-pin port and placed in the On-Line mode, communications activity will switch to the 15-pin port. The CCM ports built into the CPU function *only* as slave devices.

CAUTION

The circuits connected to these ports are not isolated from the backplane; therefore, caution should be taken when connecting external devices to the ports. It is recommended that any device connected to these ports be connected to the same power source as the Series Five PLC. For long distance communications via an RS-422 link, it is recommended that the GE Fanuc Adaptor Unit IC630CCM390, which has an RS-422/422 and RS-232/422 isolating repeater feature, be used - especially if ground potential differences exist between the host device and CPU power sources.

Communications Port DIP Switches

Directly below the top communications port is a 4-position DIP switch used for setting certain CCM port operating parameters for the bottom port.

Switch 1: is used to select the mode of operation for CCM communications, either RS-232 or RS-422.

Switch 2: is used to select the CCM ID for communications with Logicmaster 5 software or other CCM host device.

Switches 3 and 4: are used to select the baud rate for communications.

The following table shows these settings, as they are listed on the back of the large hinged door of the CPU.

Table L-1. CCM Port DIP Switch Definitions

POSITION	DEFINITION		
1	ON - CCM port communicates via RS-232		
	OFF - CCM port communicates via RS-422		
2	ON - CCM ID is 1		
	OFF - CCM ID obtained from the CPU memory cartridge		
3 AND 4	BAUD RATE SELECTION		
	Switch 3	Switch 4	Baud Rate (BPS)
	OFF	OFF	300
	OFF	ON	1200
	ON	OFF	9600
	ON	ON	19200

Connection to the Cimstar I Computer

For the Cimstar I computer, the 9-pin upper connector on the top of the Multifunction module is used for RS-232 direct communications over distances of less than 50 feet. For communications over distances greater than 50 feet, the RS-422 port on the Industrial Option board is used instead. The connector for this port is located on the underside of the Multifunction module if the industrial option is installed.

The default factory settings are COM1 for the RS-232 port and COM2 for the RS-422 port. These designations may be changed, as described in GEK-90527, *Cimstar I Reference Manual.*

Cabling and pinouts for the Cimstar I computer are the same as those shown for the Workmaster computer in this appendix.

Multifunction Module

The standard Multifunction module provides two ports:

1. The top area of the module has a 25-pin port that is a Centronics-type parallel interface normally used for a printer. The parallel port in the Multifunction module is shipped as LPT1.
2. There is also a 9-pin port that can be used for direct communication, when the distance between the Cimstar I computer and the Series Five CPU is less than 50 feet. The serial port on the Multifunction module is shipped as COM1.

Industrial Option Board

The Industrial Option board to the Multifunction module provides an RS-422 serial port, an AC power-fail circuit, and a joystick interface. The connector for the RS-422 serial port is located on the bottom of the Multifunction module. The port is normally configured as COM2, but can be changed. The RS-422 port may be totally disabled in order to have a second RS-232 port on a user-supplied board designated as COM2.

Connection to the Workmaster Computer

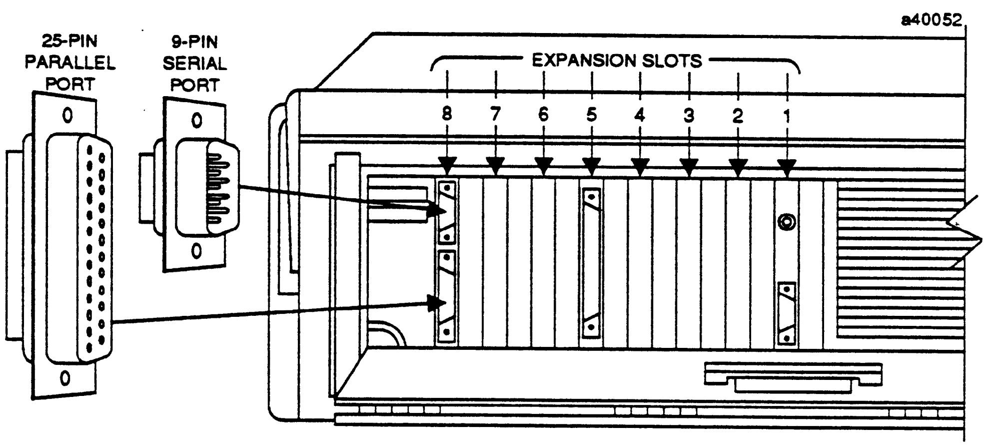
For the Workmaster industrial computer, the 9-pin upper connector on the Combination Adapter card is used for RS-232 direct communications over distances of less than 50 feet. For communication over distances greater than 50 feet, the Asynchronous/Joystick card must be used.

The designation as port COM1 is usually assigned to the RS-232 port on the Combination Adapter card, as described in this appendix. You can change this by assigning port COM1 to the RS-232/RS-422 port on the Asynchronous/Joystick card instead. This reassigns port COM2 to the Combination Adapter card.

In addition, you can select either port 1 or port 2 for communication on the Communication Setup menu.

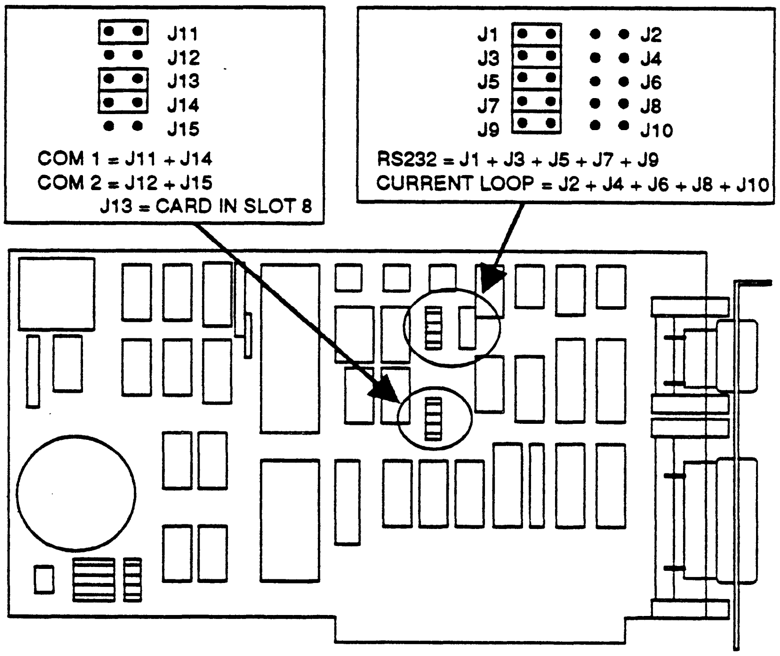
Combination Adapter Card

The Combination Adapter card (expansion slot 8) contains 2 ports, as shown in the following illustration:



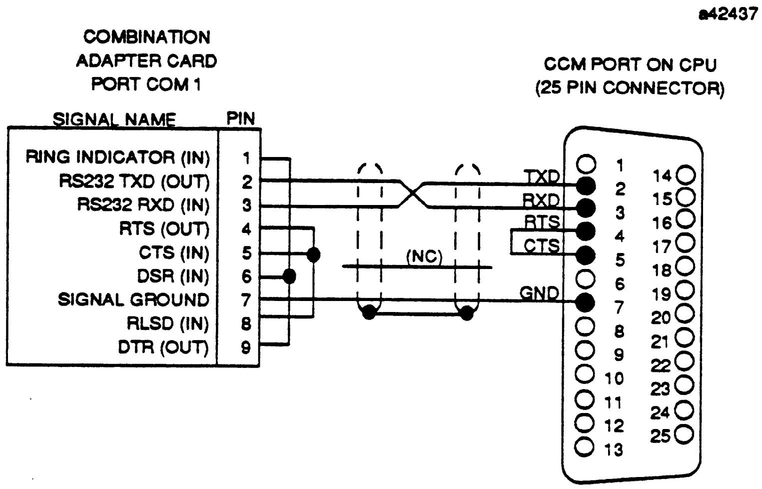
1. The 9-pin upper port on the Combination Adapter card is normally used for direct communication, when the distance between the Workmaster computer and the Series Five CPU is up to 50 feet. The Combination Adapter card is shipped to operate as COM1, as shown below:

a41043

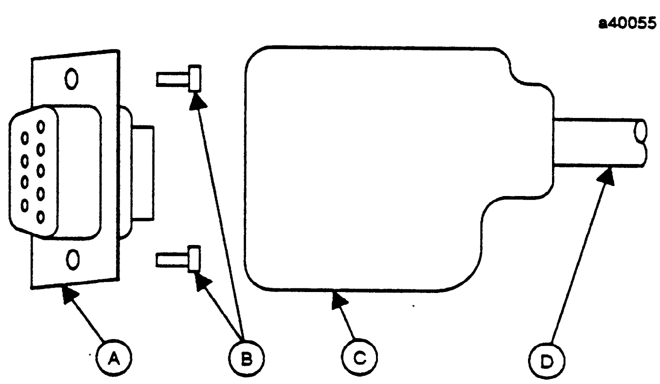


2. The 25-pin lower port, designated LPT1, is a parallel Centronics interface normally used for a printer. This port is described later this appendix.

The following illustration shows the cable assembly for RS-232 communication between the 9-pin female connector on the Combination Adapter card and the 25-pin female connector on the CPU.



The following illustration shows the connector and cable for attachment to the Combination Adapter card.



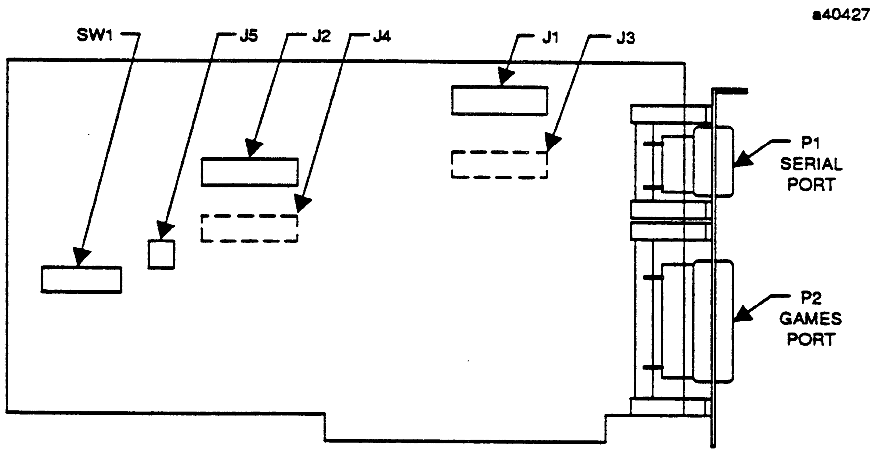
A CONNECTOR: CANNON DE9S (FEMALE)
B SCREWLOCK: CANNON D20419
C HOOD: CANNON DE110963-1
D CABLE: BELDEN 9300 SERIES (SHIELDED TWISTED PAIR)

A standard 25-pin male D connector is used to connect to the CCM communications port on the Series Five CPU. The screws which are used to secure this connector to the CPU use metric threads. GE Fanuc offers a 25-pin male D connector with hood and metric screws as catalog number IC655ACC525A. This connector is also contained in the accessory kit IC655ACC520A.

Asynchronous/Joystick Card

The Asynchronous/Joystick card, IC640BGB311, is a user-installed option card which provides RS-232 or RS-422 communications to the Series Five CPU or to another serial device.

This card has two ports. The 9-pin upper port is used for connection to the Series Five CPU. The lower port is for use with the joystick. The following illustration shows the location of the ports and the configuration jumpers and switches.



There are two types of Asynchronous/Joystick card, those with jumper J5 (type B), and those without (type A).

Version A of the Asynchronous/Joystick Card

The electrical interface for the RS-232/RS-422 port is set up by placing two DIP shunt packages (one 16-pin pack and one 14-pin pack) in the appropriate sockets. The 14-pin pack is placed in socket J2 or J4, and the 20-pin pack is placed in socket J1 or J3.

INTERFACE TYPE	SHUNT LOCATIONS	
	20-PIN	14-PIN
RS-232	J3	J4
RS-422	J1	J2

The other card options for IC640BGB311A are selected using the DIP-switch package SW1.

SWITCH #	OPEN FUNCTION	CLOSED FUNCTION
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

NOTE

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.

Version B of the Asynchronous/Joystick Card

This version of the Asynchronous/Joystick card 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 LOCATIONS	
	20-PIN	14-PIN
RS-232	J3	J4
RS-422	J1	J2

Other card options for IC640BGB311A are selected using the DIP-switch package SW1.

SWITCH #	OPEN FUNCTION	CLOSED FUNCTION
1	Game port enabled	Game port disabled
2	Serial port disabled	Serial port enabled
3	COM2 selected	COM1 selected
4	Transmit data not enabled by RTS	Transmit data enabled by RTS
5	Transmit data not enabled by GND	Transmit 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

NOTE

Switches 4 and 5 are for RS-422 only and should never both be on at the same time.

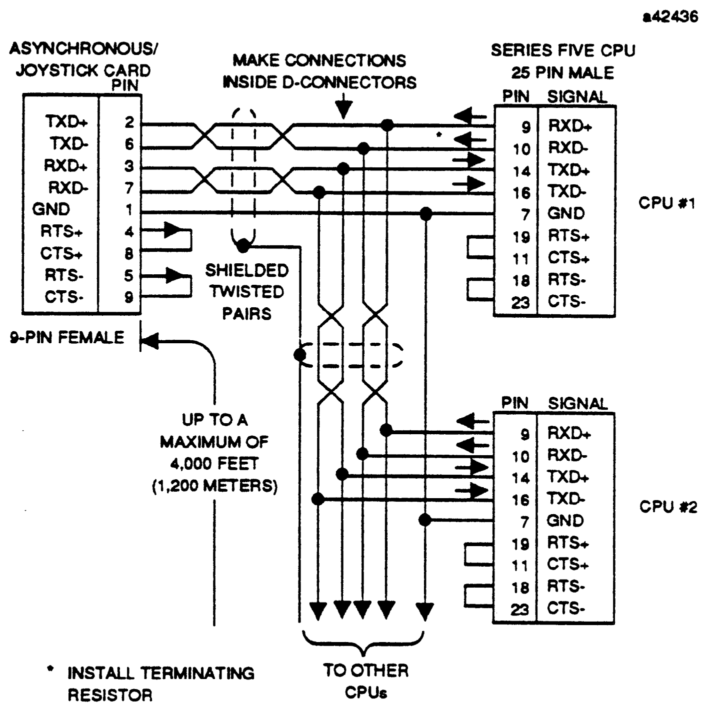
Switches 7 and 8 pertain to RS-232 only. In the RS-422 configuration, DSR and RLSD are forced to a TRUE state regardless of the positions of these switches.

FUNCTION	JUMPER 5 ON PINS
Select COM1	2 - 3
Select COM2	1 - 4

Table L-2. Asynchronous/Joystick Card Versions A or B Switch 1 Settings (RS-232 or RS-422)

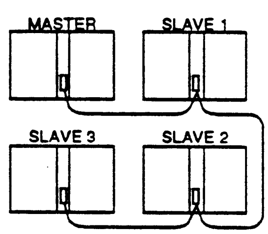
	SWITCH							
	1	2	3	4	5	6	7	8
COM1	OFF	ON	ON	ON	OFF	ON	ON	ON
COM2	OFF	ON	OFF	OFF	ON	ON	ON	ON

The following illustration shows the pin-outs for an RS-422 cable between the Workmaster computer and two CPUs. Refer to the description of the Combination Adapter card for connector and cable part numbers.



NOTE

WHEN WIRING RS-422 MULTIDROP CABLES, REFLECTIONS ON THE TRANSMISSION LINE CAN BE REDUCED BY CONFIGURING THE CABLE IN A DAISY CHAIN FASHION AS SHOWN HERE.

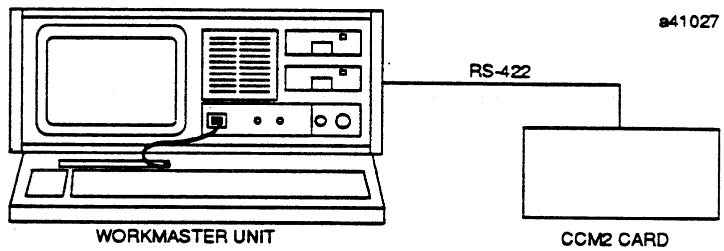


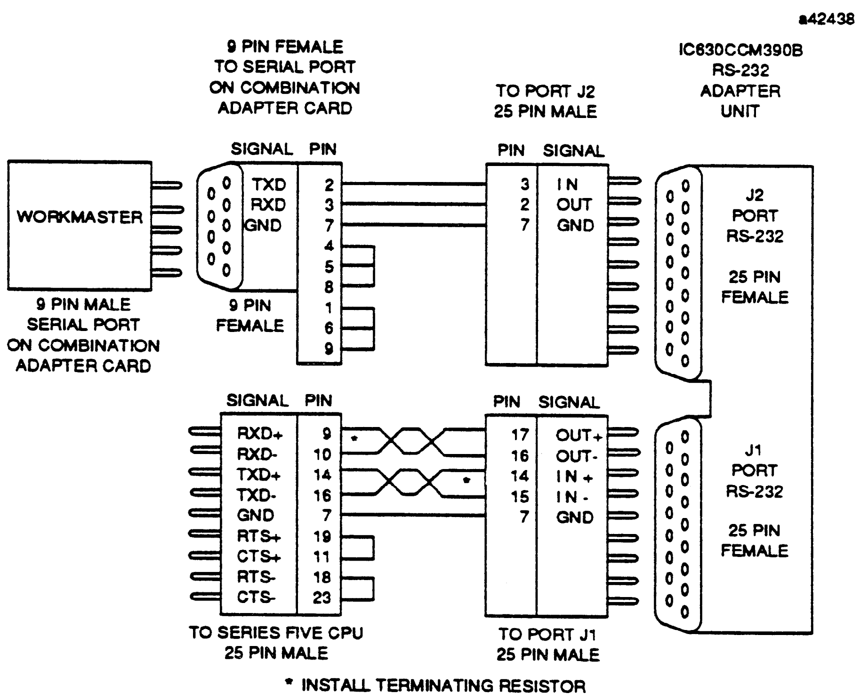
ALSO IT IS RECOMMENDED TO MAKE ANY NECESSARY CONNECTIONS INSIDE THE CABLE CONNECTOR. IT IS NOT RECOMMENDED TO USE TERMINAL STRIPS OR OTHER TYPES OF CONNECTORS ALONG THE LENGTH OF THE TRANSMISSION LINE.

An RS-422 link must terminate with the proper resistance to minimize reflection on the line. Some devices, such as the Asynchronous Joystick card, already have terminating resistors in the circuit. If you are making connection to a device that does not have such built-in resistance, you should provide it. A resistor can be installed in the connector at either end of a link, between the Receive Data (+) and Receive Data (-) pins. No terminating resistor is needed for intermediate drops. If a Series Five CPU is the end of an RS-422 link, then 150-ohm terminating resistors should be installed across each signal pair (+,-). The resistors can be wired into the connector.

Connecting the Workmaster Computer with an Adapter Unit

The following illustrations show the connection from the serial port (RS-232) on the Combination Adapter card through an RS-232 to RS-422 adapter unit (IC630CCM390B) to the CCM port.



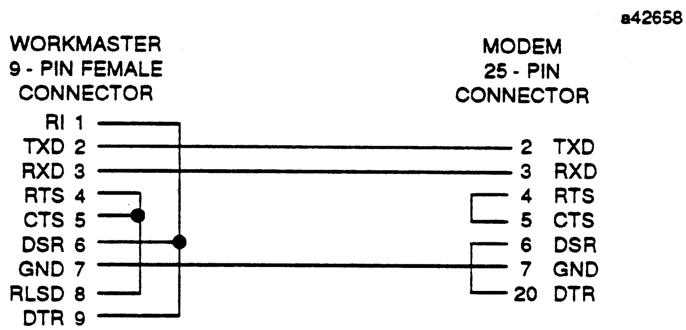


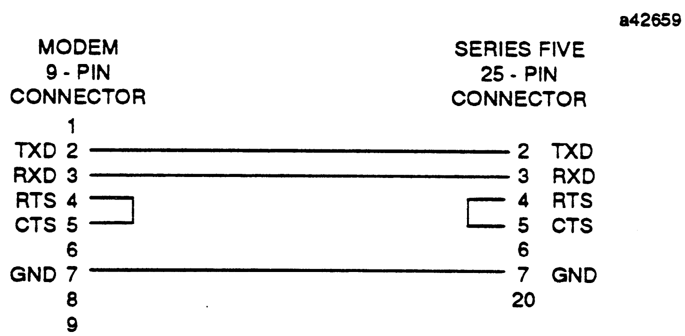
Modems

The Logicmaster 5 system supports full-duplex modems which are compatible with the Bell System 212 standard. In order to use modems with Logicmaster 5 software, the following hardware is required:

- A Workmaster or Cimstar I industrial computer, or IBM personal computer.
- Two smart modems (Bell System 212 compatible).
- A Series 5 PLC system. For use with switched carrier modems, a CPU revision C or greater must be used.
- A cable from the host computer to the modem.
- A cable from the modem to the Series Five PLC.
- Two telephone cables.

The next two illustrations show the pin connections between a Workmaster computer and modem, and between a modem and Series Five PLC.





Using a Smart Modem

A "smart" modem is one that can dial and answer the phone. To dial, the modem requires several control characters followed by the ASCII digits of the telephone number. Logicmaster 5 software does not provide a method of directly sending these characters to a serial port.

To use a smart modem, follow these steps:

1. Using an editor, create a text file containing the control characters and the telephone number. In DOS, this may be 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.

   NOTE

   The control and dialing commands may vary between modems. Consult your modem user's manual for further information.

2. Set up the modem.

   A. Boot up the Logicmaster 5 system.

   B. Configure 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
   ```

   C. Press the Setup Port (F1) key.

3. Background print the file.

   A. In the Communications Setup menu, de-select the port 1 for CPU communication port. To do this, leave the work area blank and press the Select Ports (F3) key.

   B. Go to the Print menu, and print the file to the serial port that is connected to the modem.

4. Establish serial communications.

   A. Return to the Communications Setup menu, and re-select the port for the CPU communications.

   B. Turn the keyswitch to on-line to place the computer in the On-Line mode.

RAM Disk Card

An Expanded Memory card (RAM Disk) is an optional memory card in your computer. It provides volatile memory that can be used for temporary file storage. The RAM Disk card can be used to store the Logicmaster 5 overlay files. It can also be used to store parts of a ladder logic program when the Windowing function is active. Windowing allows programs to have up to 10,000 rungs, and 5K nicknames. For more information about windowing, refer to chapter 10 of this manual.

NOTE

> Intel/Lotus Expanded Memory Board drivers that require more than 5K of RAM for both code and data are not supported by Logicmaster 5 software.

Using a Workmaster or Cimstar I Computer with a RAM Disk Card

If your Workmaster or Cimstar I industrial computer came equipped with an Expanded Memory card from GE Fanuc - NA, it is already set up to use the RAM Disk feature.

If your computer was not originally supplied with an Expanded Memory card, the card can be purchased separately from GE Fanuc - NA. In the Workmaster computer, it should replace the 384K RAM card if one is present. Logicmaster 5 software will operate with the card as installed if you are using a floppy-diskette system.

Adding the Expanded Memory Card

With an IBM personal computer, you can add an Expanded Memory card purchased from GE Fanuc - NA, or an equivalent card. The card must be compatible with the Lotus Expanded Memory device interface specifications. If you purchase the card from GE Fanuc - NA, follow the installation instructions provided with the card. The Logicmaster 5 software contains the files required to use the RAM Disk feature.

NOTE

> To invoke overlay loading from the RAM Disk, the overlay files must be copied to the RAM Disk prior to invoking Logicmaster 5 software. Refer to section 3 of chapter 2 for information on copying overlay files to the RAM Disk.

If you plan to use the RAM Disk card from GE Fanuc - NA, the DOS system configuration file (CONFIG.SYS) must be set up to load two special device drivers. These drivers are contained on a diskette shipped with the RAM Disk card. The diskette contains the following four files:

```
GEXMEM.SYS
GEXMEM2.SYS
GEXMDISK.SYS
GEXMTEST.EXE
```

GEXMEM2.SYS and GEXMDISK.SYS are the files required for use with the Logicmaster 5 software. These two files should be transferred to diskette 1, or to the \LM5 subdirectory if you are using a hard disk.

You will need to follow the instructions provided in GEK-96631 in order to configure the RAM Disk card for your system. This publication is shipped with the RAM Disk card. However, it will be helpful to note the following points:

1. A switch bank is located on the top edge of the RAM Disk motherboard, opposite its edge connector. Even though the switches are underneath the daughterboard, you can still flip them with a pointed instrument without removing the daughterboard. To turn a switch on, flip it toward the top edge of the board.
2. If you have only one RAM Disk card in your system, you should only need to adjust switches 7 and 8, which are toward the edge of the motherboard with the metal installation bracket. These switches are used to designate up to one half of the total 1024K bytes of RAM Disk memory as normal system memory. This memory will be used by DOS for running application programs. Normally, you should allocate as much memory from the RAM Disk as required to fill your system memory out to 640K bytes. Any remaining memory on the RAM Disk is referred to as "expanded memory" and may be used to emulate a fast-access floppy disk.

For example, if your computer has 256K bytes of memory, you should allocate 384K bytes of the RAM Disk to the system. This provides a total of 640K bytes of system memory with a remainder of 640K bytes of expanded memory. However, if your computer is already loaded with 640K bytes of memory, you should allocate none of the RAM Disk to the system, providing a total of 1024K bytes of expanded memory.

For a Workmaster computer, part of the memory on the RAM Disk card is used as the 640K of RAM needed to run the Logicmaster 5 software. You should read the instructions provided with the card for information about switch settings, to be sure this memory is properly assigned.

The following table summarizes the switch settings for switches 7 and 8.

SW7	SW8	MOTHERBOARD CONFIGURATION		TOTAL EXPANDED MEMORY
		SYSTEM MEMORY	EXPANDED MEMORY	
on	on	none	512K	1024K
off	on	128K (after 512K)	384K	896K
off	off*	384K (after 256K)	128K	640K
on	off	512K (after 64K) (total = 576K)	none	512K

Total Expanded Memory in the above table refers to the amount of memory which may be reserved for use as a fast-access floppy disk. This is done through the CONFIG.SYS command line which loads the device driver GEXMDISK.SYS.

Once you have installed the RAM Disk in your computer, you can test it by running the program GEXMTEST.EXE, which is provided on the diskette. This is strongly recommended.

Finally, you should edit your CONFIG.SYS file to load the RAM Disk drivers. For example:

```
device=gexmem2.sys -c21c
device=gexmdisk.sys -k640
```

If you are using a hard disk, you should also specify the \LM5 path. For example:

```
device=\lm5\gexmem2.sys -c21c
device=\lm5\gexmdisk.sys -k640
```

The values shown above (-c21c and -k640) specify the RAM Disk's configuration register address (switch 2) and memory allocation (switches 7 and 8). The value (-k640) refers to the amount of expanded memory that you wish to reserve for use as a fast-access floppy disk. You may reserve up to the total listed in the preceding table.

In order to activate the RAM Disk drivers, you must restart the computer after the editing the CONFIG.SYS file.

Video-7 Enhanced Graphics Adapter (VEGA) Card

Logicmaster 5 software will support the Video-7 Enhanced Graphics Adapter (VEGA) card operating as the primary display adapter in the computer. The VEGA card must be configured as either a monochrome display adapter or a color graphics adapter. The IBM Enhanced Color Display monitor may be used with the VEGA card configured as a color graphics adapter.

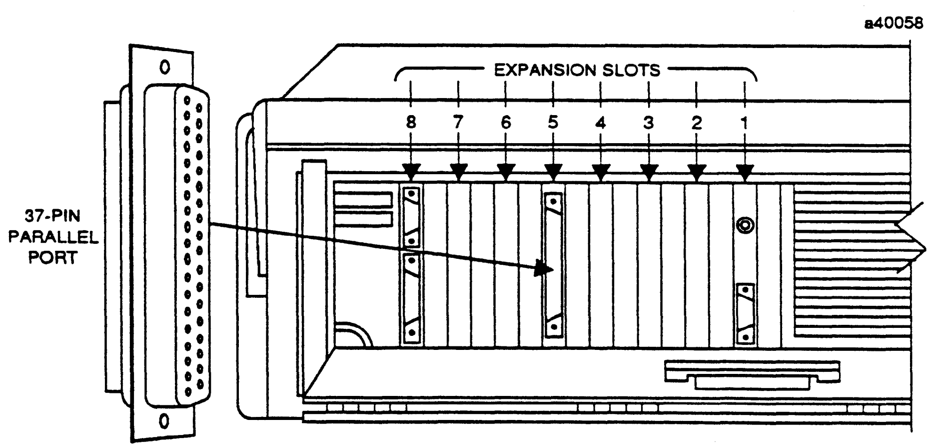
The VEGA toggle switch should be set to the right (as you look at the card edge-on, with the toggle switch at the top). Other switches should be set according to the type of display monitor being used, as follows:

DISPLAY TYPE	VEGA SWITCHES					
	1	2	3	4	5	6
Monochrome	off	off	on	off	off	off
Color/Enhanced	off	off	off	on	off	off

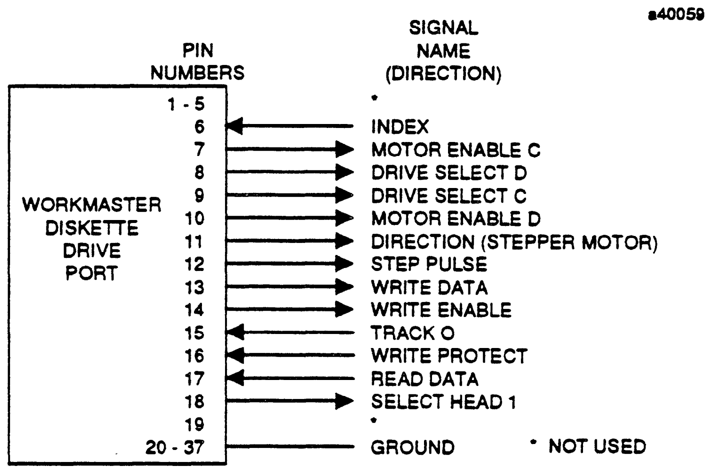
Other switches on the system board of your computer may need to be set as well. For the Workmaster computer, and for IBM PC and PC-XT machines, switches 5 and 6 of switch block 1 must be set to on. For the Cimstar I computer, and for IBM PC-AT personal computers, the diagnostic setup program must be run to configure the machine for the type of monitor (monochrome or color) which will be used.

Diskette Drive Adapter Card

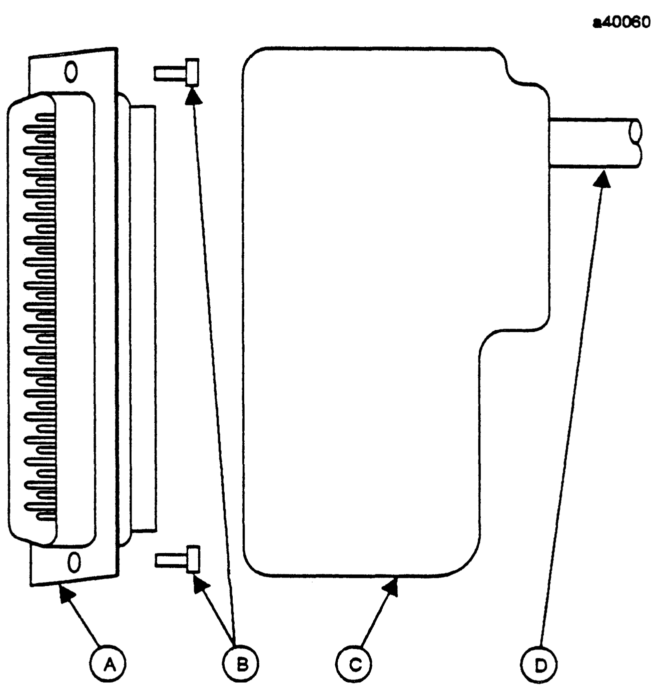
The Diskette Drive Adapter card (expansion slot 5 of the Workmaster computer) provides an interface to an external drive for 5.25-inch diskettes. The location of the 37-pin port is shown in the following illustration:



The next illustration shows the pin-outs for the diskette drive port. All outputs of this port are at standard TTL levels.



The next illustration shows the user connector and cable part numbers:

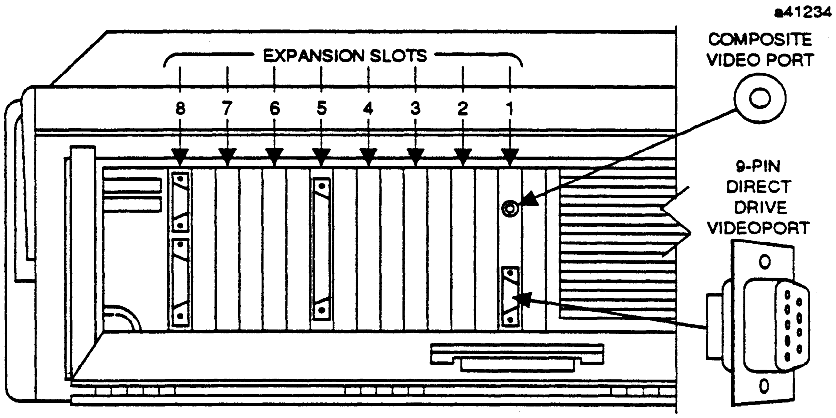


A CONNECTOR: CANNON DC37P (MALE)
B SCREWLOCK: CANNON D20419
C HOOD: CANNON DE110963-4
D CABLE: BELDEN 9300 SERIES (SHIELDED TWISTED PAIR)

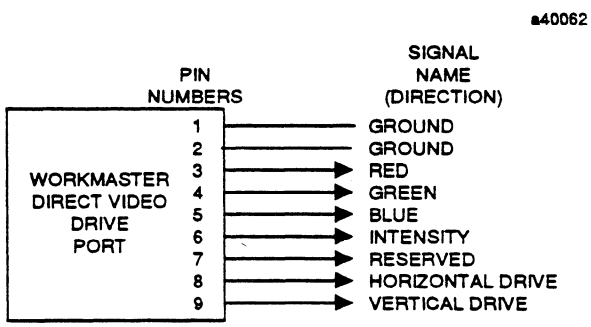
Color/Graphics Monitor Adapter Card

The Color/Graphics Monitor Adapter card (expansion slot 1 of the Workmaster computer) is connected internally to the amber monitor of the Workmaster unit.

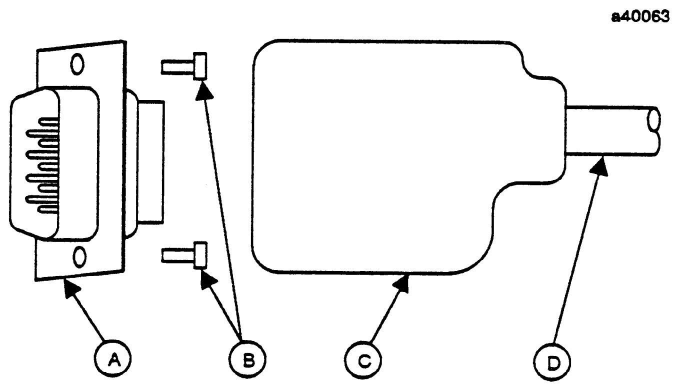
Externally, it provides a direct drive TTL interface and a composite video interface. The direct drive interface uses a 9-pin D-type connector and the composite interface uses a phono-plug type connector. The location of these interfaces is shown in the following illustration:



Pin-outs for the 9-pin connector for the direct drive port are shown below:

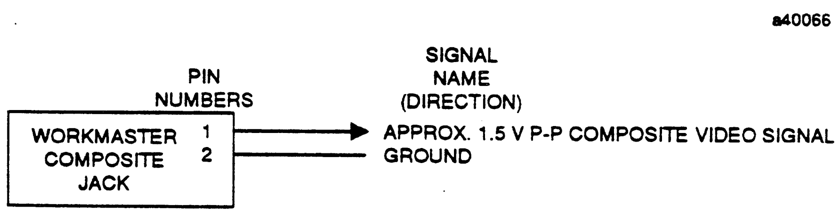


The following illustration shows the connector and cable for attachment to the Color/Graphics Monitor Adapter card.

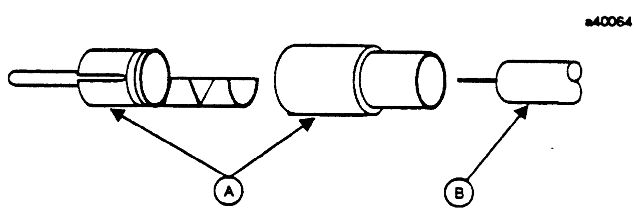


A CONNECTOR: CANNON DE9P (MALE)
B SCREWLOCK: CANNON D20419
C HOOD: CANNON DE110963-1
D CABLE: BELDEN 9300 SERIES (SHIELDED TWISTED PAIR)

The next illustration shows the circuits for the Composite Video Port:



The user connector and cable part numbers for the Color/Graphics Monitor Adapter card are shown below:



A CONNECTOR: SWITCHCRAFT 3558 PHONO PLUG
B CABLE: 75-OHM RG-58/U COAXIAL CABLE

Parallel Port Protocol

When communicating through the parallel port on the Workmaster computer, Logicmaster 5 software will make a character available on the data lines, wait for the printer to pull the BUSY (pin 11) line low, and then strobe the data to the printer by setting the STROBE (pin 1) line low and then high. This is repeated until the Logicmaster 5 system has no more characters to send to the printer.

Printer signals are made available through the parallel printer port on the back of the Workmaster computer. These signals and pin assignments are shown in the following table:

PIN NO.	SIGNAL NAME	DESCRIPTION
1	Strobe	The printer may read the data bits when this signal is pulled low by the Logicmaster 5
2	Data Bit 0	These signals represent bits 1 through 8 of the parallel data being sent to the printer.
3	Data Bit 1	
4	Data Bit 2	
5	Data Bit 3	
6	Data Bit 4	
7	Data Bit 5	
8	Data Bit 6	
9	Data Bit 7	
11	Busy	A character is not strobed to the printer as long as the printer holds this signal high.
Pins 18-25	Signal Ground	
Pins 10, 12-17	Not used	

Serial Port Protocol

When sending a character to a printer through one of the serial ports on the Workmaster computer, Logicmaster 5 software first sets RTS (pin 4) and DTR (pin 9 or 20) high. It will then wait for CTS (pin 5) and DSR (pin 6) to be set high by the printer. Then, a character will be issued. This is repeated until the Logicmaster 5 system has no more characters left to send to the printer.

If the printer wishes to prevent a character from being issued by the Workmaster computer, it must pull either CTS or DSR low before receiving the last data bit in the preceding character.

If a printer connected to one of the serial ports does not support this handshaking, the RTS signal pin must be jumpered to the CTS signal pin and the DTR signal pin must be jumpered to the DSR signal pin at the Workmaster side of the cable. The baud rate must then be adjusted so that the printer does not miss any characters.

Printer signals are made available through a 9-pin connector (port 1) and a 25-pin connector (port 2) on the back of the Workmaster computer. These signals and pin assignments are shown in the following table:

PIN NO.	SIGNAL NAME	DESCRIPTION
2	TXD	Serial data output to the printer.
3	RXD	Serial data received from the printer.
4	RTS	This signal is set high by Logicmaster 5 to indicate that it is ready to send data.
5	CTS	This signal is set high by the printer to indicate that is is ready to receive data.

PIN NO.	SIGNAL NAME	DESCRIPTION
6	DSR	This signal is set high by the printer to indicate that it is ready to receive data.
7	SG	Signal Ground.
9*	DTR	This signal is set high by Logicmaster 5 to indicate that is ready to send data.
20		
Pins not used		- port 1: 1, 8 - port 2: 1, 8-19, 21-25

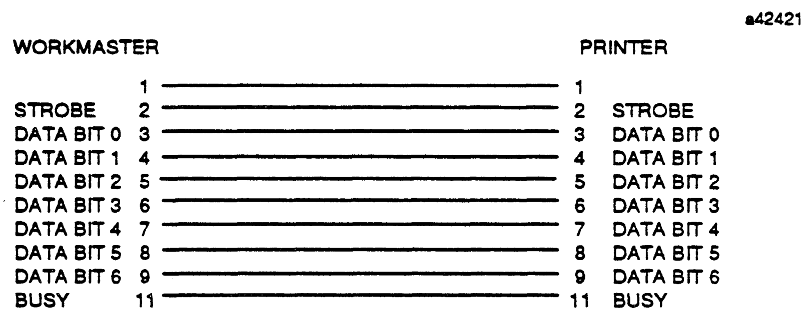
*Pin 9 on port 1, pin 20 on port 2.

Printer Cable Diagrams

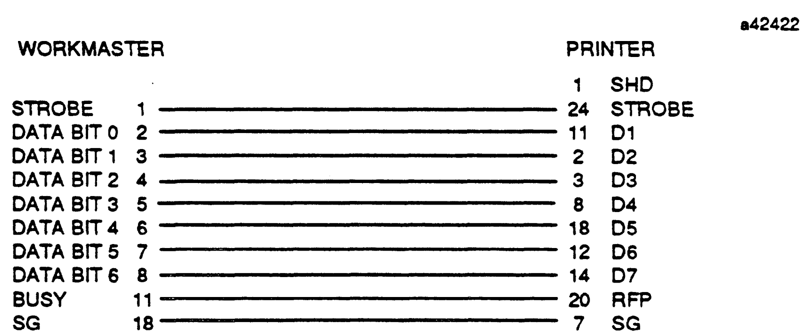
Cable diagrams for several types of printers are given below.

Parallel Interface with BUSY/STROBE Handshaking

For IBM and Epson FX+ Series printers:

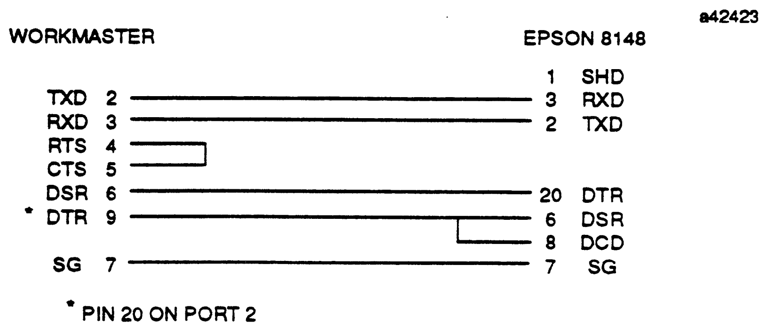


For Terminet 300 Series printers - standard parallel interface:

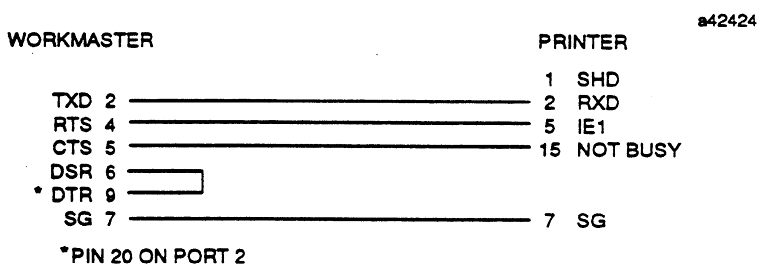


Serial Interface with Level One Handshaking

For Epson 8148 Intelligent Serial Interface (used with Epson FX and RX Series printers), Epson 8145 Serial Interface Type 2 (used with Epson MX Series printers):

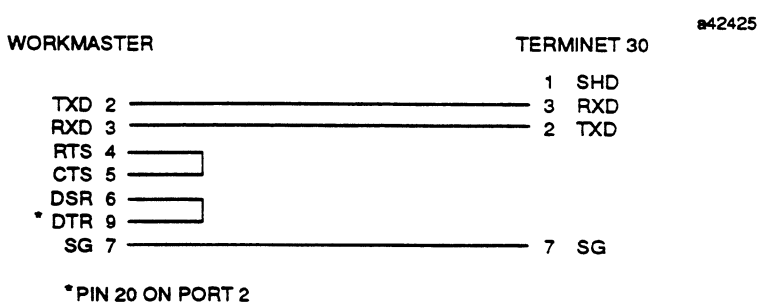


For Terminet 300 Series printers:



Serial Interface with Level Zero Protocol

For Terminet 30 printers:



Appendix B
Glossary of Terms

A

Address A specific memory location.

Analog A value measurement of physical variables, such as rotation and distance.

AND (Logical) A mathematical operation between bits. All bits must be 1 for the result to be 1.

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.

B

Background Some computer functions, such as background printing, can be performed in the ''background'' while other functions are used.

Backup A duplicate version of a program, created prior to editing the program.

Basic Series Five Function
A group of program functions available with the Series Five PLC. These include all the programming functions of the Series Five CPU.

Baud A unit of data transmission. Baud rate is the number of bits per second transmitted.

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. In the Series Five PLC, a byte is 8 bits.

Byte Boundary The bit which marks the beginning of a new 8-bit byte. For example, 1, 9, 17.

C

Chain A set of I/O channels. There are two I/O chains - Main chain and the Auxiliary I/O chain. In a conventional I/O system, each chain can have up to 1024 inputs and 1024 outputs. In an Expanded I/O system, each chain can have up to 8 channels. Each channel consists of up to 1000 inputs and 1000 outputs.

Channel In an Expanded I/O system, the term channel refers to a set of up to 1000 inputs and 1000 outputs. There are 2 channels in the Real I/O chain and 2 channels in the Internal Output chain, and 1 channel of 512 points in the Internal Input chain.

Constant 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 device that interprets instructions, makes decisions, and executes the instructions based on the decisions. In this manual, the term CPU is used to refer to the CPU module of the Series Five PLC.

CPU Keyswitch The keyswitch on the CPU of the Series Five PLC. Used to place the CPU in Run/Stop mode or Terminal mode.

CPU Version The Series Five CPU contains two sets of firmware: One contains operating instructions for the Relay Ladder program. The other contains instructions for maintaining the CPU operating environment.

Cross-Reference Table
A table that keeps track of program references.

D

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 or Skip function.

Double Precision Number
A twos complement value. In the Series Five PLC, it consists of two 16-bit words (31 bits and sign bit). The value range for such a number is -2,147,483,648 to +2,147,483,647.

Drive A floppy-diskette drive or hard-disk drive. The identification of the drive, such as drive A.

E

EOR (Exclusive OR)
A matherical operation between two bits. If only one of the bits is 1, the result is 1. If the bits are both 0 or both 1, the result is 0.

Explicit Reference
A register or I/O reference whose address is explicitly used as a program reference.

F

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 may change with the program. The Logicmaster 5 software displays the current assignments of the function keys at the bottom of the screen.

H

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.

I

Implicit Reference
A register or I/O reference other than the explicit reference which is also used by a program function. For instance, in a table the first reference is the explicit reference and the rest of the references in the tables are implicit.

IOR (Inclusive OR)
A mathematical operation between bits. If any bit is 1, the result is 1.

Input Devices Devices that mechanically or electrically supply data to the Series Five PLC. Typical input devices are limit switches, pushbuttons, pressure switches, digital encoders, and analog devices.

Instruction Set A group of program functions available in the Series Five CPU.

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.

L

Ladder Diagram
A graphic representation of decisional logic.

Latch A program function that causes an output to go on and stay on, even if power or the input is removed. It is a "retentive" function.

Line of Logic A rung of ladder logic may contain up to 8 lines of logic in parallel. A single line may contain up to 9 elements in series.

List A group of consecutive storage locations in memory, used for data manipulation. The beginning address and length of the list are set up in the program. Data is accessed from either the top or the bottom of the list.

Load The function used to transfer programs to the Logicmaster system's RAM memory.

M

Master Software
The original Logicmaster 5 software diskettes shipped from the factory.

Matrix A group of consecutive 16-bit storage locations in memory. The beginning address and length of the matrix are set up in the program. Individual bits in the matrix may be operated on by program instructions.

Memory Mapping
The assignment of inputs, outputs, and other data to pre-defined locations in CPU memory.

Memory Size The number of registers of memory in the CPU.

Mnemonic An abbreviation or other representation of a program instruction. The mnemonic appears in the ladder diagram where the function is used. For example, the mnemonic for "Preset" is PRE.

Mode Select Switch
The keyswitch on the front of the Workmaster computer that selects the mode of the Logicmaster 5 system. When using another type of computer, mode is selected in software.

Monitor Mode A mode of operation that allows the operating program to be monitored. No program changes can be made in Monitor mode.

O

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 5 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.

One-Shot A discrete reference to a ladder diagram element, usually a coil in a line of logic, which is energized for one scan of the CPU. This occurs when there is an off-to-on transition of the referenced input.

OIT (Operator Interface Terminal)
An operator device with a display screen and keyboard. An OIT may be part of the Series Five PLC application.

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.

P

Parity A type of integrity check on data.

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.

R

Retentive Output An output that will remain on in its last state, if power is removed.

Rung A unit of ladder logic. One rung may have up to 8 parallel lines of logic connected to the left rail, but these must be combined so that there is just one connection to the right rail.

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.

Real Reference A program reference that represents a hardware device.

Reference Tables A group of formatted tables which can display the values of I/O and registers in the system.

Reference An I/O or register address that supplies status or data to an instruction in a program.

Register A group of 15 consecutive bits in register memory. Each register is numbered, beginning at 00001. Register memory is used for temporary storage of numerical values, and for bit manipulation.

S

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 Series Five PLC, which stores the characteristics of the CPU. A similar function in the Logicmaster 5 software is also called the Scratch Pad.

Serial Version Logicmaster 5 software communicates with the Series Five CPU through a serial link to the CCM2 port, using CCM protocol.

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 5 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 Logicmaster 5 menu. It lists all the principal system functions, and the function keys that control those functions.

T

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.

Timer An internal function that can be used to control the operating cycle of other devices by a preset and accumulated time interval.

Twos Complement A form of binary arithmetic used to perform binary subtractions with addition techniques. The twos complement negative of a binary number is formed by inverting each bit in the number and adding 1 to the result. For example, the twos complement of 0011 is 1100+1, or 1101.

U

Unlatch A function that causes an output to turn off, no matter how briefly it was turned on.

V

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.

W

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.

Appendix C
Logicmaster 5 Error Codes

Listed below are descriptions of possible Logicmaster 5 error codes that could appear on the Supervisor screen.

Table N-1. Initilization Errors

ERROR NUMBER	DESCRIPTION	CORRECTIVE ACTION
2	OUT OF MEMORY CONDITION	Check for correct parameters in the CONFIG.SYS file. Verify that no other programs are RAM resident or running in Background mode. If running from a copied diskette or hard disk, verify that the diskette was copied using the Logicmaster Duplicate Master function and not a DOS copy.
14 or 539	WORKMASTER THERMAL SWITCH OR KEYSWITCH	Verify that the keyswitch is not between positions. Check the connections between the keyswitch and the Combination Adapter board. If the problem still exists, run Workmaster diagnostics.

Table N-2. System Software Errors

ERROR NUMBER	DESCRIPTION	CORRECTIVE ACTION
0	OUT OF MEMORY CONDITION	Check for the correct parameters in the CONFIG.SYS file. Verify that no other programs are RAM resident or running in Background mode. If running from a copied diskette or hard disk, verify that the diskette was copied using the Logicmaster Duplicate Master function and not a DOS copy.
6	WORKMASTER THERMAL SWITCH	Check for a connection problem from the thermal switch to the Combination Adapter board. If the problem still exists, run Workmaster diagnostics.

NOTE

For other error codes, contact field service personnel at GE Fanuc, Charlottesville, Virginia.

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 conditions listed below. If a key function does not display, check this list:

- Available software options.
- Scratch Pad content.
- Cursor position.
- Program logic at the cursor position.
- Logicmaster 5 operating mode (computer keyswitch position).
- CPU Memory Protect keyswitch position.

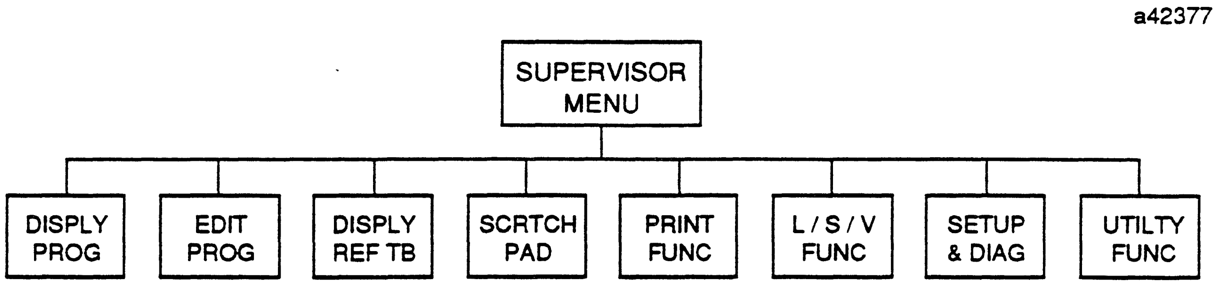


Figure D-1. Supervisor Menu

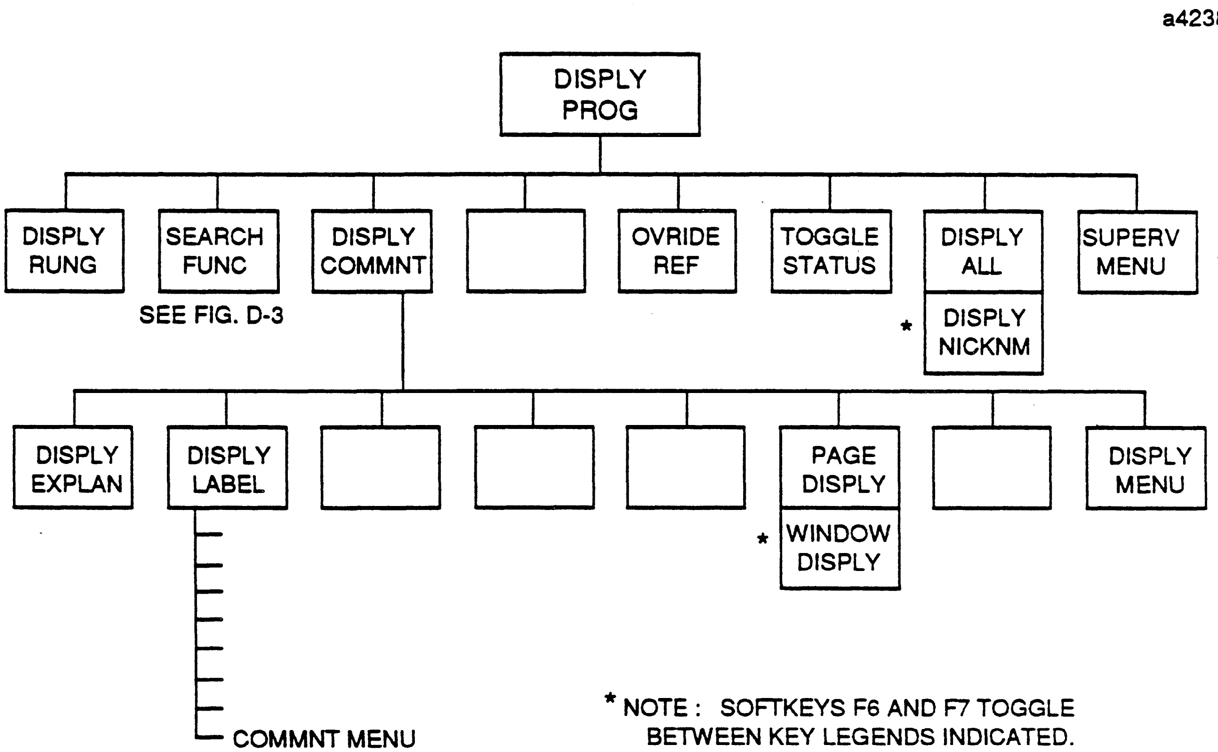


Figure D-2. Display Program Software Functions

NOTE

The data flow for the Search function is common to both the Display Program and Edit functions.

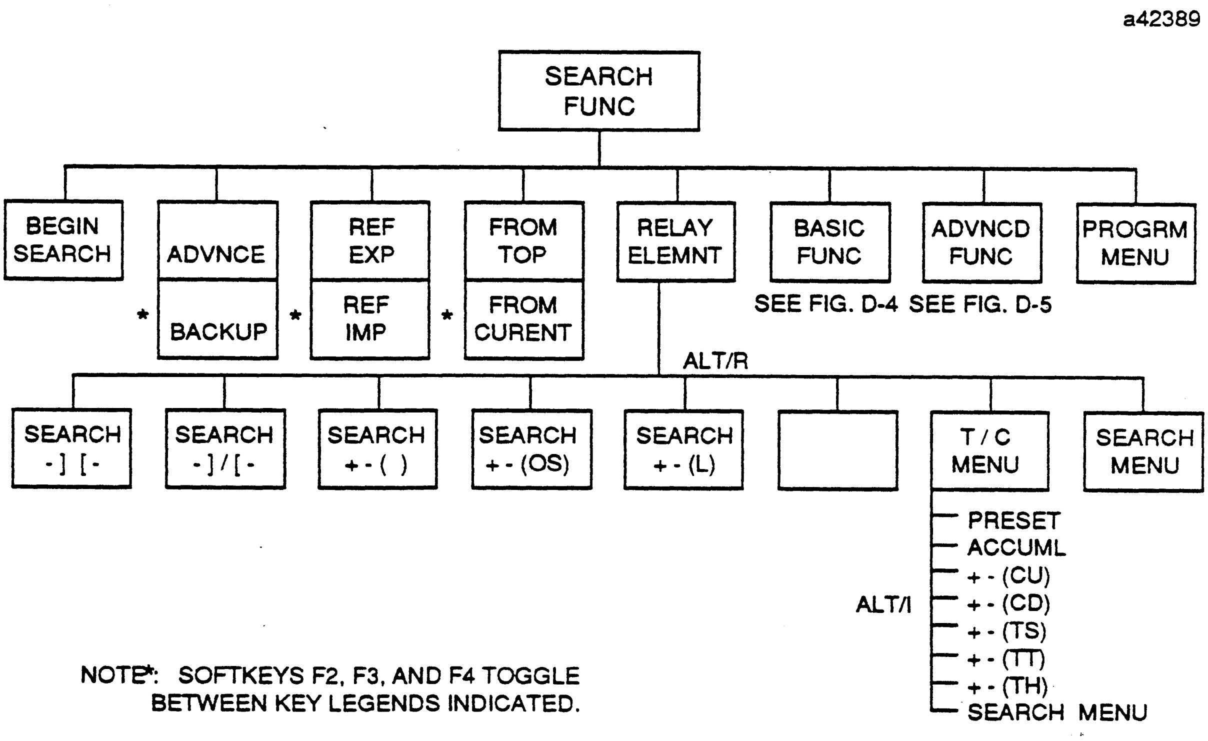


Figure D-3. Search Function

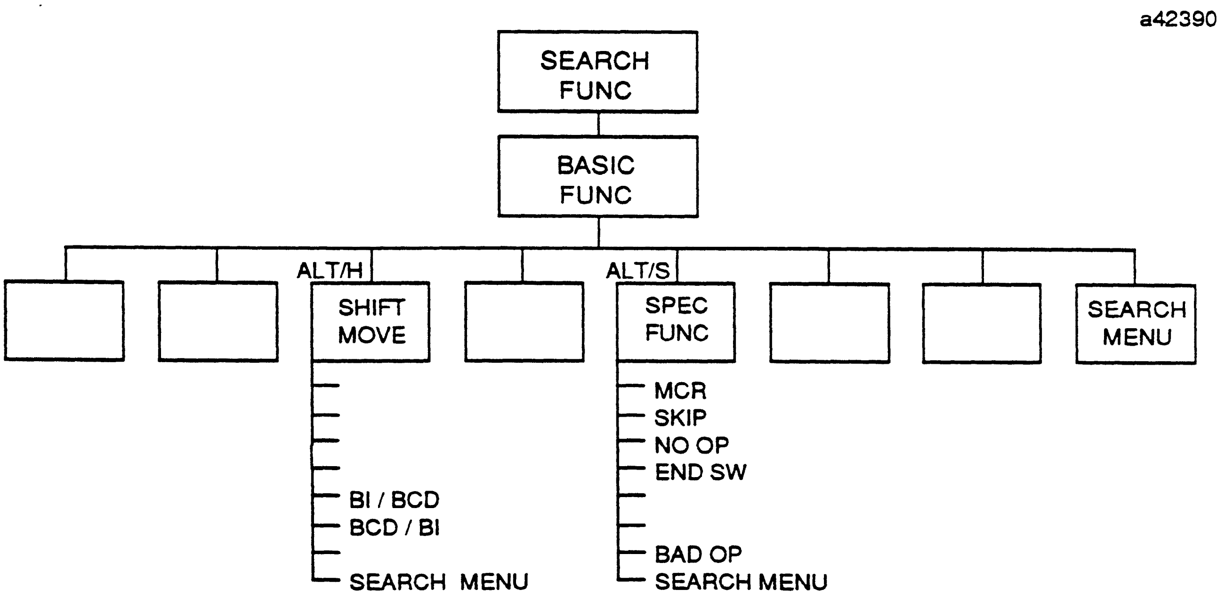


Figure D-4. Basic Functions

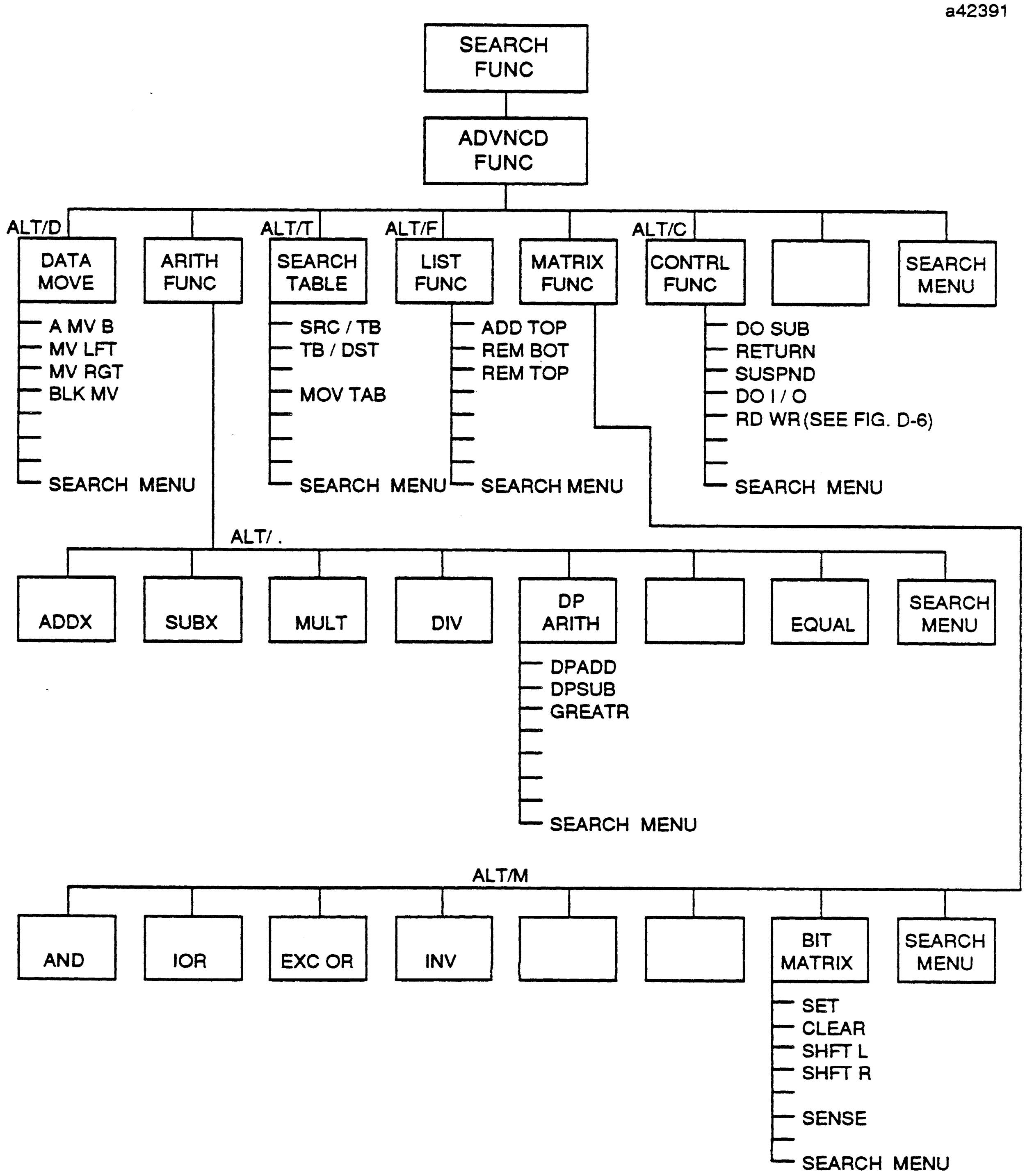


Figure D-5. Advanced Functions

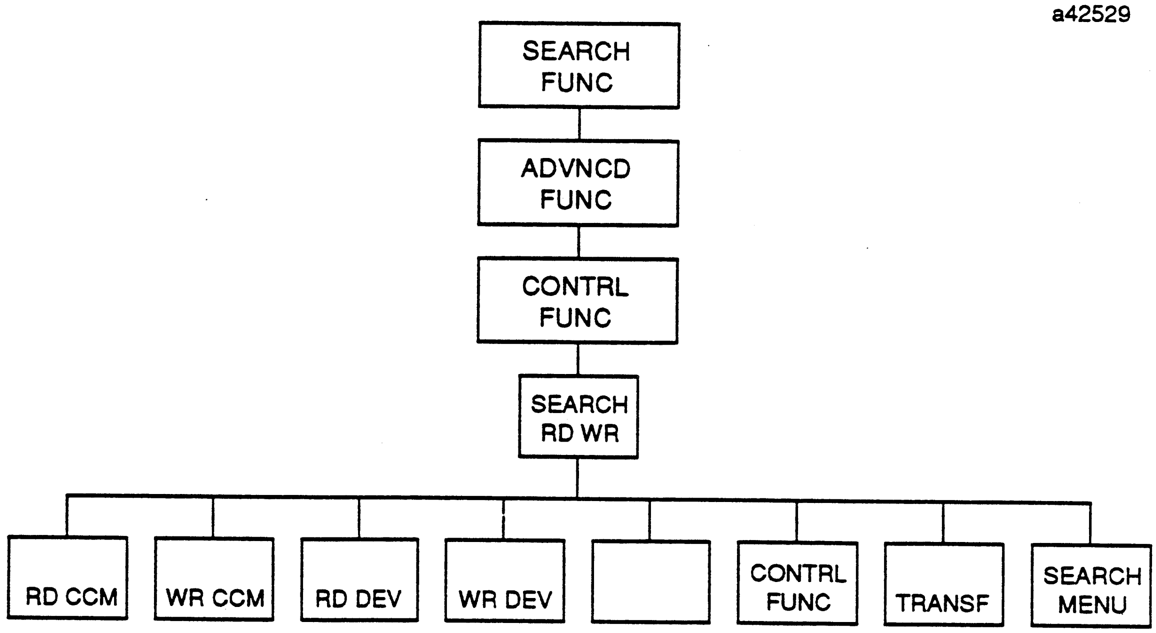


Figure D-6. Read/Write Functions

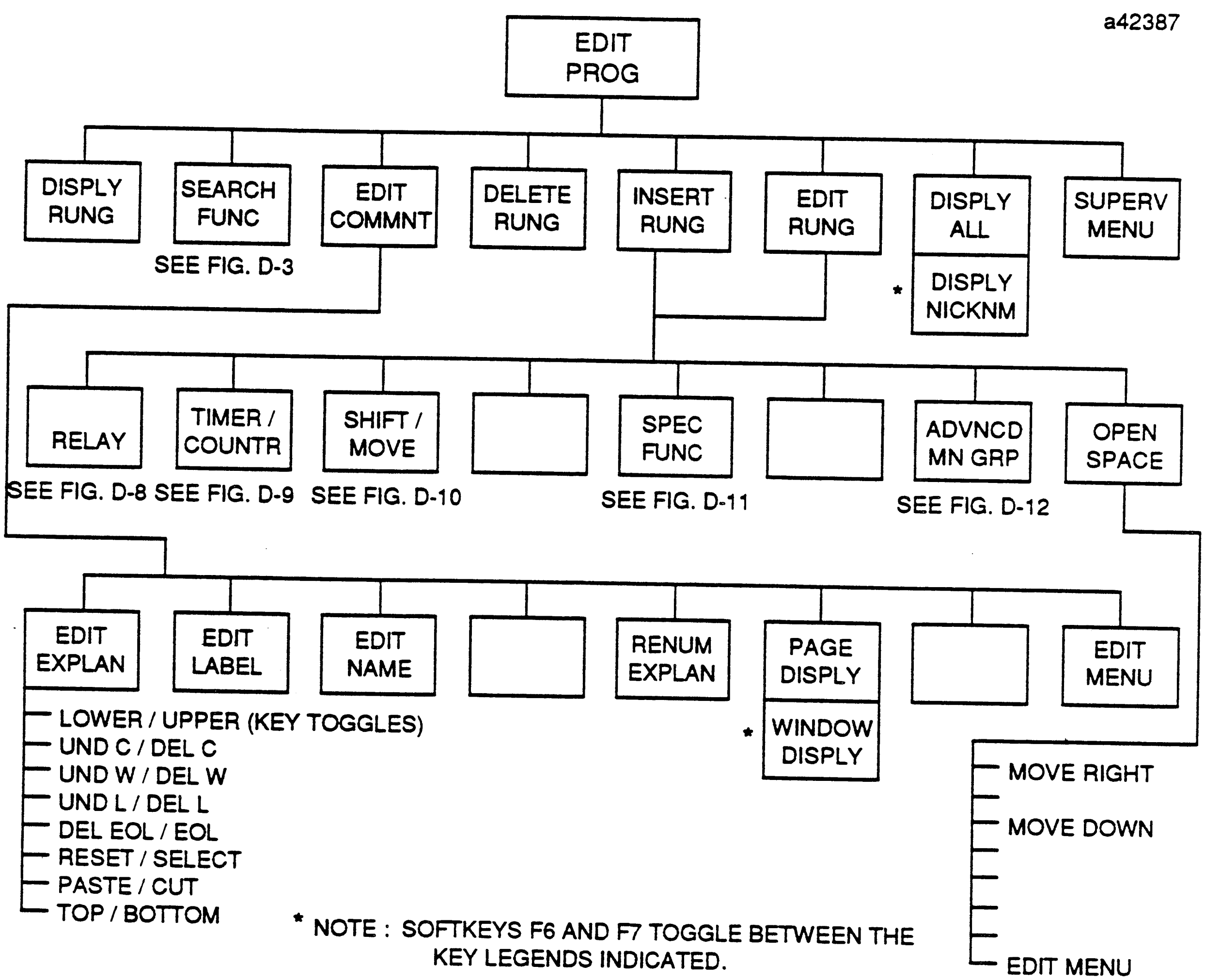


Figure D-7. Edit Program Software Functions

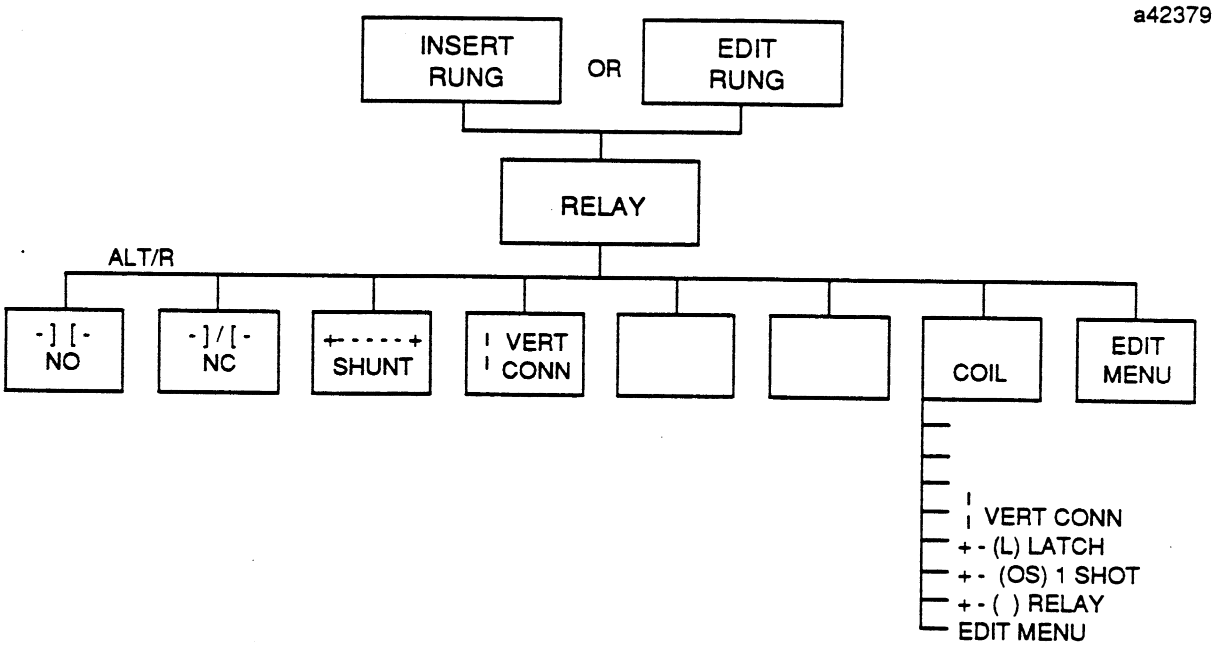


Figure D-8. Relay Functions

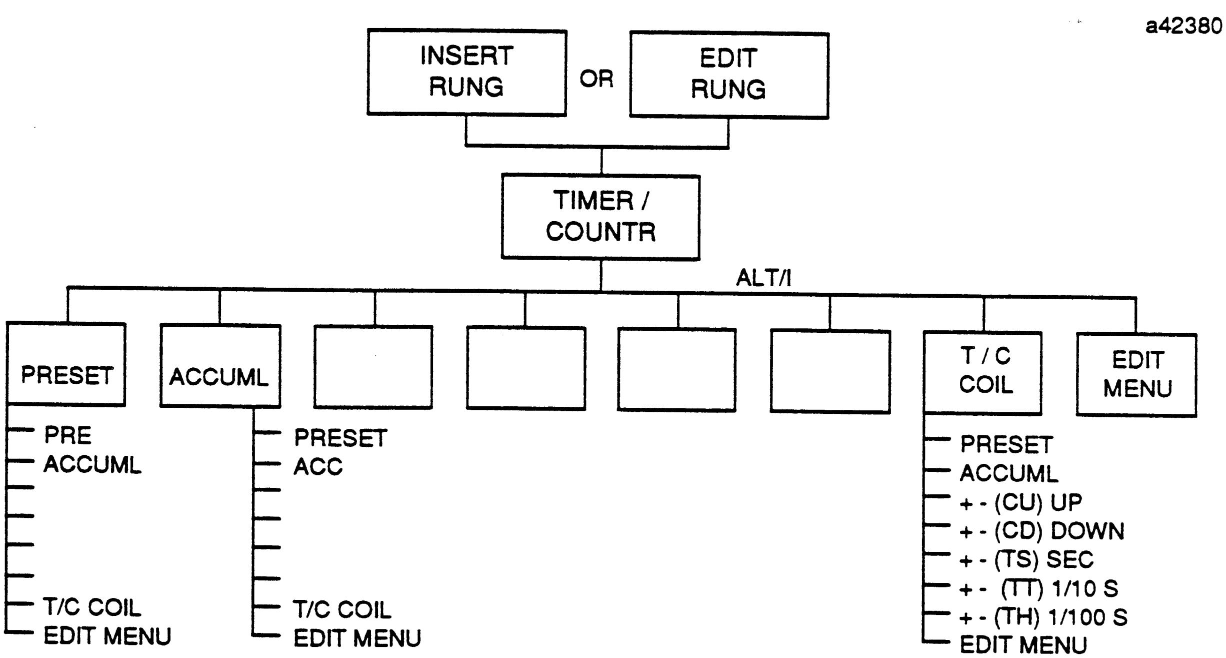


Figure D-9. Timer/Counter Functions

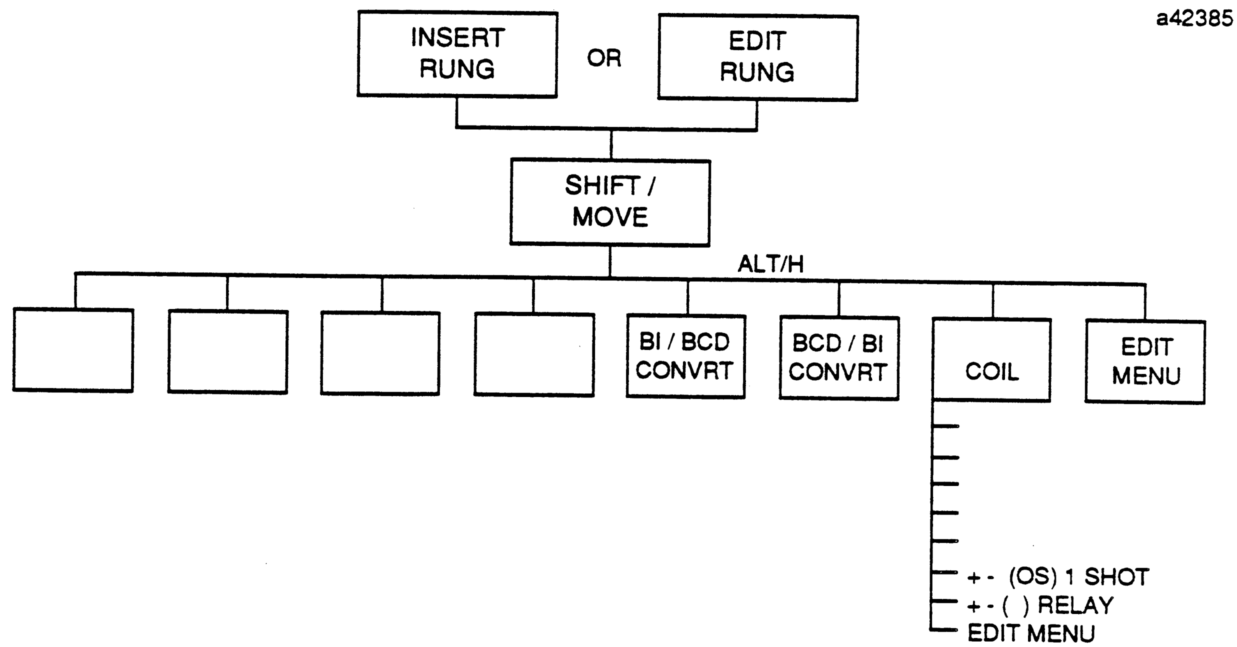


Figure D-10. Shift/Move Functions

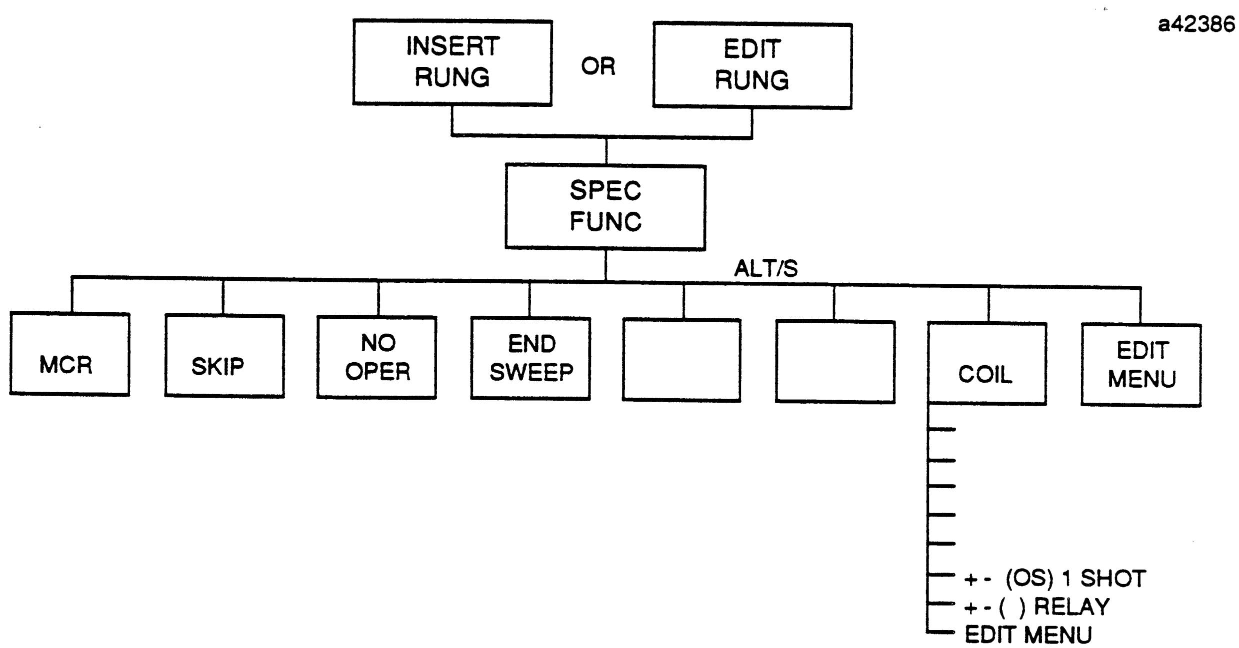


Figure D-11. Special Functions

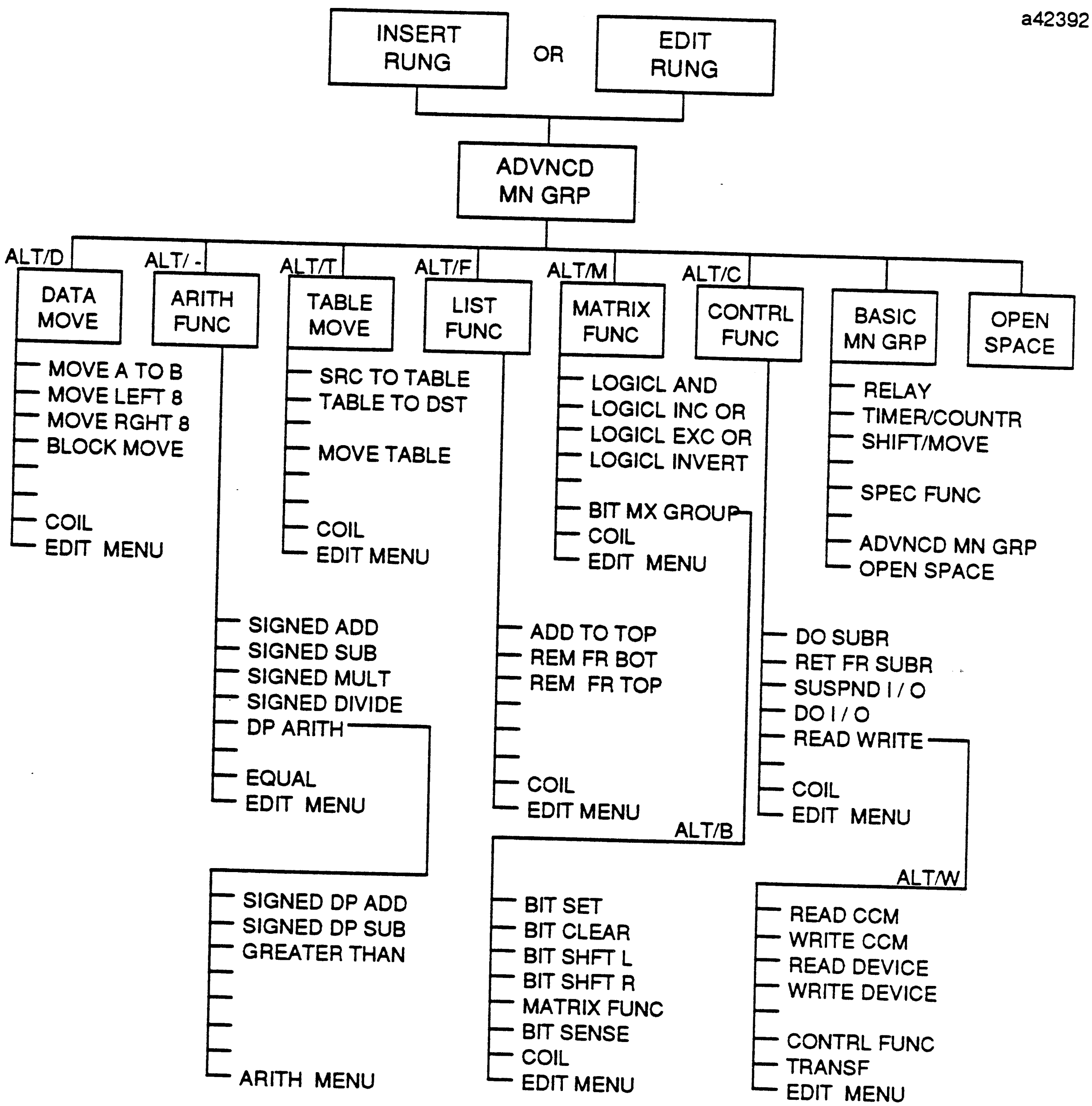


Figure D-12. Advanced Mnemonics Group

GFK-0023

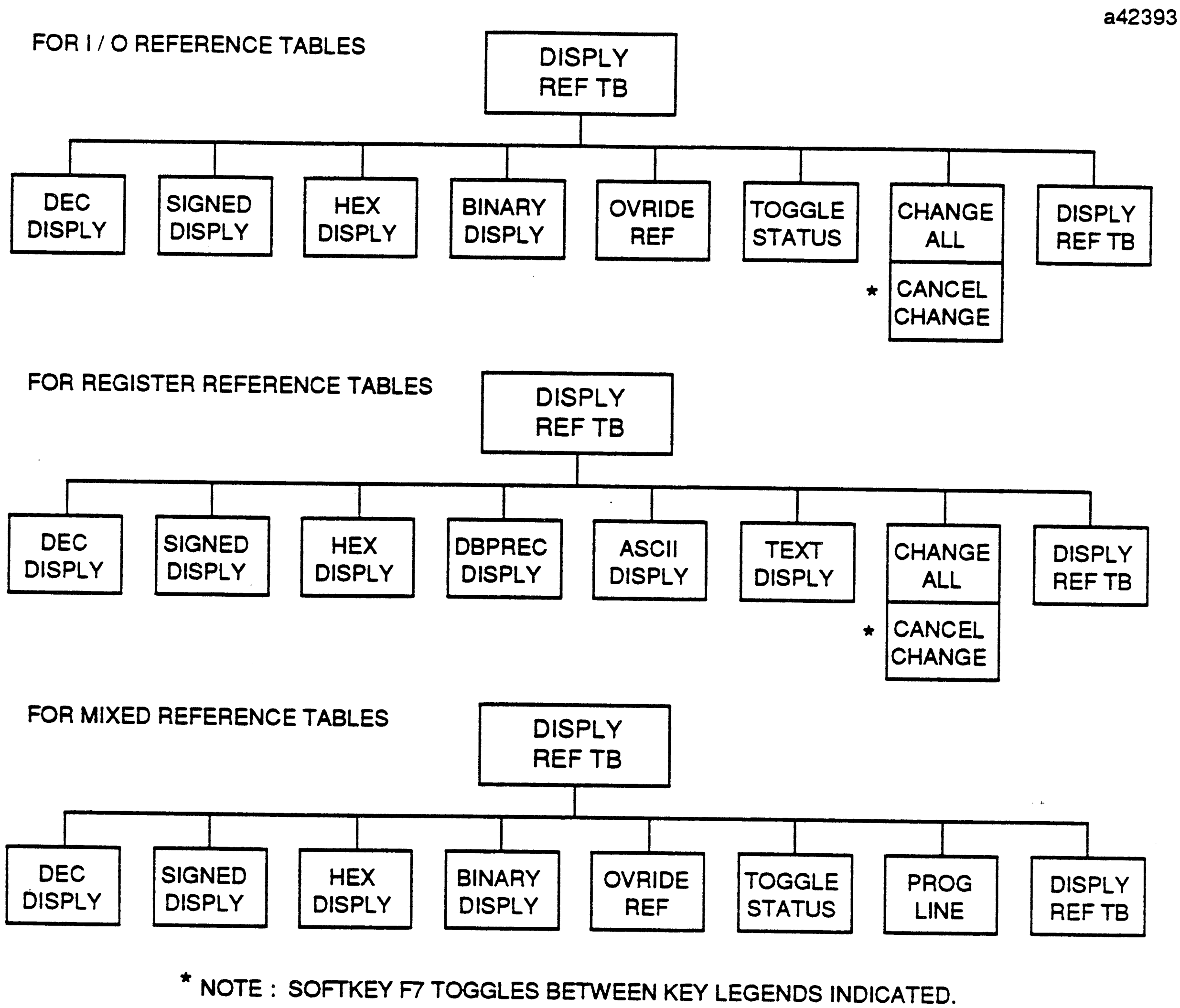


Figure D-13. Display Reference Tables

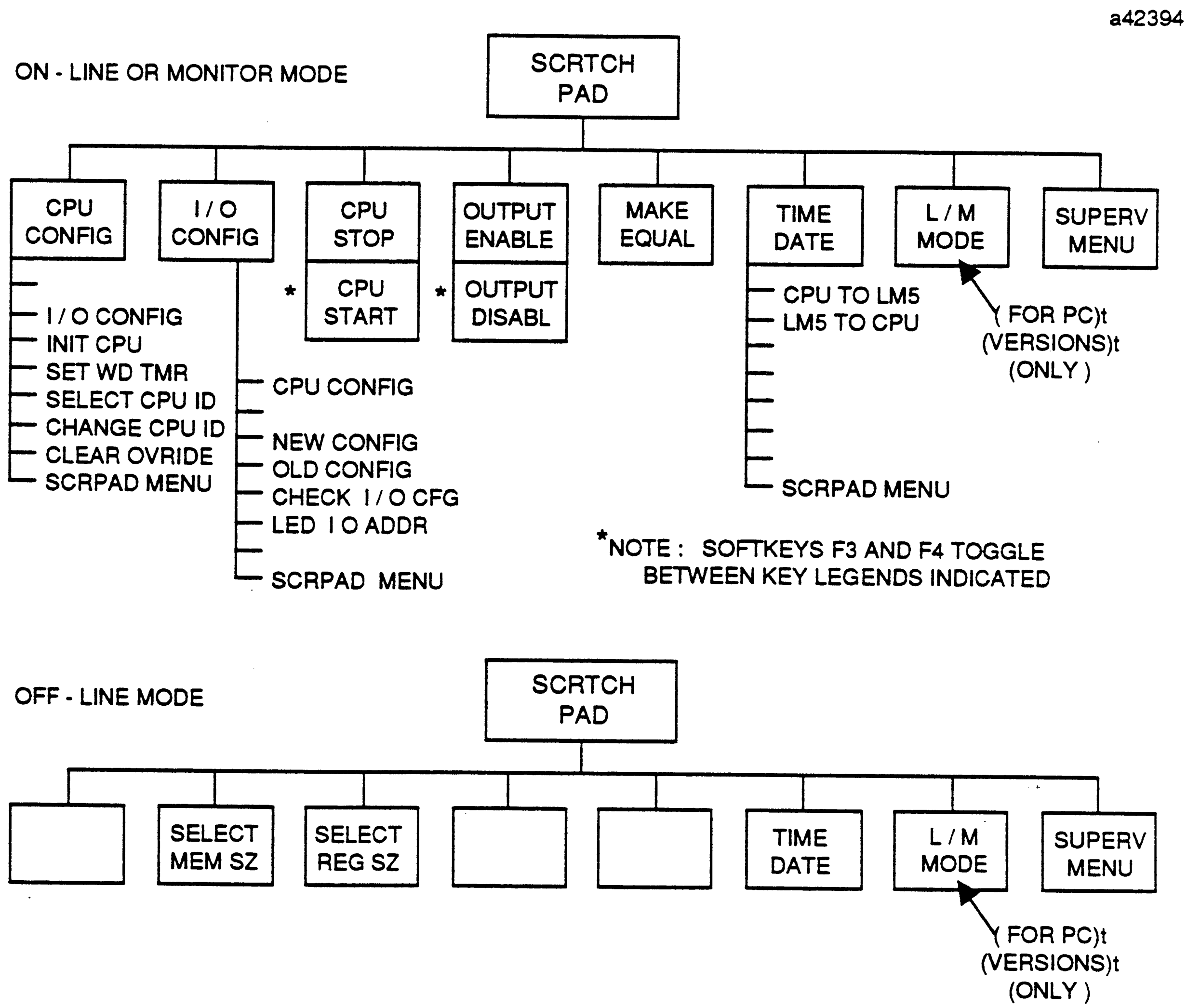


Figure D-14. Scratch Pad Functions

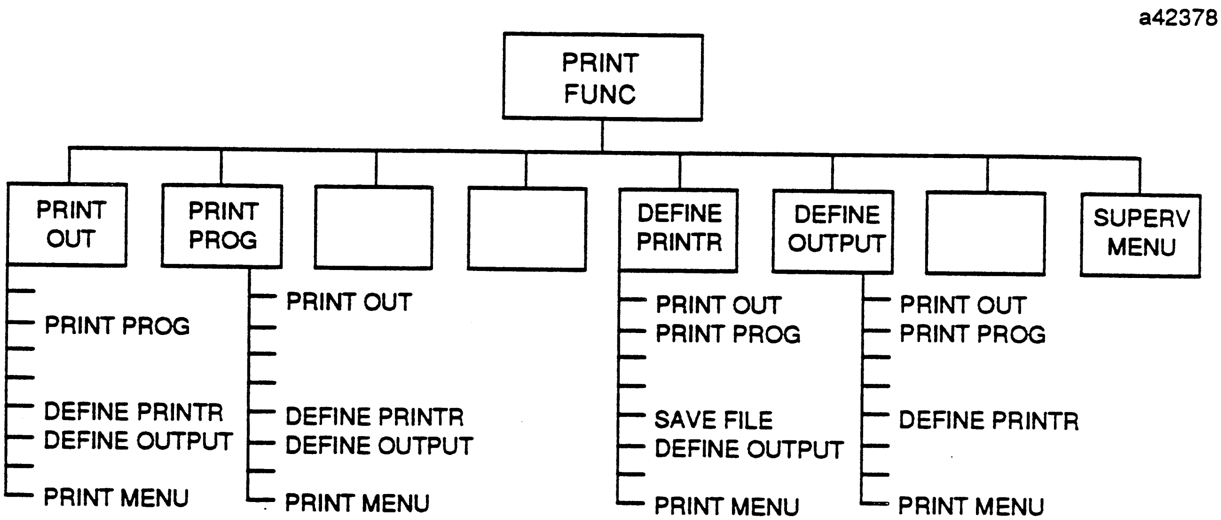


Figure D-15. Print Function

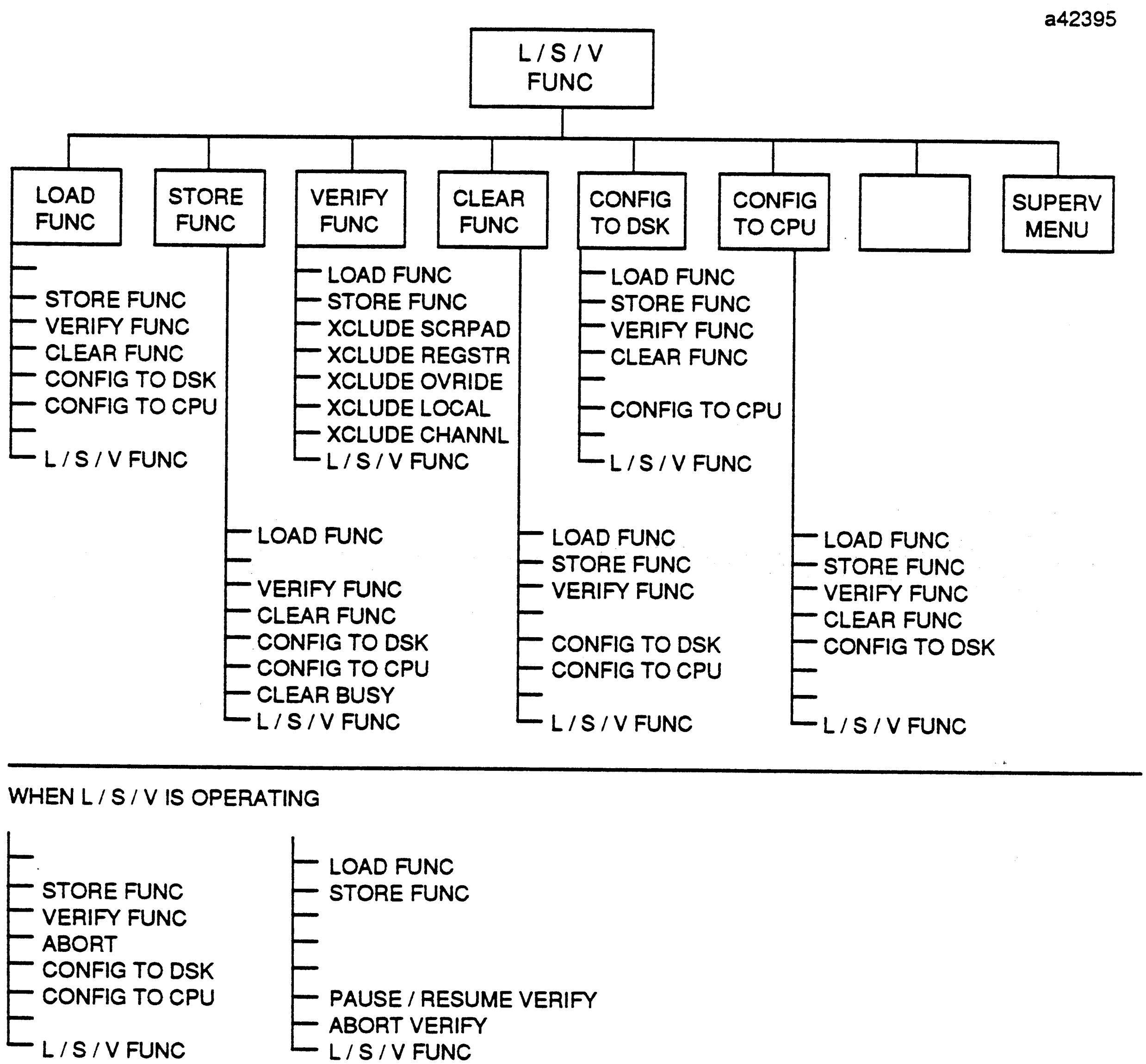


Figure D-16. Load/Store/Verify Functions

GFK-0023

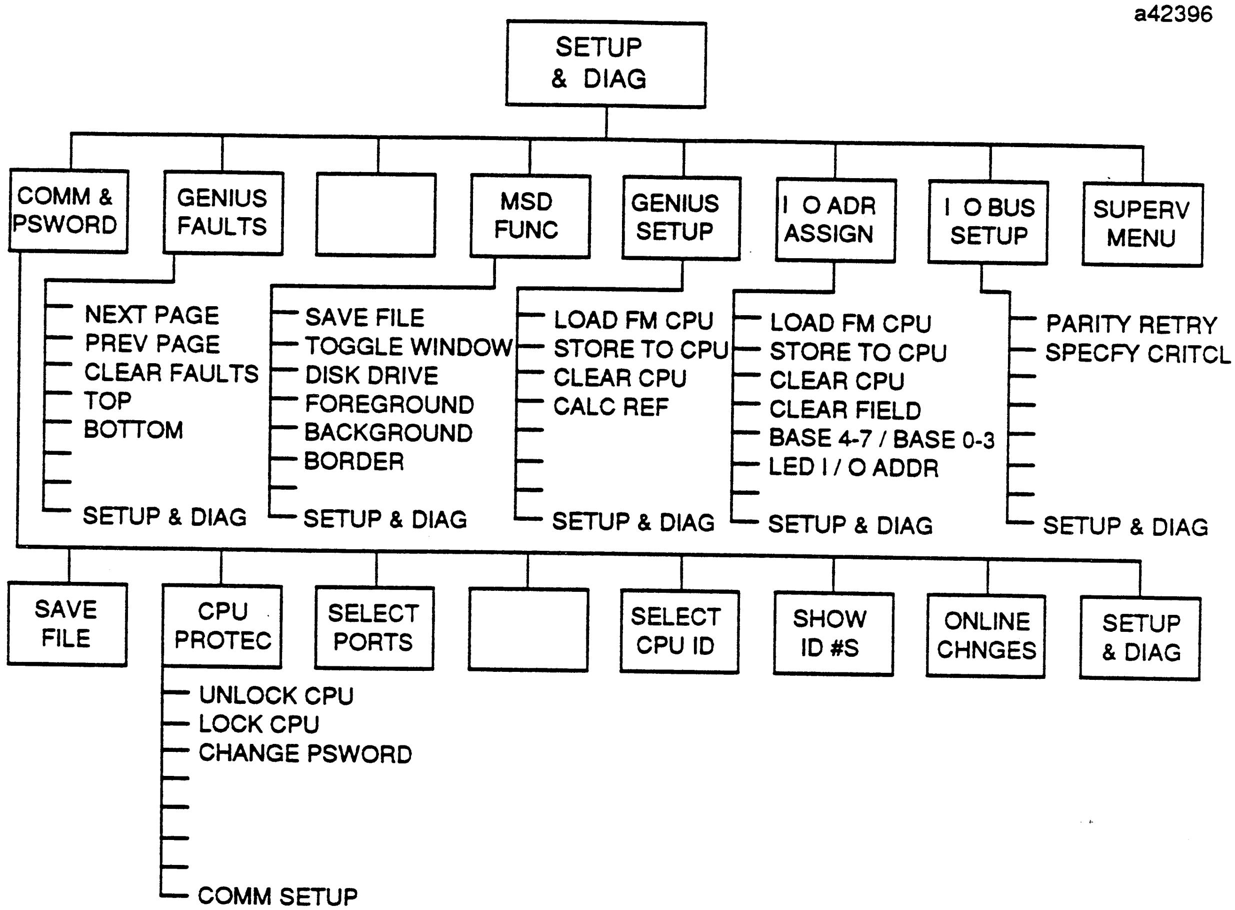


Figure D-17. Setup and Diagnostics

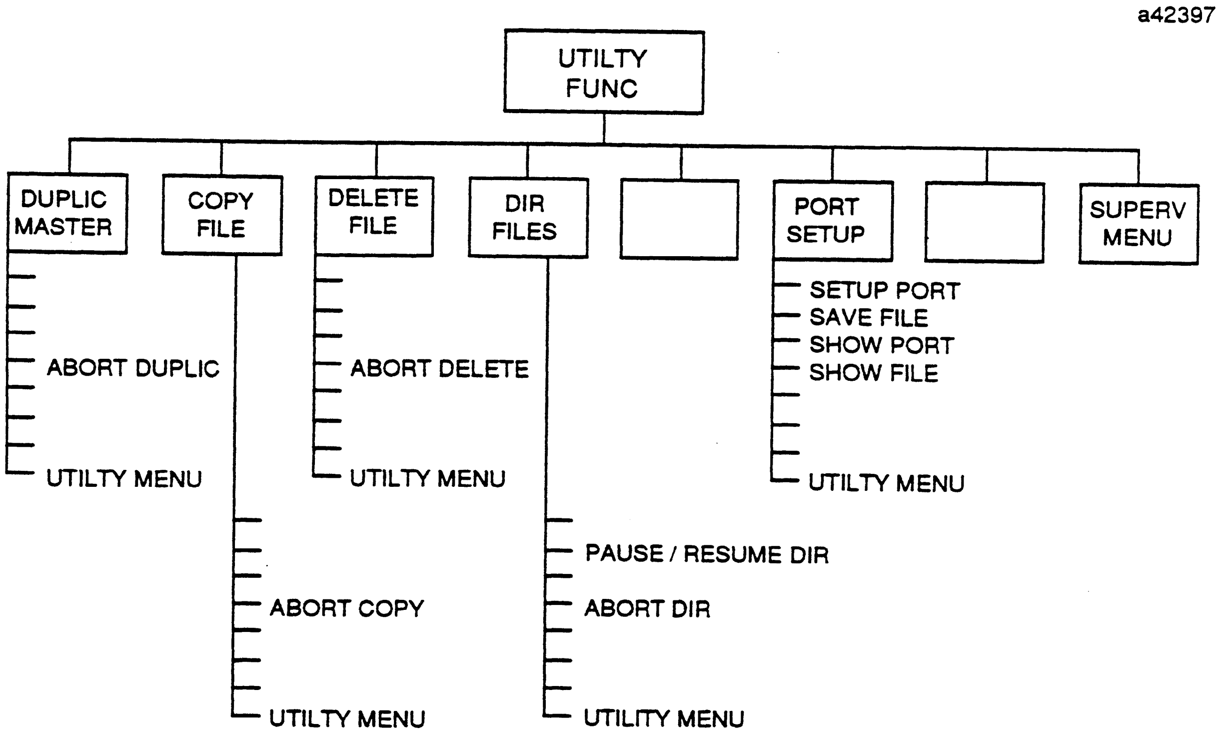


Figure D-18. Utility Functions

Appendix E
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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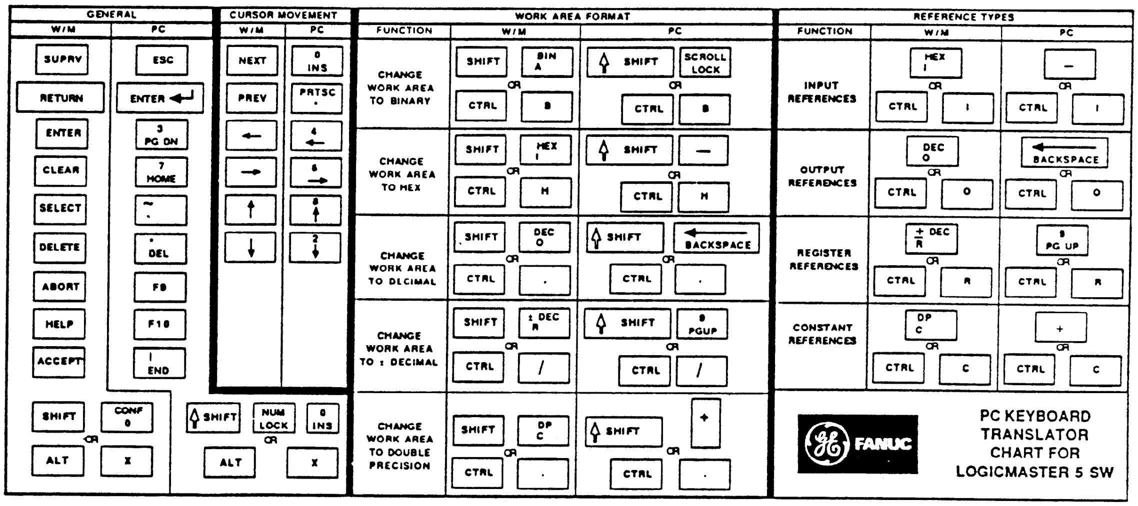
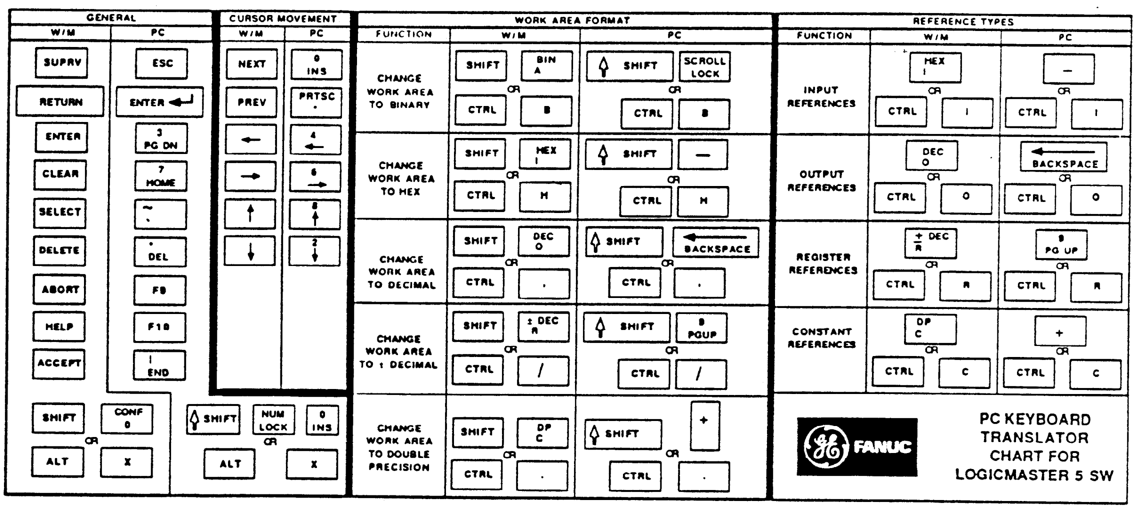

GENERAL
W/M
PC
SUPRV
ESC
RETURN
ENTER
ENTER
3 PG DN
CLEAR
7 HOME
SELECT
DELETE
DEL
ABORT
F9
HELP
F10
ACCEPT
1 END
SHIFT
CONF 0
OR
ALT
X
CURSOR MOVEMENT
NEXT
0 INS
PREV
PRTSC
4
6
8
2
SHIFT
NUM LOCK
0 INS
ALT
X
WORK AREA FORMAT
FUNCTION
CHANGE WORK AREA TO BINARY
SHIFT BIN A OR CTRL B
SHIFT SCROLL LOCK OR CTRL B
CHANGE WORK AREA TO HEX
SHIFT HEX I OR CTRL H
SHIFT — OR CTRL H
CHANGE WORK AREA TO DECIMAL
SHIFT DEC O OR CTRL .
SHIFT BACKSPACE OR CTRL .
CHANGE WORK AREA TO ± DECIMAL
SHIFT ± DEC R OR CTRL /
SHIFT 9 PGUP OR CTRL /
CHANGE WORK AREA TO DOUBLE PRECISION
SHIFT DP C OR CTRL .
SHIFT + OR CTRL .
REFERENCE TYPES
INPUT REFERENCES
HEX I OR CTRL I
− OR CTRL I
OUTPUT REFERENCES
DEC O OR CTRL O
BACKSPACE OR CTRL O
REGISTER REFERENCES
± DEC R OR CTRL R
9 PG UP OR CTRL R
CONSTANT REFERENCES
DP C OR CTRL C
+ OR CTRL C
FANUC
PC KEYBOARD TRANSLATOR CHART FOR LOGICMASTER 5 SW


GENERAL
W/M
PC
SUPRV
ESC
RETURN
ENTER
ENTER
3 PG DN
CLEAR
7 HOME
SELECT
DELETE
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ABORT
F9
HELP
F10
ACCEPT
1 END
SHIFT
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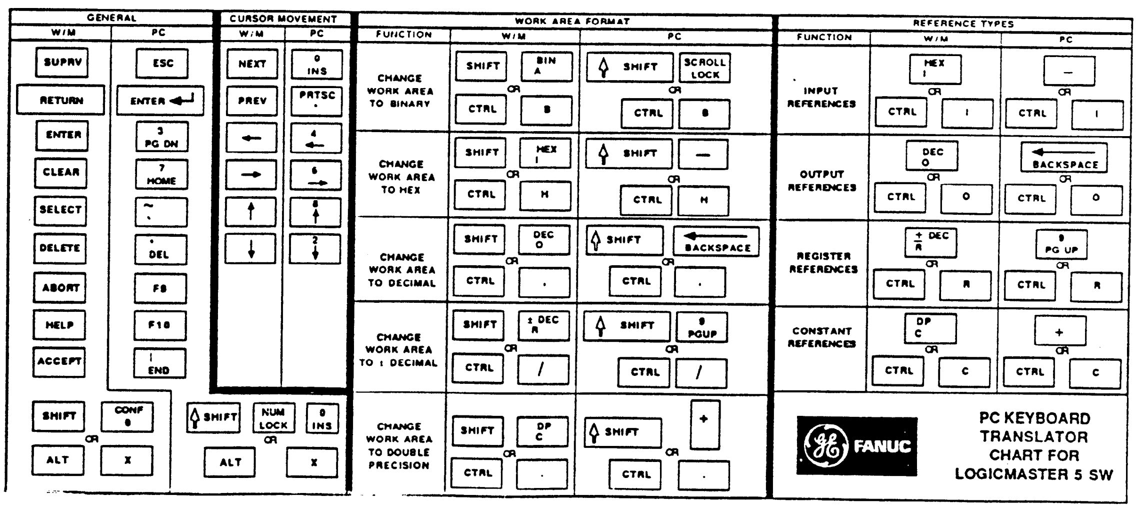
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FANUC
PC KEYBOARD TRANSLATOR CHART FOR LOGICMASTER 5 SW

Control Key Functions

CTRL I	Input
CTRL O	Output
CTRL R	Register
CTRL C	Constant
CTRL 1	Channel 1+
CTRL 2	Channel 2+
CTRL -	Toggle + or -
CTRL ,	Decimal
CTRL .	Double precision
CTRL /	Signed decimal
CTRL H	Hexadecimal
CTRL B	Binary
CTRL Z	Clear
CTRL D	Delete Character
CTRL S	Select next line
CTRL E	Enter function
CTRL A	Accept rung
CTRL P	Previous rung
CTRL N	Next rung
CTRL W	Shift/Enter
CTRL U	Indirect Register (A)

Logicmaster 5 Alternate Key Functions

ALL MODES

ALT 1	Toggle LM5 mode
ALT 2	Change CPU mode
ALT P	Print screen
ALT X	Confirm prompt

SUPERVISOR MENU

ALT L	Load user logic
ALT Z	Exit to DOS

DISPLAY PROGRAM

ALT E	Rung explanation
ALT L	Coil label
ALT O	On-Line changes

TEACH SESSION

ALT J	Start
ALT K	End
ALT V	View
ALT F1-F8	Invoke

EDIT PROGRAM

ALT B	Bit Matrix function
ALT C	Control function
ALT D	Data Move function/delete rungs
ALT F	List function
ALT G	Read .SDE file
ALT H	Shift/Move function
ALT I	Timer/Counter function
ALT M	Matrix function
ALT R	Relay function
ALT S	Special function/global substitute
ALT T	Table Move function
ALT W	Read/Write func/write .SDE
ALT -	Arithmetic function

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ALT -	Arithmetic function

A

B

C

G

H

I

K

L

M

N

O

P

R

U

V

W

GE Fanuc Automation North America, Inc., Charlottesville, Virginia