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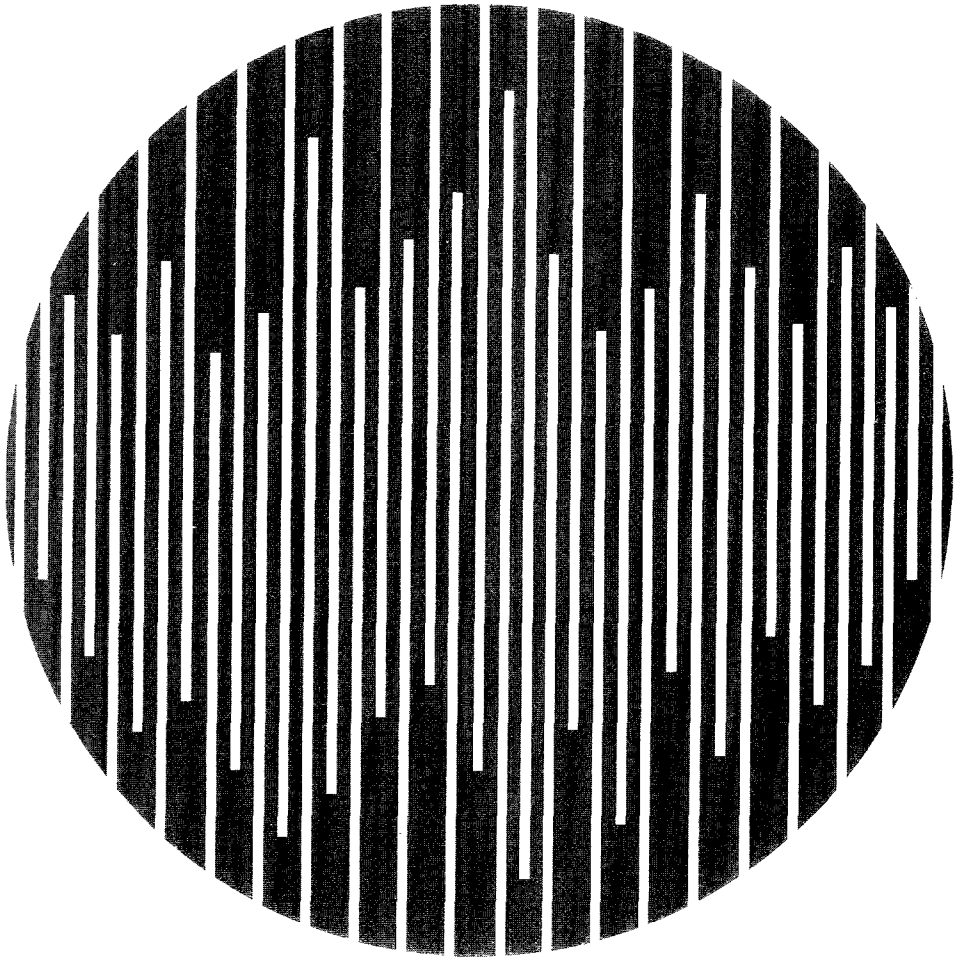
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Modicon
884 Programmable Controller
Programming Guide

PI-884A-001 Rev C

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Modicon
884 Programmable Controller

PROGRAMMING GUIDE

SUBJECT: Instructions for using the 884 Programmer and Configurator Tape (AS-T884-001) with the Modicon P190 Programmer and the 884 Programmable Controller.

June, 1989

Modicon, Inc.
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PREFACE

This guide contains information on the configuration, programming and use of the 884 Programmable Controller.

Use the following documents in conjunction with this guide:

PI-884A-002	884 PC System Planning and Installation Guide
PI-884A-005	884 PC Tape Loader User's Guide
PI-884A-006	884 PC Maintenance Manual
PI-884A-003	884 PC Programming Reference Card

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SECTION 1
INTRODUCTION

This manual provides instructions for using the Modicon 884 Programmable Controller. The 884 PC offers a replacement for relays and solid state electronics, and performs many types of control functions in a variety of industrial environments. The 884 PC provides basic relay replacement, diagnostic monitoring, data collection and storage, and report generation. Easy to learn ladder logic is used to program the 884 PC via the P190 Programmer.

The 884 PC offers a minimum of 2K words of user logic and 1K registers, as well as 256 discrete I/O points in any mix, and additional analog/register capacity. The 884/P190 combination provides powerful editing tools and high security bus protocol.

Section 2 describes the P190 Programming Panel, tape drive, Memory Protect function and CRT screen. Section 3 explains the Power-Up and Attach levels of the 884 Programmer/Configurator Tape. Section 4 describes the operating functions that can be accessed through the PC Operations Menu and Section 5 describes how to configure the 884 PC. Section 6 provides an introduction to ladder logic and programming and Section 7 introduces basic programming and arithmetic functions. Section 8 describes the data transfer move functions, and the sequencer function. Data transfer matrix functions are explained in Section 9 and special functions are described in Section 10. The Appendices contain the Error Message definitions, Password Operations and PC Memory Error function.

The components needed to start using the 884 PC are as follows:

Module Housing, 19 inch or 27 inch
P800 Power Supply module
884 Controller module with one Modbus port
User selected set of 800 Series I/O modules
P190 Programmer Panel
P190/884 W806 cable
P190/884 Programmer/Configurator tape
P190/884 Tape Loader tape

Optional equipment is described in the 884 PC Maintenance Guide.

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SECTION 2
THE P190 PROGRAMMER

This section describes the Modicon P190 Programmer. The P190 Programmer is used to program and configure the 884 PC. For additional P190 information, not 884 PC specific, consult the Modicon P190 Programmer User's Manual.

2.1 KEYBOARD

The P190 keyboard has four sections: alphabetic keys, numeric keys, function keys and software label keys. See Figure 2-1. All of the cursor and function keys are used, except for the CHG NODE and EXIT keys.

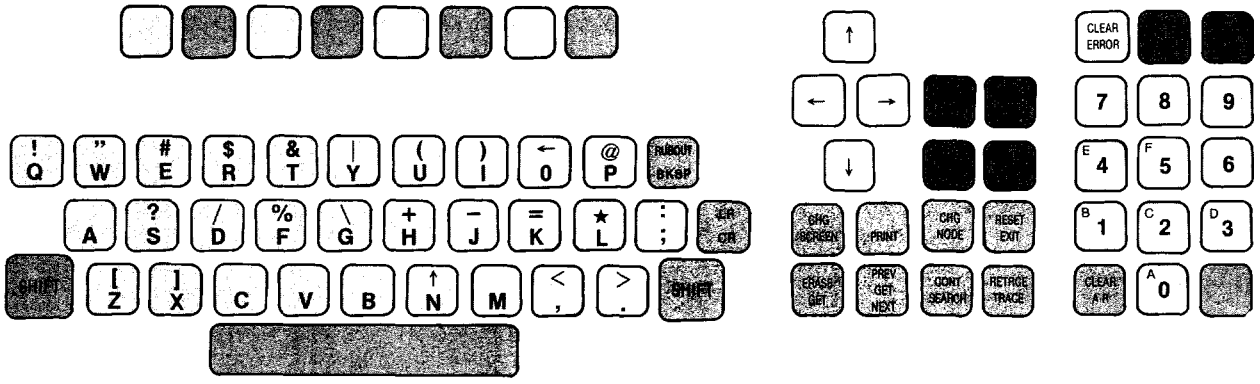


Figure 2-1. P190 Keyboard

2.1.1 Alphabetic Keys

The alphabetic keys are used to enter all alphabetic data. The SHIFT key, when pressed with an alphabetic key, activates the upper key function. The RUBOUT key is used to blank out information at the area where the cursor is placed. Figure 2-2 illustrates the alphabetic keyboard.

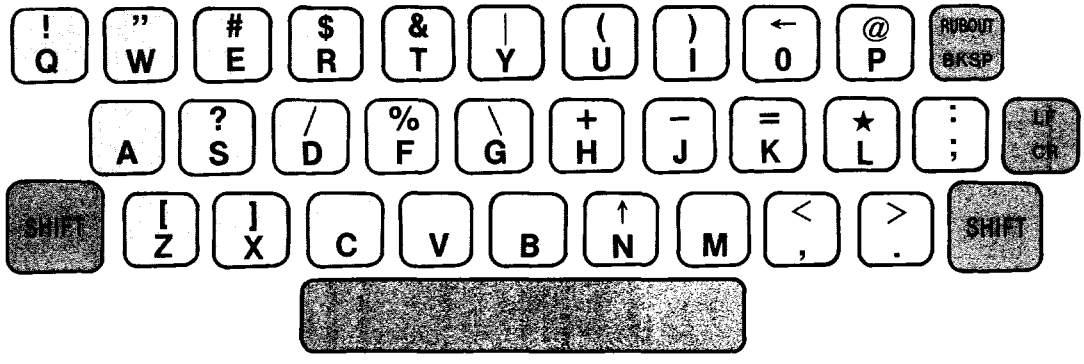


Figure 2-2. Alphabetic Keyboard

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2.1.2 Numeric Keys

Numeric keys are used to enter numeric data in the Assembly Register. The Assembly Register (AR) is the only place you can enter numeric data. Figure 2-3 illustrates the numeric keyboard.

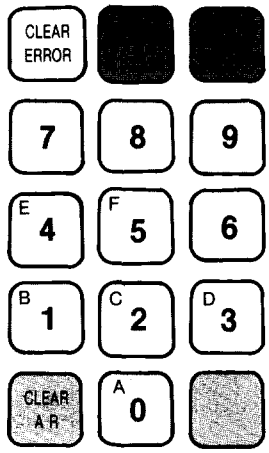


Figure 2-3. Numeric Keyboard

2.1.3 Function Keys

Function keys are used to control screen displays and to enter and edit data. The cursor control keys are located on the function keyboard. These keys move the cursor up or down, or to the left or right. Use of the PRINT key causes the screen display to be copied to the ASCII printing device attached to the second peripheral port of the P190. The first 19 lines on the screen are printed when the PRINT key is pressed. To print all 24 lines, press the SHIFT key concurrently. The P190 User's Manual decribes the use of the other keys found here. Figure 2-4 illustrates the function keys.

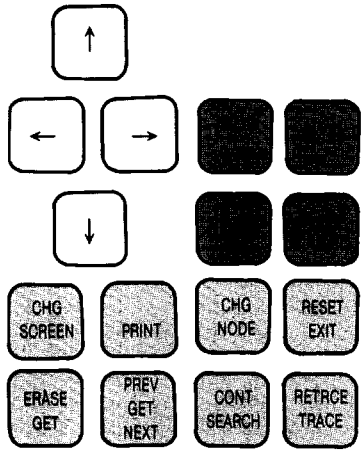


Figure 2-4. Function Keys

2.1.4 Software Label Keys

All the P190/884 PC software tapes display software labels on the P190 screen. These software labels tell you what software capabilities are available from a specific screen display.

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There are eight available labels, alternating white and black blocks at the bottom of the screen. These labels correspond to the eight software label keys on the top row of the P190 keyboard, just below the screen as shown in figure 2-5. These are blank keys, alternating grey and white, corresponding to the software labels above them. The black software label matches the grey software label key beneath it, and the white software label matches the white software label key beneath it.

The software label keys change with each new function. All software labels which use two lines are dual function keys. The bottom function is activated by pressing the corresponding software label key. To activate the top function, the software label key must be pressed simultaneously with one of the SHIFT keys.



Figure 2-5. Software Label Keys

2.2 SHIFT LOCK

Because it is sometimes difficult to press two keys simultaneously, the P190/884 PC tapes offer a special SHIFT function. On the P190 there is a blank orange key beside the cursor control keys, to the left of the numeric keys. This key is used as a SHIFT key. Its function is similar to a SHIFT LOCK.

When this key is pressed, the whole keyboard is in SHIFT position and the word SHIFT appears in the lower left of the P190 screen. Once another key is pressed, the SHIFT LOCK is released. If this SHIFT key is pressed and then is not needed, press the key again to return to the normal keyboard.

2.3 TAPE DRIVE

The P190 tape drive is located in the upper right-hand corner of the programmer, beside the CRT screen. See Figure 2-6.

Tapes are used to load software programs into the P190 and user logic into the 884 PC. You can also copy and save software programs using the Tape Loader Tape. For more information see the 884 PC Tape Loader User's Guide.

To insert a tape, hold it so that the metal plate is on the underside and the exposed tape is toward the tape drive. Insert the tape and press firmly until the tape clicks into place. To remove the tape, open the door to the tape drive and press the eject pushbutton.

P190/884 PC tapes use software overlays. Leave the tape in the drive, because the P190 will be rereading it from time-to-time.

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NOTE

Before inserting any programming tape, be sure that the RECORD tab has been snapped to the right or removed altogether. This prevents any possibility of writing over the tape and erasing the P190/884 programming software.

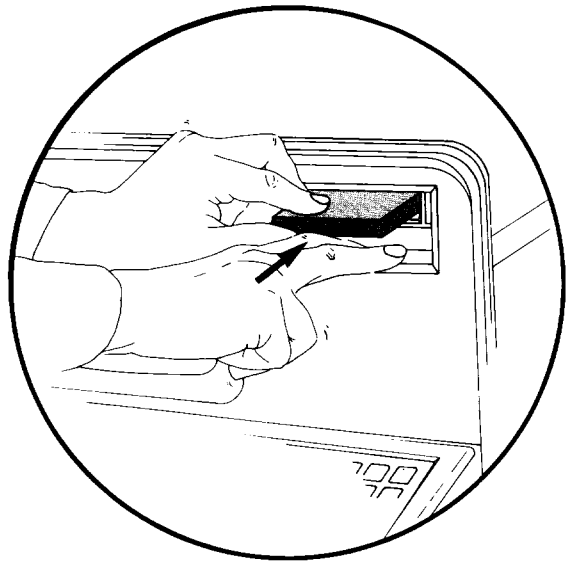


Figure 2-6. Inserting a Tape Into the Tape Drive

2.4 MEMORY PROTECT

The Memory Protect key on the P190 panel determines the operating mode, Monitor or Program, of the P190.

If this key is in the Lock position (see Figure 2-7a), the P190 is in Monitor mode. In Monitor mode you can examine any information in the PC, but you cannot change any portion of the PC's memory, or start or stop the PC.

If you attempt to Attach to a password protected P190/884 PC, the Password Ops screen appears and asks for the correct password. If you do not know the password, turn the Memory Protect key on the P190 to the Lock (Monitor Mode) position. Monitor Mode redisplays the ATTACH screen. Press the ATTACH software label key to examine any information in the PC. In Monitor Mode you cannot make any changes in the PC's memory, but you can still search and display logic and I/O configurations already there.

If the key is in the Unlock position (see Figure 2-7b), the P190 is in Program mode. In Program mode you can examine and change any information in the PC's memory, and START or STOP the PC.

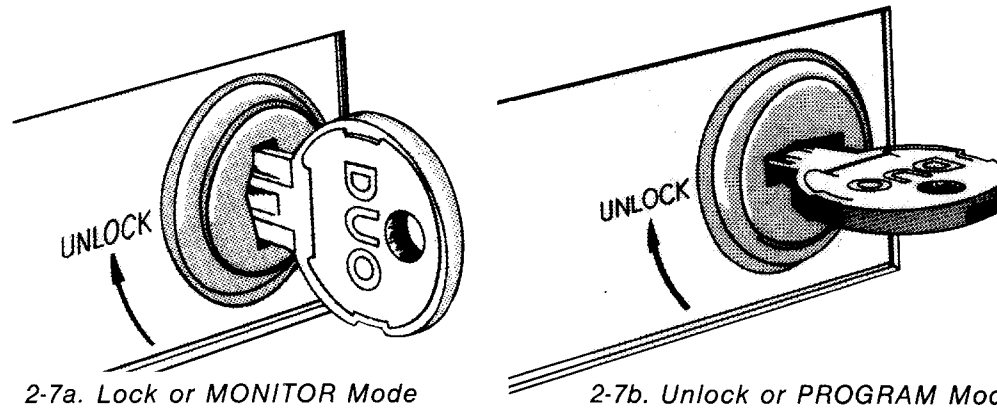
NOTE

The Memory Protect key on the 884 PC has an ON position and an OFF position.

If the key switch changes during an operation, the system will return to the Power-Up, ATTACH, level (See Section 3.1).

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Functions described in this manual are labeled PROGRAM or MONITOR to define the key switch setting required for the given operation.



2-7a. Lock or MONITOR Mode *2-7b. Unlock or PROGRAM Mode*

Figure 2-7. Memory Protect Key

2.5 PERIPHERAL PORT SETTING

On the rear of the P190, behind a screw-on plate, are two sets of dip switches used to set the peripheral port parameters. By using these switches, you can control the mode of communications used for each of the two RS-232-C type ports. The five selections are:

BAUD RATE
PARITY/NO PARITY
EVEN/ODD PARITY
7/8 BITS PER CHARACTER
1/2 STOP BITS

The left set of switches is dedicated to PORT 1 and are used to communicate with the designated controller. The right set of switches is dedicated to PORT 2 and are generally used for output communications to a printer. The settings for each of these ports are as follows: 1 = UP and 0 = DOWN. Table 1 gives the switch settings for the peripheral port parameters.

NOTE

These switches should only be changed when the power to the P190 is OFF, because the P190 only reads switch settings on the Power-Up cycle. They may be changed when the power is on, but then the P190 must be turned off and on again for the switches to be read.

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Table 1 Peripheral Port Switch Settings

Port Settings:

Baud Rate	S1	S2	S3	S4				
Parity Ena/Dis					S5			
Parity Select (Odd/Even)						S6		
Stop Bits (1/2)							S7	
Data Bits (7/8)								S8
	S1	S2	S3	S4	S5	S6	S7	S8

NOTE: The baud rates supported by the P190 are noted with an *.

Baud Rate:		S1	S2	S3	S4
19200	-	1	1	1	1
9600*	-	1	1	1	0
7200*	-	1	1	0	1
4800*	-	1	1	0	0
3600*	-	1	0	1	1
2400*	-	1	0	1	0
2000*	-	1	0	0	1
1800*	-	1	0	0	0
1200*	-	0	1	1	1
600*	-	0	1	1	0
300*	-	0	1	0	1
150*	-	0	1	0	0
134.5*	-	0	0	1	1
110*	-	0	0	1	0
75	-	0	0	0	1
50	-	0	0	0	0

Parity ENA/DIS:		S5
parity enable	-	1
parity disable	-	0

Parity Select:		S6
even parity	-	1
odd parity	-	0

Stop Bits:		S7
1 stop bit	-	1
2 stop bits	-	0

Data Bits:		S8
8 data bits	-	1
7 data bits	-	0

The 884 PC factory settings for Modbus port 1 are: RTU mode, parity enabled, one stop bit, 9600 baud.

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SECTION 3
POWER-UP AND OPERATION LEVELS

This section describes the Power-Up and Operation Levels. After the P190 Programmer is turned on, a simple diagnostic test is automatically run. During the test a variety of patterns appear on the CRT. When the test ends a message appears on the CRT that tells you to load the Programmer and Configurator Tape.

3.1 POWER-UP LEVEL (ATTACH)

Insert the P190/884 PC Programmer and Configurator Tape (AS-T884-001) into the P190 tape drive. The P190 starts loading the tape automatically. While the tape is loading, messages such as "Loading Baseline" and "Loading PC Operations" appear at the top of the screen. When the P190 has finished loading the tape, the Power-up and Attach screen (Figure 3-1) appears.

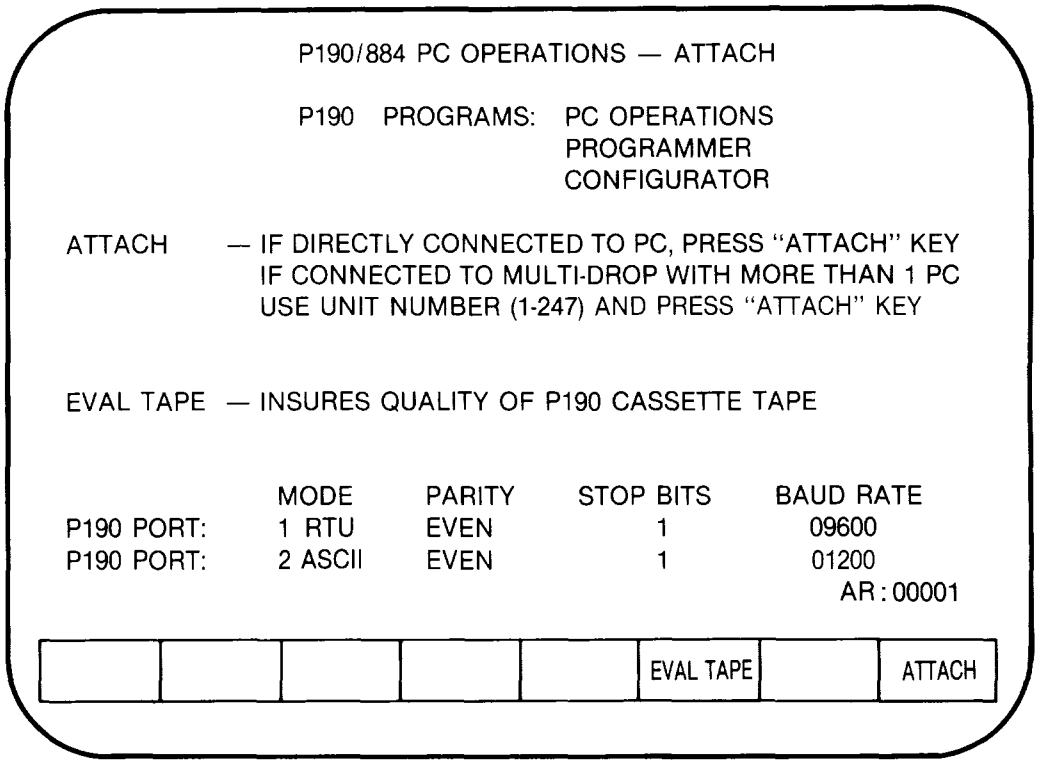


Figure 3-1. Power-up and Attach Screen

The message displayed on the screen advises:

> IF DIRECTLY CONNECTED TO PC, PRESS "ATTACH" KEY. IF CONNECTED TO MULTI-DROP WITH MORE THAN 1 PC, USE UNIT NUMBER (1-247) AND PRESS "ATTACH" KEY.

The AR (Assembly Register) automatically displays the unit number 1. This value is the address, or PC unit number of the 884 PC communicating with the P190. Use this number or enter the applicable number and press the ATTACH software label key.

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If no error is detected and if the PC is not password protected, the PC Operations Menu screen (Figure 3-2) appears. (The use of passwords is explained in Appendix C of this manual. If you ATTACH to a password protected P190/884 PC and do not know the password, turn the Memory Protect key on the P190 to the LOCK position to proceed from the Password screen.). To start the PC, press the START PC software label key.

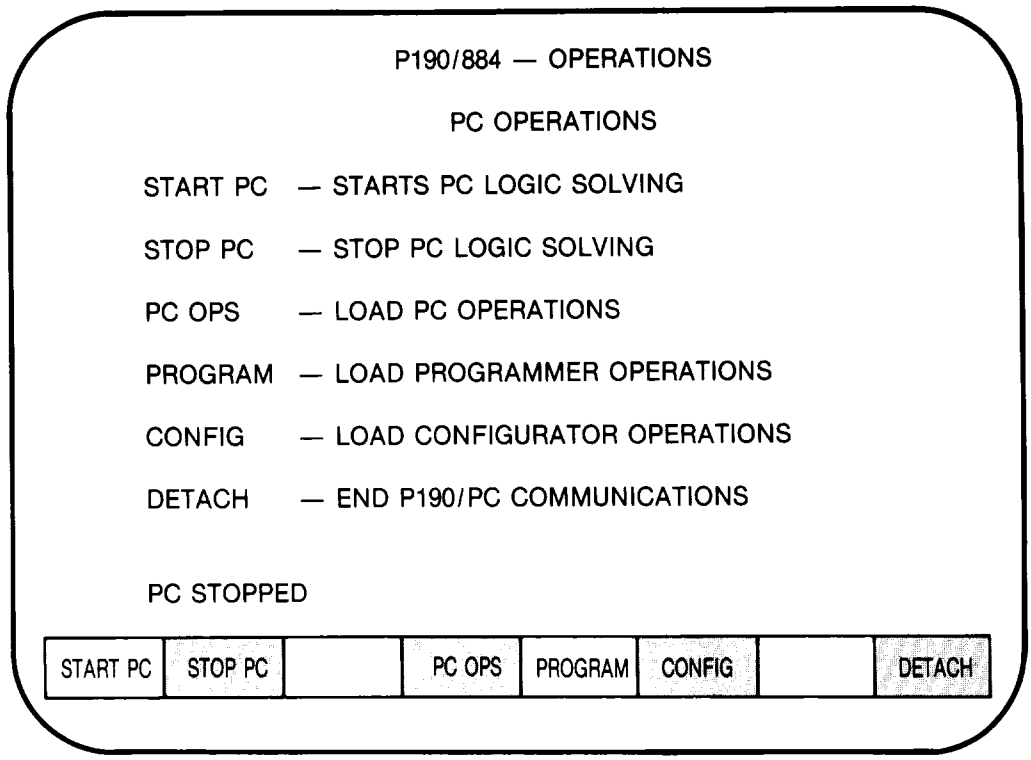


Figure 3-2. PC Operations Menu Screen

3.2 OPERATION LEVEL

Once the Operation Level has been reached the PC Operations Screen (Figure 3-2) appears on the screen. The following software label keys are displayed on this screen:



NOTE

These software label keys are for the Programmer/ Configurator Tape. Other P190/884 PC tapes have different software label keys.

3.2.1 Start PC (START PC)

Press this software label key and the software labels, PROCEED and CANCEL, appear on the screen. Press PROCEED and the 884 PC will START to read inputs, solve logic and write outputs. The message PC RUNNING appears on the prompt line. Press CANCEL to abort the function.

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If the START PC software label key is pressed while the controller is running, this message appears on the screen:

ERROR: PC RUNNING.

3.2.2 Stop PC (STOP PC)

Press this software label key and the software labels PROCEED and CANCEL appear on the screen. Press PROCEED to STOP the 884 PC. The message P C STOPPED appears on the prompt line. Press CANCEL to abort the function.

3.2.3 PC Operations (PC OPS)

Press this software label key and the following software labels appear:

		CLEAR PC		PC CONFIG			OPERS

If the CLEAR PC software label key is pressed, PC Memory menu appears (See Section 4.1). The PC CONFIG software label key displays the configuration table and the OPERS software label key redisplays the PC Operations Menu (Figure 3-2).

The functions available by pressing the PC OPS software label key are explained in Section 4.

3.2.4 Programmer Operations (PROGRAM)

To load Programmer Operations, press this software label key. The functions available are explained in Section 6.

3.2.5 Configurator Operations (CONFIG)

Press this software label key to load the Configurator software. The functions available are explained in Section 5.

NOTE

A 60 second delay occurs while the configuration instructions are read from the tape. The message, "LOADING CONFIGURATOR" and the flashing prompt "LOADING" appear on the P190 screen.

3.2.6 Detach (DETACH)

Press this software label key to end communications between the P190 and the 884 PC. The 884 PC cannot be programmed if it is not attached to the P190. After pressing the DETACH software label key and then the PROCEED software label key, the PROCEED/CANCEL software label keys disappear and you are at the Power-up level.

NOTE

You will notice, that after you press many of the software label keys, a screen appears that displays the PROCEED and CANCEL software labels. Press the PROCEED software label key to begin the procedure or press the CANCEL software label key to stop it and return to the most recently used screen.

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SECTION 4
PC OPERATIONS

This section describes the operating functions that can be accessed from the PC Operations menu. Each software label key, and what it does is discussed. A flow chart illustrating these software labels is shown in Figure 4-1.

Press the PC OPS software label key and the following software labels appear on the screen:

		CLEAR PC		PC CONFIG			OPERS

4.1 CLEAR PC (CLEAR PC)

Press the CLEAR PC software label key and the following software labels appear on the screen:

ALL MEM	USER LOG	REGISTERS	EN COIL	EN DISC	EVAL TABLE		PREV MENU

Memory Protect must be OFF to Clear memory. If it is not OFF, this message appears: MEMORY PROTECT IS ON.

4.1.1 All Memory (ALL MEM)

Press the ALL MEMORY software label key, followed by the PROCEED software label key, to clear all memory. This includes the following:

1. Fill all user logic with END OF LOGIC nodes.
2. Change all coil states to ENABLED OFF.
3. Clear all register values.
4. Clear the Traffic Cop table to zero.
5. Clear the password table.

The message, ALL MEMORY CLEARED, appears on the prompt line.

4.1.2 User Logic (USER LOG)

Press the USER LOGIC software label key and press the PROCEED software label key to fill user logic with END OF LOGIC nodes. The message, USER LOGIC CLEARED, appears on the prompt line.

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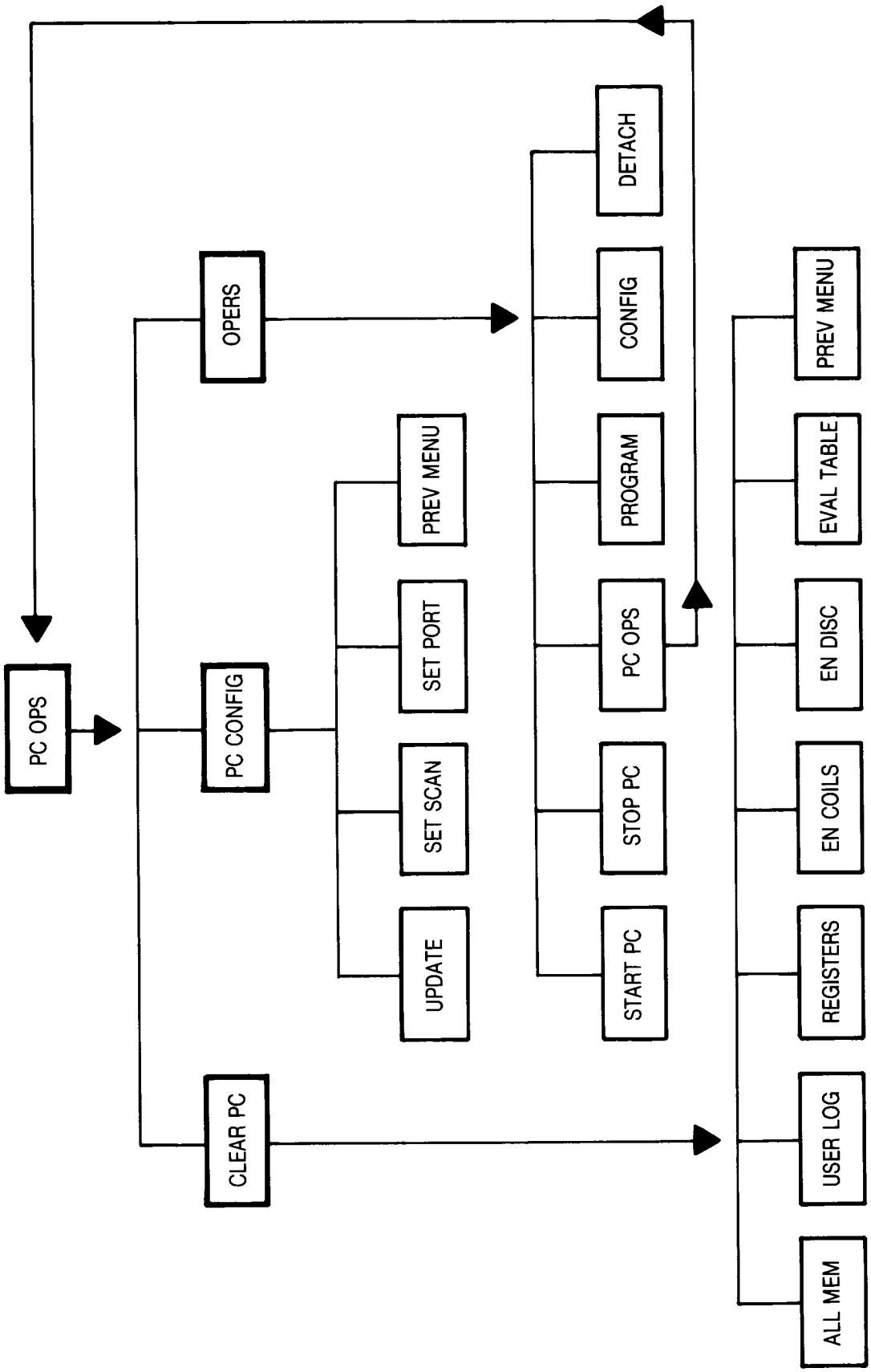


Figure 4-1. PC Operations Software Label Key Flow Chart

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4.1.3 Registers (REGISTERS)

Press the REGISTERS software label key to set chosen register values to zero. The following software labels appear on the screen:

FROM	TO	ALL	HELP	CLR RNG	PROCEED	CANCEL	PREV MENU

These keys are used to select the range of registers to be cleared.

4.1.3.1 From and To (FROM/TO)

The FROM and TO software label keys are used to set the range of registers to be cleared. Any references can be entered except input register (3XXX) references. The TO reference number must be equal to or greater than the FROM reference number. After entering the desired values, press PROCEED to activate the clear function. CANCEL aborts the function.

4.1.3.2 Clear All Registers (ALL)

Press the ALL software label key, followed by PROCEED to clear all the registers except 30XXX input registers. Press CANCEL to abort the function.

4.1.3.3 Help (HELP)

Press the HELP software label key to display the HELP screen. This screen explains the function of each software label key.

4.1.3.4 Clear Ranges (CLR RNG)

Press the CLR RNG software label key to clear FROM and TO ranges.

4.1.4 Enable Coils (EN COILS)

Press the EN COILS software label key to set chosen coils to enabled state.

4.1.5 Enable Discrete Inputs (EN DISC)

Press the EN DISC software label key to set chosen discrete inputs to enabled state.

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4.1.6 Initialize Tables (INIT TABLE)

Press the INIT TABLE software label key to initialize the table specified in the AR. The PC must be stopped before a table can be cleared. As soon as you have pressed the INIT TABLE software label key, the following screen appears:

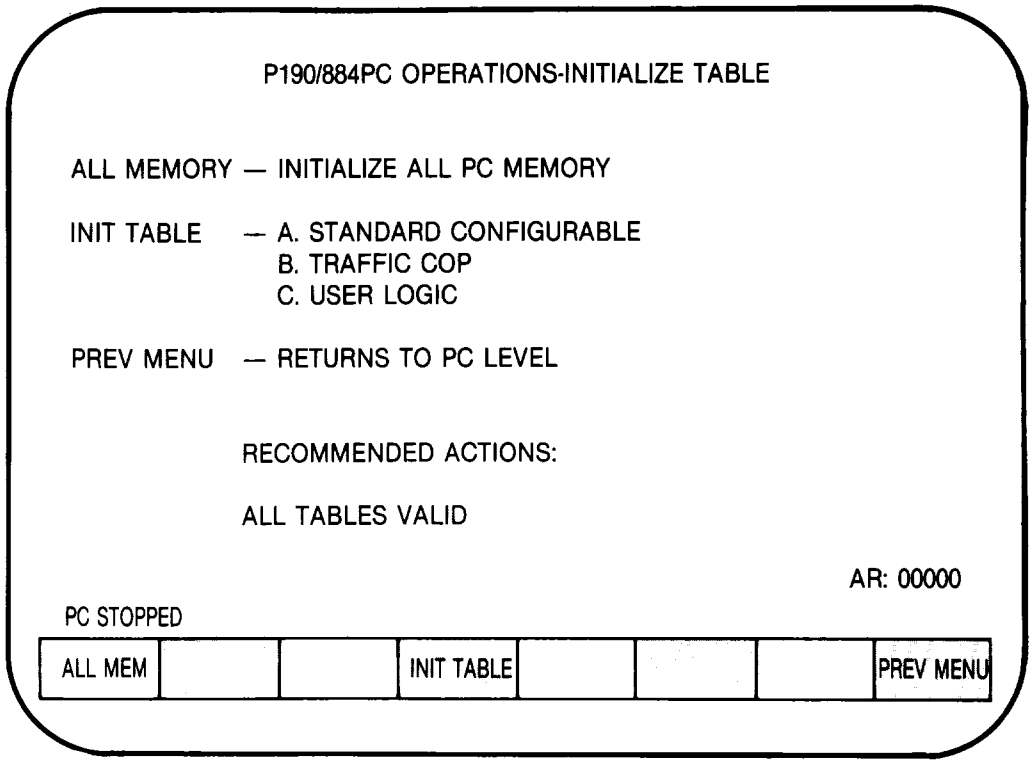


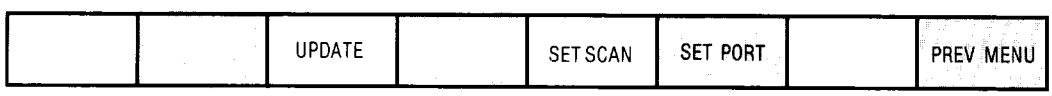
Figure 4-2. Initialize Table screen

The software labels on this screen are ALL MEM, INIT TABLE, and PREV MENU. If all tables are as they should be, the message, ALL TABLES VALID, appears on the screen, beneath RECOMMENDED ACTIONS.

If you need to initialize all memory, press the ALL MEM software label key. To initialize an individual table, enter the applicable letter, A, B or C in the AR and press the INIT TABLE software label key. Repeat this process, one table at a time until all recommended tables have been initialized. Remember, the PC must be STOPPED in order to perform any of these functions.

4.2 PC CONFIG

Press the PC CONFIG software label key, to bring up the software labels UPDATE, SET SCAN and SET PORT. These software label keys are used to set the scan and communication parameters.



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4.2.1 Update (UPDATE)

Press the UPDATE software label and the Configuration Table, currently displayed on the screen, will be updated and will reflect all recent changes .

4.2.2 Set Scan (SET SCAN)

This function allows your program to be scanned at a fixed interval or at the natural scan rate. This does not allow the controller to solve logic faster or to end a scan prematurely. If a constant scan value is not used, or if a value less than the natural scan rate is entered, the 884 PC will operate at its natural scan rate. If the SET SCAN is invalid, the natural, or free run scan will override SET SCAN.

4.2.2.1 Constant Scan (CONSTANT)

The Constant Scan function allows you to set a target scan time between 1 and 195 milliseconds. Target scan time is the time between the start of one scan and the start of the next scan. It is not the time between the end of one scan and the start of the next scan. This function is useful in applications in which data must be sampled at constant time intervals.

Press the CONSTANT software label key to enter a constant scan time. Enter a scan time between 1 and 195 milliseconds in the AR and press the ENTER key.

4.2.2.2 Free Run Scan (FREE RUN)

Press the Free Run Scan software label key to cancel the Constant Scan function. This allows the controller to run at its natural scan rate.

4.2.3 Set Port (SET PORT)

Press the SET PORT software label key to display the following software labels:

RTU ASCII	NO PARITY	EVEN ODD	1 STOP BIT 2 STOP BIT		BAUD RATE		PREV MENU

These keys are used to set the communication parameters for the Modbus port on the 884 PC. The parameters are set in 884 PC memory and the MEM/DIP switch (located behind the battery access cover on the 884 PC) must be set on MEM position.

4.2.3.1 RTU/ASCII

This software label key selects the Modbus communication mode — RTU or ASCII. Press the Remote Terminal Unit (RTU) software label key and the SHIFT key for RTU mode. This mode is generally used to communicate between the 884 PC and the P190 programmer. It can also be used for other Modbus communications.

Press the ASCII software label key (without the SHIFT key) for ASCII. ASCII (American Standard Code for Information Interchange) mode is used for Modbus communications.

On the initial configuration, the controller defaults to RTU.

4.2.3.2 No Parity (NO PARITY)

Press the NO PARITY software label key to select the NO PARITY option.

On the initial configuration, the controller defaults to even PARITY.

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4.2.3.3 Even/Odd (EVEN/ODD)

This software label key is only used if PARITY is selected. Press the EVEN software label key and the SHIFT key to select EVEN parity. Press the ODD software label without the SHIFT key to select ODD parity.

On the initial configuration, the controller defaults to EVEN parity.

4.2.3.4 Stop Bit (1 STOP BIT/2 STOP BIT)

Press this software label key and the SHIFT key to select 1 STOP bit. Press this software label key without the SHIFT key to select 2 STOP bits. On the initial configuration, the controller defaults to 1 STOP BIT.

4.2.3.5 Baud Rate (BAUD RATE)

Enter one of the following baud rates in the AR:

50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, or 19200.

Press the BAUD RATE software label key to enter the value.

On the initial configuration, the controller defaults to a baud rate of 9600.

NOTE

The P190 itself cannot communicate at 19200 baud and/or in ASCII code, but can set the PC to do so for use with other devices.

4.3 DEVICE ADDRESS

The Device Address is a field displayed on the 884 PC Configuration Table screen. It is set via a switch on the 884 PC. It is not possible to enter a Device Address using software.

The P190 is capable of communicating, through a modem, with multiple devices in a line. The address of the device is determined by its location in the line. If only one device, an 884 PC, is communicating with the P190, enter the device address of 1.

On the initial configuration, the controller defaults to the device address of 001.

4.4 DETACH

Press the DETACH software label key to terminate communications between the P190 and the 884 PC. The P190 cannot program the 884 PC if it is not attached to it. The ATTACH software label key is displayed on the screen.

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SECTION 5
CONFIGURING THE 884 PC

This section describes how to configure the 884 PC. The 884 PC must be configured to your system requirements before it can be programmed. The 884 PC System Planning and Installation Guide describes basic system requirements and general configuration guidelines that must be completed before the Traffic Cop can be configured.

To configure the 884 PC you need a P190 Programmer and an AS-T884-001 Programmer & Configurator Tape. To begin, insert the tape in the tape drive on the P190 Programmer as described in Section 2.

5.1 CONFIGURATION (CONFIG)

Press the CONFIG software label key on the PC Operations Menu and then press the PROCEED software label key. The P190/884 PC Configurator Menu (Figure 5-1) appears as soon as the configuration instructions have been read from the tape. Four software label keys appear: PASSWD OPS, OPTIONS, I/O CONFIG, OPERS. The software label key flowchart is shown in Figure 5-2.

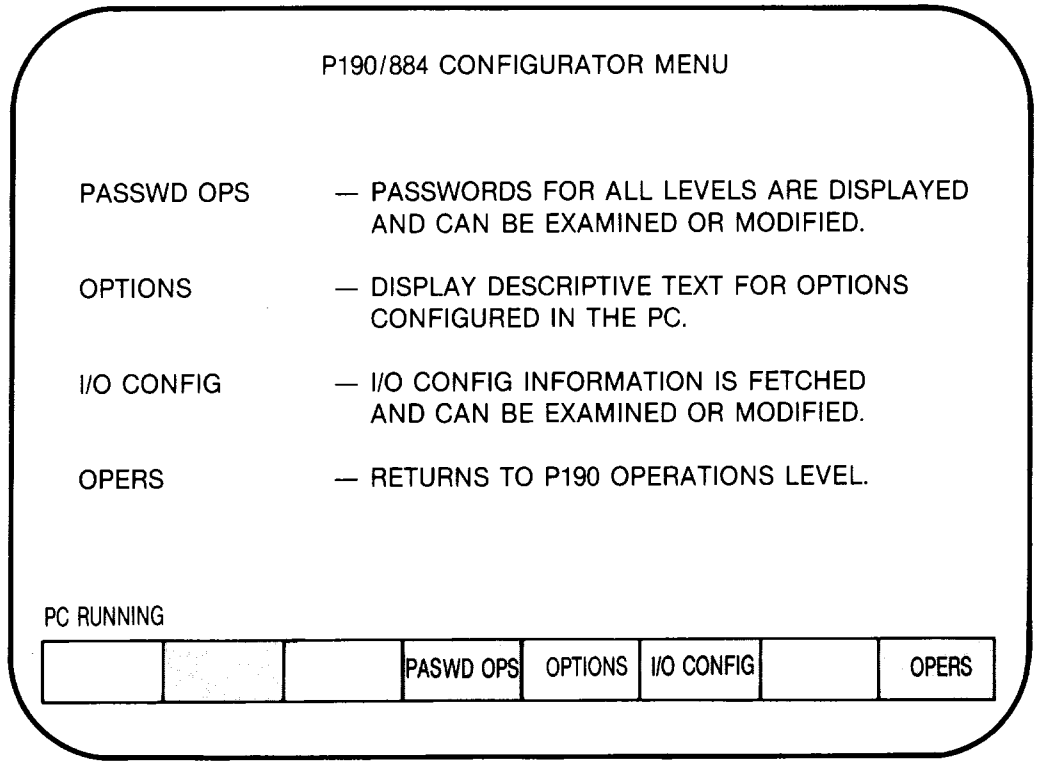


Figure 5-1. P190/884 PC Configurator Menu

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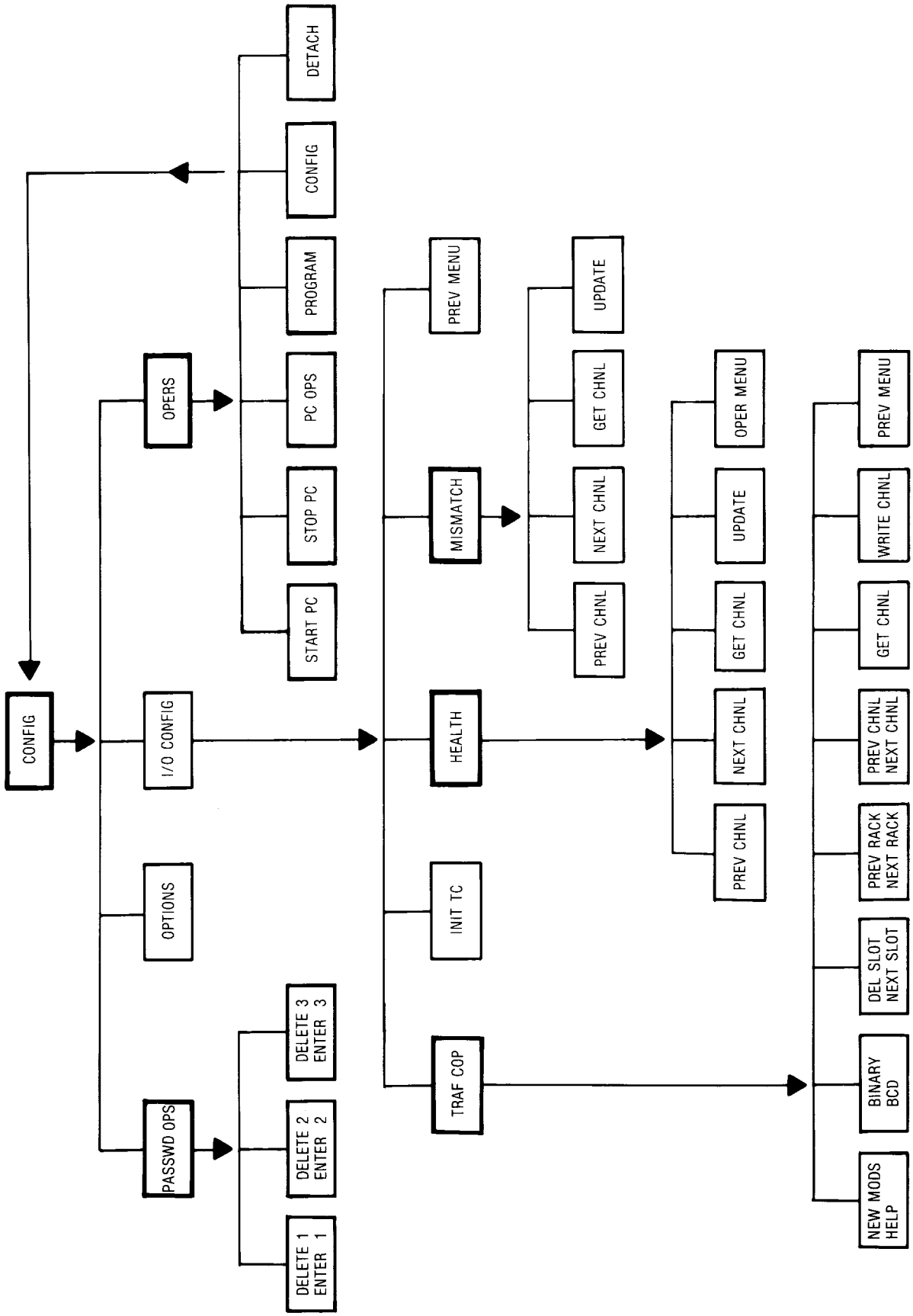


Figure 5-2. Configuration - Software Label Key Flowchart

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5.2 I/O CONFIGURATION (I/O CONFIG)

This is the main part of the configuration software. The PC must be stopped before you can configure the Traffic Cop. The Traffic Cop allows you to match the 884 PC/800 series I/O program addresses with what will be installed and/or actually exists in the field. It also tells the 884 PC how an input signal should be used in user logic, and where an output signal should be sent. The format of register data (BCD or Binary) is determined here, too.

Press the I/O CONFIG software label key to display the number of the I/O channel to be configured. Only one channel can be configured in the initial release of the 884 PC. Future releases will have the capability of more configured channels. Figure 5-3, I/O Channels Configured screen, displays software label keys that are described in this section. In Programmer Mode, key in the number of I/O channels to be configured in the AR, and press ENTER. (If you are in Monitor Mode. you can only display and examine the information).

To build a Traffic Cop, the 884 PC must be stopped. If the PC is running you can read the I/O modules and the reference numbers, but cannot make any changes.

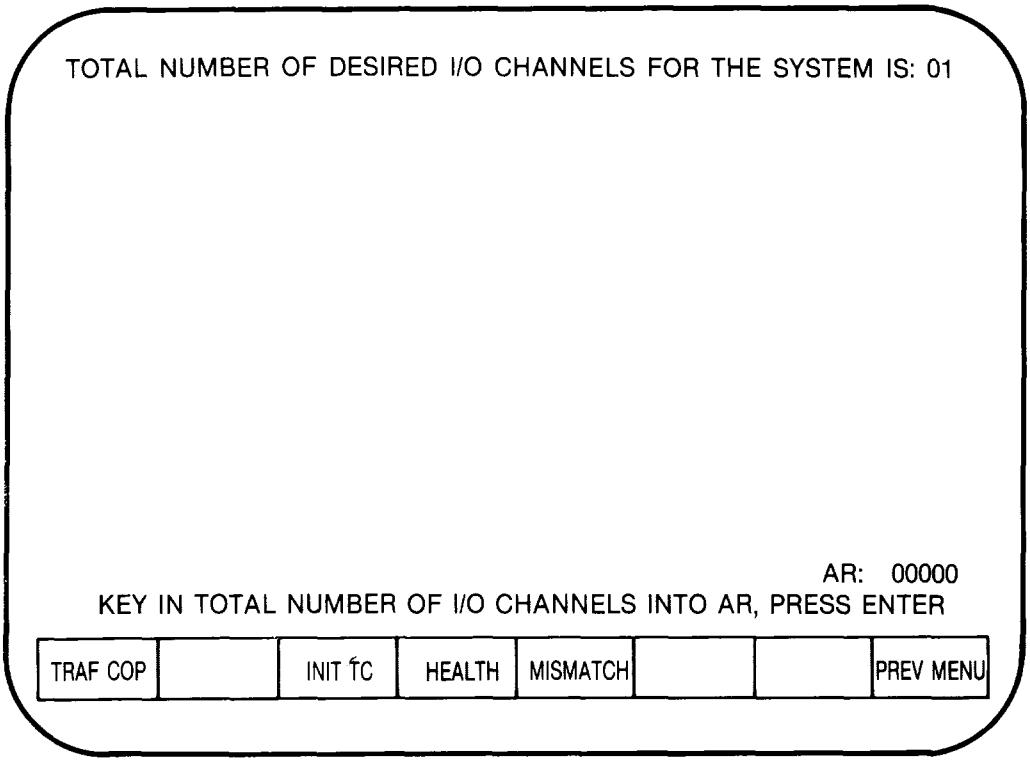


Figure 5-3. I/O Channels Configured Screen

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5.2.1 Traffic Cop (TRAF COP)

Press the TRAF COP software label key to display the I/O Channel Traffic Cop screen (Figure 5-4). This shows the I/O slot configuration for channel 1, rack 1.

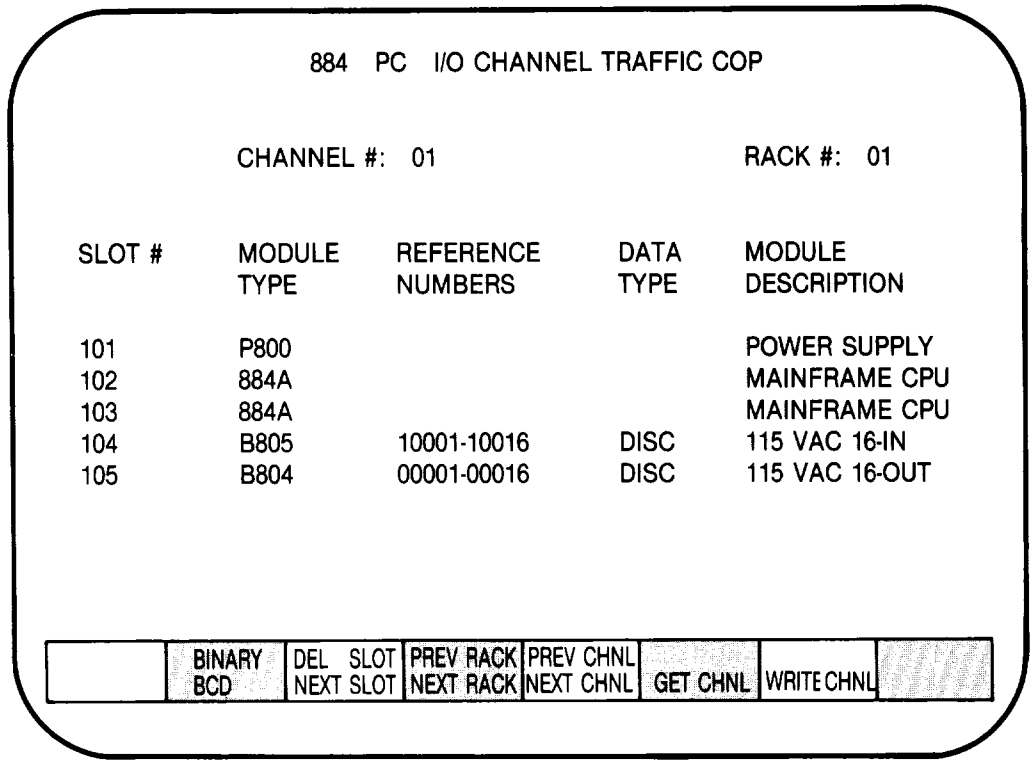


Figure 5-4. I/O Channel Traffic Cop Screen

Up to 11 slots of configuration information can be displayed for one rack. All slots with a module installed, or all slots, up to the highest number configured, are displayed. If a slot has not been configured, or has no module installed, "B8" appears for the MODULE TYPE. A brief description of each field on the I/O Channel Traffic Cop screen is given below.

5.2.2 CHANNEL

This is the number of the channel currently displayed on the CRT. You can have up to 32 fully configured I/O slots per channel, divided between a maximum of five racks.

5.2.3 RACK

This is the number of the rack of I/O slots currently displayed on the CRT.

5.2.4 SLOT

This number indicates the physical location of a module for a specific channel. The number format is "RSS". The "R" is the rack number and the "SS" is the number of the specific slot within the rack. It can be any number from 1 through 11.

5.2.5 MODULE TYPE

A Module Type is used to distinguish one module from another. The numbering system format, B8XX, goes from B802 to B899.

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The configured module type can be input by the user or read from the existing module in that slot. If you choose to enter the module type, the cursor must be on the "MODULE TYPE" field and the number entered must be between B802 and B899. The following prompt will appear at the bottom of the CRT screen when the cursor is positioned on this field: KEY IN MODULE NUMBER (02 TO 99) AFTER B8, PRESS ENTER. "B8" always is displayed for a new slot; only the last two digits have to be entered. As soon as the ENTER key is pressed, the number is validated. Moving the cursor before pressing the ENTER key causes an error message (ERROR: ILLEGAL MODULE TYPE.) If an invalid module number is entered, an error will appear at the bottom of the CRT screen.

Any module number can be configured in any slot. Inputs or outputs, 8 or 16 points, can be put in any location, in any mix, up to the limitations of the system.

When you enter an I/O module number on the screen, it will appear highlighted if it does not match what is in the actual rack. If an asterisk (*) appears with a module number on the screen, it means this number was supplied to the 884 PC by the I/O module already installed in the slot. If you enter a module number that differs with the one shown, that number will be highlighted to indicate that a mismatch exists. The configurator allows you to put the modules wherever you want, but it warns you if your configuration disagrees with what is physically in the slots.

If you enter an invalid number in the module type field, the cursor remains on the last digit entered. Press the RUBOUT/BACKSPACE key to move the cursor and enter a new, valid module number.

Whenever you change a configured module type, by entering a new module number, all information for the previous module type for that slot is deleted.

When entering the module type, the maximum number of I/O points for input or output for a channel cannot be exceeded. If this occurs, an error appears (ERROR: MAX OUTPUT/INPUT LENGTH OF 512 I/O POINTS EXCEEDED). More than 32 slots cannot be entered or an error appears (ERROR: MAX OF 32 ENTERED SLOTS EXCEEDED).

If the cursor is positioned on a slot where the module type is highlighted (configured module is different from the module in the rack), a prompt appears at the bottom of the CRT screen, ACTUAL MODULE TYPE IS B8XX or NO MODULE TYPE IN SLOT. You can then replace the module type information in the table with what exists in the rack.

5.2.6 REFERENCE NUMBERS

The range of reference numbers points to the area in memory that receives the data from the input module, or holds the data to be sent to the output module. The reference number can be discrete, register etc.

The configured module type must be entered before the cursor can be moved to this area. When the cursor is at the REFERENCE NUMBER field, the following prompt appears at the bottom of the screen: KEY IN APPROPRIATE REFERENCE FOR MODULE (TYPES 0,1,3,4). After the reference number is entered, press the ENTER key. This validates the reference number. If an invalid reference number was entered, the entry will stay on the screen with the cursor positioned at the last digit entered. Use the RUBOUT/BACKSPACE key to move the cursor and change an invalid reference number.

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For illegal reference numbers the following error is displayed, ERROR: INVALID REFERENCE NUMBER OR ILLEGAL REFERENCE TYPE.

For discrete references the starting reference must be at a byte boundary (multiple of 8 plus 1). If not, an error is displayed at the bottom of the CRT screen, (ERROR: DISCRETE REF MUST START ON A MULTIPLE OF 8 PLUS 1).

Reference numbers point to the range of memory in the PC for receiving or sending data for the I/O modules. A caution message is displayed and a confirmation is required when specifying any reference numbers already used in the I/O Configuration. This is not an error.

Register reference numbers can be assigned to discrete I/O modules. BCD conversion is not allowed for 4 point I/O modules.

5.2.7 DATA TYPE

This entry determines if the input/output register data will be in BCD (Binary Coded Decimal), or BINARY form. BCD input data is converted to binary upon input; BCD output data is converted from binary to BCD upon output. Binary data does not need conversion upon input or output. Data type for discrete type references is DISC.

5.2.8 MODULE DESCRIPTION

This is a 14 byte comment copied from a stored table into the module description column. Examples are "115 VAC 16-OUT" and "POWER SUPPLY".

5.3 I/O CHANNEL TRAFFIC COP EDITOR

A "compare" function exists for the 800 Series modules. If a module exists in the rack, but the MODULE TYPE on the screen is blank, the table item for that slot will display the applicable module type. If the MODULE TYPE is already displayed, this number remains. This allows the choice of using the type of the module in the rack, or the type in the table item.

NOTE

No continual checking of what is out in the field occurs when this table is displayed or modified. Information is only fetched from the controller when a new channel of information is displayed. If modules are changed while looking at a channel, the changes will not be seen until that channel is re-displayed.

To edit the I/O Channel Traffic Cop, the cursor is moved to the applicable entry. Use the cursor position keys on the P190 keypad to move the cursor to the appropriate place.

If the slot is empty, or if changes are to be made to a current module type, only the two "XX" digits (of the B8XX Configured Module type) and the appropriate reference numbers are entered. The cursor moves one character to the right each time data is entered.

When you have finished configuring the 884 PC, press WRITE CHNL software label key in order to save the TRAFFIC COP in the 884 PC. If WRITE CHNL is not pressed the TRAFFIC COP will not be saved.

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The software label keys that appear on the I/O Channel Traffic Cop screen are described below.

5.3.1 HELP

Press this software label key to access four HELP screens for the I/O configuration table. These screens provide most information required to do a configuration. They are there to help you when a manual is not available.

When the key is pressed, I/O configuration information appears on the screen along with the software labels NEXT HELP and TC SCRN (Traffic Cop screen).

To continue reading information, press NEXT HELP. The second screen of I/O information appears on the CRT screen. To reach the third screen, press NEXT HELP again. The fourth and final screen is reached by pressing NEXT HELP again.

If the NEXT HELP software label key is pressed when the fourth HELP screen is displayed, the first HELP screen reappears.

To return to the I/O configuration table from any of the four menus, press TC SCRN.

5.3.2 BINARY/BCD

When references are entered into the Reference Number Field on the P190 screen, the data type defaults to BIN (binary) for 3XXXX and 4XXXX references and to DISC (discrete) for 0XXXX and 1XXXX references.

To convert the register data type from binary to BCD,(Binary Coded Decimal), position the cursor on the appropriate configured slot and press the BCD software label key. To change the type back to binary, press BINARY software label key with the SHIFT key. Binary conversion is allowed for 4 point discrete I/O modules configured as register references, but not BCD conversion.

5.3.4 Delete Slot/Next Slot (DEL SLOT/NEXT SLOT)

This software label key is used to enter or edit the slot information in the I/O Traffic Cop.

The first three slots in rack number 1 of each channel in the Traffic Cop are reserved for the power supply and mainframe CPU modules. They are slots 101, 102, and 103.

Each channel has a maximum of 32 configured slots distributed among five racks.

Slot information can be entered, beginning at the fourth slot. To enter new data, press the NEXT SLOT software label key. A message appears on the prompt line: KEY IN MODULE NUMBER (02 to 99) AFTER B8, PRESS ENTER KEY.

You must use the NEXT SLOT software label key to create a new slot. NEXT SLOT can also be used to move between existing slot information.

Press the DEL SLOT software label key with the SHIFT key to delete the slot information currently at the cursor position. This is the DELETE SLOT function.

5.3.5 Previous Rack/Next Rack (PREV RACK/NEXT RACK)

This software label key allows you to move to an adjacent rack to examine or modify information.

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Press the PREV RACK software label key with the SHIFT key to gain access to the information for the rack before the rack currently displayed (the current rack minus one). This is the Previous Rack function.

Press the NEXT RACK software label key to gain access to the information for the rack immediately following the rack currently displayed. This is the Next Rack function.

Both of these functions have a wrap-around capability. If the previous rack function is selected while in rack 1, the slot information for rack 5 is displayed. The opposite is true with the next rack function. If you are in the last rack (rack 5) when selecting this function, the first rack's information is displayed on the screen.

5.3.6 Previous Channel/Next Channel (PREV CHNL/NEXT CHNL)

This software label key allows you to move to an adjacent channel to examine or modify information.

Press the PREV CHNL software label key with the SHIFT key to gain access to the slot configuration information for the channel before the channel currently displayed (the current channel minus one). This is the Previous Channel function.

To gain access to the information for the channel after the channel currently displayed, press the NEXT CHNL software label key, without the SHIFT key. This is the Next Channel function.

Both of these functions have a wrap-around capability. If the previous channel function is selected while in channel 1, the slot information for the highest channel number configured (1,2,3, or 4) is displayed. The opposite is true with the next channel function. If you are in the highest channel number when this function is selected, channel 1's slot information is displayed on the screen.

5.3.7 Get Channel (GET CHNL)

The GET CHNL software label key allows you to choose any of the configured channels and examine or modify that channel's configured slot information.

When the GET CHNL software label key is pressed, the message "KEY IN CHANNEL # INTO THE AR FOR SLOT INFORMATION, PRESS ENTER KEY" appears on the prompt line of the P190 screen. Enter a channel number in the AR, 1 through highest configured channel number only, and press the ENTER key.

All the information for rack 1 of the selected channel is displayed. To examine or modify other racks within the same channel, use the PREV RACK/NEXT RACK software label key. The PREV CHNL/NEXT CHNL software label key is used to move to another channel. The PREV MENU software label key returns you to the I/O Channels Configured screen.

5.3.8 Write Channel (WRITE CHNL)

Press the WRITE CHNL software label key and the PROCEED software label key to enter the configuration information in the PC. If this is NOT done ALL edited Traffic Cop work will be lost. When the WRITE CHNL software label key is pressed, the software labels PROCEED and CANCEL appear on the screen along with the prompt: PRESS PROCEED TO WRITE CHANNEL X TO THE PC OR PRESS CANCEL TO STOP THE OPERATION.

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If the WRITE CHNL and PROCEED software label keys are not pressed the new configuration information is not received by the PC.

5.4 INITIALIZE TRAFFIC COP (INIT TC)

Press the INIT TC and the PROCEED software label keys to empty all parts of the Traffic Cop. The 884 PC must be stopped to do this. The next time you press the TRAF COP software label key, the 884 PC will poll the modules in the racks and return their numbers and positions. All reference numbers will be cleared.

5.5 HEALTH

Press the HEALTH software label key, while the controller is running, to see if individual modules are functioning as they should and agree with the modules configured in the Traffic Cop.

If you configured the system to match the I/O Modules in the rack, and the PC is running, all the active lights on the front of the I/O Modules should be on. If not, a slot has been misconfigured, or there is a defective module.

If all the active lights are on, press the HEALTH software label key. If the Traffic Cop matches the active modules the following message appears on the screen: MODULES OK FOR THIS CHANNEL. (See Figure 5-5).

If a module does not match or is defective, it will be listed on the HEALTH screen as UNHEALTHY.

This command makes it easy to check the configuration and to troubleshoot the system.

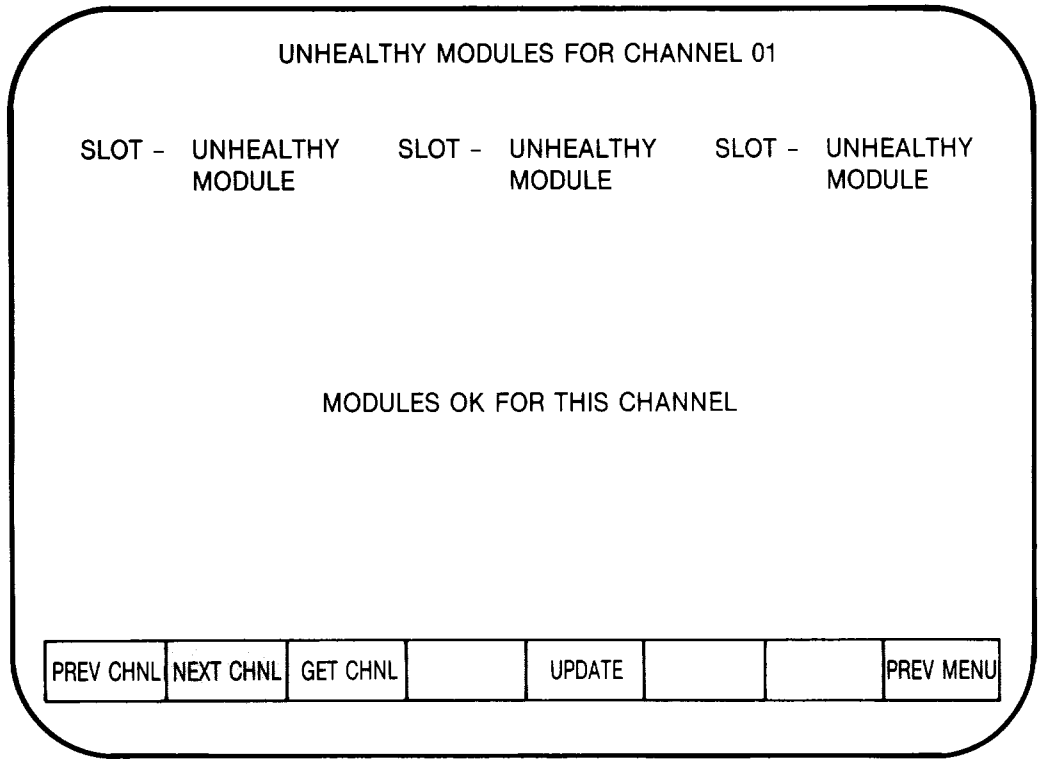


Figure 5-5. Sample Healthy Display Screen

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5.5.1 UPDATE

Press the UPDATE software label key to update the currently displayed health information.

NOTE

This display is NOT updated automatically but only upon request.

5.5.2 Previous Channel (PREV CHNL)

Press the PREV CHNL software label key to read the health information for the channel just before the current channel.

5.5.3 Next Channel (NEXT CHNL)

Press NEXT CHNL label key to read the health information for the channel following the channel displayed on the screen.

5.5.4 Get Channel (GET CHNL)

Press the GET CHNL software label key and enter the channel number desired. The health information for this channel is displayed on the screen.

5.6 MISMATCH

Press the MISMATCH software label key, while the controller is stopped, to obtain a list of everything in the rack that does not match the configuration. The MISMATCH screen (Figure 5-6) not only tells you there is a mismatch, but it tells you what the configured model is and what the actual model is. The MISMATCH feature is another way to check your configuration and trace any errors in your system.

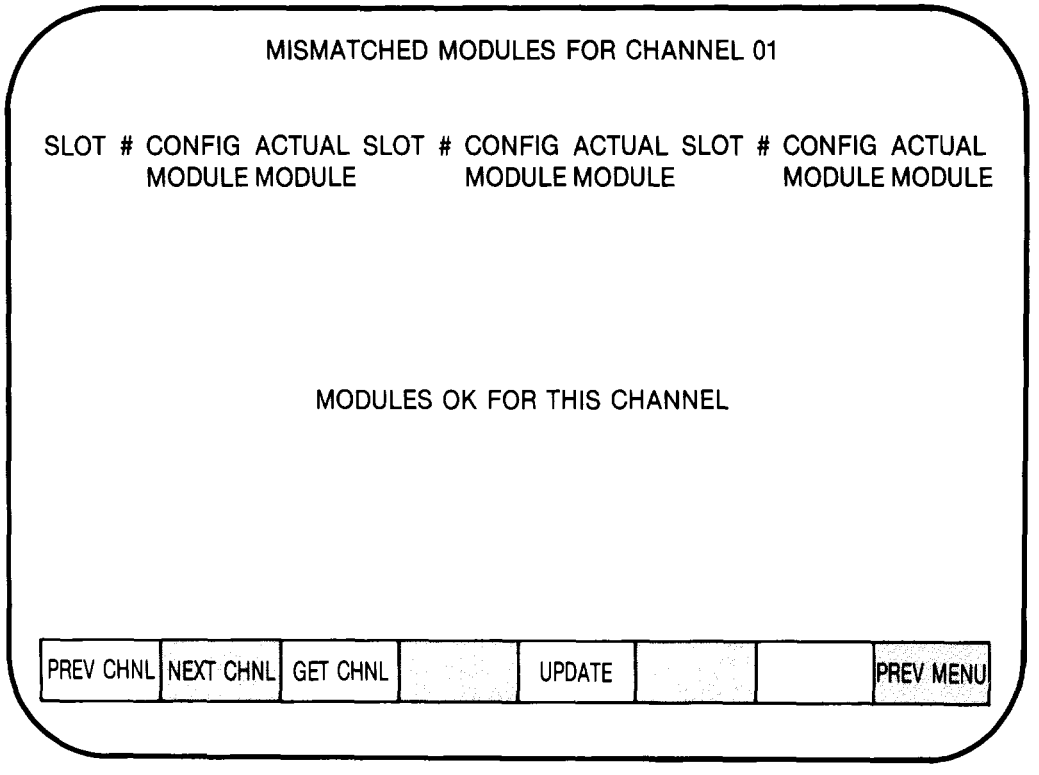


Figure 5-6. Sample of Mismatch Display Screen

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5.7 Previous Menu (PREV MENU)

Press the PREV MENU software label key to return to the previous menu.

5.8 TRAFFIC COP EXAMPLE

The 884 PC must be STOPPED before you can build a TRAFFIC COP.

Press the I/O CONFIG software label key on the Configurator Menu. The next screen to appear is the I/O Channels Configured screen (Figure 5-3).

Press the TRAF COP software label key and the I/O Channel Traffic Cop screen (Figure 5-4) appears.

To configure Input Module B805-016, 115 VAC 16 PT, move the cursor to the Module Type column next to Slot 104. B8* is already displayed on the screen, enter 05 and press the ENTER key. Notice that as soon as you press ENTER, the 884 PC automatically displays the appropriate Module Description, 115 VAC 16-IN.

The cursor is now at the Reference Number field. A message is displayed at the bottom of the screen: KEY IN APPROPRIATE REFERENCE FOR MODULE (TYPES 1,3) Key in 10001 and press ENTER. The 884 PC completes the entry with the correct number of input addresses, in this case, 10016. It also displays DISC for Data Type.

If you keyed in 30001, for example, the 884 PC completes the entry and displays BINARY for Data Type. You can change BINARY to BCD, (Binary Coded Decimal), by pressing the BCD software label key.

To configure a B804 Output Module, press the NEXT SLOT software label key (or you can use the Down Arrow cursor key). Key in 04 and press ENTER.

Now the cursor has moved to the Reference Number field, and the message at the bottom of the screen, again, displays the appropriate references for this module. Key in 00001. The 884 PC completes the entry and displays DISC for Data Type.

If, for example, you keyed 40001 in the Reference Number field, the 884 PC automatically completes the entry and displays BINARY in the Data Type field.

Press the WRITE CHNL software label key to save the channel you just configured. You now have a choice to PROCEED or CANCEL. Remember, if you want to save this channel you must press WRITE CHNL, followed by PROCEED. If you do not want to save it, after pressing WRITE CHNL, press CANCEL.

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SECTION 6
INTRODUCTION TO LADDER LOGIC AND PROGRAMMING

This section provides the information necessary to create, read, delete, and insert networks as well as edit individual networks. It also describes how to use the reference screens and the search function.

This section also describes the basic ladder logic used in programming the 884 PC. The logic elements used include relay contacts, coils, references, registers, and function blocks. The controller's logic is structured into networks, and programmed into the 884 PC via a P190 Programmer. The controller scans each network and solves the logic which controls the input to other logic in the program, or controls an output (i.e., turning ON a switch, stopping a process, resetting a meter, etc.).

The P190 Programmer is organized into two logic editing modes; the Element Editor and the Network Editor. Both editing modes use a series of P190 display screens and software labels. Instructions on how to use the editing modes and the appropriate software labels are also covered in this section.

6.1 HOW TO ENTER A PROGRAM

A P190 Programmer is used to enter programs into the 884 PC. (If you need more information on the P190, see the P190 Programmer User's Manual.) To enter a program, follow the instructions below:

1. Insert the 884 PC Programmer and Configurator Tape into the P190 tape drive. (The 884 PC must be configured to meet your specifications before a program will run as programmed. Section 5 provides the configuration and Traffic Cop information needed to accomplish this).

   NOTE

   Leave the tape in the drive. The P190 rereads the tape from time to time.

2. Press the ATTACH software label key.

   This is the Attached Level. These software label keys are used to change the 884 PC's status. (If passwords have been used, the Password Level is next, not Attached Level. See Appendix C for Password Operation instructions.)

3. Press the PROGRAM software label key and then the PROCEED software label key. (A thirty second delay occurs while the programming instructions are read from the tape).

4. The ELEMENT EDITOR screen appears.

5. Press the CREATE NET software label key.

A power rail appears on the left of the P190 screen and the cursor is located in the top left node. The following software labels are displayed:

READ NET	CREATE NET	DEL NET		NETWRK ED			OPERS

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Each software label key, when pressed, brings up another set of software labels. The software label keys needed to enter a program are illustrated in a flow chart in Figure 6-5. To return to the original set of software labels, shown at the top of Figure 6-5, from any level of software labels except the Power-Up level, press the PREV MENU software label key.

6.2 NETWORKS

A network is a set of interconnected logic elements which represents all, or part, of the user's 884 PC program. Each network has a maximum width of 11 columns and a maximum length of 7 rows. The eleventh column is provided exclusively for coils. See Figure 6-1.

A network can contain any combination of relay contacts, coils (eleventh column only), counters, timers, and arithmetic, data transfer (DX), and special function blocks. The logic can occupy the whole network area or just a portion of it.

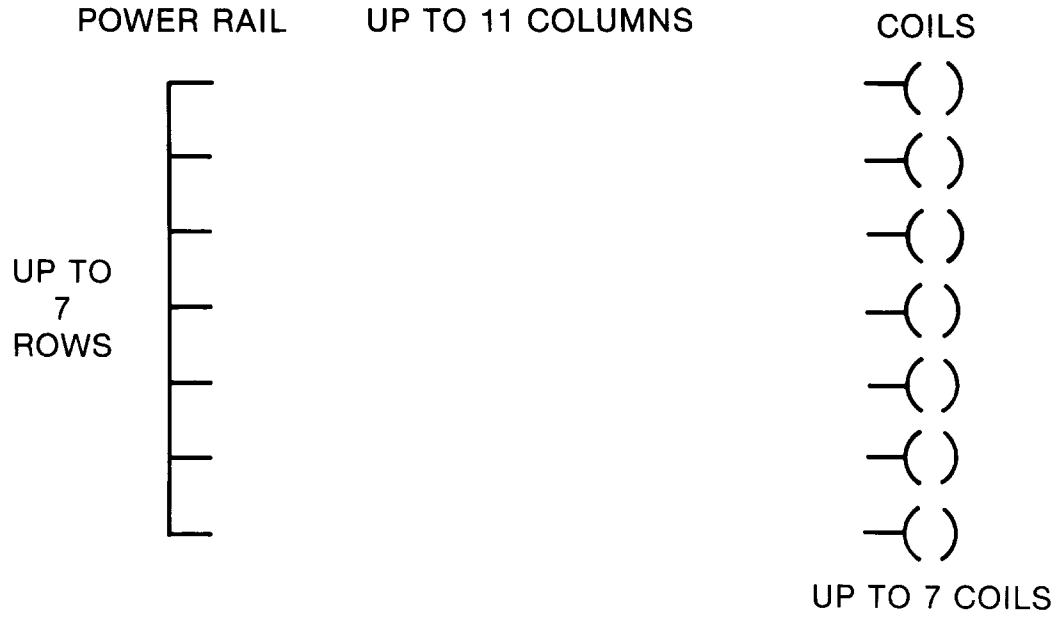


Figure 6-1. Network Parameters

6.3 REFERENCES

Reference numbers are used to identify relay contacts, coils, inputs, outputs, latches and registers. There are seven types of references. Each type has a different code digit to identify it; this digit is the first of five consecutive digits. The reference types and their functions are listed in Table 6-1.

NOTE

These numbers refer to actual registers or discretes within the controller which contain numerical values or ON/OFF conditions. An X is any digit, 0 through 9; however, it may have a specific limit (e.g., max. 6) as designated in the configuration table.

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Table 6-1. References

0XXXX — Coil/Discrete Output

- A discrete (ON/OFF) signal that is controlled by logic.
- Can be used to drive a real output through an output module.
- Can be used internally to drive one or more contacts in user logic.
- The following coils are reserved for internal status indicators:

  761 Battery OK
  762 Memory Protect
  763 Remote I/OP Health
  764 - 768 Reserved

1XXXX — Discrete Input

- Status of the input is controlled by an input module.
- Used to drive contacts in user logic.
- Can be used repeatedly in the program.

2XXXX — Sequencer or Sequencer Relay

2XX00 — Sequencer Register

- Used for sequencer and drum control functions.

2XXSS — Sequencer Reference or Relay.

- SS refers to the step number in 2XX00 Sequencer (If 20100 is the Sequencer then 20101 references the 01 step number).
- Used to control a contact
- Used to provide step information.

3XXXX — Input Register

- A numerical input from an external source (i.e., thumbwheel, analog signal, or high speed counter).
- Sixteen consecutive discrete signals.
- Can be binary or binary coded decimal (BCD).

4XXXX — Holding/Output Register

- Used to store numerical information, decimal or binary, in the controller.
- Can output Binary or BCD numerical information to an output module.

5XXXX — Double Precision Register

- Used for double precision signed math.
- Used to store double precision, 8 digits plus sign numerical information in the controller.

9XXXX — Latch

- A discrete used only in a Latch function block.
- Its state is maintained through a power cycle.

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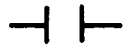
6.4 RELAY CONTACTS

The relay contact is the basic programming element. It can be referenced to either a logic coil (0XXXX), a discrete input (1XXXX), or a sequencer (2XXSS). The contact is opened (no power passing through) or closed (power passing through) when a certain condition exists (for example, when a logic coil is energized or de-energized or an input signal turns ON or OFF).

Relay contacts can be normally open, normally closed, or transitional.

6.4.1 Normal Contacts

The two most commonly used contacts are:

Normally Open (NO) Contact 

Normally Closed (NC) Contact 

When the coil or discrete input is ON, the normally open (NO) contact is closed and passes power, and the normally closed (NC) contact is open and does not pass power.

When the coil or discrete input is OFF, the NO contact is open and does not pass power, and the NC contact is closed and passes power. See Table 6-2.

Table 6-2. Normally Open and Normally Closed Contacts

	NO Contact	NC Contact
Coil or Discrete Input is ON	passes power	does not pass power
Coil or Discrete Input is OFF	does not pass power	passes power

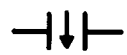
6.4.2 Transitional Contacts

A transitional contact passes power for one scan, when energized (OFF to ON or ON to OFF) by the coil or discrete input to which it is referenced. It is not affected by the ON or OFF state of the logic coil or discrete input after the transition.

Sometimes it is necessary for a function to be performed only once. In this case a transitional contact is used because it only transmits once each time it is energized.

Since there are two different transitions (OFF to ON and ON to OFF), there are two transitional contacts:

Positive Transitional Contact (OFF to ON) 

Negative Transitional Contact (ON to OFF) 

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6.4.3 Inserting Contacts

A relay contact is inserted into a program by positioning the cursor over the desired location, entering a 0XXXX, 1XXXX, or 2XXSS reference into the Assembly Register (AR) and pressing the appropriate software label key.

To change the type of relay contact, position the cursor over the contact to be changed and press the desired software label key. To change the reference numbers below a contact, position the cursor over the contact, enter a new value into the AR, and press the ENTER key.

6.5 VERTICAL AND HORIZONTAL SHORTS

Vertical and horizontal shorts are straight line connections between contacts.

Vertical shorts are used to connect contacts and function blocks one above the other in a network. Vertical shorts can also be used to connect inputs or outputs in a function block to create either/or conditions. When two contacts are connected by vertical shorts, a vertical short on each side, power is allowed to pass through if either, or both, contacts receive power.

To enter a vertical short, position the cursor to the left and above the reference desired for the short, and press the VER OPEN/VER SHORT software label key. A vertical short is cleared (or opened) by pressing the VER OPEN software label key and the SHIFT key.

Horizontal shorts are used in combination with vertical shorts to expand logic within a network without breaking the power flow. They can be used to create either/or conditions using basic relay contacts. (See Figure 6-2.)

A vertical short is used to connect the horizontal short to the top logic line.

To enter a horizontal short, position the cursor over the reference desired for the short and press the horizontal short software label key. To clear a horizontal short, press the DELETE NODE software label key.

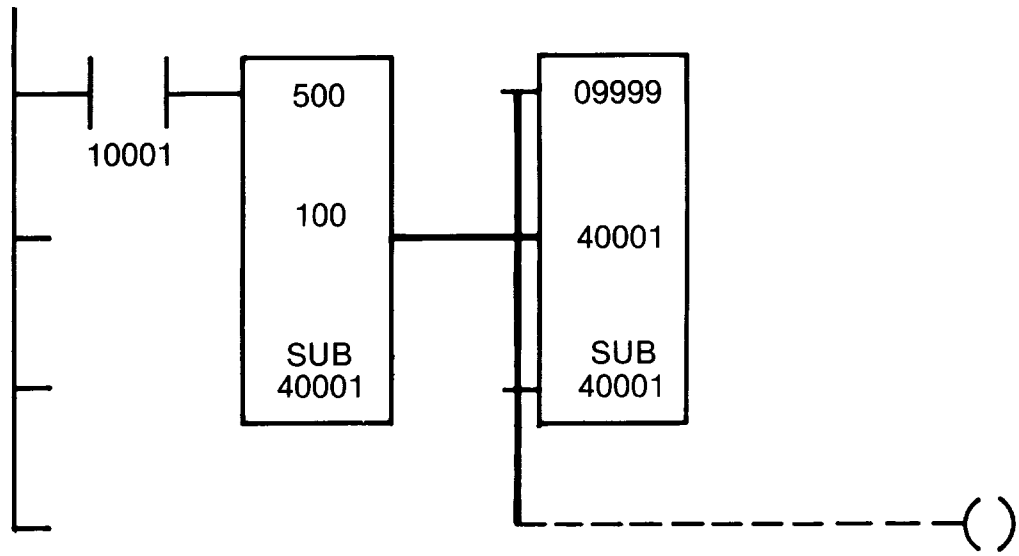


Figure 6-2. Shorts

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6.6 COILS

A coil is used to activate logic within a program, and/or to control an output circuit. It is represented by a 0XXXX reference number and either of two symbols:

A Normal, Non-retentive Coil, —( )— , is turned OFF if power is removed and later restored (power cycle).

A Latched, Retentive Coil, —(L)— , retains its previous state through a power cycle.

NOTE

A normal, non-retentive, disabled coil retains its disabled state through a power cycle.

Coils are always displayed in the far right (eleventh) column of a network, although they are actually located and solved in the column of the network in which they were programmed. Each network can contain a maximum of seven coils.

Each 0XXXX reference can be used as a coil only once, but can be referenced to any number of relay contacts. Some logic functions use coils in groups of 16 (eg., DRUM, T→R, BLKM, etc.). Partially programmed logic elements can refer to a 0XXXX coil more than once because the 884 PC's logic solver passes over elements displaying "????" references on the CRT screen.

A logic coil is inserted into a program the same as a relay contact, except that the cursor does not have to be over column eleven. The cursor can be directly beside the last logic element in a row. When the COIL software label key (—( )— or —(L)—) is pressed, dashed lines are inserted and the coil is placed in the coil column. The only reference allowed is a 0XXXX reference, unlike relay contacts which allow 0XXXX, 1XXXX, or 2XXSS references.

The following coils are reserved for special status indicators:

761 Battery OK
762 Memory Protect
763 Remote I/O Health
764-768 Reserved

6.7 DISABLE/ENABLE

Any logic coil or discrete input in a program can be disabled, and forced ON or OFF, from the P190 keyboard. DISABLE separates the state of the coil from control of the PC logic. On inputs, DISABLE separates the input state from the actual field device. This is an important difference. DISABLE/ENABLE is used for debugging and wiring I/O devices and allows you to test the changes before you actually change your existing logic.

Disabling a coil or input causes the programmed logic to bypass that particular coil or input. Use of the FORCE ON and FORCE OFF software label keys allow you to control the state of that particular coil or input. Memory Protect must be OFF.

To disable a coil or input, follow the instructions below:

1. Ensure that Memory Protect is OFF on both the P190 Programmer and the 884 PC.

2. Press the CHANGE SCREEN hardware key.

3. Press the PART. REF software label key.

4. Enter the coil reference number or discrete input reference number in the Assembly Register (AR).

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5. Press the GET COL/GET REF software label key or the ERASE/GET key.

The reference number appears at the cursor position with its state, ON or OFF, and the following software labels appear on the screen:

GET COL GET REF	PREV REF NEXT REF	ERASE COL ERASE REF		ENABLE	DISABLE	FORCE ON	FORCE OFF

6. Press the DISABLE software label key.

The coil or input is now DISABLED ON or DISABLED OFF, depending on its state when the DISABLE key was pressed.

Coils may also be DISABLED or ENABLED from the logic screen. If you have a network displayed on the CRT, and want to DISABLE a coil, position the cursor on the coil and press the COILS software label key. The DISABLE/ENABLE and FORCE ON/FORCE OFF software label keys are now displayed and you may proceed.

Press the FORCE ON or FORCE OFF software label keys to change the state of the coil or input. Press the ENABLE software label key to enable the coil or input. If the coil or input is enabled, it cannot be forced ON or forced OFF; it retains the actual state, based on the logic or real input status.

WARNING

Certain logic functions can change the state of a disabled coil. All DX function blocks override the disabled status of a coil in the destination node. This may cause personal injury if a coil, assumed to have been disabled, changes state while a repair is being made.

6.8 CONTROLLER SCAN

The 884 PC scans the networks in your program to solve the logic. The scan starts at the top left of a network and goes from top to bottom in each column working from the left column towards the right column. See Figure 6-3.

Coils are displayed in the eleventh column on the P190 screen. This does not mean that they are always solved in this column. If the logic controlling a particular coil is in column 6 and dashed lines connect the logic to the coil, that coil is solved in column 7. For example, in Figure 6-4, coil 00006 is solved before contacts 10004 and 10005 and coil 00003.

The scan starts in network 1, continues in network 2 and continues until the scan reaches the end of the program. This means that when a column of logic is solved, its solutions are available for use in the next column. Then the outputs are serviced and the logic solve cycle starts over again.

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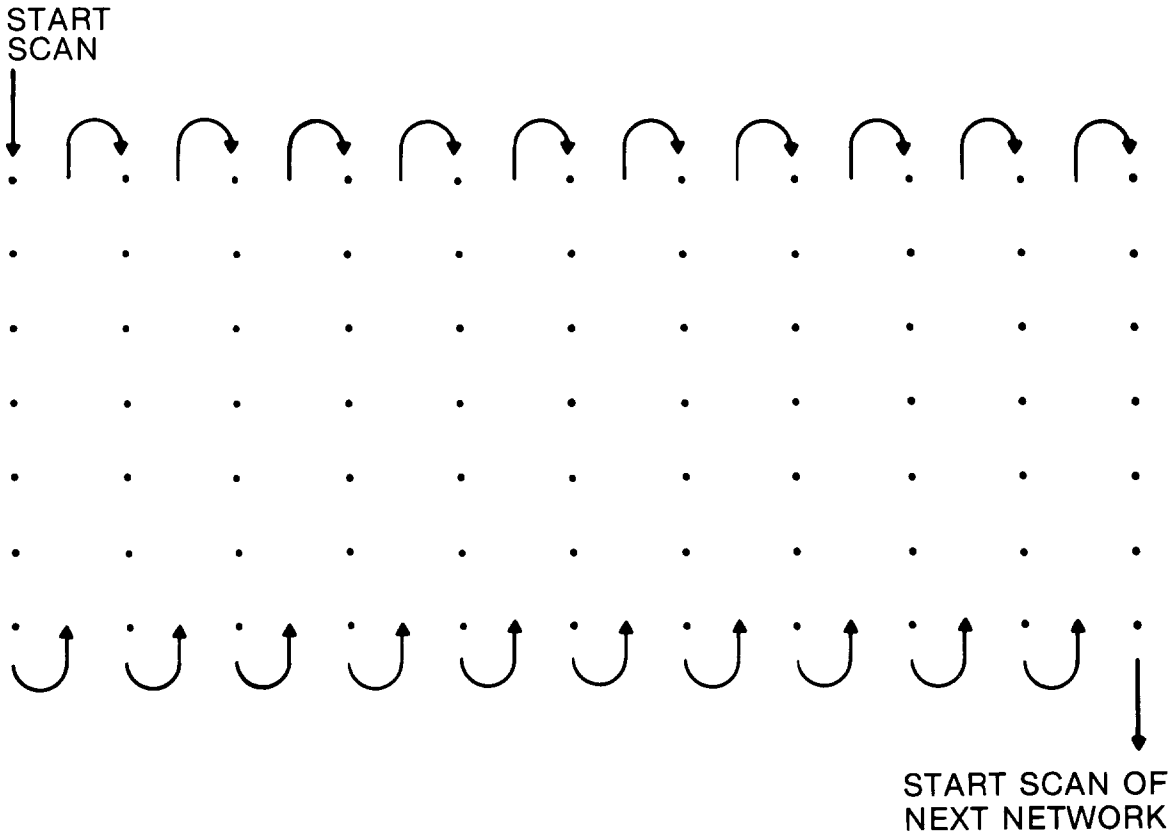


Figure 6-3. SCAN

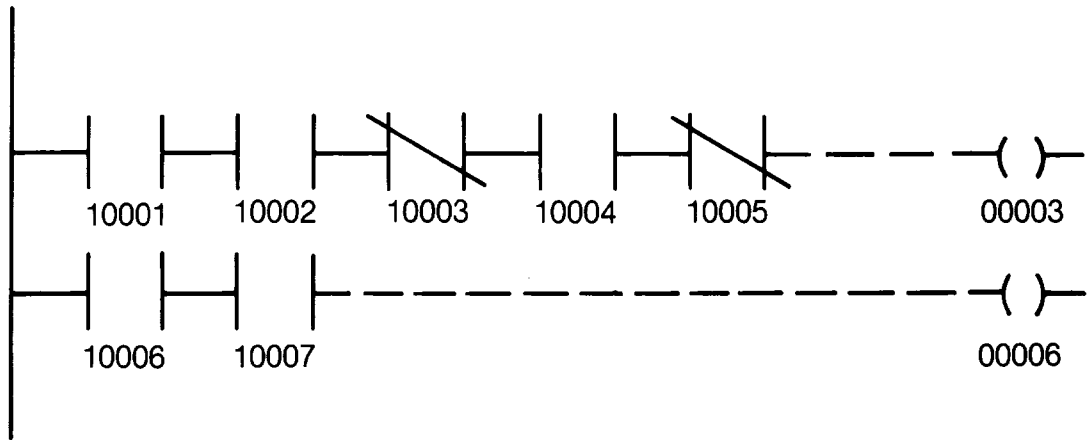


Figure 6-4. Order of Coil Solving

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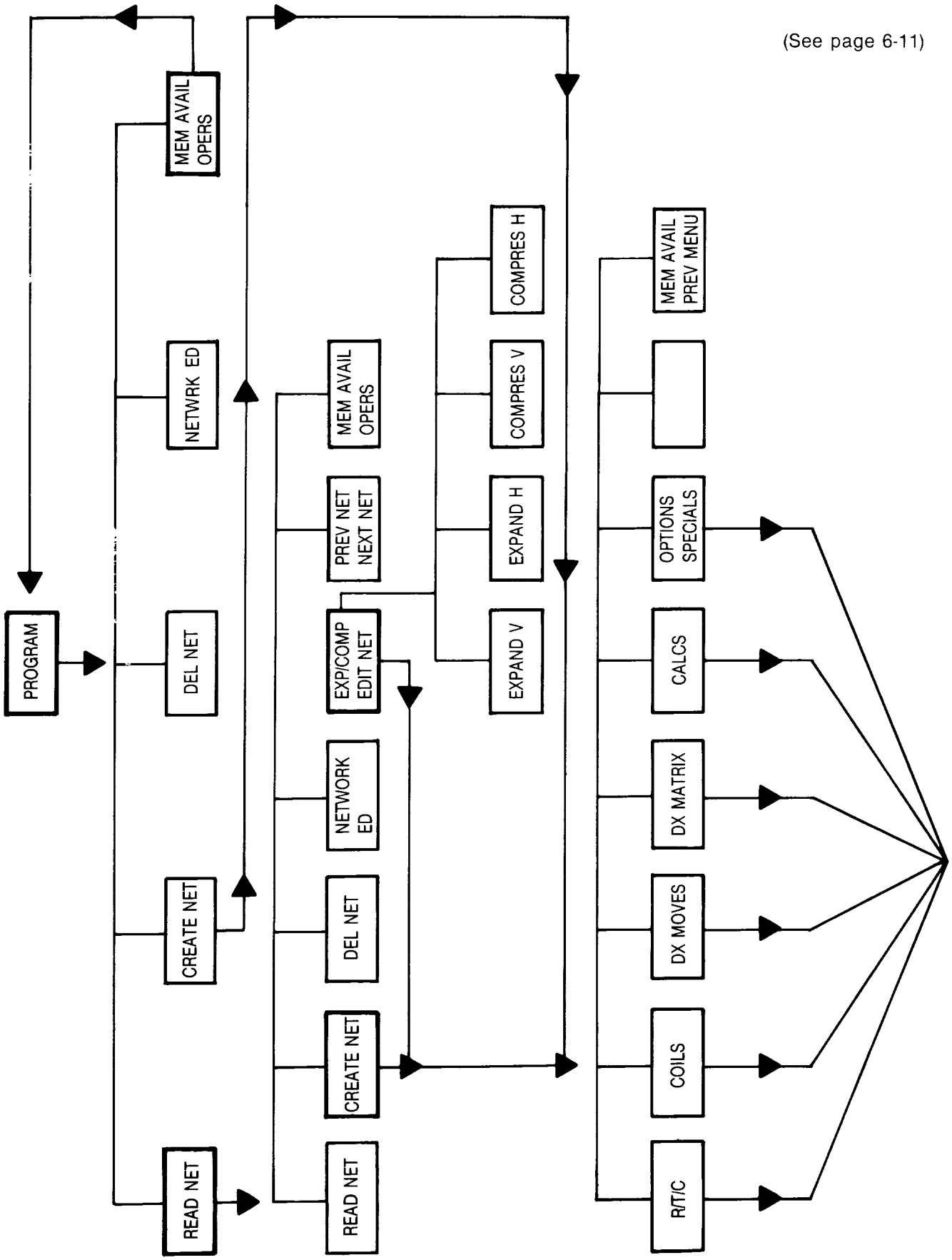
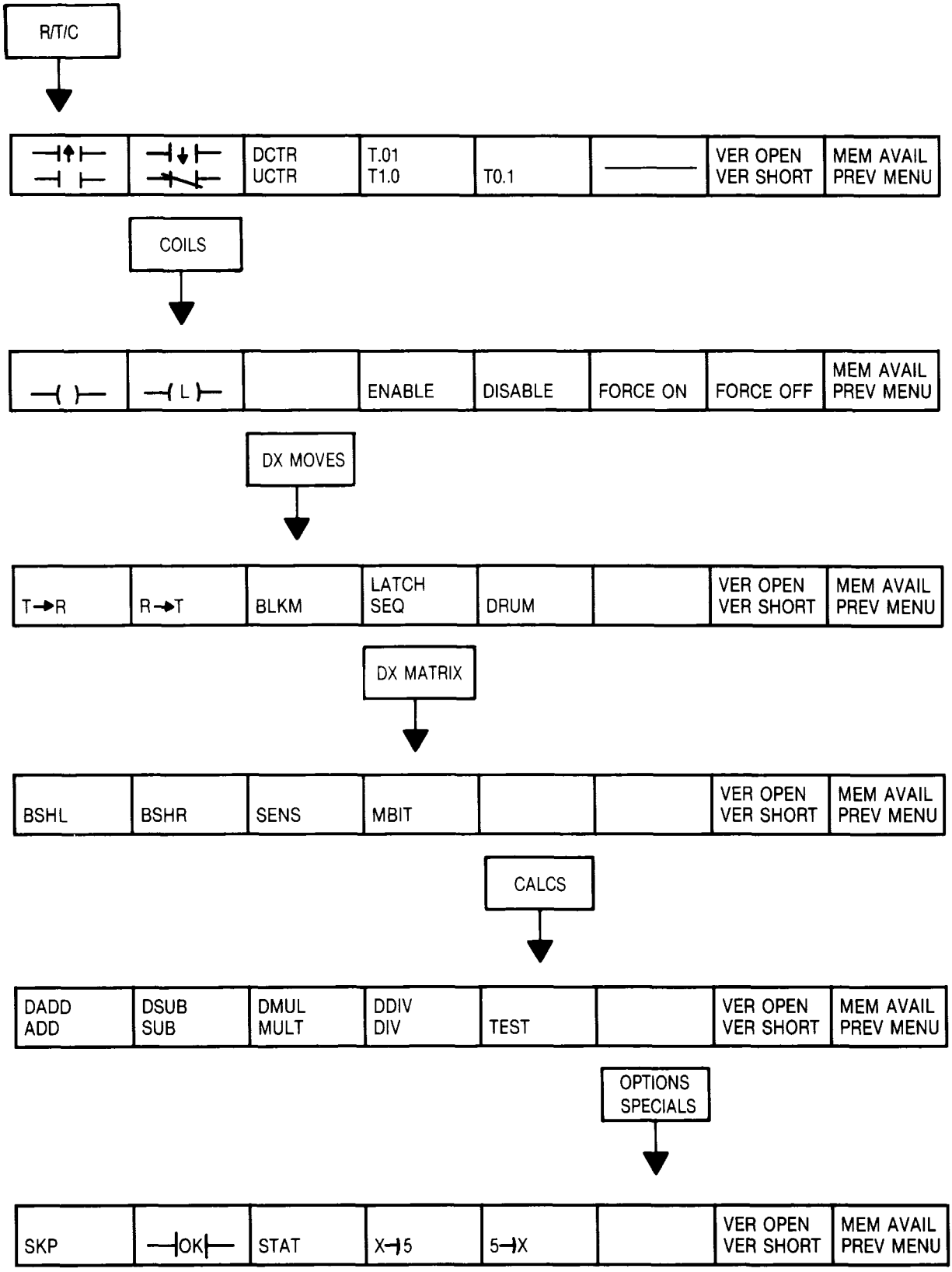


Figure 6-5. Element Editor Software Label Flow Diagram

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Figure 6-5. Element Editor Software Label Flow Diagram (cont)



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6.9 ELEMENT EDITOR

The P190/884 PC Programmer provides two modes of editing; the Element Editor and the Network Editor. The Element Editor is the on-line editing mode. In this mode, all user-requested changes are sent directly to the 884 PC, as they are entered into the P190 Programmer. The 884 PC processes this change, and solves any modified logic on the next controller scan. The Element Editor screen is displayed when the PROGRAM software label key is pressed.

Press the PROGRAM software label key (on the PC Operation Menu) and then press the PROCEED software label key. A message is displayed:

PLEASE WAIT — LOADING PROGRAMMER

When the loading is complete the Element Editor screen, containing the following software label keys, is displayed on the CRT.

READ NET	CREATE NET	DEL NET		NETWORK ED			MEM AVAIL OPERS

If the 884 PC is running, you can enter one element at a time and see the power flow change instantly. If the 884 PC is stopped, you can enter an entire network or group of networks. As soon as the 884 PC is started, the new network, or group of networks, will run at once. If the 884 PC is running, the power rail is highlighted; if the 884 PC is stopped, the power rail is dim. See Figure 6-5 for the software label key flowchart of the Element Editor.

6.9.1 Read Network (READ NET)

The READ NET software label key allows you to read and display a designated network on the P190's screen.

Enter the number of the network to be displayed in the AR. Press the READ NET software label key and the following software labels are displayed:

READ NET	CREATE NET	DEL NET		NETWORK ED	EXP/COMP EDIT NET	PREV NET NEXT NET	MEM AVAIL OPERS

The number of the network appears in the upper left-hand corner of the screen. The network power flow is displayed if the 884 PC is running and if the network is not within an active skip block. Press the EDIT NET software label key to display the cursor on the CRT screen and to edit the displayed network.

6.9.2 Create Network (CREATE NET)

The CREATE NET software label key allows you to enter a new network into the 884 PC. Press the CREATE NET software label key to create and edit a network on the P190 screen. The network area is blank, except for a power rail on the left. The cursor is placed at row 1, column 1 and the following software labels are displayed on the screen:

R/T/C	COILS	DX MOVES	DX MATRIX	CALCS	OPTIONS SPECIALS		MEM AVAIL PREV MENU

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These functions are explained in Sections 7, 8, 9, and 10.

When the CREATE NET software label key is pressed, the new network will start at the end of your current group of networks. If you have seven networks in your system, this will CREATE NET #8.

6.9.2.1 Start Next Hardware Key Function (START NEXT)

The CREATE NET software label key is not the same as the START NEXT hardware key. If you press the START NEXT hardware key, the new network will start, immediately following the network currently displayed on the screen. If you have 10 networks in your system and #5 is displayed on the screen, the START NEXT hardware key will create #6, and will renumber the remaining networks accordingly. The following describes the differences between the CREATE NET software label key and the START NEXT hardware key.

1. If no power rail is on the screen and 00000 in the AR:

   Both CREATE NET and START NEXT go to the end of the program and start the next network in sequence.

2. If there is a network on the screen and 00000 in the AR:

   CREATE NET goes to the end of the program and starts the next network in sequence.

   START NEXT creates a new network, numbered one more than the one displayed. It then renumbers the remaining networks.

3. If there are any numbers (from 00001 to the highest network number) in the AR, both CREATE NET and START NEXT will define a new, empty network using the value in the AR. Any higher numbered networks are renumbered.

To access the Element Editor software labels from the START NEXT screen, press PREV MENU software label key. The following software label keys appear:

READ NET	CREATE NET	DEL NET		NETWRK ED	EXP / COMP EDIT NET	PREV NET NEXT NET	OPERS

Press the EDIT NET software label key to get the software label keys needed to create a network.

As the network is entered onto the P190 screen it is entered into the 884 PC.

6.9.3 Delete Network (DEL NET)

The DEL NET software label key allows you to delete a network from the 884 PC.

Enter the number of the network to be deleted in the AR. Press the READ NET software label key; then press DEL NET to delete the network.

If there are 10 networks in the 884 PC and network #1 is deleted, the remaining networks are renumbered, starting at 1 and ending at 9.

If network #5 is deleted the remaining networks, 6-10, are renumbered 5-9.

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6.9.4 Expand/Compress (EXP/COMP)

The Expand/Compress software label key allows you to expand or compress networks, either horizontally or vertically. You can also select how many rows or columns to add or delete.

NOTE

Use of the Expand or Compress functions may change PC logic.

Press the EXP/COMP software label key, with the shift key, and the following software label keys are displayed:

EXPAND V	EXPAND H	COMPRES V	COMPRES H				MEM AVAIL PREV MENU

6.9.4.1 Expand Vertically (EXPAND V)

When you press the EXPAND V software label key, with 00000 in the AR, one entire rung (the rung where the cursor is positioned) of the relay ladder logic will be moved down one as shown in Figure 6-6a and 6-6b.

NOTE

The cursor can be placed anywhere in the row to be created. It does not have to be over an element. There must be at least one blank row under the last row containing programming elements or the Expand Vertical is not allowed.

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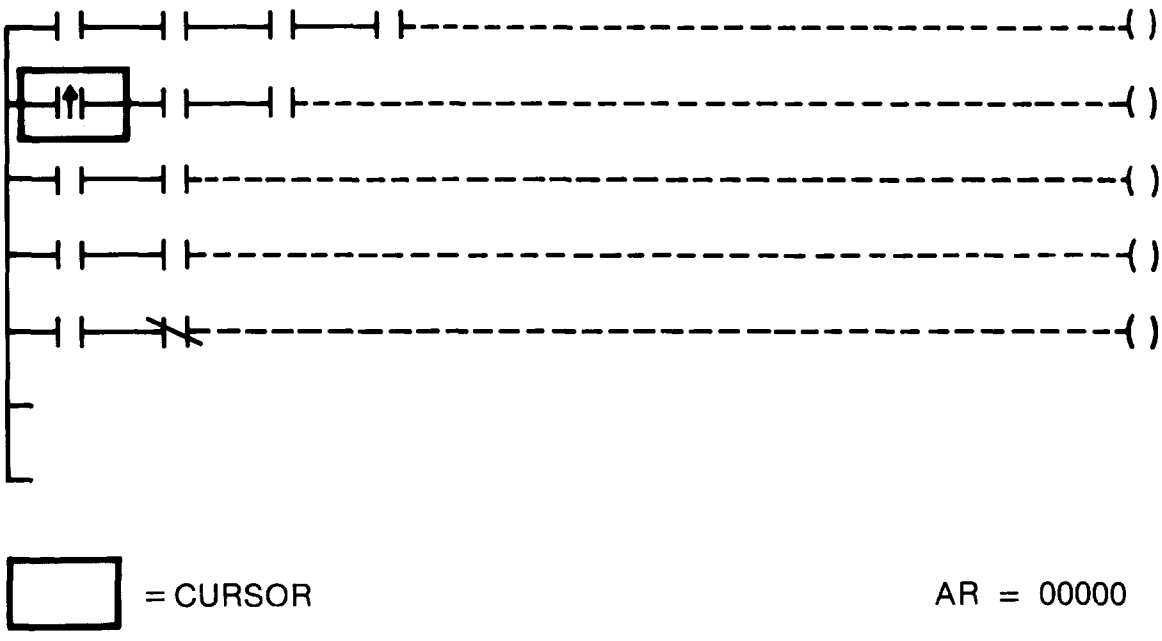


Figure 6-6a. Expand Vertical, 00000 in AR, Before

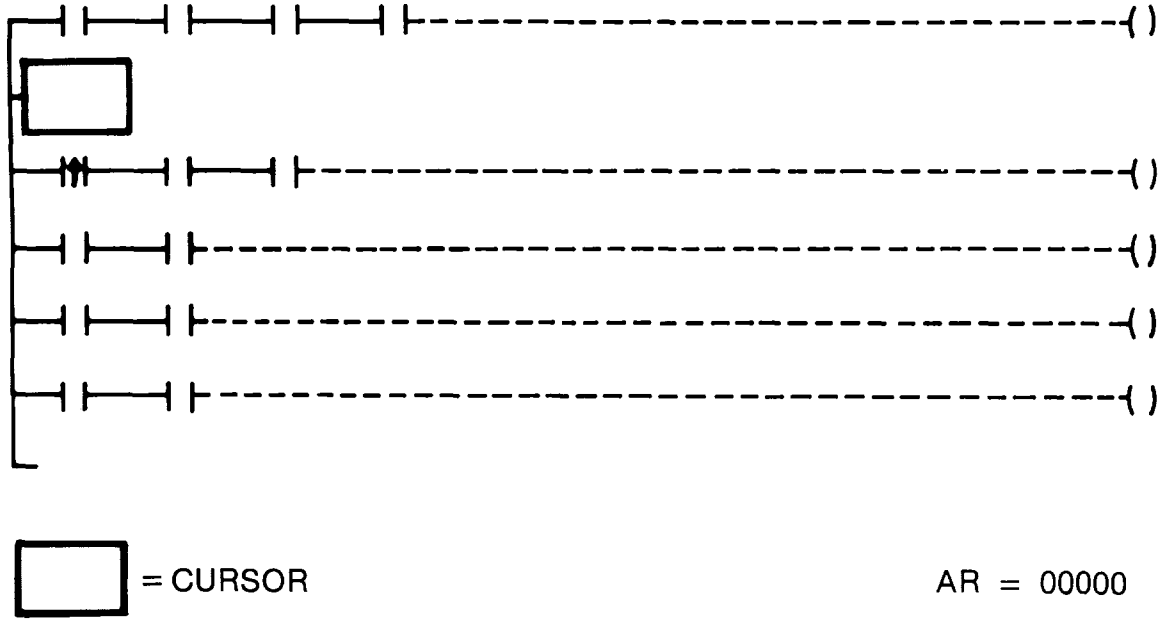


Figure 6-6b. Expand Vertical, 00000 in AR, After

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If you key a non-zero number, such as "2" in the AR, two contacts, beginning with the contact the cursor is over, will be moved down. Look at the examples in Figure 6-6c and 6-6d.

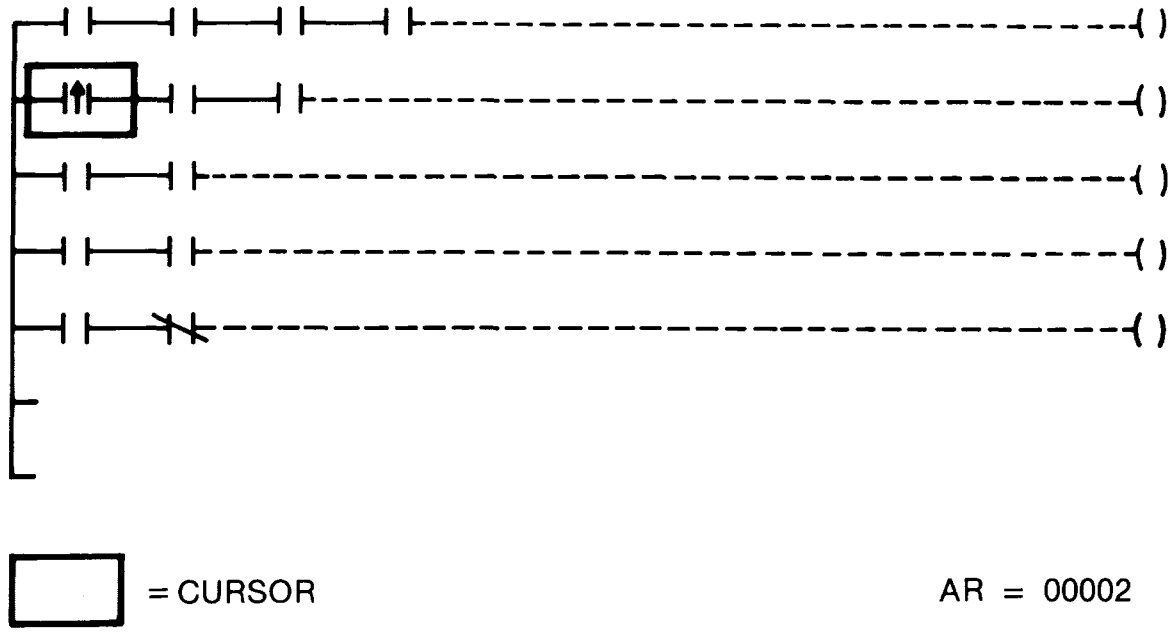


Figure 6-6c. Expand Vertical, 00002 in AR, Before

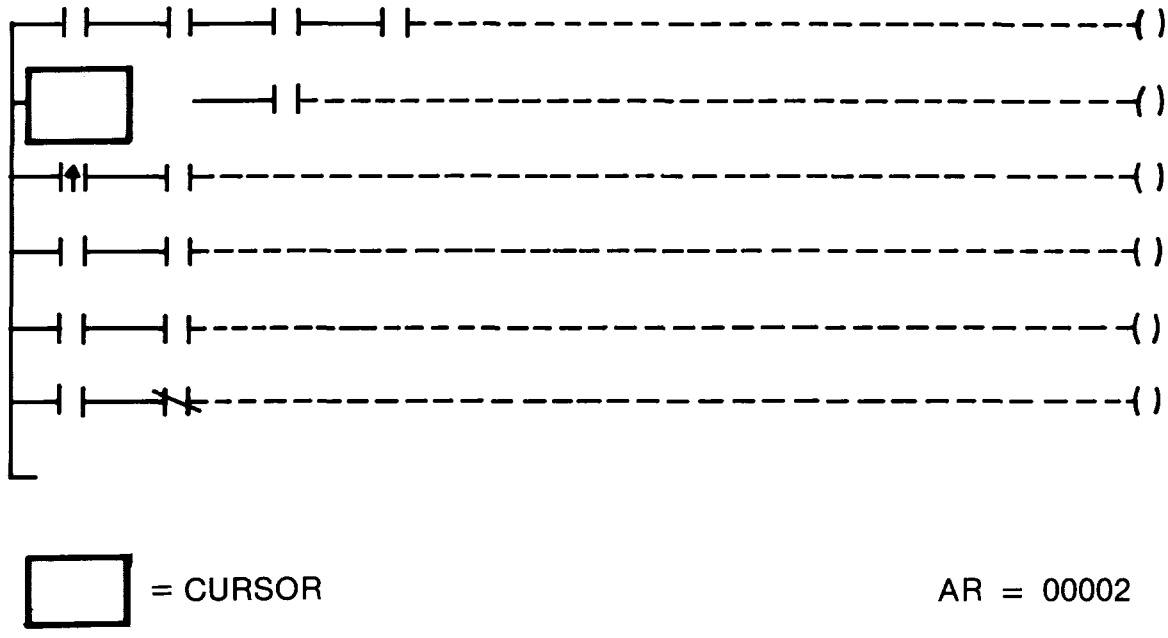


Figure 6-6d. Expand Vertical, 00002 in AR, After

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6.9.4.2 Expand Horizontally (EXPAND H)

The EXPAND H software label key works just like the EXPAND V except it expands horizontally. Look at the example in Figure 6-7a and 6-7b. If 00000 is in the AR, the entire rung, where the cursor is positioned, is moved horizontally.

NOTE

The cursor can be placed anywhere in the column to be created. It does not have to be over an element. There must be a blank column to the right of the cursor or the Expand Horizontal is not allowed.

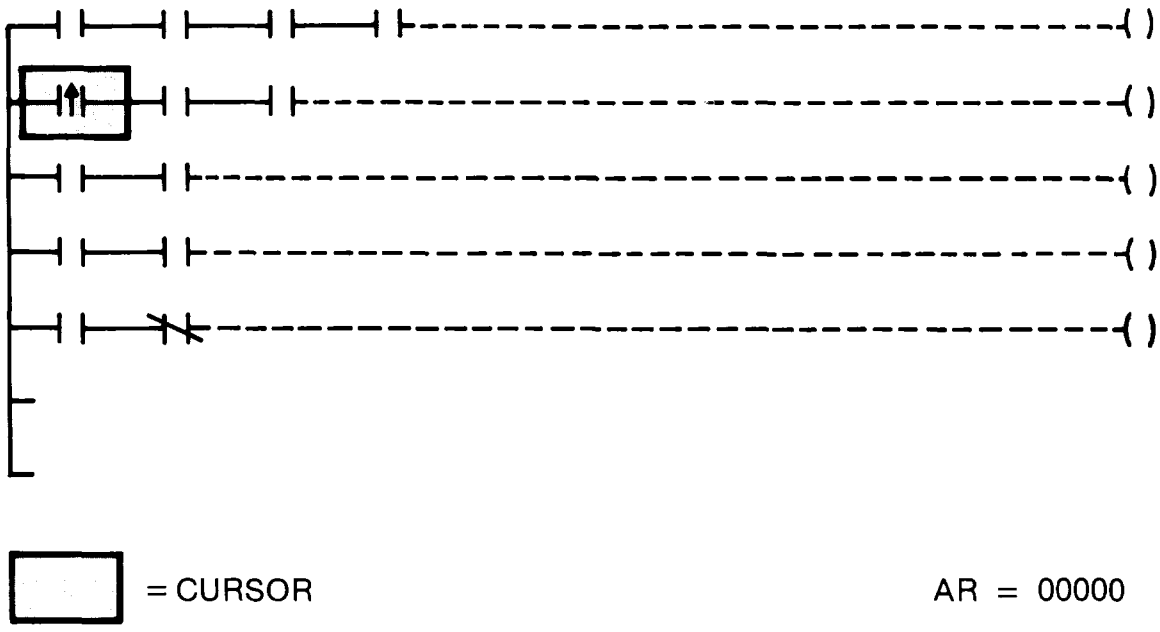


Figure 6-7a. Expand Horizontal, 00000 in AR, Before

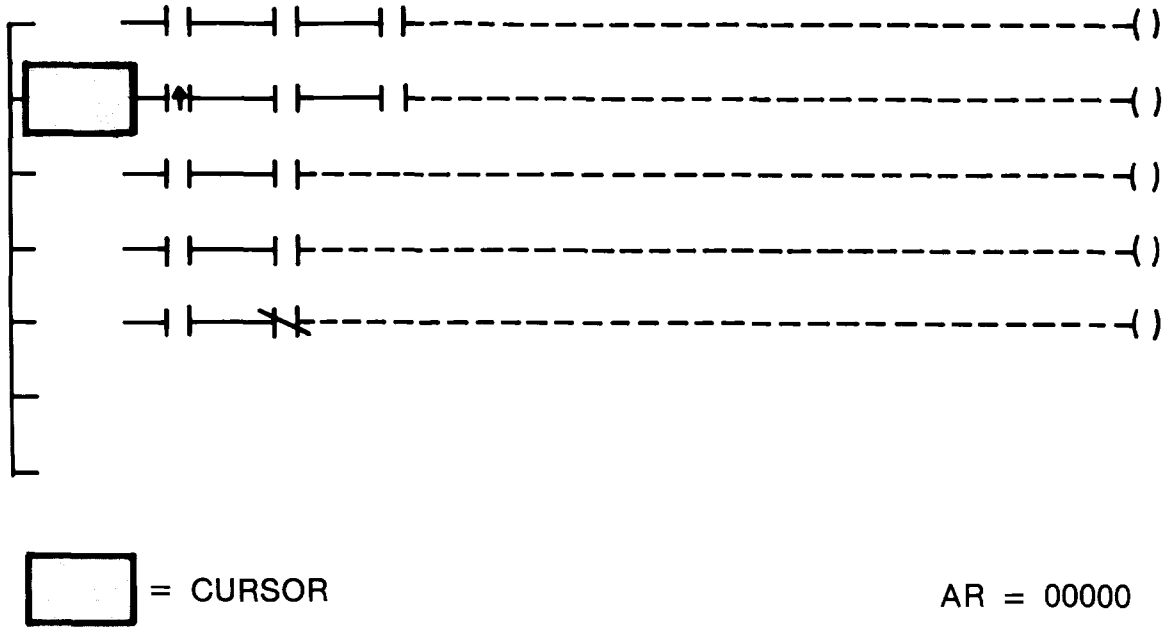


Figure 6-7b. Expand Horizontal, 00000 in AR, After

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If the AR has 00002 in it, two contacts, the contact where the cursor is positioned plus the one below it are moved horizontally as shown in Figure 6-7c and 6-7d.

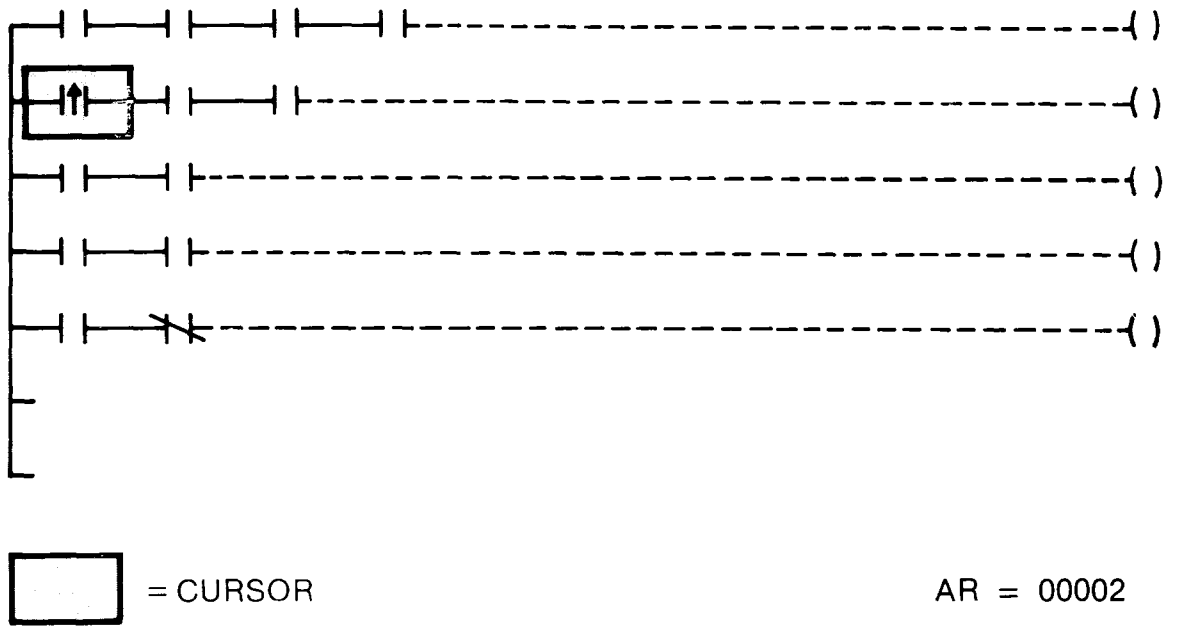


Figure 6-7c. Expand Horizontal, 00002 in AR, Before

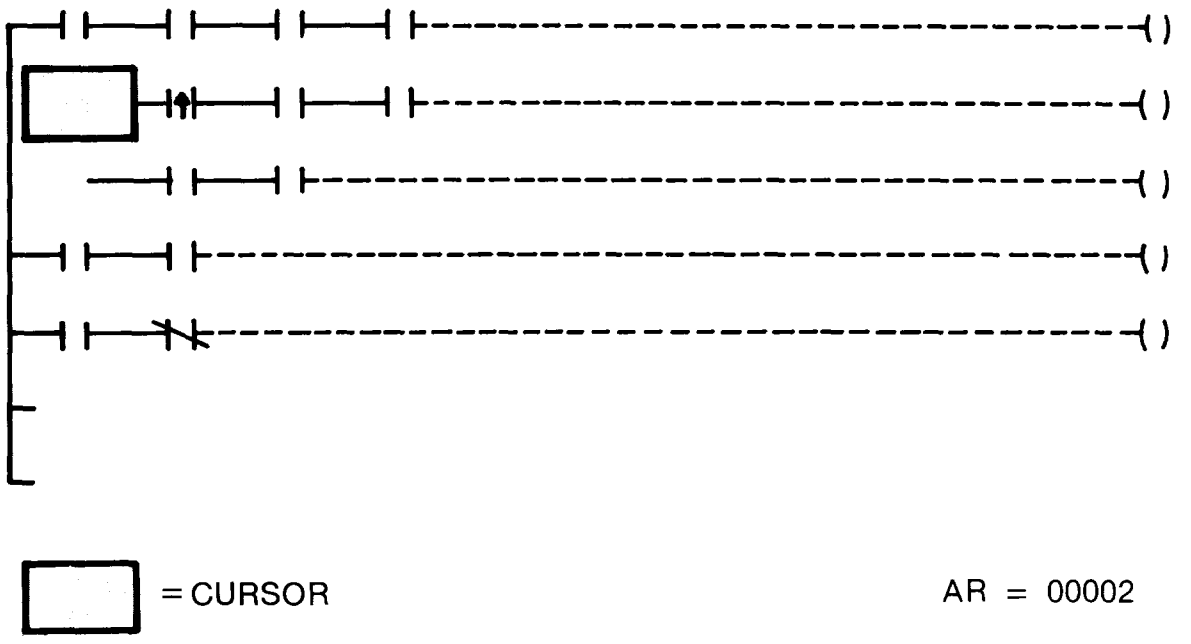


Figure 6-7d. Expand Horizontal, 00002 in AR, After

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6.9.4.3 Compress Vertically (COMPRES V)

The COMPRES V software label key works the reverse of EXPAND V. If 00000 is in the AR, the entire rung (where the cursor is positioned) will be deleted and the rungs below will be moved up one as shown in Figure 6-8a and 6-8b.

NOTE

Compress Vertically is not allowed if the cursor is placed over a programming element or if the row to be deleted contains a programming element.

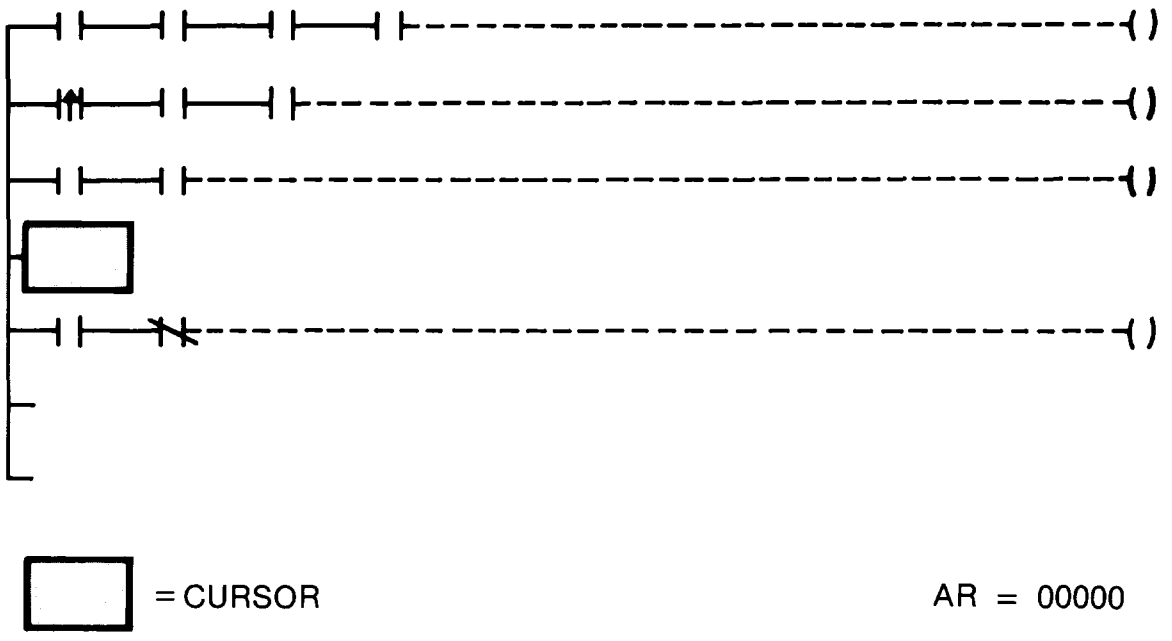


Figure 6-8a. Compress Vertical, 00000 in AR, Before

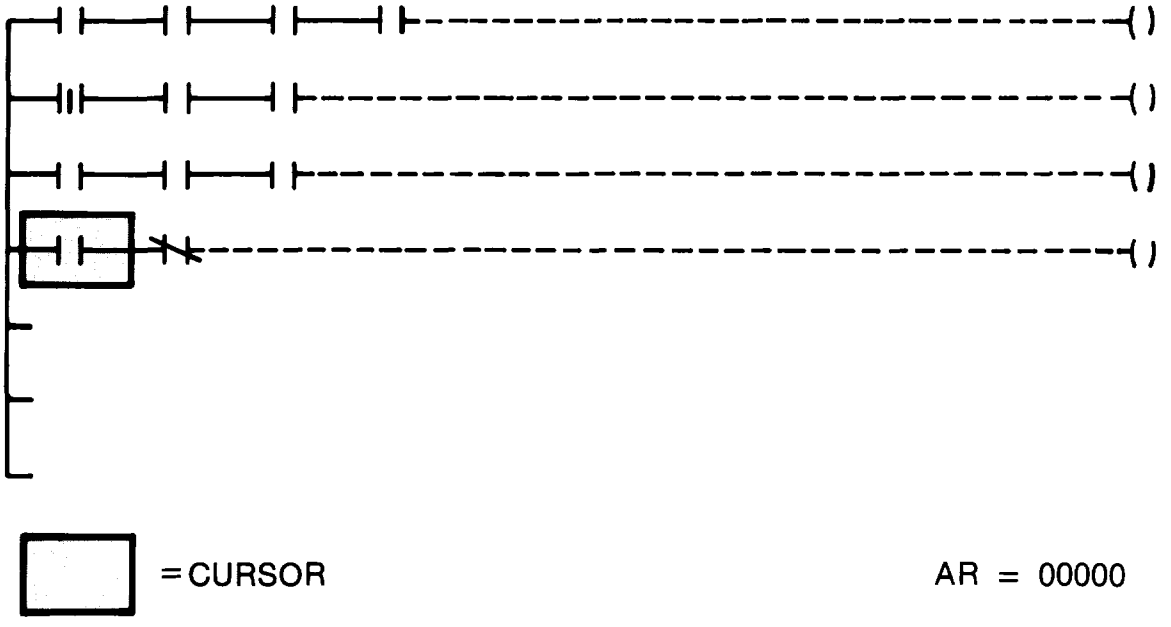


Figure 6-8b. Compress Vertical, 00000 in AR, After

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If you key a non-zero number, such as 2 in the AR, two contacts, beginning at the contact the cursor is over, will be deleted, and any contacts below will be moved up as shown in Figure 6-8c and 6-8d.

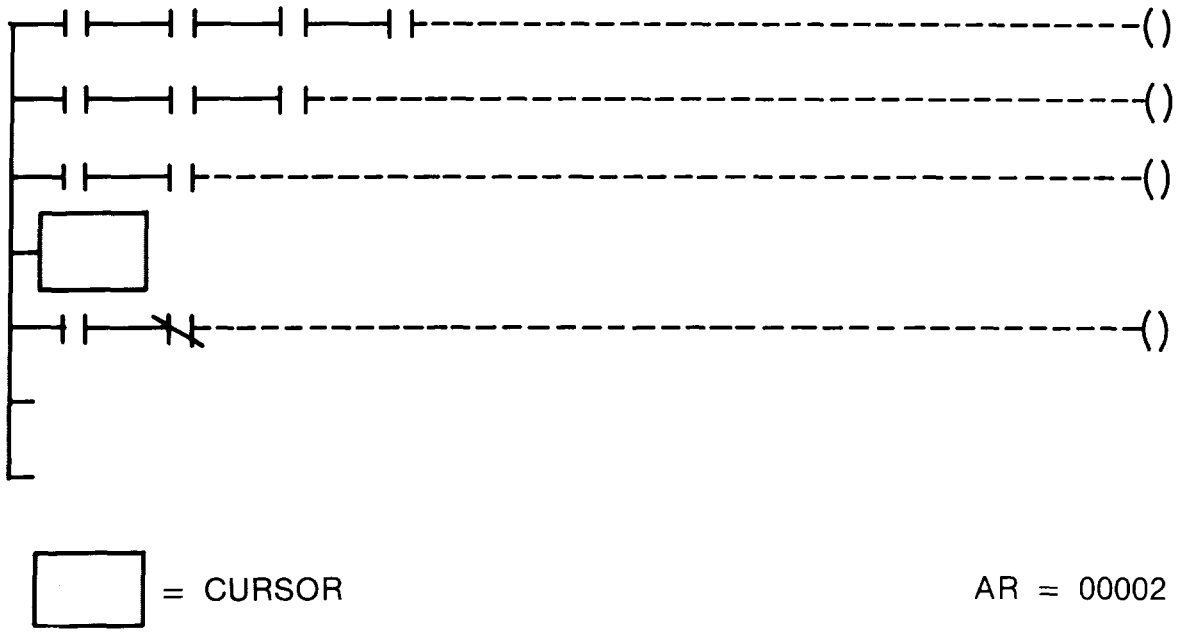


Figure 6-8c. Compress Vertical, 00002 in AR, Before

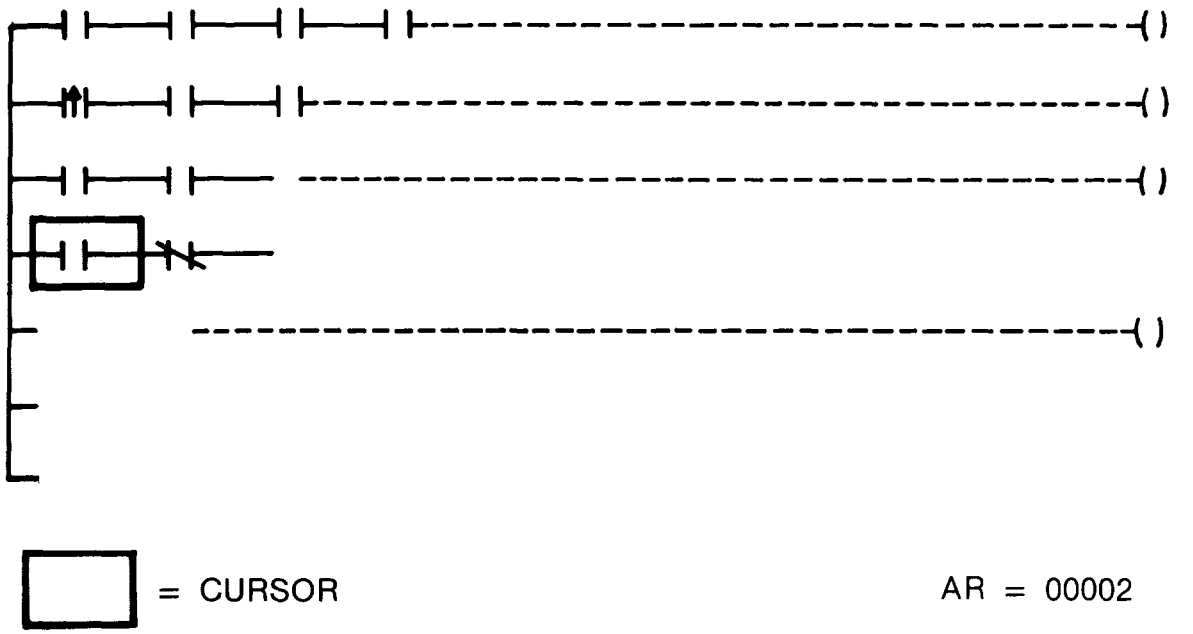


Figure 6-8d. Compress Vertical, 00002 in AR, After

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6.9.4.4 Compress Horizontally (COMPRES H)

The COMPRES H software label key works the same as the COMPRES V, except it compresses or deletes horizontally.

The logic in Figure 6-9a shows a network, with 00000 in the AR, before pressing the COMPRESS HORIZONTAL software label key. The revised network is shown in Figure 6-9b.

NOTE

Compress Horizontal is not allowed if the cursor is located over a programming element or if the column to be deleted contains a programming element.

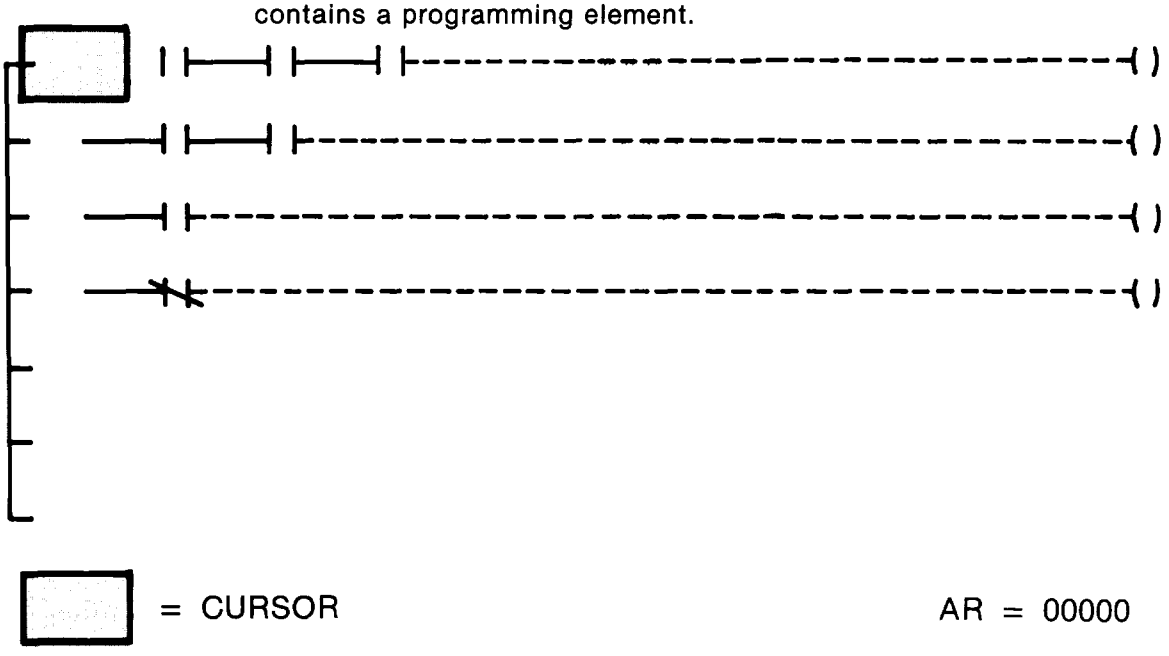


Figure 6-9a. Compress Horizontally, 00000 in AR, Before

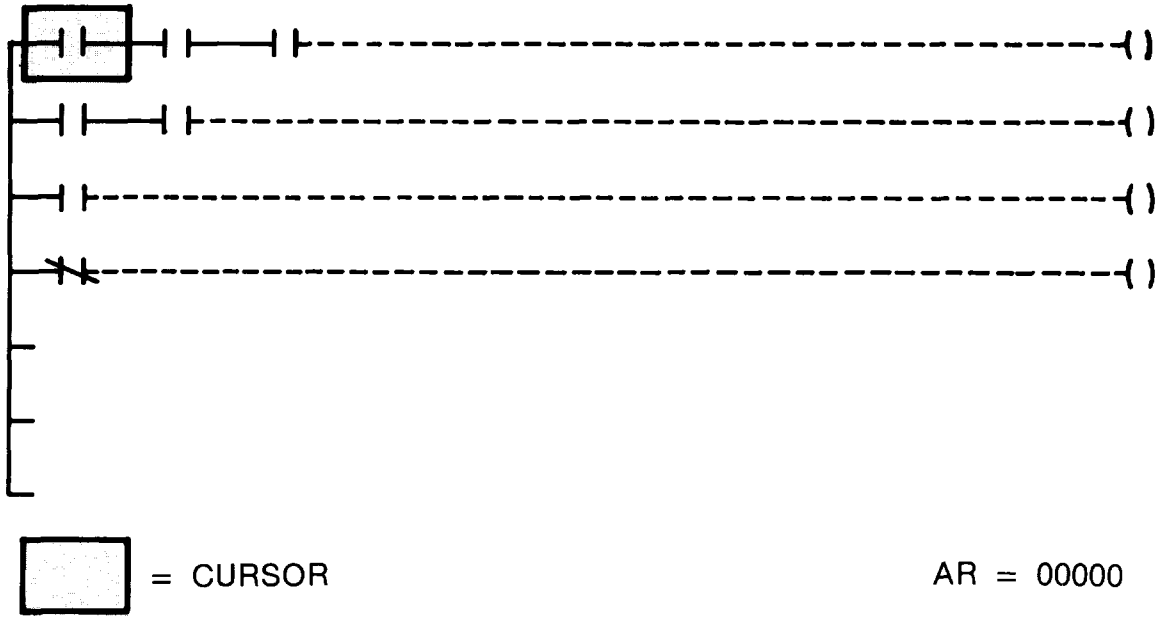


Figure 6-9b. Compress Horizontal, 00000 in AR, After

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If you key a non-zero number, such as 2 in the AR, two contacts, beginning with the contact the cursor is positioned on will be moved horizontally as shown in Figure 6-9c and 6-9d.

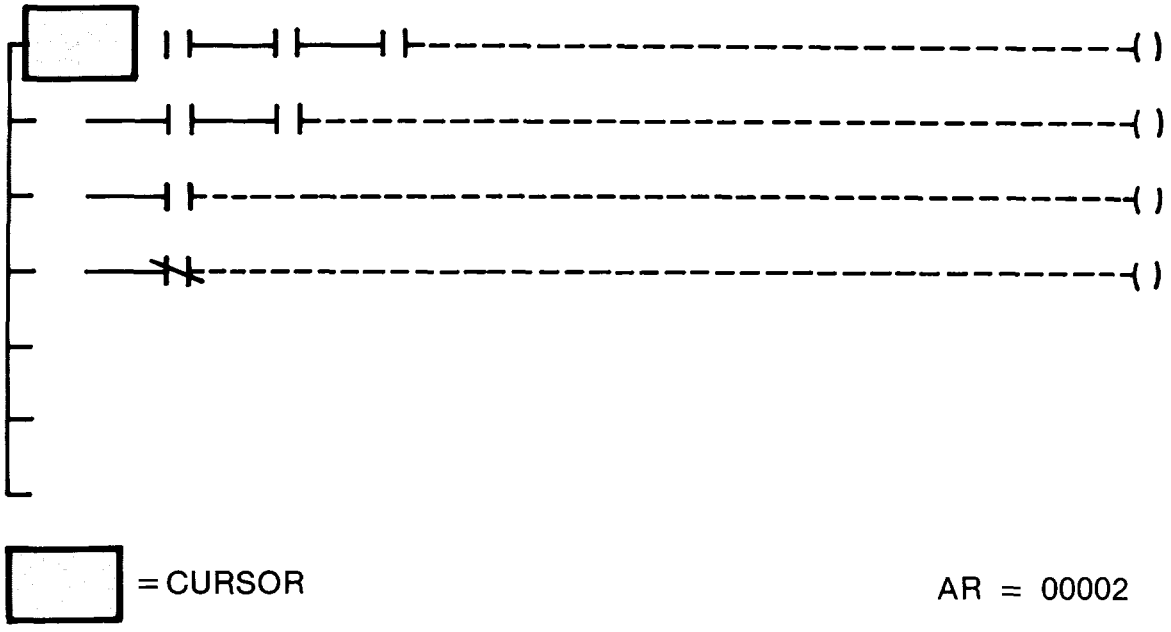


Figure 6-9c. Compress Horizontally, 00002 in AR, After

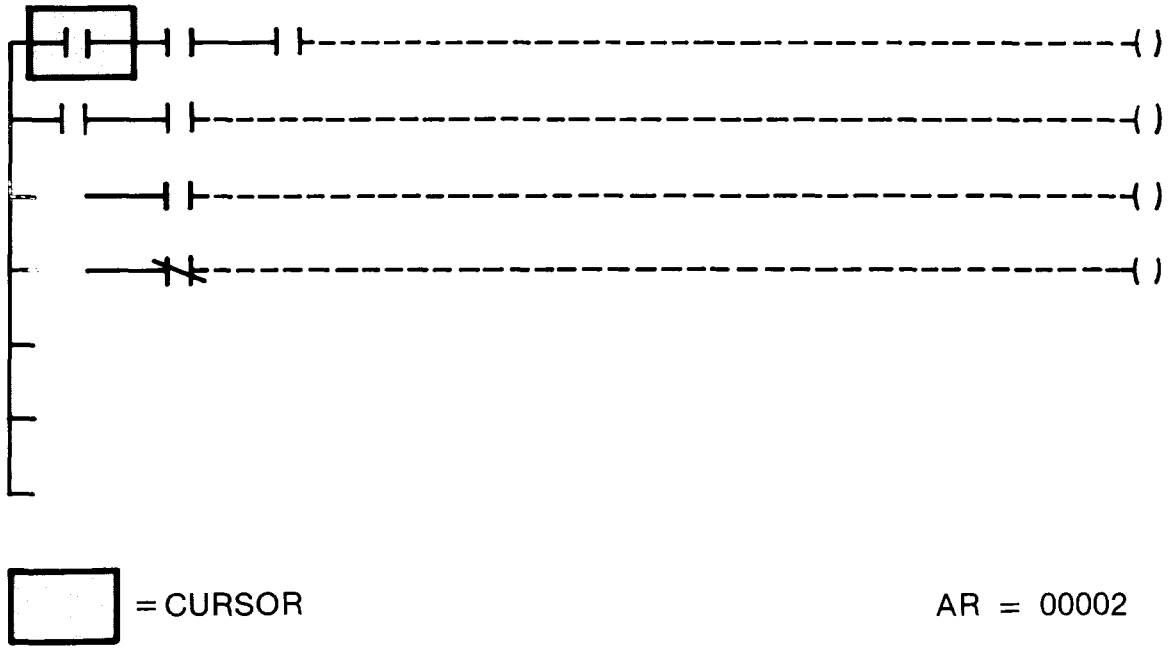


Figure 6-9d. Compress Horizontal, 00002 in AR, After

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6.9.5 Edit Network (EDIT NET)

The EDIT NET software label key provides the ability to edit networks. After pressing this software label, the cursor appears on the logic screen and the Relays, Timers, and Counters screen is displayed.

Press the EDIT NET software label key to reach the programming elements software labels. (As soon as EDIT NET is pressed the cursor appears on the CRT screen over the first element of the displayed network.) The following software labels are displayed:

R/T/C	COILS	DX MOVES	DX MATRIX	CALCS	OPTIONS SPECIALS		MEM AVAIL PREV MENU

These software label keys are used to enter a logic program.

6.9.6 Previous Network/Next Network (PREV NET/NEXT NET)

This software label key allows you to move from one network in order to read an adjacent network.

Press the SHIFT key and the PREV NET software label key to display the network before the one currently displayed. For example, if network 3 is displayed and SHIFT key and the PREV NET software label key are pressed, network 2 takes the place of network 3 on the screen.

Press the NEXT NET software label key (without the SHIFT key) to move to the network after the one currently displayed.

For example, if network 5 is displayed and the NEXT NET software label key is pressed, network 6 replaces network 5 on the screen.

6.10 NETWORK EDITOR (NETWK ED)

The Network Editor allows you to make changes to the 884 PC's program without immediately affecting the 884 PC. Changes are sent to the 884 PC in whole networks when you specify REPLACE NET, INSERT NET or EXCHANGE NET.

This means that you can build an entire network in the NETWORK EDITOR, and INSERT it anywhere in your existing program. You can also build a new network in the NETWORK EDITOR and REPLACE a network currently in your existing program. Troubleshooting is easier because you can make changes to an existing network, use the EXCHANGE NET function to test them, and if the changes do not work, use a FLIP NET and another EXCHANGE NET to get back the original network. These functions are explained later in this section. See Figure 6-10 for the software label key flowchart of the Network Editor.

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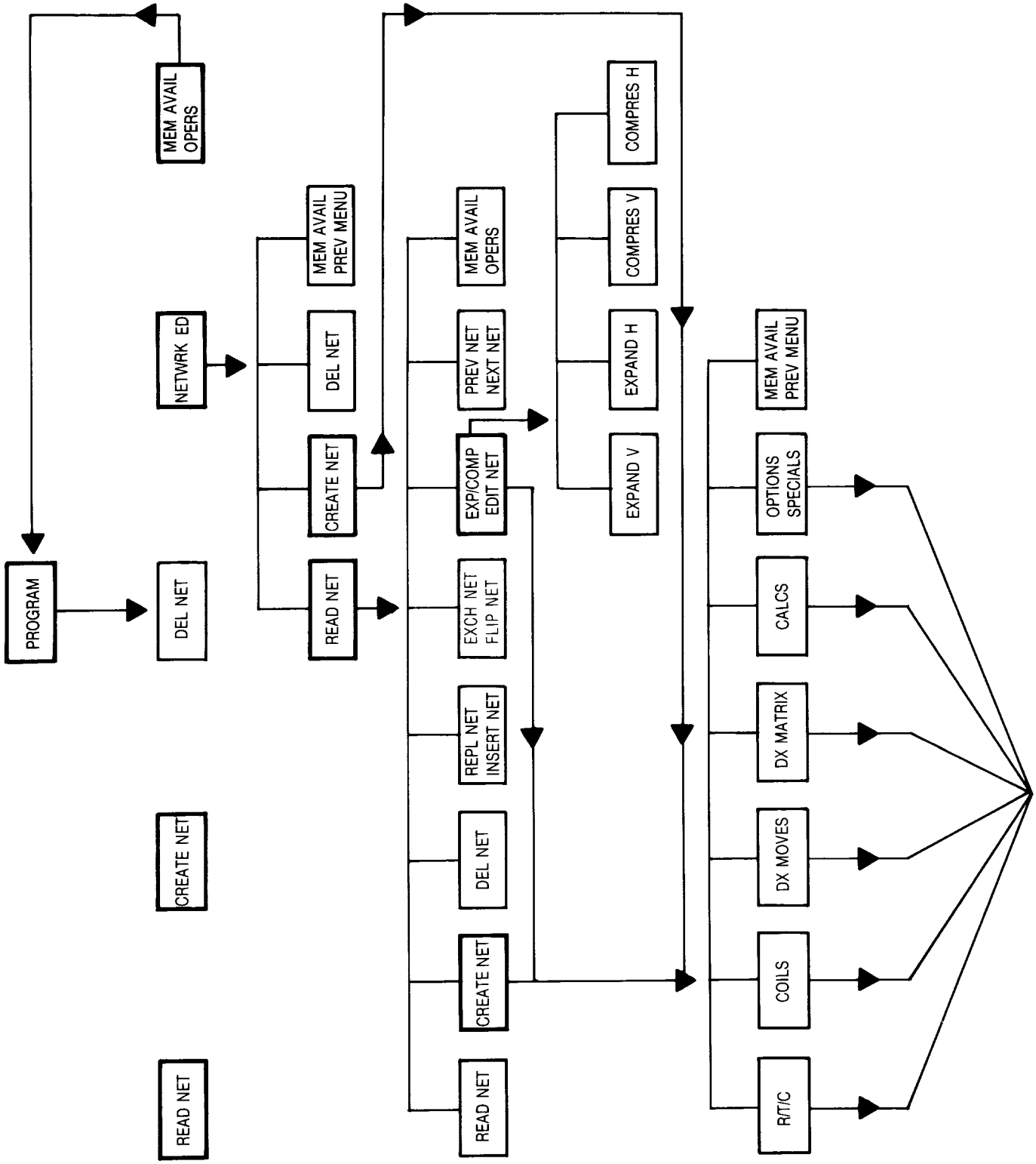


Figure 6-10. Network Editor Software Label Flow Diagram

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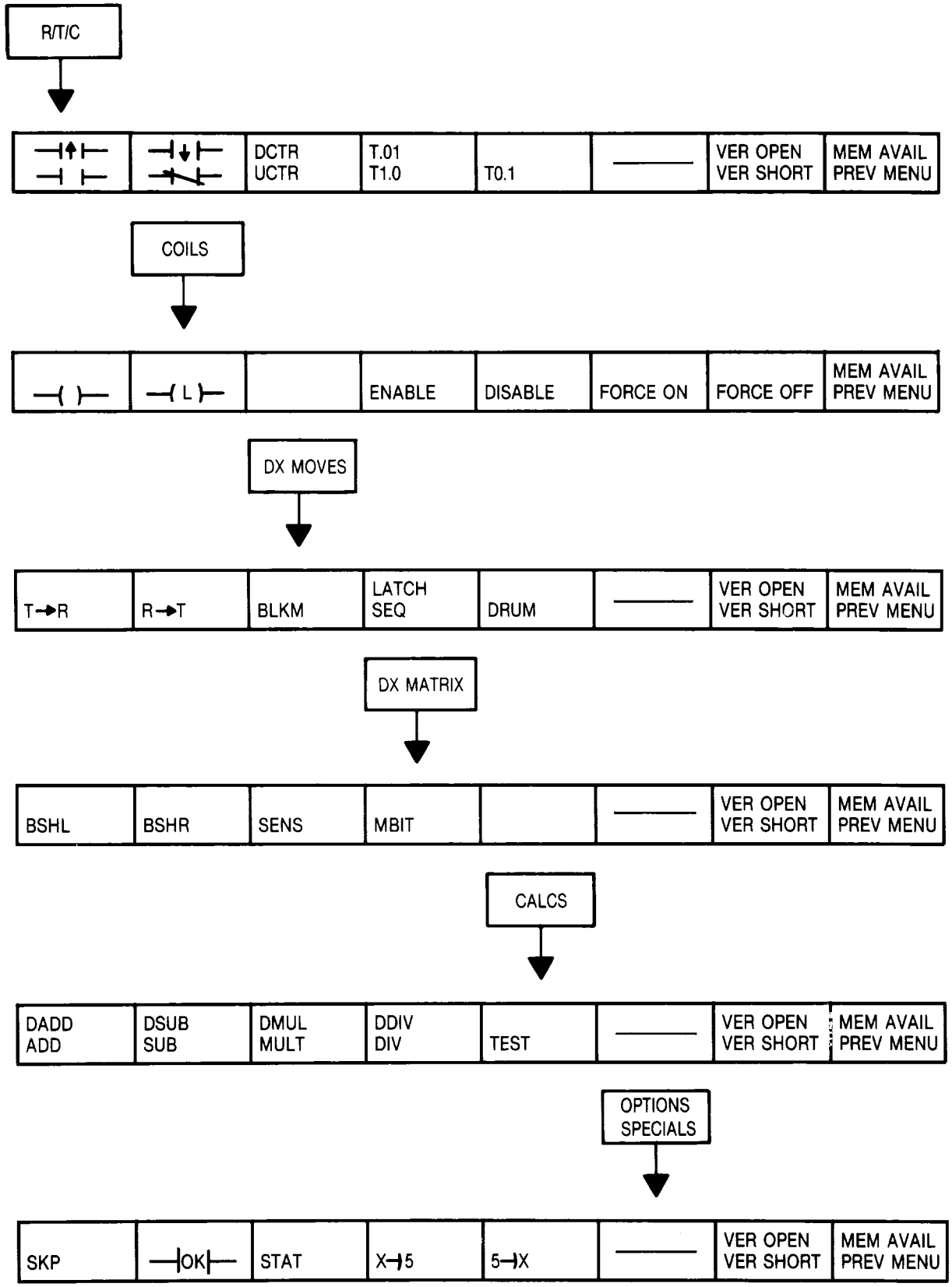


Figure 6-10. Network Editor Software Label Flow Diagram (cont)

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To get to the Network Editor mode, press the PROGRAM software label key on the PC Operations Menu. The Element Editor screen automatically appears with the following software label keys:

READ NET	CREATE NET	DEL NET		NETWRK ED			OPERS

Press the NETWORK ED software label key. Notice the change in the software label keys:

READ NET	CREATE NET	DEL NET					MEM AVAIL PREV MENU

6.10.1 Read Network (READ NET)

The READ NET software label key allows you to display and read a designated network on the P190's screen.

Enter the number of the network to be read in the AR. Press the READ NET software label key to read the network from the controller and display it on the P190 screen. The number of the network appears in the upper left-hand corner of the screen. Press the EDIT NET software label key to display the cursor and to add to or change the network. The following software label keys are displayed after you press READ NET:

READ NET	CREATE NET	DEL NET	REPL NET INSRT NET	EXCH NET FLIP NET	EXP COMP EDIT NET	PREV NET NEXT NET	MEM AVAI PREV MEN

NOTE

The power flow within the network is highlighted until the first change is made in the network.

6.10.2 Create Network (CREATE NET)

Press the CREATE NET software label key to create a network on the P190 screen. The network area is blank except for a power rail on the left.

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When this software label key is pressed, the following software labels are displayed:

R/T/C	COILS	DX MOVES	DX MATRIX	CALCS	OPTIONS SPECIAL		MEM AVAIL PREV MENU

These functions are explained in Sections 7, 8, and 9.

6.10.3 Delete Network (DEL NET)

Enter the number of the network to be deleted in the AR. Press the READ NET software label key and then the DEL NET software label key to delete the network.

6.10.4 Replace Network/Insert Network (REPL NET/INSRT NET)

The Replace/Insert Network functions exist only in the Network Editor Mode. This function allows you to replace (or change) elements within an existing network and then by using the REPL NET function, cause the change to occur in the 884 PC's memory. This happens automatically, with every change, if you are in the Element Editor.

If you find that the new A network does not work, and you want the original network A back, press the FLIP NET software label key, then the EXCH NET software label key. First the original Network A reappears and then, it replaces Network A in the 884 PC's memory.

The FLIP NET function can only be used in conjunction with the EXCH NET function. The P190 has two memory areas. The contents of one memory area is visible on the screen. The other memory area is used only for storage of one network, and its contents are not visible. This part is called the Network Memory Stack.

6.10.4.1 Replace Network (REPL NET)

To replace ⊣ ⊢ with ⊣/⊢ in Network 1 you must type 1 in the AR and press READ NET. When Network 1 appears on the screen, press EDIT NET and the R/T/C software label key. Make the change, (press ⊣/⊢) then press the PREV MENU software label key twice. Type a 1, for Network 1, in the AR and press the SHIFT key and the REPL NET software label key. The message, CHANGED PC NETWORK: 0001 appears, confirming that the change has been made.

6.10.4.2 Insert Network (INSRT NET)

The Insert Network software label key allows you to create a new network and then insert it into the 884 PC. The 884 PC then renumbers all existing networks, from that number on, to make room in the program for the new network.

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To INSERT, create a new network. When it is complete, type the number of the new network in the AR (00002, for example) and press the INSRT NET software label key. The message, INSERTED INTO PC, NETWORK:0002 appears, confirming that the insertion has taken place.

6.10.5 Exchange Network/Flip Network (EXCH NET/FLIP NET)

The Exchange Network function allows you to exchange the network on the screen for a network in the controller. With a network on the screen, enter the number of the network (in the controller) to be exchanged in the AR. Press the EXCH NET software label key and the Shift key.

This function allows you to create a network on the screen and then EXCHANGE it for an existing network in the 884 PC's memory. For example, if you have a program with ten networks in the 884 PC, and have a "bug" in network A, you can read network A into the memory of the P190. Network A can now be edited "off line", without disturbing the original network that is still in the 884 PC's memory. Press the EXCH NET software label key to exchange the edited A network with the original A network. A message appears on the screen, CHANGED PC NETWORK: 0005.

If you find that the new A network does not work, and you want the original network A back, press the FLIP NET software label key, then the EXCH NET software label key. First the original network A reappears and then it replaces network A^1 in the 884 PC's memory.

The FLIP NET function can only be used in conjunction with the EXCH NET function. The P190 has two memory areas. The contents of one memory area is visible on the screen. The other memory area is used only for storage of one network, and its contents are not visible. This part is called the network memory stack.

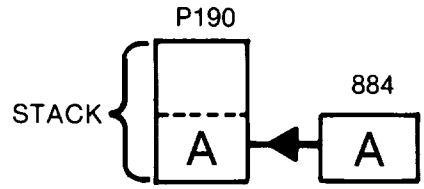
The FLIP NET command moves a network shown on the screen into the memory stack and moves the stored network onto the screen. Figure 6-11 describes the five commands used in the EXCH NET/FLIP NET functions.

NOTE

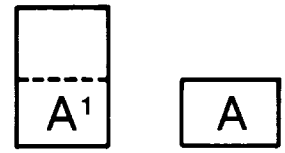
If you press the EXCH NET software label key TWICE in a row without pressing FLIP NET software label key between, your original network will be lost.

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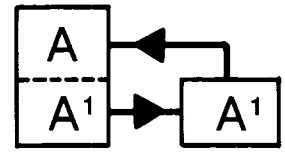
1. With network A in the 884 PC, press READ NET to read it into the P190.



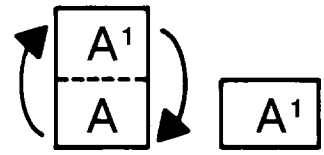
2. Press EDIT NET and change the network to A¹. You now have A in the 884 PC and A¹ on the P190 screen.



3. Press EXCH NET. The original network A is moved into the P190 NET. The edited A¹ is now on the P190 screen and in the 884 PC.



4. Press FLIP NET to get the original network A onto the P190 screen. The edited network A¹ is now in the P190 NET and in the 884 PC.



5. Press EXCH NET again and you will be back where you started. The original network A is back in the 884 PC and network A¹ is saved in the stack.

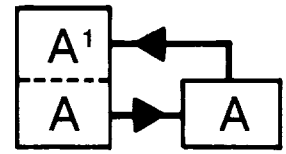


Figure 6-11. EXCH NET/FLIP NET Commands

NOTES

The Flip Net function can only be used after an Exchange Network function. Flip Net can be used again and again, i.e., as a toggle.

If another function (e.g., Read Network) is used after Exchange Network, the buffer is cleared and Flip Net is not allowed (NET EMPTY error message will be displayed.)

6.10.6 Expand/Compress (EXP/COMP)

The Expand/Compress software label key allows you to expand or compress networks, either horizontally or vertically. You can also select how many rows or columns to add or delete. These functions are explained in detail in 6.9.4 in ELEMENT EDITOR.

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6.10.7 Edit Network (EDIT NET)

The EDIT NET software label key allows access to the relay ladder logic software label keys. These software label keys are explained fully in 6.9.5 in ELEMENT EDITOR.

6.10.8 Previous Network/Next Network (PREV NET/NEXT NET)

The PREV/NET/NEXT NET software label key allows you to move from one network in order to read an adjacent network. These functions are explained in 6.9.6 in ELEMENT EDITOR.

6.11 CHANGE SCREEN HARDWARE KEY (CHG SCREEN)

In the Network Editor or Element Editor modes press the CHG SCREEN hardware key on the P190 panel, to reach the following software labels:

DRUM				LOGIC	FULL REF	PART REF	SRCH DSPLY

After you have pressed CHANGE SCREEN, and accessed whichever function required, press the LOGIC software label key to return to the Logic screen. You will find that the network displayed on the Logic screen is exactly as it was prior to CHANGE SCREEN, including cursor position.

6.11.1 Drum Screen (DRUM)

This function allows the display, on the P190 screen, of the current information for a particular drum. To obtain this information, a network must be on the screen and the cursor must be over a fully programmed drum function block. Press the CHG SCREEN hardware key on the P190 panel, then the DRUM software label key. Figure 6-12 is an example of a Drum Display. The following software label keys appear:

UPDATE	GET STEP #	ENTER HEX	SET BIT	CLEAR BIT			RESTORE

In the left-hand column is the type of display, the number of the network in which the Drum function is located, the register or group of discretes holding the destination, the pointer register, and the drum length. The next column contains the source register or groups of discretes. Sixteen registers or groups of discretes can appear in this column at one time. The next column contains the step numbers. The following four columns contain the register values in binary format (CONTACT). The last column contains the same register values in hexadecimal format.

To examine steps which are not currently displayed, enter a step number in the AR and press the GET STEP software label key, or press the down cursor at the bottom step.

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If the GET STEP function is used, the step requested, plus the next fifteen steps, if fifteen exist, are displayed.

To change a contact value move the cursor to the CONTACT using the cursor control keys. Position the cursor over the value to be changed and press either the ON (=1) or OFF (=0) software label key. The value changes and the cursor automatically moves one position to the right. The hexadecimal value automatically changes to agree with the binary.

To change all 16 contacts simultaneously to hexadecimal values, position the cursor over any contact in the desired step, enter the desired value into the AR and press the ENTER HEX software label key.

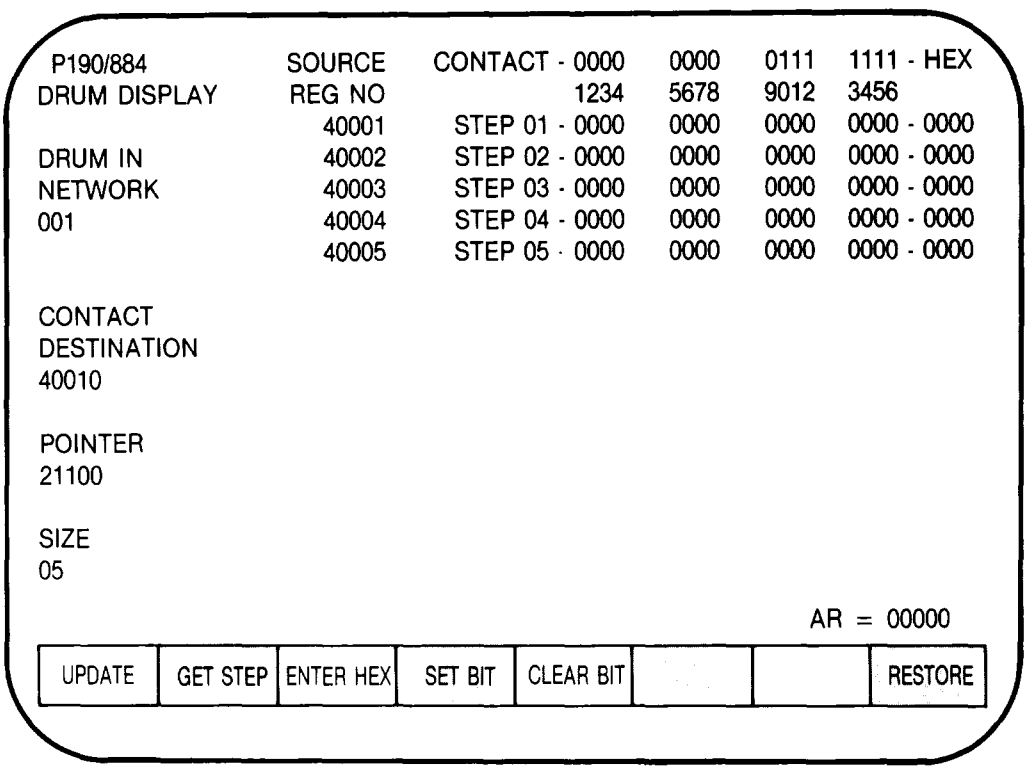


Figure 6-12. Sample Drum Display

6.11.3 Logic Area of the Network Screen (LOGIC)

Press the LOGIC software label key to exit the Change Screen functions and return to the logic area. i.e., either the Network or Element editor screen displayed prior to Change Screen. You will notice that the screen, including the cursor position, remains exactly as it was prior to CHANGE SCREEN.

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6.11.4 Full Reference Screen (FULL REF)

The Full Reference Screen is used to call up discretes and registers to read and/or change their status and/or contents. It starts in the top row of the screen and occupies 18 rows. An example of a Full Reference Screen is in Figure 6-13.

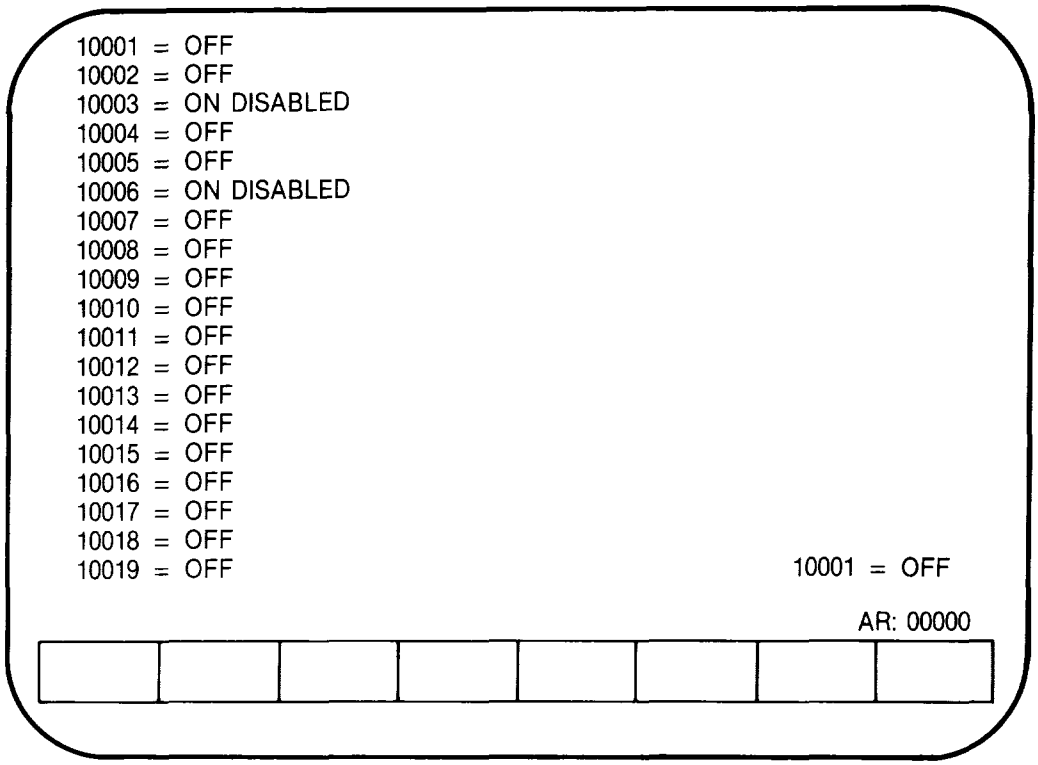


Figure 6-13. Full Reference Screen

When the FULL REF software label key is pressed, the GET COL/GET REF software label appears on the screen.

6.11.4.1 Get Column/Get Reference (GET COL/GET REF)

To obtain the status or content of a single reference, enter a valid reference number into the AR and press the GET REF software label key. The reference specified in the AR is displayed, with its state or contents, at the cursor position. The cursor remains in its original position.

The Get Column function is used to list a column of references on the screen. Enter a valid reference number in the AR. Press the GET COL software label key and the SHIFT key. Starting at the cursor position, with the reference in the AR, a column of references, and their states or values, are displayed. The column displays the particular type of reference number, up to a maximum of 18 references (three on partial reference screen). If there are not enough of the specified reference types to fill the column, the listing stops; the next type of reference numbers are not displayed.

NOTE

The GET COL/GET REF software label key is always available when on the full or partial reference screens.

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6.11.4.2 Previous Reference/Next Reference (PREV REF/NEXT REF)

These two functions are used to obtain information on additional references without entering the reference numbers. These software labels are displayed only when the cursor is positioned on a reference.

When the PREV REF software label key is pressed with the SHIFT key, the cursor moves up one position and the previous reference is read in and displayed, erasing the old reference at the cursor position.

When the cursor reaches the top of the screen, it remains in that position and displays the new reference over the old reference each time the PREV REF software label key is pressed.

The Next Reference function is similar to the Previous Reference function. To get the Next Reference, press the NEXT REF software label key. The cursor moves down one position and gets the next reference. The new reference writes over the old reference.

If the cursor is at the bottom of the screen, each time the next reference function is selected, the new reference writes over the bottom reference.

NOTE

The PREV REF/NEXT REF software label key is only available if the cursor is over a reference.

6.11.4.3 Erase Column/Erase Reference (ERASE COL/ERASE REF)

Press the ERASE COL software label key and the SHIFT key to erase a column of references, from the cursor position to the bottom of the column. The cursor remains in its original position.

Press the ERASE REF software label key to delete a single reference and its state or contents from the screen. The cursor remains in its original position.

NOTE

The ERASE COL/ERASE REF software label key is only available when the cursor is over a reference.

6.11.4.4 Display Hexadecimal/Display Decimal (DISP HEX/DISP DEC)

Position the cursor over a register reference (2XX00, 3XXXX, 4XXXX, or 5XXXX) and press the DISP HEX software label key and the SHIFT key. The register's contents are displayed in hexadecimal format. The display looks like the following: 40001 = 010F HEX.

Press the DISP HEX/DISP DEC software label key to display the register's contents in decimal format. The display looks like this: 40001 = 0000 DECIMAL

NOTE

This software label key is only available when the cursor is over a register reference (2XX00, 3XXXX, 4XXXX, or 5XXXX).

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6.11.4.5 Display ASCII/Display Binary (DISP ASCII/DISP BIN)

Position the cursor over a register reference (2XX00, 3XXXX, or 4XXXX) and press the DISP ASCII software label key. The contents of the register are displayed in ASCII code. The display looks like this: 40001 = AB ASCII.

Press the DISP BIN software label key to display the register's contents in binary format. The display looks like this: 40001 = 1111000011110000.

NOTE

The DISP ASCII/DISP BIN software label key is only available when the cursor is over a register reference (2XX00, 3XXXX, or 4XXXX). It is not available when the cursor is over a 5XXXX reference.

6.11.4.6 Set All/Set Bit (SET ALL/SET BIT)

The set function is used to set a bit(s) in a register, displayed in binary, to the value one (ON).

Position the cursor over a register reference displayed binary (2XX00, 3XXXX, or 4XXXX) and press the SET ALL software label key with the SHIFT key. All the bits in the specified register are set to one (ON) and the cursor moves to the first bit position.

To set bits individually, position the cursor over a bit and press the SET BIT software label key. The cursor moves one bit position to the right. On the 16th bit the cursor will wrap to bit position one.

NOTE

The cursor can be moved one bit position at a time, within a reference displayed in binary, by holding down the SHIFT key while pressing the cursor left or right keys.

6.11.4.7 Clear All/Clear Bit (CLEAR ALL/CLEAR BIT)

The Clear function is used to clear a bit(s) in a register to zero (OFF).

Position the cursor over a register reference displayed in binary and press the CLEAR ALL software label key with the SHIFT key. All the bits in the specified register are cleared to zero (OFF) and the cursor moves to the first bit position.

To clear individual bits, position the cursor over the bit to be cleared, and press the CLEAR BIT software label key. The cursor moves one bit position to the right. On the 16th bit, the cursor will wrap to bit position one.

NOTE

The SET ALL/SET BIT software label key is only available when the cursor is over a register reference displayed in binary (2XX00, 3XXXX, or 4XXXX). It is not available when the cursor is over a 5XXXX reference.

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The CLEAR ALL/CLEAR BIT software label key is only available when the cursor is over a register reference displayed in binary (2XX00, 3XXXX, or 4XXXX). It is not available when the cursor is over a 5XXXX reference.

6.11.4.8 Plus/Minus (PLUS/MINUS)

These functions allow you to change or specify the numerical sign of the double precision number stored in a 5XXXX register.

These keys only appear when the cursor is over a 5XXXX register reference in the decimal display mode.

Press the PLUS software label key to make the value in the register positive.

Press the MINUS software label key to make the value a negative.

6.11.4.9 Enable/Disable (ENABLE/DISABLE)

When in a Full or Partial Reference screen, these functions are used to enable or disable coils or discrete inputs only. To perform either function the cursor must be positioned over a 0XXXX coil reference or 1XXXX discrete input reference.

Press the ENABLE software label key, with the SHIFT key, to enable a disabled coil or discrete. Press the DISABLE software label key to disable a coil or discrete and allow that coil or discrete to be forced ON or OFF.

6.11.4.10 Force On/Force Off (FORCE ON/FORCE OFF)

These functions allow you to force the state of a disabled coil or discrete reference to OFF or ON.

Press the FORCE ON software label key with the SHIFT key to cause a disabled coil or discrete input to the ON state. For example,

```
    00002 = OFF
Press DISABLE
    00002 = OFF DISABLED
Press FORCE ON
    00002 = ON DISABLED
```

Press the FORCE OFF software label key to force a disabled coil or discrete to the OFF state.

NOTE

FORCE ON/FORCE OFF are available only when the cursor is over a coil (0XXXX) or discrete input (1XXXX) reference and may be used only if that reference has been disabled.

6.11.5 Partial Reference Area of Network Screen (PART. REF)

The partial reference screen is used to call up discretes and registers, in order to read their status and/or contents while still displaying logic. It is below the logic screen and occupies three rows and three columns as shown in Figure 6-14. Its location allows a network, and reference information to be displayed at the same time.

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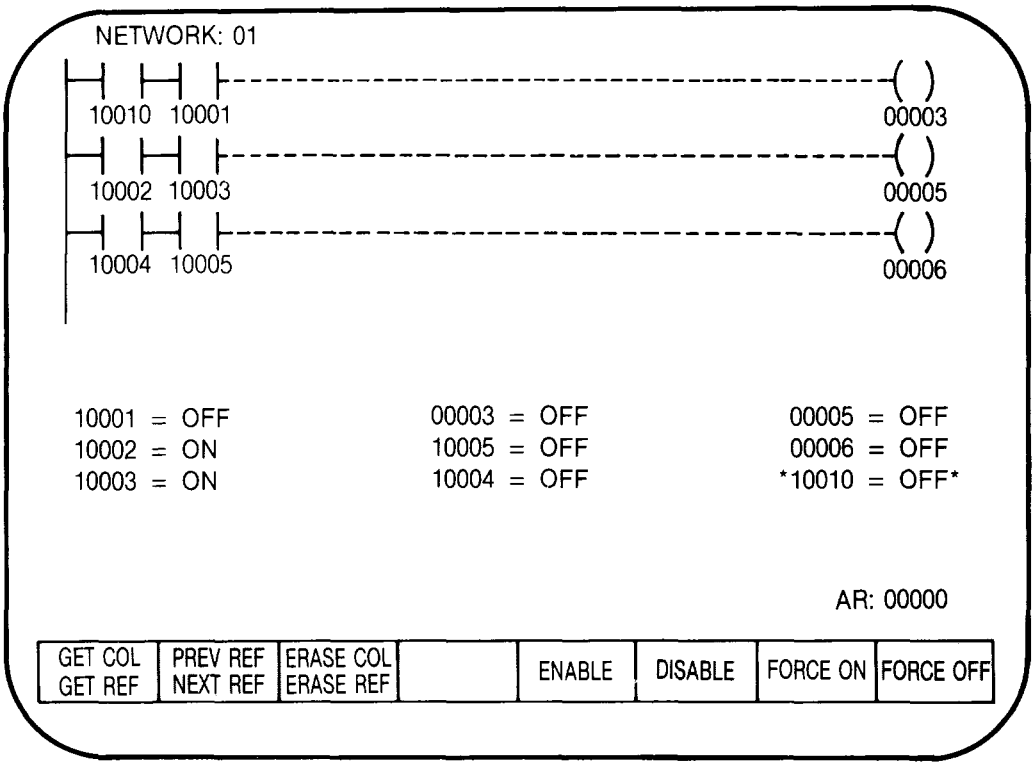


Figure 6-14. Partial Reference screen

When the PART. REF software label key is pressed, the GET COL/GET REF software label key appears. The other software labels, and their functions, are the same as those used with the Full Reference screen. These are explained in section 6.11.4.

6.11.6 Search Display (SRCH DSPLY)

The Search Display function allows you to search for reference numbers and/or element types. The entire program is searched for the specified value(s). A message appears on the screen to indicate when a search is in progress. When a match is found the network containing the match is displayed on the screen and a message: MATCH IS FOUND AT ROW XX,COL XX OF FIRST OCCURRENCE. To continue the search, press the CONTINUE key on the P190 Panel.

Press the SRCH DSPLY software label key and the cursor moves to the search area on the network screen (lower right-hand corner). Enter a single search parameter in the AR. Press the ENTER key, followed by the SEARCH hardware key on the P190 keyboard. A relay contact, coil, function block, or a function block with a specific reference can also be searched for. The latter are entered via the applicable software label key. To return to the Logic screen, press the CHANGE SCREEN hardware key and then the LOGIC software label key.

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6.12 LOGIC EXAMPLE

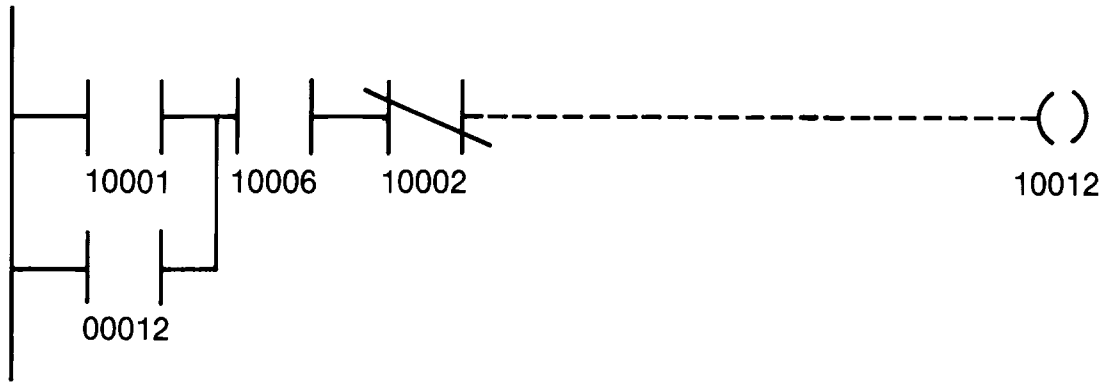


Figure 6-15. Logic Example

Enter the logic as follows:

1. Press the R/T/C software label key.

   Software labels for the relay contacts appear on the screen, along with other software labels not needed at this time.

2. Enter 10001 into the Assembly Register (AR).

3. Press ⊣ ⊢ .

4. Press → .

5. Enter 10006 into the AR.

6. Press ⊣ ⊢ .

7. Press → .

8. Enter 10002 into the AR.

9. Press ⊣/⊢ .

10. Press → .

11. Press the PREV MENU software label key.

    The original set of software labels reappears.

12. Press COILS.

    Software labels for coils appear on the screen, along with other software labels not needed at this time.

13. Enter 12 into the AR.

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14. Press —( )— .
15. Press → .

    The cursor moves to the first node in the same row (wrap-around).

16. Press R/T/C software label key.
17. Press VER SHORT (Vertical Short).
18. Press PREV MENU twice.
19. Press ↓ .
20 Enter 12 into the AR.
21. Press R/T/C.
22. Press —| |— .

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SECTION 7
BASIC PROGRAMMING AND ARITHMETIC FUNCTIONS

This section covers basic programming functions, relays, counters, timers and a test function. It also includes two types of arithmetic functions, single precision and double precision, for addition, subtraction, multiplication, and division.

7.1 RELAYS

The Relay Contact is the basic programming element. It can be referenced to a logic coil, a discrete input, or a sequencer.

Relay contacts can be normally open or normally closed, or transitional.

7.1.1. Normal Contacts

The most commonly used contacts are:

NORMALLY OPEN (NO) CONTACT ⊣ ⊢

NORMALLY CLOSED (NC) CONTACT ⊣/⊢

When the coil or discrete input is ON, the normally open (NO) contact is closed and passes power, and the normally closed (NC) is open and does not pass power.

When the coil or discrete input is OFF, the NO contact is open and does not pass power; the NC contact is closed and does pass power.

7.1.2 Transitional Contacts

The transitional contact passes power for one scan, when energized (OFF to ON for a positive transitional contact, or ON to OFF for a negative transitional contact) by the coil or discrete input to which it is referenced. It is not effected by the ON or OFF state of the coil or discrete input after the transition. When a function needs to be transformed only once, a transitional contact is used, because it only transmits once each scan.

Positive Transitional Contact ⊣↑⊢ (OFF to ON)

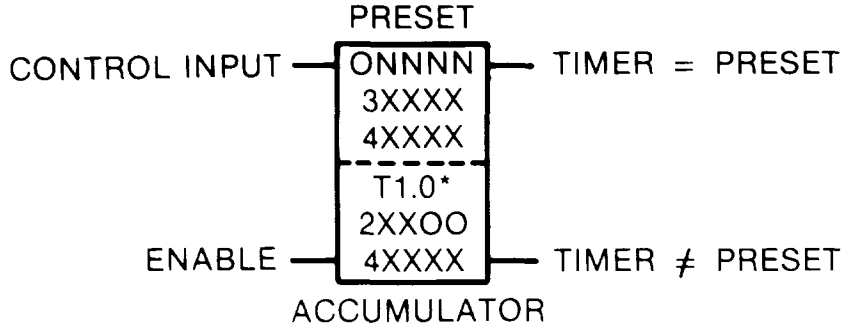
Negative Transitional Contact ⊣↓⊢ (ON to OFF)

Contacts are discussed in more detail in Section 6.4. of this manual.

7.2 TIMER (TXX*)

FUNCTION

The Timer function uses any one of three time bases to record time. The 884 PC is capable of counting time in seconds, tenths of seconds, and hundredths of seconds.



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*T1.0 = seconds;
T0.1 = tenths of seconds;
T.01 = hundredths of seconds.

FUNCTION BLOCK

- The top section (preset) of the function block contains the preset value for the timer. It can be any constant up to 9999, a 30XXX input register reference, or a 4XXXX holding register reference.

  For example, if the preset value is 009, it represents either 9 seconds (T1.0), .9 seconds (T0.1) or .09 seconds (T.01). If the value is 050, it is either 50 seconds (T1.0), 5 seconds (T0.1), or .5 seconds (T.01).

NOTE

If the preset value is greater than 9999, the timer value is cleared to zero and both outputs do not pass power. If preset equals zero and accumulator equals zero, top output will be ON.

- The bottom section (accumulator) contains a 2XX00 sequencer register reference, or a 4XXXX holding register reference. This register holds the timer value. It increases in time, starting at zero and going up to the preset value, as long as the top input receives power and the timer is less than the preset. The timing is cumulative until the reset is activated.

INPUTS

- The top input controls the operation. When it receives power and the bottom input also receives power, the timer value increases time. When the top input loses power, the timer stops increasing.
- When power is removed from the bottom input the timer is reset, clearing the accumulator to zero. The timer increases in time if the top and bottom inputs are receiving power simultaneously.

OUTPUTS

- The top output passes power when the timer value equals the preset value.
- The bottom output passes power when the timer value is not equal to the preset value, and the control input and the bottom input are receiving power.

NOTE

Only one output passes power at a time.

EXAMPLE

The following paragraph provides a detailed explanation of the logic used in Figure 7-1.

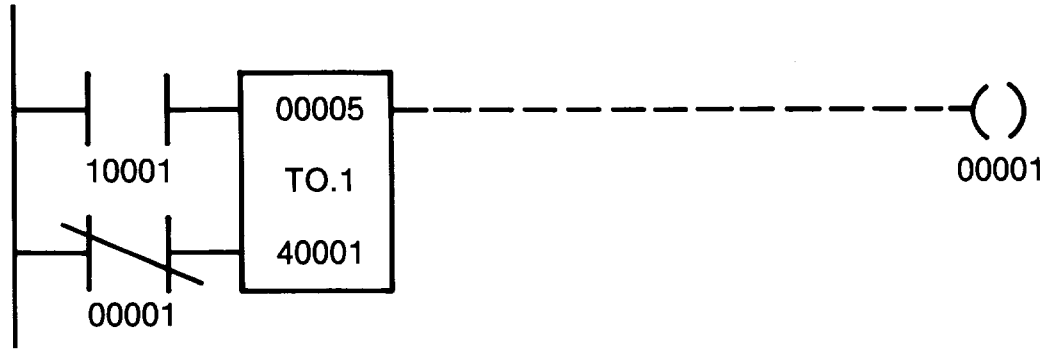


Figure 7-1. Timer

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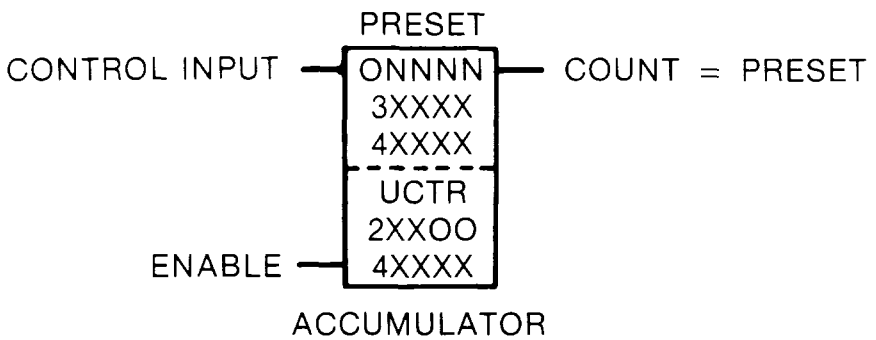
When input 10001 is energized, the top input receives power and register 40001 begins accumulating time in seconds. When the value in register 40001 equals 5, the top output passes power and energizes coil 00001. Power is removed from the bottom input on the next scan and the timer value is set to zero.

7.3 COUNTERS

7.3.1 Up Counter (UCTR)

FUNCTION

The Up Counter function increases the count value by one, for each scan the control input allows, until the preset maximum value is reached.



FUNCTION BLOCK

- The top section of the function block contains the preset value for the counter. It can be a constant up to 9999, a 30XXX input register reference, or a 4XXXX holding register reference. The preset value is the maximum value the counter can reach.

NOTES

If the preset value is greater than 9999, the accumulated count value is cleared to zero.

The controller sets the accumulated count value to equal the preset if an attempt is made to enter a count value greater than the preset.

- The bottom section contains either a 2XX00 sequencer register reference, or a 4XXXX holding register reference. This register contains the current count value (accumulator). The value represents the number of scans the operation has completed since the last reset. The current count value can never exceed the preset value.

INPUTS

- The top input controls the operation. The count value increases by one, each scan. (A transitional contact must be used to count events.)

- The counter is reset when power is removed from the bottom input. Any transitions of the top input are ignored when power is removed from the bottom input.

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OUTPUT

- The top output passes power when the count value is equal to the preset value.
- The bottom output is inactive and always OFF.

EXAMPLE

The following paragraph provides a detailed explanation of the logic used in Figure 7-2.

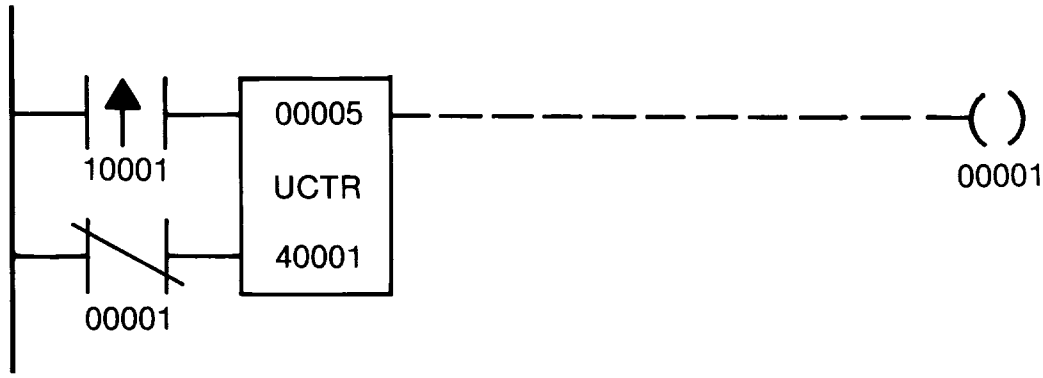


Figure 7-2. Up Counter

Each time input 10001 makes the transition from OFF to ON, the value in register 40001 increases by one. When this value reaches 5, the top output passes power and coil 00001 is energized. The power is removed from the bottom input on the next scan and the counter value is reset to zero.

NOTE

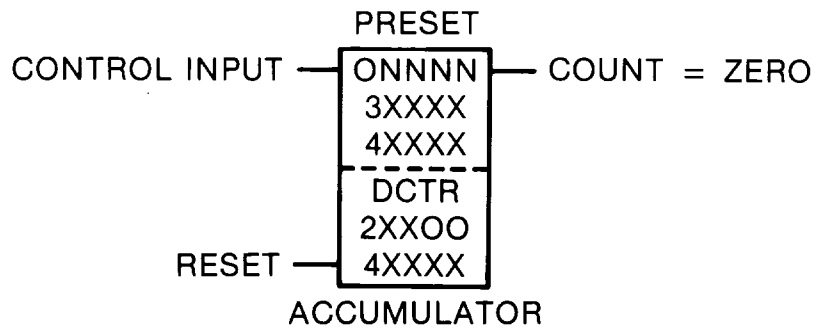
A transitional contact (⊣↑⊢) must be used on the top input, instead of a normal contact (⊣ ⊢), or the counter will increase the accumulator value by one, for each scan.

7.3.2 Down Counter (DCTR)

FUNCTION

The Down Counter function counts down, from a preset value, towards zero.

The count value decreases by one each scan.



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FUNCTION BLOCK

- The top section of the function block contains the preset value for the counter. It can be a constant up to 9999, a 30XXX input register reference, or a 4XXXX holding register reference.

NOTES

If the preset value is greater than 9999, the count value is cleared to zero.

The controller sets the count value equal to the preset if an attempt is made to enter a count value greater than the preset.

- The bottom section contains either a 2XX00 sequencer register reference or a 4XXXX holding register reference. This register contains the current count value. The difference between the preset value and the current count, equals the number of scans completed since last reset.

INPUTS

- The top input controls the operation. The count value decreases by one, each scan.

- The counter is reset when power is removed from the bottom input. Any transitions of the top input are ignored when power is removed from the bottom input.

OUTPUTS

- The top output passes power when the count value is equal to zero.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-3.

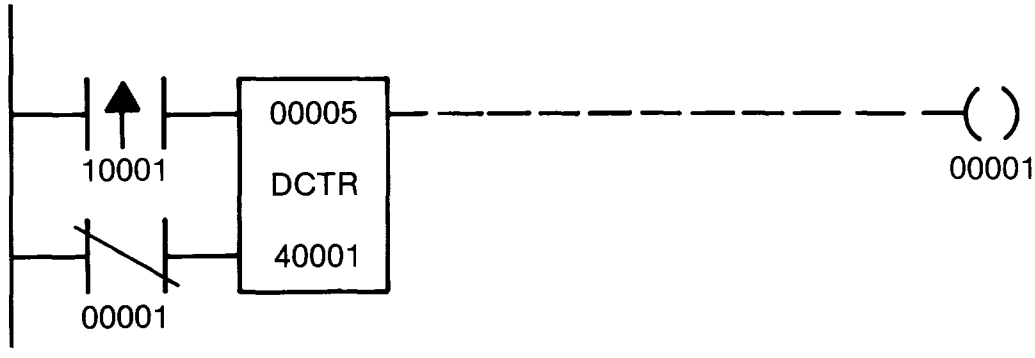


Figure 7-3. Down Counter

When input 10001 is energized, the top input receives power and the count is decreased by one.

Each time input 10001 makes the transition from OFF to ON, the value in register 40001 increases by one. When this value reaches 5, the top output passes power and coil 00001 is energized. The power is removed from the bottom input on the next scan and the counter value is reset to preset.

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NOTE

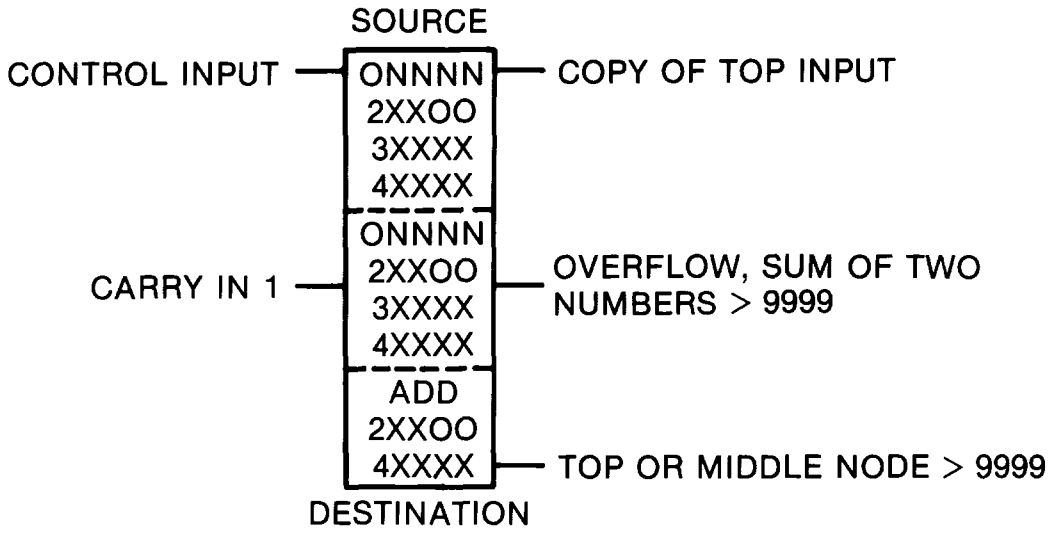
A transitional contact (⊣↑⊢) must be used on the top input, instead of a normal contact (⊣ ⊢), or the counter will increase the accumulator value by one, for each scan.

7.4 ADDITION

7.4.1 Single Precision (ADD)

FUNCTION

The Single Precision Add function adds two values together (contents of top and middle sections) and places the sum in a sequencer or holding register (bottom section).



FUNCTION BLOCK

- The top and middle sections of the function block each contain a value which can be either a constant (up to 9999) or one of the following references: a 2XX00 sequencer register, a 30XXX input register, or a 4XXXX holding register. The values in the top and middle sections are added together when the top input receives power.

- The bottom section contains either a 2XX00 sequencer register reference or a 4XXXX holding register reference. This register holds the sum of the values in the top and middle sections.

INPUTS

- The top input controls the operation. When it receives power, the value in the top section is added to the value in the middle section, and the sum is placed in the bottom section's register.

- The middle input, when receiving power, causes a 1 to be carried into the operation (i.e., top section plus middle section plus 1 equals bottom section). Used to "chain" ADD Blocks for multi-precision results.

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OUTPUTS

- The top output passes power when the top input receives power.
- The middle output passes power when the result of the operation is greater than 9999 (overflow). The sum stored in the bottom section is adjusted by subtracting 10,000 from the sum.
- The bottom output passes power if the value in either the top or the middle section is greater than 9999. This is an error condition. Add is not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-4.

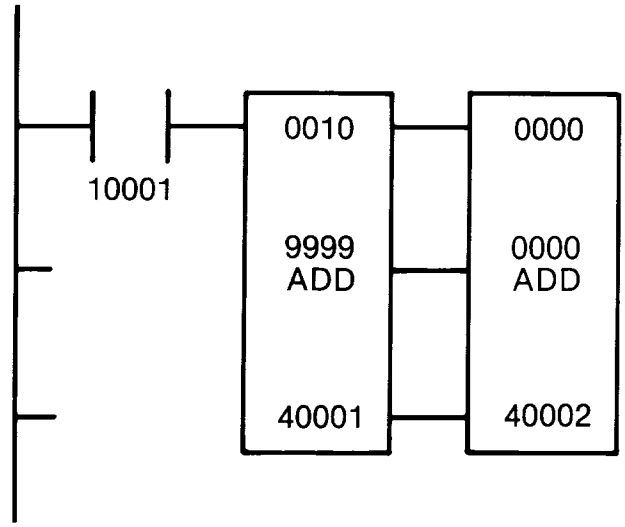


Figure 7-4. Single Precision Addition

When input 10001 is energized, the top input receives power and the values, 10 and 9999 are added together. The result is placed in register 40001.

In this example, the result will be greater than 9999 and the second ADD block's top and middle inputs receive power; the middle input activates a carry of one and a 1 is placed in register 40002. This is illustrated below:

				40001	40002	
0010	+	9999	=	0009	0001	Answer is 10,009

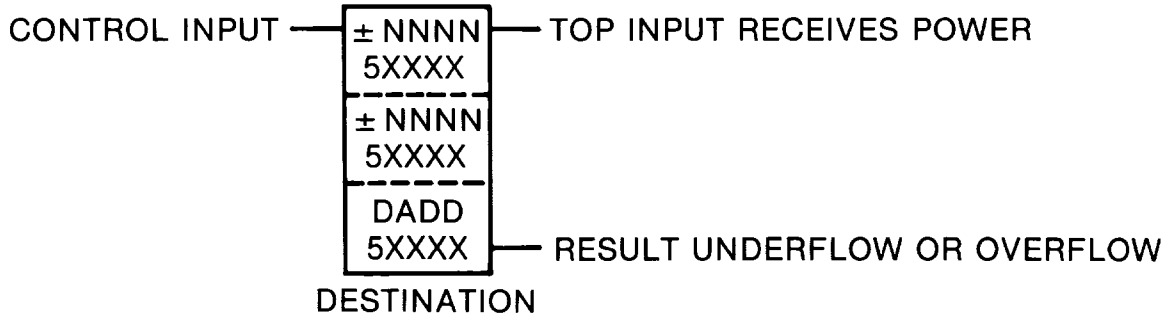
In this way, ADD blocks can be chained together to provide accurate, multi-precision results.

7.4.2 Double Precision (DADD)

FUNCTION

The Double Precision Add function adds two values together; these values are signed and can be up to 8 digits in length. The result of the addition is placed in a 5XXXX double precision register.

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FUNCTION BLOCK

- The top and middle sections of the function block contain values which can be constants within the range of −9999 to +9999, or 5XXXX double precision register references. The top and middle values are added together when the top input receives power.

- The bottom contains a 5XXXX double precision register reference. This register holds the sum of the top and middle values.

INPUT

- The top input controls the operation. When it receives power, the top value is added to the middle value, and the sum is placed in the bottom double precision register.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when the result is not within the legal value range: $(-2)^{31}$ result 2^{31}. This is either an underflow or overflow error condition. Add not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-5.

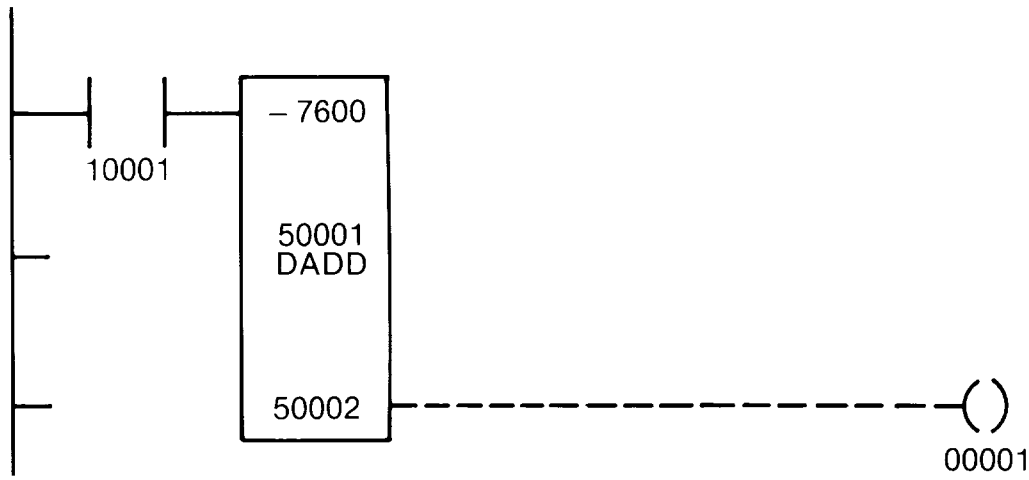


Figure 7-5. Double Precision Addition

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When input 10001 is energized, the top input receives power and the value, −7600, is added to the value in 50001. The result is placed in register 50002.

If the value in register 50001 is +00091980, the result placed in register 50002 is +00084380. This is illustrated below:

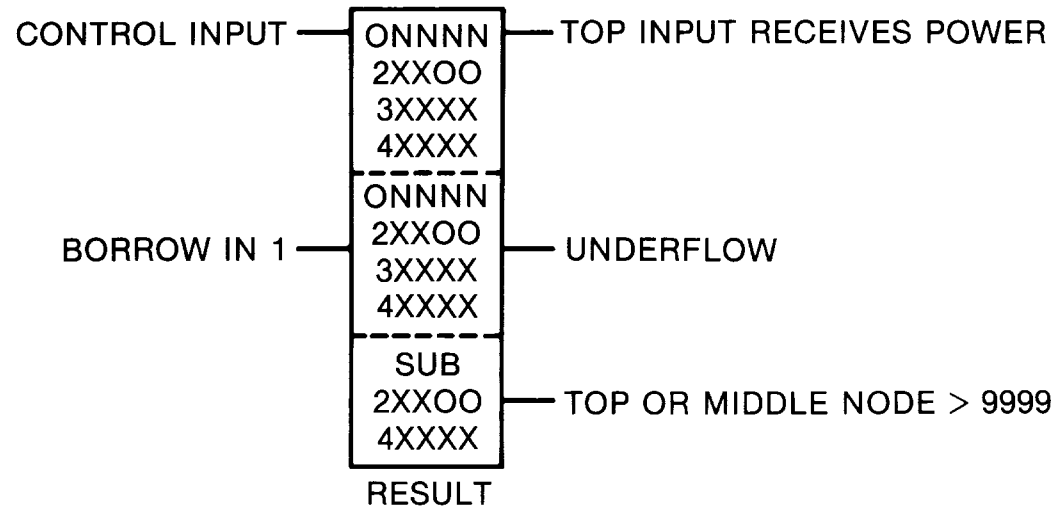
		50001		50002
−7600	+	+00091980	=	+00084380

7.5 SUBTRACTION

7.5.1 Single Precision (SUB)

FUNCTION

The Single Precision Subtract function subtracts the value in the middle section from the value in the top section, and places the difference in the bottom section's sequencer or holding register.



FUNCTION BLOCK

- The top and middle sections of the function block each contain a value which can be a constant (up to 9999) or one of the following references: a 2XX00 sequencer register, a 3XXXX input register, or a 4XXXX holding register. The middle value is subtracted from the top value when the top input receives power.
- The bottom contains either a 2XX00 sequencer register reference or a 4XXXX holding register reference. This register holds the difference between the top and middle values. The subtraction is performed every scan that the input is energized.

INPUT

- The top input controls the operation. When it receives power, the middle value is subtracted from the top value and the difference is placed in the bottom register section.
- The middle input, when receiving power, causes a one to be borrowed into the operation (i.e., a 1 is subtracted from the difference between the top and middle values). Used to "chain" SUBTRACT blocks for multi-precision results.

OUTPUTS

- The top output passes power when the input receives power.

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- The middle output passes power when the result is an underflow condition (used in "chaining").
- The bottom output passes power when the top value or the middle value is greater than 9999. This is an error condition. Subtract not performed.

EXAMPLE
The following paragraphs provide a detailed explanation of the logic used in Figure 7-6.

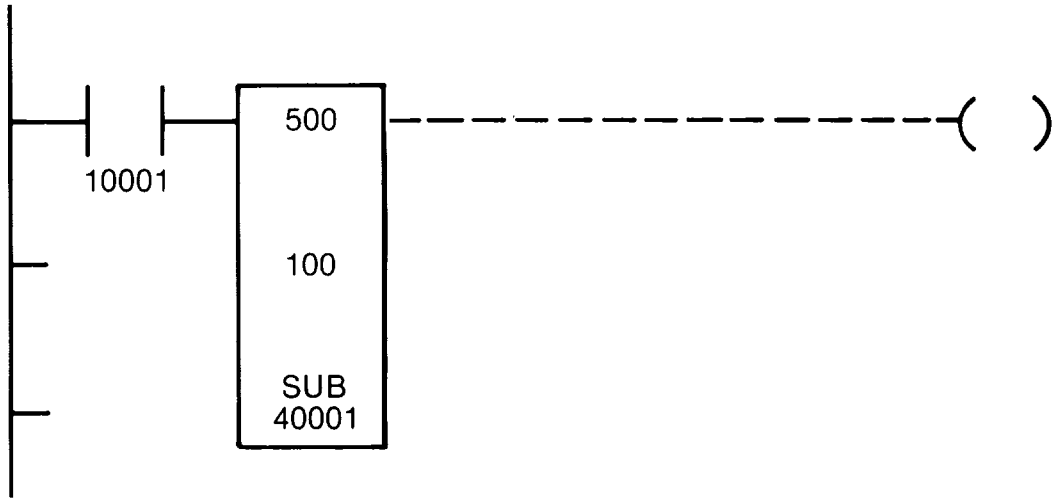
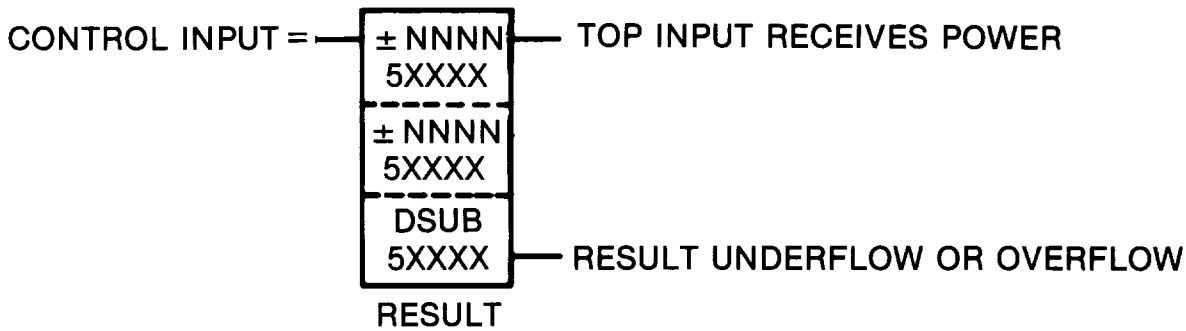


Figure 7-6. Single Precision Subtract Logic

When input 10001 is energized, the top input receives power. The value, 100, in the middle section is subtracted from the value, 500, in the top section. The result, 0400, is placed in register 40001. If the value in the middle section had been greater than the value in the top section, an underflow condition would cause the middle output to pass power.

7.5.2 Double Precision (DSUB)

FUNCTION
The Double Precision Subtract function subtracts the middle value from the top value; these values are signed and, in the 5XXXX double precision registers, can be up to 8 digits in length. The result of the subtraction is placed in a 5XXXX double precision register.



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FUNCTION BLOCK

- The top and middle sections each contain a value which can be a constant within the range of −9999 to +9999, or a 5XXXX double precision register reference. The middle value is subtracted from the top value when the top input receives power.

- The bottom section contains a 5XXXX double precision register reference. This register holds the difference between the top and middle values.

INPUT

- The top input controls the operation. When it receives power, the middle value is subtracted from the top value and the difference is placed in the bottom double precision register.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when the result is not within the legal value range: $(-2)^{31}$ result 2^{31}. This is either an underflow or overflow error condition. Subtract not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-7.

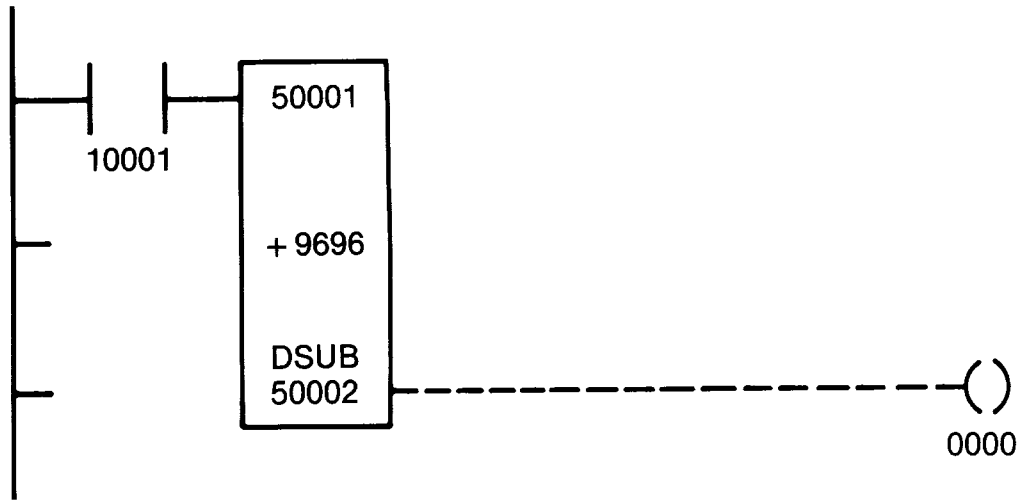


Figure 7-7. Double Precision Subtraction

When input 10001 is energized, the top input receives power. The value +9696 is subtracted from the value in register 50001, and the result is placed in register 50002.

If the value in register 50001 is +01203442, the result placed in register 50002 is 1193746.

50001				50002
+01203442	−	(+9696)	=	01193746

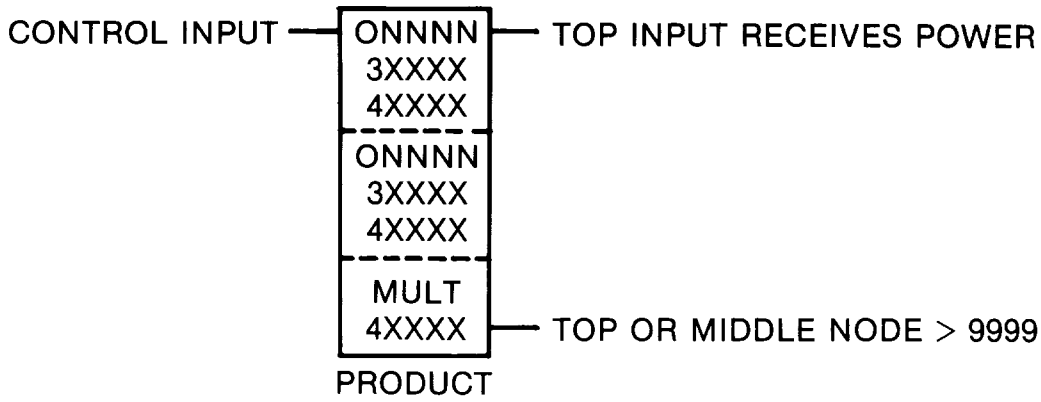
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7.6 MULTIPLICATION

7.6.1 Single Precision (MULT)

FUNCTION

The Single Precision Multiply function calculates the product of the values in the top and middle sections, and places the answer in two consecutive holding registers referenced in the bottom section of the function block. Two consecutive holding registers are used because the product of two 4-digit numbers can be up to eight digits in length.



FUNCTION BLOCK

- The top and middle sections each contain a value which can be a constant up to 9999, a 3XXXX input register reference, or a 4XXXX holding register reference. The top and middle values are multiplied together.

- The bottom contains a 4XXXX holding register reference. This holding register holds the high order portion of the product, even if it is zero. The next consecutive holding register (4XXXX + 1) holds the low order portion of the product. For this reason, the numerically highest holding register in the 884 PC cannot be used.

INPUT

- The top input controls the operation. When it receives power, the top value is multiplied by the middle value, and the product is placed in the bottom holding register(s).

OUTPUT

- The top output passes power when the top input receives power.
- The bottom output passes power if the top or middle value is greater than 9999. This creates an error condition. Multiply not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-8.

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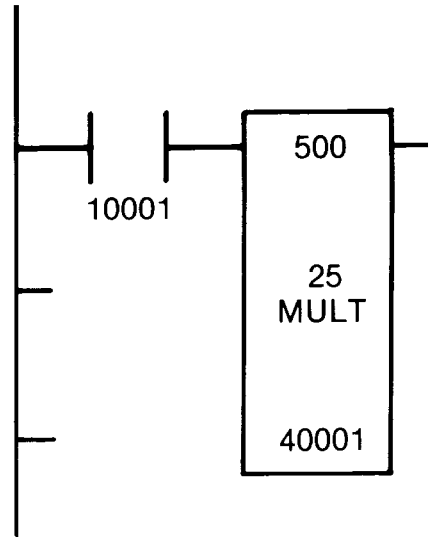


Figure 7-8. Single Precision Multiplication

In this example, when input 10001 is energized, the top input receives power and 0500 is multiplied by the 25. The resulting product is stored in registers 40001 and 40002.

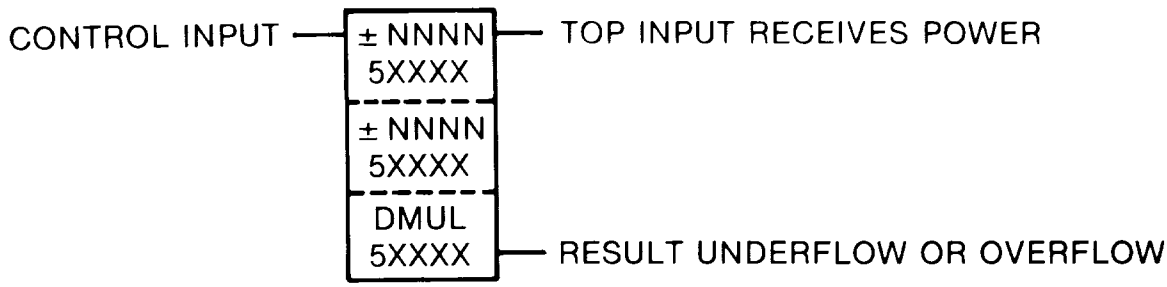
Register 40001 contains 0001 and 40002 contains 2500, the product is 12500.

				40001	40002
500	×	25	=	0001	2500

7.6.2 Double Precision (DMUL)

FUNCTION

The Double Precision Multiply function multiplies two values; these values are signed. The result of the multiplication can be up to eight digits in length, and is placed in a 5XXXX double precision register.



FUNCTION BLOCK

- The top and middle sections contain a value which can be a constant within the range of −9999 to +9999, or a 5XXXX double precision register references. The top and middle values are multiplied when the top input receives power.

- The bottom contains a 5XXXX double precision register reference. This register holds the result of the multiplication.

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INPUT

- The top input controls the operation. When it receives power, the top and middle values are multiplied, and the result is placed in the bottom double precision register.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when the result is not within the legal value range: (from -2^{31} to 2^{31}). This is either an underflow or overflow error condition. Multiply not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-9.

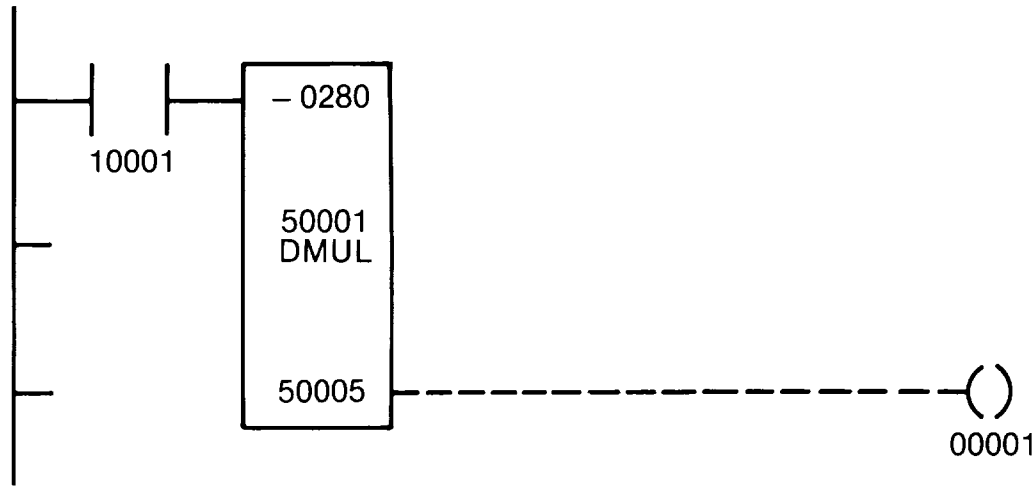


Figure 7-9. Double Precision Multiplication

When input 10001 is energized, the top input receives power and the value – 0280 is multiplied by the value in register 50001. The result is placed in register 50005.

If the value in register 50001 is – 00082280, the result placed in register 50005 is + 23038400.

$$(-0280) \times \underset{\boxed{-00082280}}{50001} = \underset{\boxed{+23038400}}{50005}$$

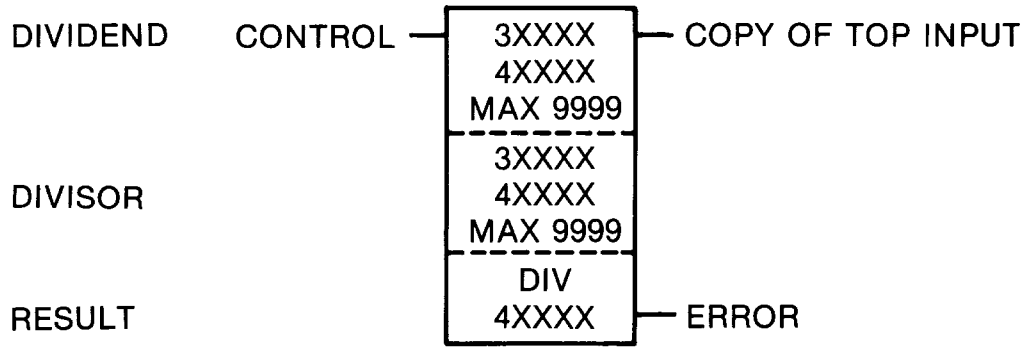
7.7 DIVISION

7.7.1 Single Precision (DIV)

FUNCTION

The Divide function divides the value in the top section by the value in the middle section, and places the quotient in the bottom holding register.

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FUNCTION BLOCK

- The top value is the dividend. It can be a constant up to 9999, a 3XXXX input register reference, or a 4XXXX holding register reference.

  The value in a register reference can be either a double precision number or a single precision number. The next consecutive register (3XXXX + 1, or 4XXXX + 1) is implied and holds the low order portion of the value.

- The middle value is the divisor. It contains a constant up to 9999, a 3XXXX input register reference, or a 4XXXX holding register reference.

- The bottom section contains a 4XXXX holding register. This holding register holds the result of the division. The next holding register (4XXXX + 1) holds the remainder. For this reason, the numerically highest holding register in the 884 PC cannot be used.

INPUT

- The top input controls the operation. When it receives power, the top value is divided by the middle value and the quotient and remainder are placed in two consecutive holding registers.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when there is an error in the operation. An error can be any of the following:

  - top value > 9999
  - middle value > 9999
  - middle value equals zero

  Divide not performed under the above conditions.

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EXAMPLE
The following paragraphs provide a detailed explanation of the logic used in Figure 7-10.

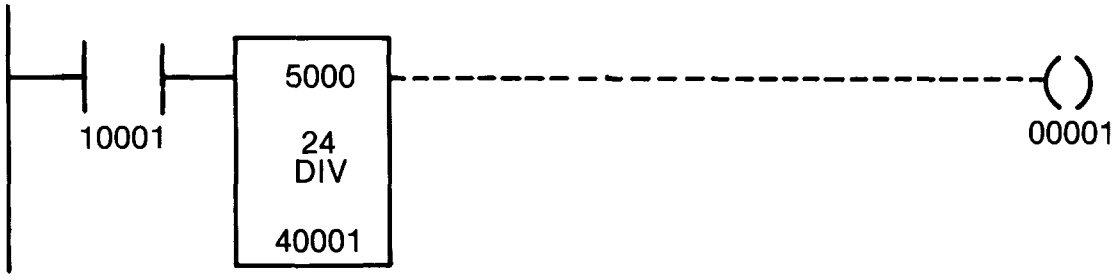


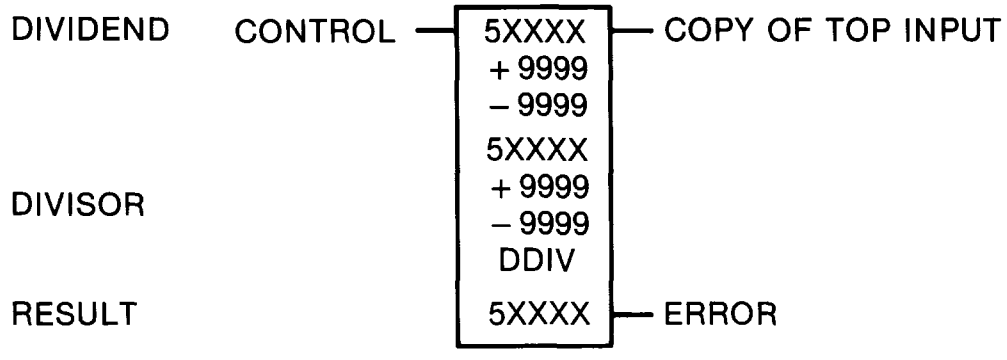
Figure 7-10. Single Precision Division

When contact 10001 is energized, the top input receives power and 5000 is divided by 24. The result is placed into register 40001 and the remainder into register 40002.

$$5000 \div 24 = \begin{array}{cc} 40001 & 40002 \\ \boxed{0208} & \boxed{0008} \end{array}$$

7.7.2 Double Precision (DDIV)

FUNCTION
The Double Precision Divide function divides the top value by the middle value; these values are signed and can be up to 8 digits in length. The result of the division is placed in a 5XXXX double precision register.



FUNCTION BLOCK
- The top and middle sections contain values which can be constants within the range of –9999 to +9999, or a 5XXXX double precision register reference.
- The bottom contains a 5XXXX double precision register reference. This register holds the result of the division. The next register (5XXXX+1) holds the remainder. For this reason, the numerically highest 5XXXX register cannot be used.

INPUT
- The top input controls the operation. When it receives power, the top value is divided by the middle value and the quotient and remainder are placed in the consecutive double precision registers in the bottom of the function block.

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OUTPUTS

- The top output passes power when the top input receives power.
- The bottom output passes power when the result is not within the legal value range of −9999 to +9999. This is either an underflow or overflow error condition. Divide not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-11.

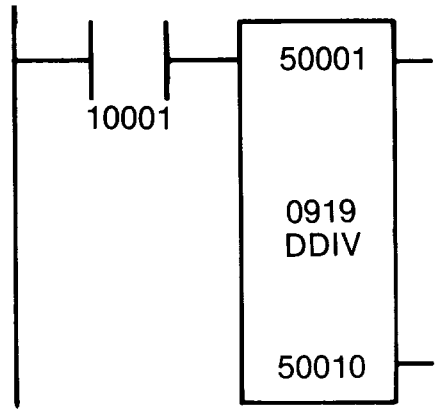


Figure 7-11. Double Precision Division

When contact 10001 is energized, the top input receives power. The value in register 50001 is divided by the value +0919. The result is placed in register 50010 and the remainder in register 50011.

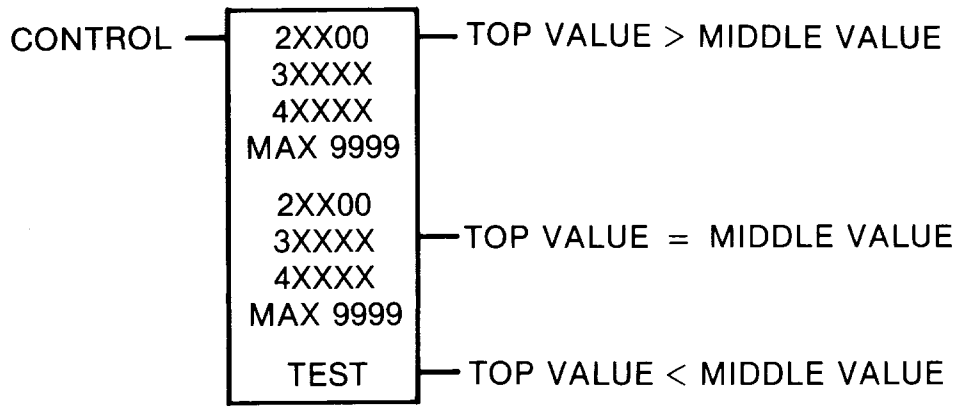
If the value in register 50001 is +05270803, the result placed in register 50010 is +00005735 and the remainder placed in register 50011 is +00000338.

50001			50010	50011
+05270803	÷ (+0919)	=	+00005735	+00000338
			RESULT	REMAINDER

7.8 TEST (TEST)

FUNCTION

The Test function performs an unsigned compare on two values.



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FUNCTION BLOCK

- The top and middle sections each contain a value which can be a constant up to 9999, or one of the following references: a 2XX00 sequencer register, a 3XXXX input register, or a 4XXXX holding register. The values in these two sections are compared but not changed.

- The bottom contains the symbol TEST.

INPUT

- The top input controls the operation. When it receives power, the top value is compared with the middle value.

OUTPUTS

- The top output passes power if the top value is greater than the middle value.

- The middle output passes power if the value in the top node equals the value in the middle node.

- The bottom output passes power if the top value is less than the middle value.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 7-12.

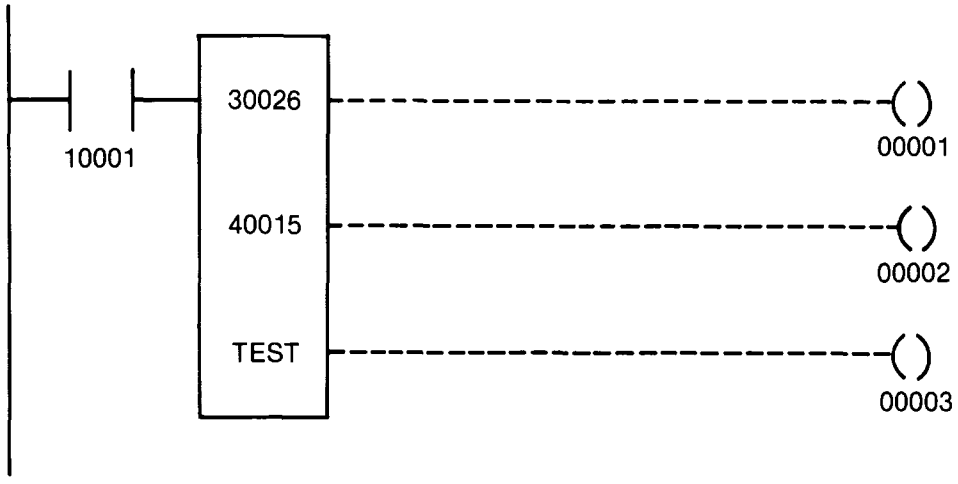


Figure 7-12. Test

When contact 10001 is energized, the top input receives power. Registers 30026 and 40015 are compared.

If the value in 30026 is greater than the value in 40015, the top output passes power to energize coil 00001.

If the value in 30026 is equal to the value in 40015, the middle output passes power to energize coil 00002.

If the value in 30026 is less than the value in 40015, the bottom output passes power to energize coil 00003.

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7.9 SUMMARY OF BASIC AND ARITHMETIC FUNCTIONS

	DCTR	UCTR	TIMER	ADD	DADD	SUB	DSUB	MULT	DMUL	DIV	DDIV	TEST
Top Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input	Control Input
Middle Input				Carry in 1	Not Used	Borrow 1	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Bottom Input	Enable	Enable	Enable	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Top Node	Max.9999, 3XXXX, 4XXXX	Max.9999, 3XXXX, 4XXXX	Max.9999, 3XXXX, 4XXXX	Max.9999, 2XX00, 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999, 2XX00, 3XXXX 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999, 3XXXX, 4XXXX,	– 9999 to + 9999, 5XXXX	Max.9999, 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999, 2XX00, 3XXXX, 4XXXX
Middle Node				Max.9999, 2XX00, 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999 2XX00, 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999, 3XXXX, 4XXXX	– 9999 to + 9999, 5XXXX	Max.9999 2XX00, 3XXXX, 4XXXX
Bottom Node	2XX00, 4XXXX	2XX00, 4XXXX	2XX00, 4XXXX	2XX00, 4XXXX	5XXXX	2XX00, 4XXXX	5XXXX	4XXXX	5XXXX	4XXXX	5XXXX	No Value
Top Output	Count = Zero	Count = Preset	Timer = Preset	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Top Node> Middle Node
Middle Output				Overflow	Not Used	Under-flow	Not Used	Not Used	Not Used	Not Used	Not Used	Top Node = Middle Node
Bottom Output	Not Used	Not Used	Timer Not = Preset	Top or Middle Node> 9999	Result Under-flow or Overflow, Error Condition	Top or Middle Node> 9999, Error Condition	Result Underflow or Over-flow, Error Condition	Top or Middle Node> 9999, Error Condition	Result Underflow or Over-flow, Error Condition	Error	Result Underflow or Over-flow, Error Condition	Top Node< Middle Node

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7.10 LOGIC EXAMPLES

7.10.1 Real Time Clock

The following paragraphs provide a detailed explanation of the logic illustrated in Figure 7-13 to program a real time clock.

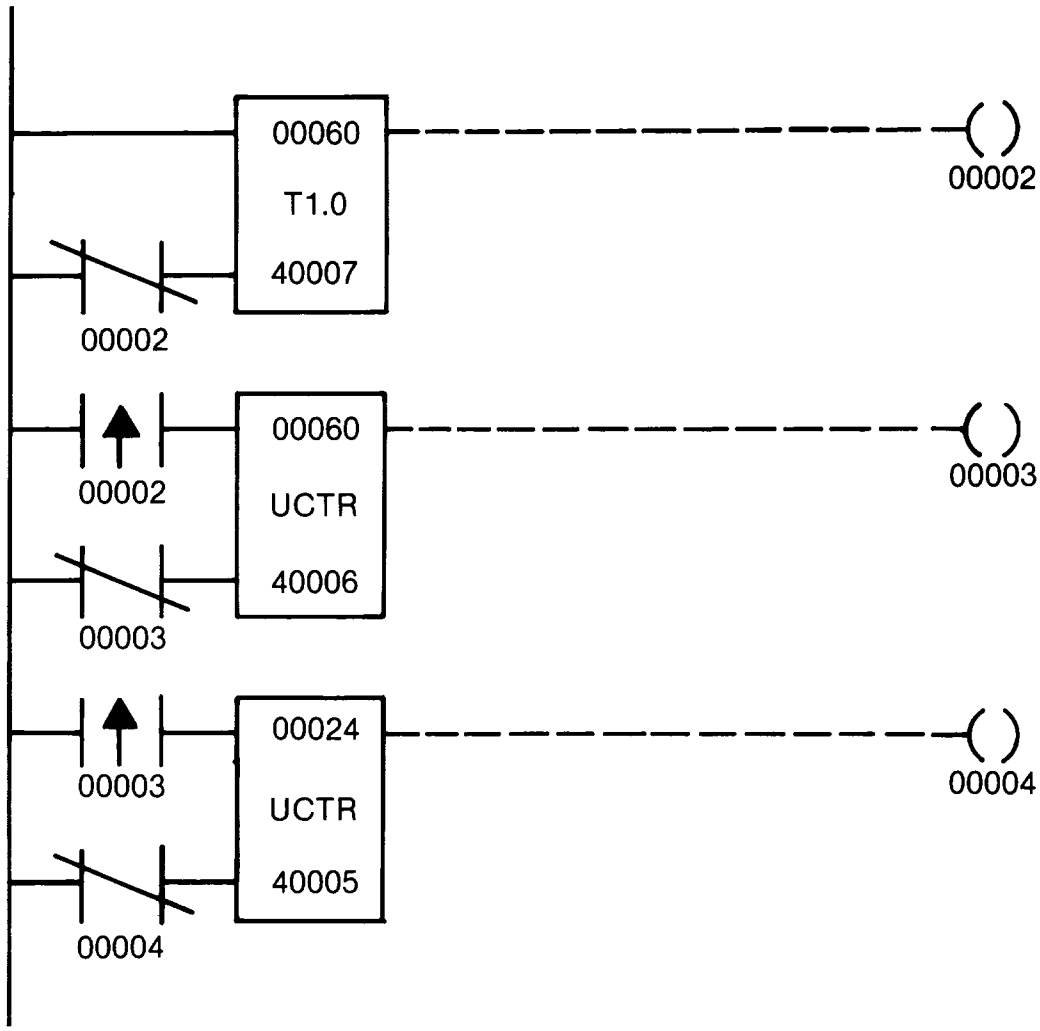


Figure 7-13. Real Time Clock

The top network in this example is the 1 minute timer. At the beginning of the logic solving, coil 00002 is OFF so both the top and bottom inputs of the timer are receiving power. Register 40001 starts increasing time in seconds until it reaches 60. At this point, the top output passes power and energizes coil 00002. Register 40001 is reset and the counter in the second network (40006) increases by one, indicating that one minute has elapsed.

Since the timer in network 1 is no longer equal to the preset, coil 00002 is de-energized and the timer resumes increasing time. Once the value in 40006 reaches 60, indicating 60 minutes, the top output passes power and energizes coil 00003. Register 40006 is reset and the counter in the third network (40005) increases by one, indicating that one hour has passed. The correct time of day can be read in registers 40005-40007 in hours, minutes, and seconds.

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SECTION 8
DATA TRANSFER (DX) MOVE FUNCTIONS AND SEQUENCER FUNCTIONS

The Move functions copy data from registers, discretes, and/or tables into other registers, discretes, or tables. The data can then be examined or changed by the controller without altering the original data.

A register is a location in the controller's memory in which a numerical value is stored. This value can be binary or binary coded decimal (BCD). In an 884 PC, the maximum decimal value is 9999 and the maximum number of bits is sixteen with the exception of 5XXXX double precision registers which have 32 bits.

A table is a group of consecutive registers or discretes. The maximum number of registers or groups of discretes in a table is 255.

Each DX function block consists of three vertical sections in a 10 x 7 section network format. The three areas are: the source, the destination, and the table length.

The top input is the control input; when the top input receives power, the function is performed. When the top input receives the power, the top output passes power. This allows function blocks to be cascaded within a network.

A Sequencer function block occupies either two or four areas and its contents vary by function.

The input(s) to a function block can be a single relay contact, another function block, or a whole network of logic.

The output(s) can be connected directly to coils, to other function blocks, to relay contacts, or left unconnected.

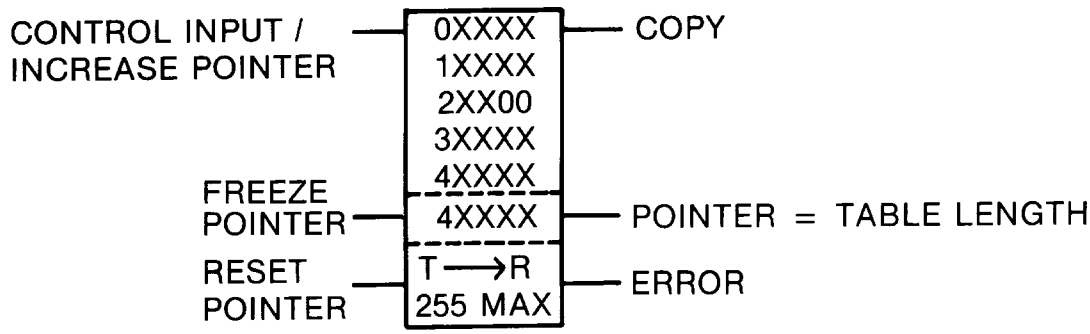
NOTE

If a single move operation is desired, use a transitional contact to control the top input.

8.1 TABLE-TO-REGISTER MOVE (T→R)

FUNCTION

The Table-to-Register Move function takes the data from a table of registers (up to 255 steps long) and moves it into a specific holding register. Each time the T→R control input is pulsed, the next value in the table is moved to the destination table.



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FUNCTION BLOCK

- The top area of the T→R function block is the source node. It can be one of the following references: a 0XXXX logic coil, a 1XXXX discrete input, a 2XX00 sequencer register, a 3XXXX input register, or a 4XXXX holding register. The source is a table of 16-bit locations. Its size is defined in the bottom area.
- The middle area is the destination. It is occupied by two consecutive 4XXXX holding registers. The first register holds the pointer value. The pointer value determines what data in the source table is to be moved. Since the pointer value is increased by one before the move is performed, enter a pointer value one less than the position of a register in the table (i.e., a pointer value of three indicates the fourth position in a table). The next consecutive holding register (4XXXX + 1) receives the data. The pointer does not receive the data.
- The bottom area contains the symbol T→R and the numerical value that specifies the source table length. This constant can range from 1 to 255.

NOTE

If the pointer register is loaded with a value greater than the table length, the 884 PC sets the pointer value to the table length and the function is not performed.

INPUTS

- The top input controls the operation. When it is receiving power and the pointer is less than the table length, the information from one register or group of discretes in the source table is copied into a single holding register.
- The middle input is the freeze pointer. When held high, this input prevents the pointer from advancing.
- The bottom input, when receiving power, resets the pointer to zero, prevents the pointer from increasing, and does not allow the function to be performed.

OUTPUTS

- The top output passes power when the top input receives power.
- The middle output passes power when the pointer value equals the table length (end of the table).
- The bottom output passes power when the pointer value is greater than or equal to the table length before the function is attempted. Error condition, Pointer = Length; Function not performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 8-1.

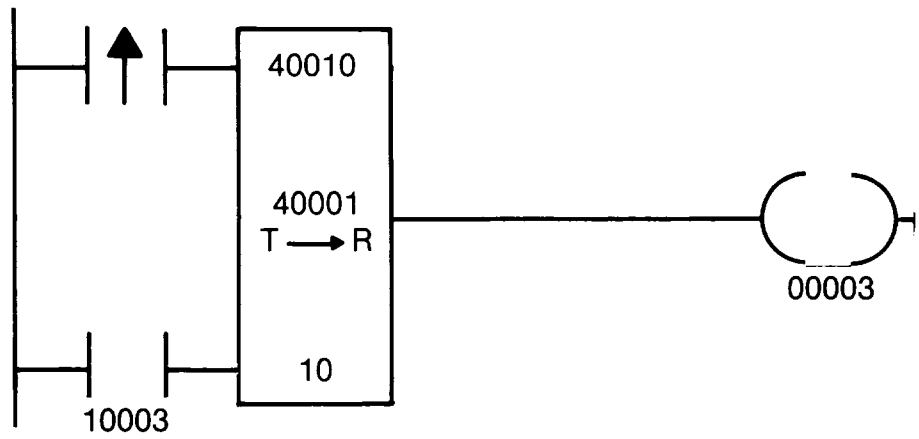


Figure 8-1. Table-to-Register Move Logic

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The table starts at 40010 and is 10 steps long. Each time 10001 is energized (must be a "one-shot"), a value from the table shifts to register 40002. 40001 keeps track of the count.

When the pointer value reaches the table length, 10, the middle output passes power and energizes coil 00003. On the next scan, the bottom input receives power and resets the pointer as well as temporarily freezing the operation. On the following scan, provided the top input is still receiving power, the function resumes.

Figure 8-2 illustrates the Table-to-Register Move described in the preceding paragraphs.

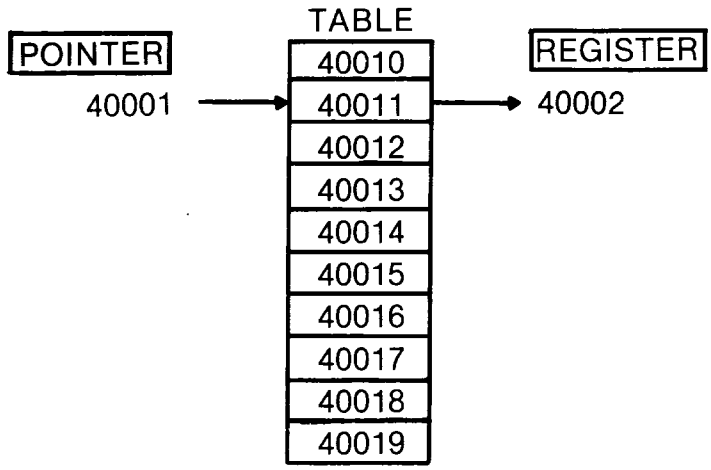
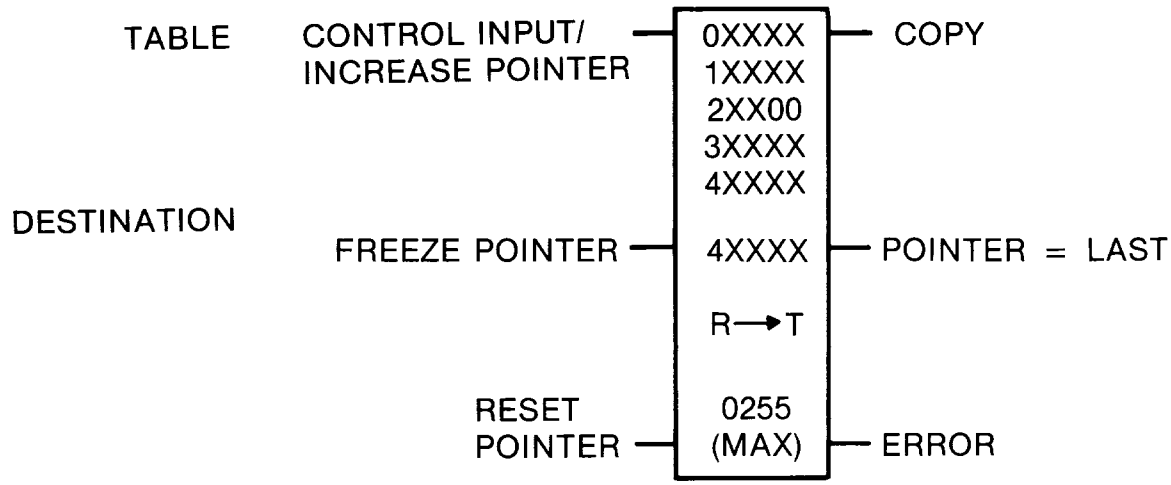


Figure 8-2. Table-to-Register Move

8.2 REGISTER-TO-TABLE MOVE (R→T)

FUNCTION

The Register-to-Table Move function copies sixteen logic coils, sixteen discrete inputs, one sequencer register, one input register, or one holding register into a single specific location within a table of registers.



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FUNCTION BLOCK

- The top area of the function block is the source. It can be one of the following references: a 0XXXX logic coil, a 1XXXX discrete input, a 2XX00 sequencer register, a 3XXXX input register, or a 4XXXX holding register. The source is a single 16-bit location (e.g., a register or group of sixteen discretes).
- The middle area is the destination . It consists of consecutive 4XXXX holding registers. The first register holds the pointer value. The pointer value points to the position in the table to which the source data will be moved. Enter a pointer value that is one less than the register position in the table, because the pointer value is increased by one before each move is performed (i.e., the pointer value of three points to the fourth position in a table). The table starts at the next register (4XXXX + 1), not at the pointer.
- The bottom area contains the symbol R→T and a numerical value which specifies the destination table length. This constant can range from 1 to 255.

NOTE

If the pointer register is loaded with a value greater than the table length, the 884 PC sets the pointer value to the table length and the function is not performed.

INPUTS

- The top input controls the operation. When it is receiving power and the pointer is less than the table length, the information in the source register or group of discretes is copied to a location in the table.
- The middle input is the freeze pointer. When held high, this input prevents the pointer from advancing.
- The bottom input, when receiving power, resets the pointer to zero, prevents the pointer from increasing, and does not allow the function to be performed.

OUTPUTS

- The top output passes power when the top input receives power.
- The middle output passes power when the pointer equals the table length (end of table).
- The bottom output passes power when the pointer value is greater than or equal to the table length before the function is attempted. Error condition when pointer = length; no function performed.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 8-3.

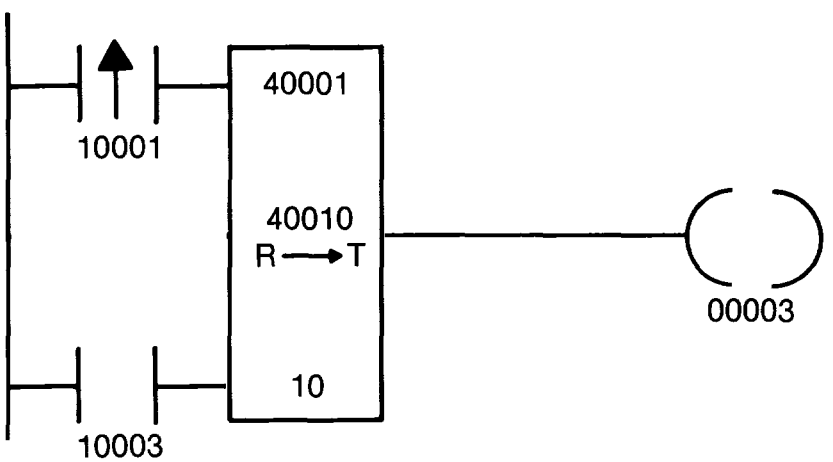


Figure 8-3. Register-to-Table Move Logic

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This instruction takes whatever is in Register 40001 and moves it into a table 10 steps long, starting at 40011. Register 40010 keeps track of the count pointer.

After several scans when the pointer value reaches the table length, the middle output passes power to energize coil 00003. On the next scan, the bottom input receives power and resets the pointer, as well as temporarily freezing the operation. On the following scan, provided the top input is still receiving power, the function resumes.

Figure 8-4 is an illustration of the Register-to-Table Move described in the preceding paragraphs.

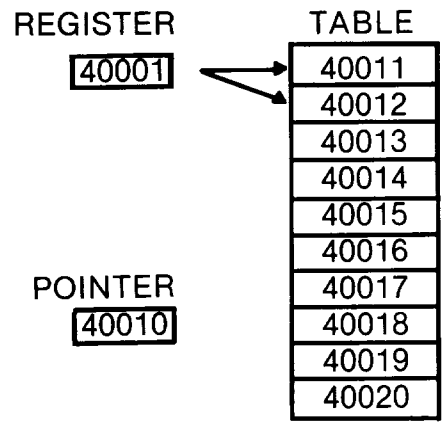
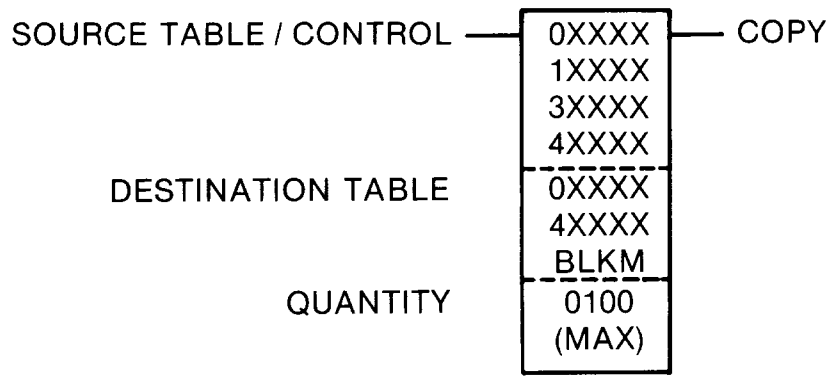


Figure 8-4. Register-to-Table Move

8.3 BLOCK MOVE (BLKM)

FUNCTION

The Block Move function copies an entire table of registers or discretes into another table on one scan. This function does not use a pointer register.



NOTE

Be careful not to overuse the BLOCK MOVE function because it has a significant effect on scan time.

FUNCTION BLOCK

- The top area of the function block is the source reference. It can be one of the following references: a 0XXXX logic coil, a 1XXXX discrete input, a 3XXXX input register, or a 4XXXX holding register. The source is a table of 16-bit locations.

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- The middle area is the destination. It can be either a 0XXXX logic coil reference or a 4XXXX holding register reference. The destination is a table of 16-bit locations, the same size as the source.

WARNING

The BLKM function overrides the disable state of a coil in the destination area of the function block. This may cause personal injury if repairs are being made and a coil has not, in fact, been disabled.

- The bottom area contains the symbol BLKM and a numerical value that specifies the table length for both the source and the destination. This constant can range from 1 to 100.

INPUT
- The top input controls the operation. When it receives power, one table of registers or discretes is copied into another table of the same length.

OUTPUT
- The top output passes power when the top input receives power.

NOTE

Only the top input and top output are used.

EXAMPLE
The following paragraph provides a detailed explanation of the logic used in Figure 8-5.

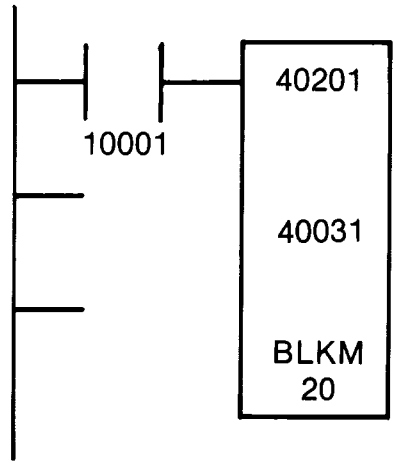


Figure 8-5. Block Move Logic

This instruction takes the contents of registers 40201-40220 and copies them into registers 40031-40050. All the registers are moved in one scan, each time the top input receives power. No output is required for this function unless cascading is desired.

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Figure 8-6 illustrates the Block Move described in the preceding paragraphs.

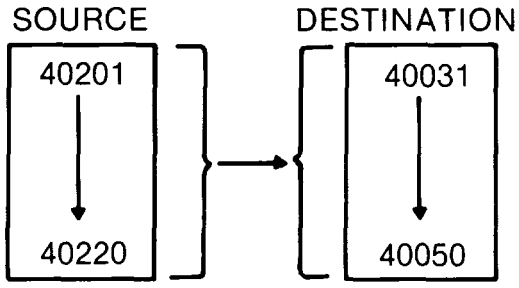
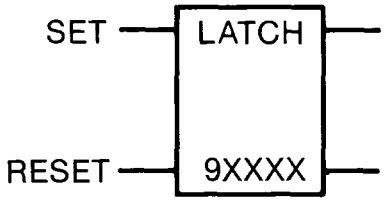


Figure 8-6. Block Move

8.4 LATCH (LTCH)

FUNCTION

This function is used to set or reset a latch. The state of the latch is maintained through a power cycle.



FUNCTION BLOCK

- The top area of the function block contains the symbol LTCH.
- The bottom area contains a 9XXXX latch reference.

INPUTS

- The top input, when it receives power, sets the latch to ON.
- The bottom input, when it receives power, resets the latch to OFF.

OUTPUTS

- The top output passes power when the top input only receives power. If both the top and bottom inputs receive power, this output does not pass power.
- The bottom output passes power when the bottom input receives power.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 8-7.

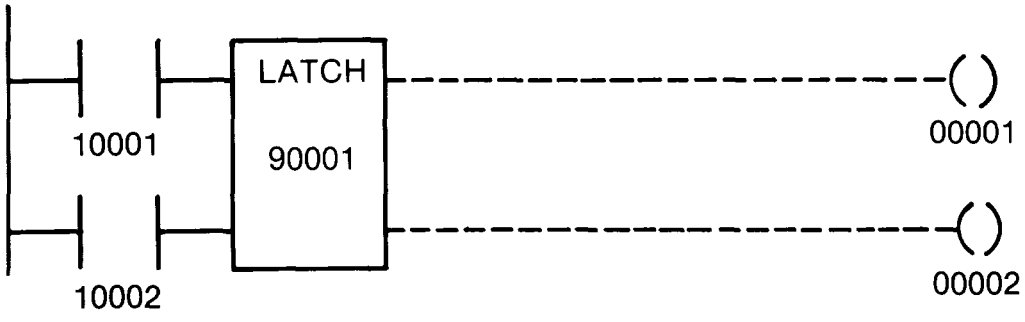


Figure 8-7. Latch Logic

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The LATCH function block is the only instruction that outputs power when no power is input. Either 01 or 02 is always ON (one always on and one always off). The output status is based on the Truth Table below.

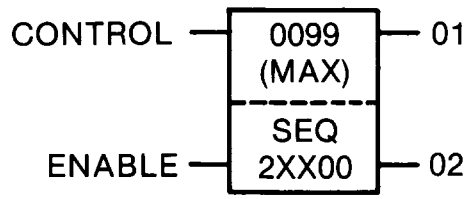
Table 8-1. Truth Table, Latch Function

Input	Input	Output	Output
10001	10002	00001	00002
ON	ON	OFF	ON
ON	OFF	ON	OFF
OFF	ON	OFF	ON
OFF	OFF	—NO STATUS CHANGE—	

8.5 SEQUENCER (SEQ)

FUNCTION

The Sequencer function allows sequential type control of a single point.



FUNCTION BLOCK

- The top area contains the preset value. It is a constant with a maximum value of 99.
- The bottom area contains the symbol SEQ and a 2XX00 sequencer register reference.

INPUTS

- The top input controls the operation and determines the number of times the operation is performed.
- The bottom input, when it receives power, enables the sequencer register, and allows it to increase. The two outputs do not pass power.

OUTPUTS

- The top output passes power when the value in the sequencer register equals the preset.
- The bottom output passes power when the top input receives power and the bottom input does not receive power.

EXAMPLE

Figure 8-8 and the following text illustrate the sequencer function.

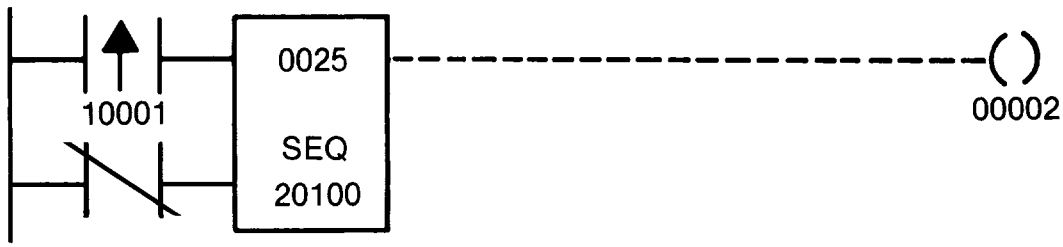


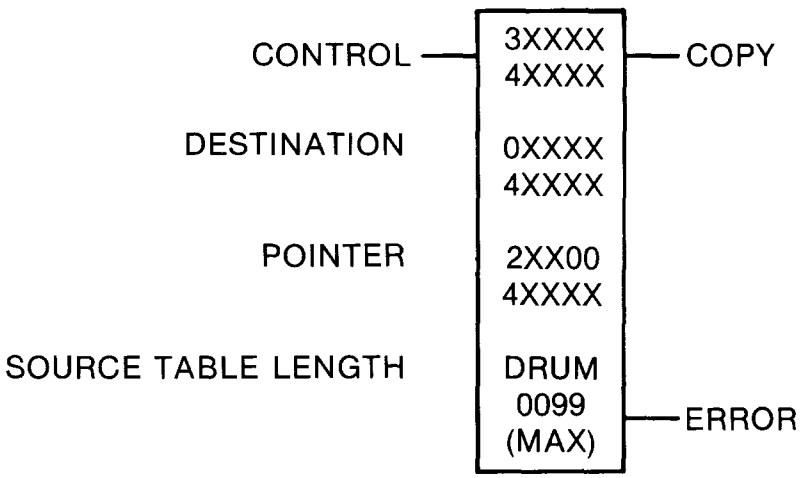
Figure 8-8. Sequencer Logic

Each time 10001 is pulsed, the value in register 20100 increases by one. When the value equals the PRESET value, coil 0002 is energized.

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8.6 DRUM (DRUM)

The Drum function allows sequential type control of multiple points.



FUNCTION BLOCK

This function block has four sections which will be referred to here as top, second, third, and bottom.

- The top section is the source. It can be either a 3XXXX input register reference, or a 4XXXX holding register reference. The source is a table of 16-bit locations whose size is defined in the bottom section.
- The second section is the destination. It can be either a 0XXXX discrete output reference, or a 4XXXX holding register reference. The destination length is one register or one group of sixteen discretes.
- The third section is the pointer. It is a 2XX00 register reference which holds the pointer value. This value controls which register in the source table is moved.
- The bottom section contains the symbol DRUM and the numerical value that specifies the source table length. This constant can range from 1 to 99.

INPUT

- The top input controls the operation. When it receives power the content of one register of the source table is moved into the destination, one register per scan.

OUTPUTS

- The top output passes power when the top input receives power.
- The bottom output passes power when the pointer value is greater than the source table length and the top input is receiving power.

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EXAMPLE
The following paragraph provides a detailed explanation of the logic used in Figure 8-9.

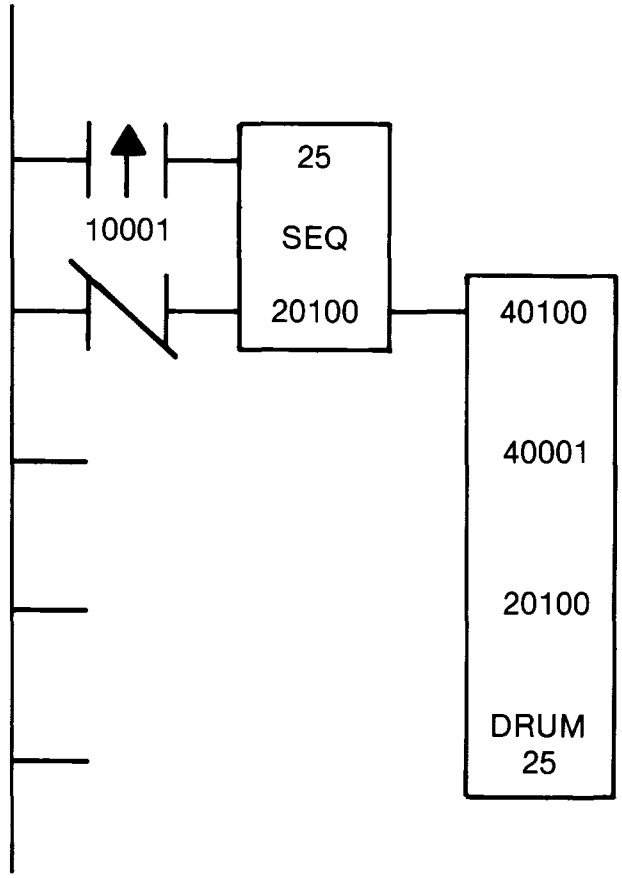


Figure 8-9. Drum Logic

The logic used to illustrate the Drum Function combines the Sequencer logic explained in 8.5 with the Drum Function block. Each time 10001 is pulsed it increments the POINTER, 20100, and moves the applicable REGISTER, 40100 through 40124, into the DESTINATION, 40001.

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8.7 SUMMARY OF MOVE AND SEQUENCER FUNCTIONS

	T→R	R→T	BLKM	LTCH	SEQ	DRUM	
Top Input	Control Input, Increase Pointer	Control Input, Increase Pointer	Control Input	Set	Control Input	Top Input	Control Input
						Second Input	Not Used
Middle Input	Freeze Pointer	Freeze Pointer	Not Used			Third Input	Not Used
Bottom Input	Reset	Reset	Not Used	Reset	Reset	Bottom Input	Not Used
Top Node	0XXXX, 1XXXX, 2XX00, 3XXXX, 4XXXX	0XXXX, 1XXXX, 2XX00, 3XXXX, 4XXXX	0XXXX 1XXXX 3XXXX, 4XXXX	LTCH	Max.99	Top Node	3XXXX, 4XXXX
						Second Node	0XXXX, 4XXXX
						Third Node	2XX00
Middle Node	4XXXX	4XXXX	0XXXX 4XXXX			Bottom Node	Max. 99
						Top Output	Copy of Top Input
Bottom Node	Max.255	Max.255	Max.100	9XXXX	2XX00	Second Output	Not Used
Top Output	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input	Bottom Node = Preset	Third Output	Not Used
Middle Output	Pointer = Table Length	Pointer = Table Length	Not Used			Bottom Output	When pointer value > than source table length and top input receives power.
Bottom Output	Pointer = or > Table Length Before Function Attempted	Pointer = or > Table Length Before Function Attempted	Not Used	Copy of Bottom Input	Top Input Receives Power/Bottom Input Does Not Receive Power		

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8.8 LOGIC EXAMPLE

8.8.1 Recipe Storage

The following paragraphs provide a detailed explanation of the logic illustrated in Figure 8-10 to program a recipe storage function.

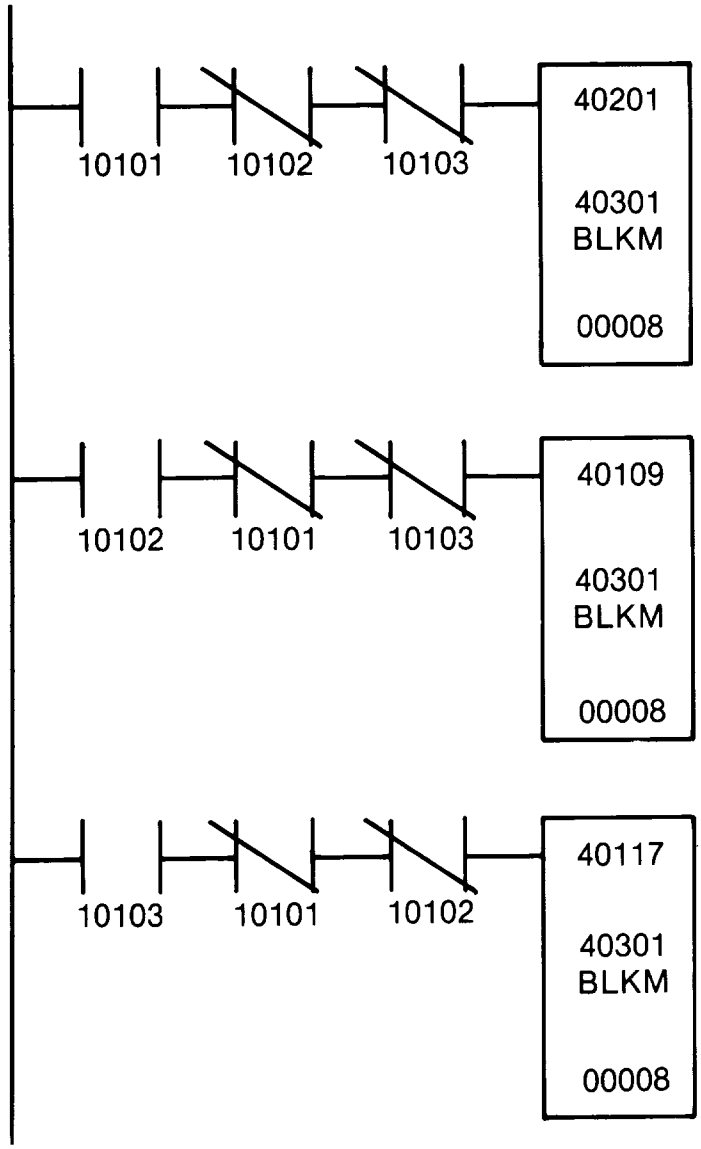


Figure 8-10. Recipe Storage

In some applications, information from various tables is needed, one table at a time, to perform various functions. An example of this is a manufacturer who produces three kinds of soup, which are similar yet have specific differences. Soups are similar, but chicken soup, mushroom soup and tomato soup contain different ingredients.

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The information, or recipe, for each soup is stored in a unique table. Since only one soup is made at a time, a working table is needed which can apply to any of the three soups. This is accomplished with a block move as shown in Figure 8-10. The tables for all the soups contain specific information in corresponding registers. These registers must also correspond with the working table's registers. For example, if the first register in one table contains cooking time, the first register in all the tables must contain cooking time.

The process is controlled from an operator panel. The panel can have three input switches; 10101, 10102, and 10103. To make soup A, the operator turns 10101 ON, and 10102 and 10103 remain OFF.

Following the logic in Figure 8-10, input 10101 is energized and passes power through normally closed contacts 10102 and 10103. The recipe for soup A is moved from table 40201-40208 to table 40301-40308. Table 40301-40308 is a working table. Each output register in this table is controlling a specific part of the operation.

When input 10102 is energized, input 10101 stops passing power and the recipe for soup B is moved from table 40109-40116 into table 40301. Note that when input 10101 stops passing power the recipe for soup A is moved out of table 40301. This process is repeated by energizing input 10103 to prepare soup C.

If the original recipe tables are used as working tables, three individual programs are required. By using one working table as illustrated in this example, only one program is needed to control the output information.

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SECTION 9
DATA TRANSFER (DX) MATRIX FUNCTIONS

A matrix is an array of databits composed of one or more consecutive registers in the 884 PC. The size of a matrix, in bits, is in even multiples of 16 (e.g., 16, 32, 48, 64, 80, etc.); each register contains 16 data bits.

Figure 9-1 is an example of the format of a 3-register matrix:

Register	Bits
40051	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
40052	17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
40053	33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

Figure 9-1. Format of a 3-Register Matrix

Each bit has a value of one or zero. Registers are generally displayed in decimal format and have to be displayed in binary format to read bit information. To obtain a register value in bit format, do the following:

1. Move the cursor to the bottom of the P190 screen.
2. Enter the register number (e.g., 40250) into the AR.
3. Press the CHANGE SCREEN key.
4. Press the PART. REF software label key.
5. Press the GET COL/GET REF software label key or the ERASE/GET key on the P190 panel. The register number appears with a value next to it in decimal format (for example, 40250 = 0023 DECIMAL).
6. Press the DISP ASCII/DISP BIN software label key. The following is displayed on the screen:

   40250 = 0000000000010111

Each bit has a value assigned to it. To determine the value of the register in binary format, add the individual bits.

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The values are:

BITS	1	2	3	4	5	6	7	8
VALUES	32768	16384	8192	4096	2048	1024	512	256
BITS	9	10	11	12	13	14	15	16
VALUES	128	64	32	16	8	4	2	1

If the bit pattern is 0000000001100100, the value is 100 (64 + 32 + 4). If the bit pattern is 0000000111110100, the value is 500 (256 + 128 + 64 + 32 + 16 + 4).

The DX MATRIX functions can revise data, shift data, or examine data in a matrix with or without altering the source.

The Bit Shift Left and Bit Shift Right function blocks occupy two sections in a 10 X 7 section network format and consist of a matrix start reference and the matrix length.

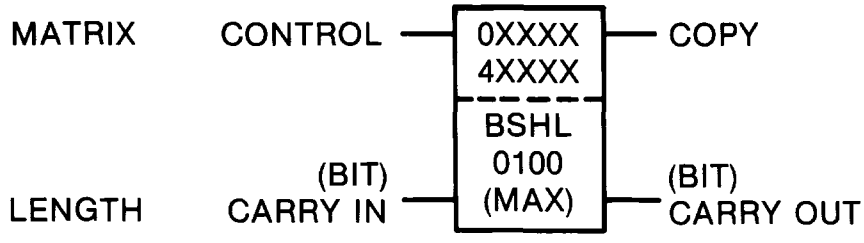
The Bit Sense and Bit Modify function blocks occupy three sections in a 10 X 7 section network format and consist of a source, a destination, and a specified matrix length in registers.

In all these function blocks, the top input is the control input; when it receives power the function is performed. The top output passes power when the top input receives power. This allows function blocks to be cascaded within a network.

9.1 BIT SHIFT LEFT (BSHL)

FUNCTION

The Bit Shift Left function shifts bits in a matrix to the left, one bit per scan. The original matrix is replaced by the newly shifted matrix.



FUNCTION BLOCK

- The top section contains either a 0XXXX logic coil reference or a 4XXXX holding register reference. This specifies the first reference in the matrix in which the shift is taking place.

- The bottom contains the symbol BSHL and the numerical value that specifies the matrix length in registers or groups of discretes. This constant can range from 1 to 100 (16 to 1600 bits).

INPUTS

- The top input controls the operation. When it receives power, all the bits in a matrix are shifted one position to the left. The first bit is shifted out of the matrix.

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- The bottom input, when it receives power, places a 1 in the vacated bit of the matrix. If this input does not receive power, a 0 is placed in the vacated bit.

OUTPUTS

- The top output passes power when the top input receives power.
- The bottom output passes power when the bit shifted out of the matrix is a one bit.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 9-2.

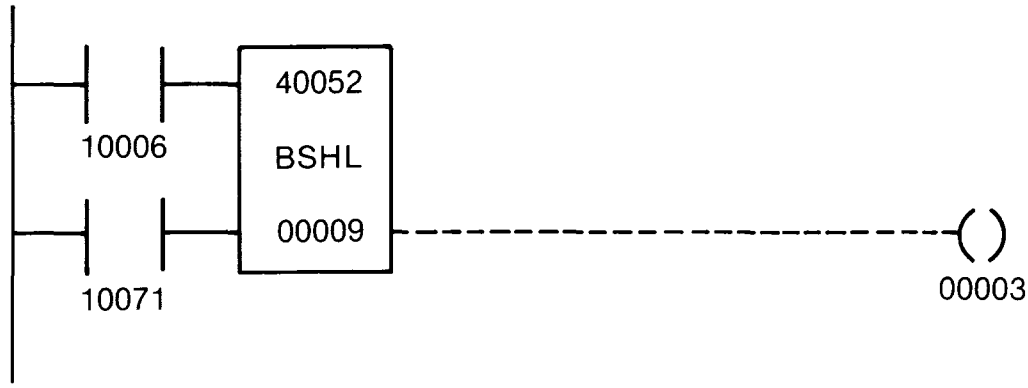


Figure 9-2. Bit Shift Left Logic

When input 10006 is energized, the top input receives power. All the bits in matrix 40052-40060 are shifted one bit position to the left.

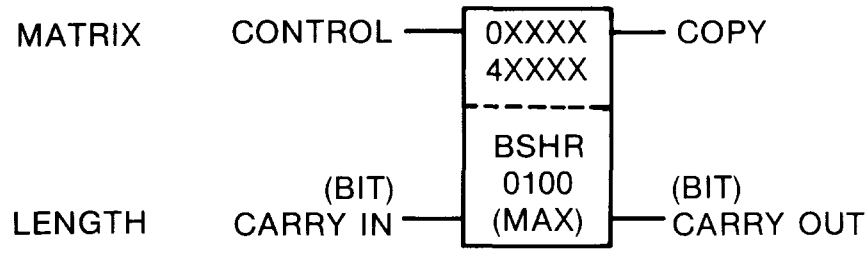
The first bit is shifted out of the matrix. If this bit is a one bit, the bottom output passes power to energize coil 00003.

If input 10071 is energized, the bottom input receives power and a one is placed in the last bit of the matrix, bit 144. If the bottom input does not receive power, a zero is placed in the last bit.

9.2 BIT SHIFT RIGHT (BSHR)

FUNCTION

The Bit Shift Right function shifts bits in a matrix to the right, one bit per scan. The original matrix is replaced by the newly shifted matrix.



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FUNCTION BLOCK

- The top contains a 0XXXX logic coil reference or a 4XXXX holding register reference. This specifies the first reference in the matrix in which the shift is taking place.

- The bottom contains the symbol BSHR and the numerical value that specifies the matrix length in registers or groups of discretes. This constant can range from 1 to 100 (16 to 1600 bits).

INPUTS

- The top input controls the operation. When it receives power, all the bits in a matrix are shifted one position to the right. The last bit is shifted out of the matrix.

- The bottom input, when it receives power, places a 1 in the vacated bit of the matrix. If this input does not receive power, a 0 is placed in the vacated bit.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when the bit shifted out of the matrix is a one bit.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 9-3.

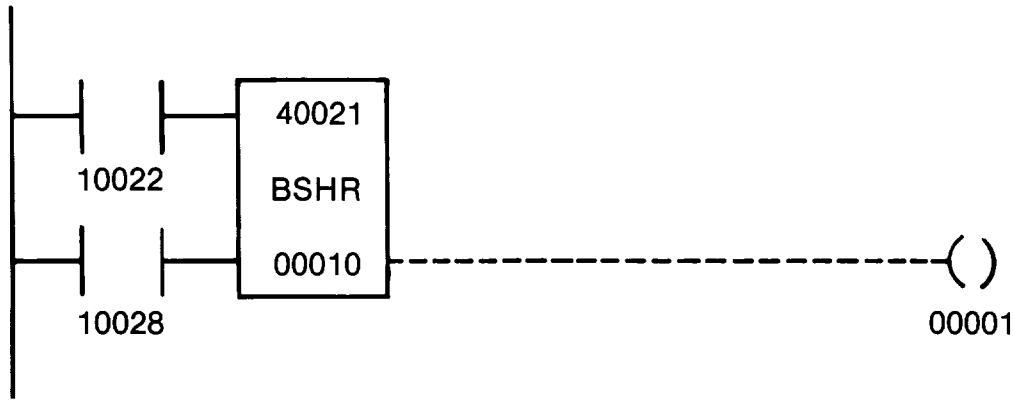


Figure 9-3. Bit Shift Right Logic

When input 10022 is energized, the top input receives power. All the bits in matrix 40021-40030 are shifted one bit position to the right.

The last bit, bit 160, is shifted out of the matrix. If this bit is a one bit, the bottom output passes power to energize coil 00001.

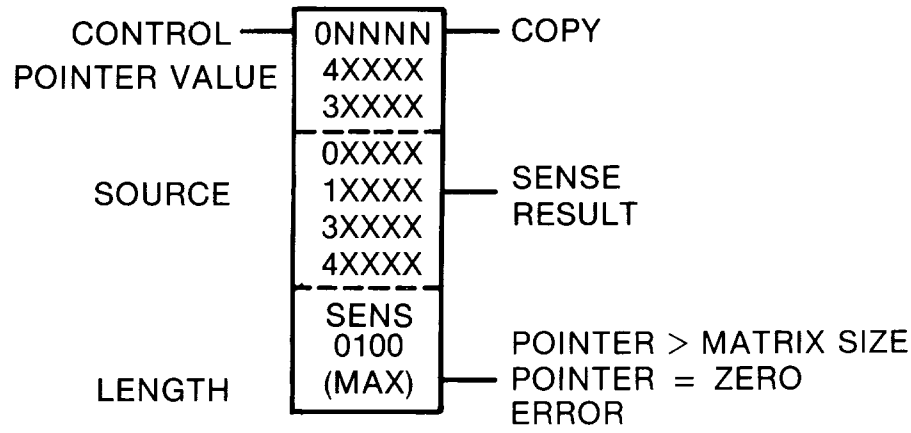
If input 10028 is energized, the bottom input receives power and a one is placed in the first bit of the matrix. If the bottom input does not receive power, a zero is placed in the first bit.

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9.3 BIT SENSE (SENS)

FUNCTION

The Logical Bit Sense function examines and reports the state of individual bits in a matrix. Only one bit can be examined per scan.



FUNCTION BLOCK

- The top holds the pointer value that controls which bit is examined. It can be a 3XXXX input register reference, a 4XXXX holding register reference, or a constant up to 1600.

- The middle is the source. It can be one of the following references: a 0XXXX logic coil, a 1XXXX discrete input, a 3XXXX input register, or a 4XXXX holding register.

- The bottom contains the symbol SENS and the numerical value that specifies the source matrix length. This constant can range from 1 to 100 (16 to 1600 bits).

INPUTS

- The top input controls the operation. When it receives power, one bit in a matrix is examined and its status is reported.

NOTE

If a pointer value is inserted which is greater than the matrix size, the pointer value is not reset, the function is not performed, and the bottom output passes power.

OUTPUTS

- The top output passes power when the top input receives power.

- The middle output passes power when the bit being examined is a one bit. This output does not pass power when the bit is a zero bit.

- The bottom output passes power if the pointer value is greater than the matrix size or if the pointer equals zero. In either case, no operation is performed.

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EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 9-4.

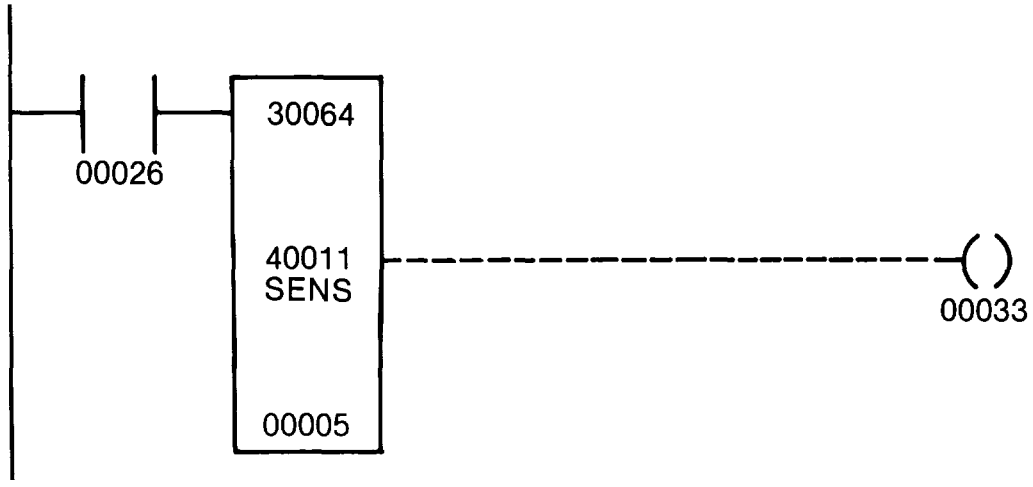


Figure 9-4. Bit Sense Logic

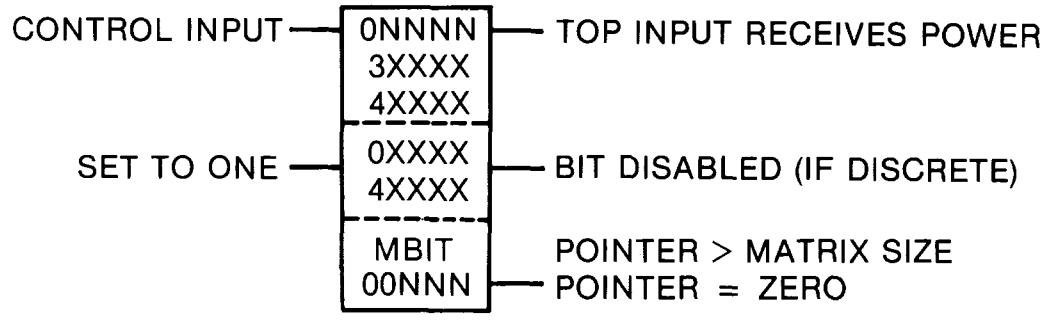
When contact 00026 is energized, the top input receives power. The bit in matrix 40011-40015 which is pointed to in register 30064, is sensed. If the bit sensed is a one-bit, the middle output passes power to energize coil 00033. If the bit is a zero bit, the middle output does not pass power.

If the value in register 30064 is 0035, the bit sensed is the third bit in register 40013.

9.4 BIT MODIFY (MBIT)

FUNCTION

The Logical Bit Modify function alters the state of individual bits in a matrix. Only one bit can be altered per scan; it can be set to one, or cleared to zero.



FUNCTION BLOCK

- The top contains the pointer that controls which bit is modified. It can be a 3XXXX input register reference, a 4XXXX holding register reference, or a constant up to 1600.

- The middle contains the source and destination; the revised data replaces the original data in the matrix. It can be either a 0XXXX logic coil reference, or a 4XXXX holding register reference. If a logic coil is used it can only be used once, in this function block. The logic coil cannot be used in another function block or in the eleventh column of a network; it can be used as a relay contact.

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WARNING

The MBIT function overrides the disable state of a coil used in the middle node of the function block. This can cause personal injury if the user assumes a coil has disabled an operation and repairs are being made, because the coil's state can change as a result of the MBIT function.

- The bottom contains the symbol MBIT and the numerical value that specifies the matrix length. This constant can range from 1 to 100 (16 to 1600 bits).

NOTE

If a pointer value is inserted which is greater than the matrix size, the pointer value is not reset, the function is not performed, and the bottom output passes power.

INPUTS

- The top input controls the operation. When it receives power, the bit specified by the pointer is either set to one or cleared to zero.
- The middle input controls whether the bit is set to one or cleared to zero. If this input receives power, the bit is set to one. If no power is received, the bit is cleared to zero.

OUTPUTS

- The top output passes power when the top input receives power.
- The middle output passes power when the bit modified is a disabled discrete.
- The bottom output passes power if the pointer value is greater than the matrix size or if the pointer equals zero. In either case, no operation is performed and the pointer value is set to the matrix size.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 9-5.

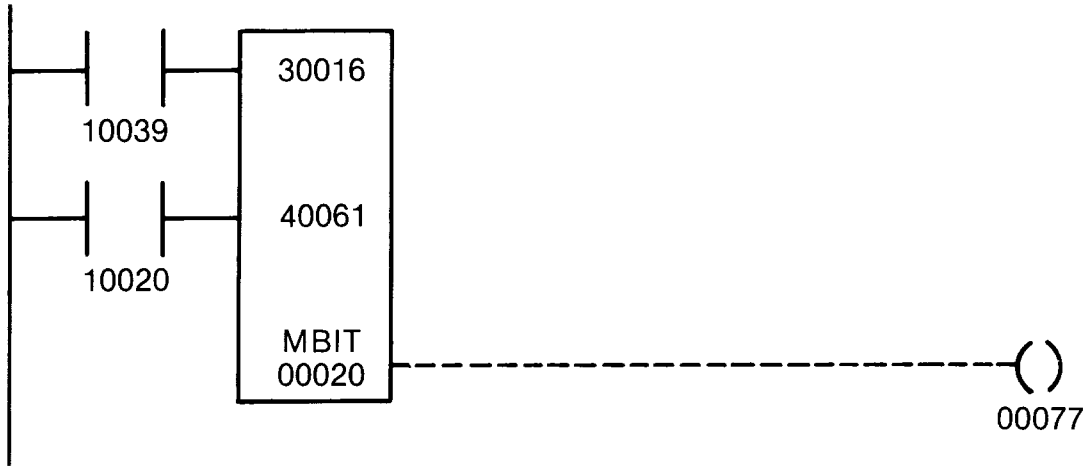


Figure 9-5. Logical Bit Modify

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When input 10039 is energized, the top input receives power. The bit in matrix 40061-40080 pointed to by the value in register 30016, is either set to one or cleared to zero depending on the middle input.

If input 10020 is energized, the middle input receives power and sets the bit to one. If the middle input does not receive power, the bit is cleared to zero.

If the pointer value is greater than the matrix size or equals zero, the bottom output passes power and energizes coil 00077.

9.5 SUMMARY OF MATRIX FUNCTIONS

	BSHL	BSHR	SENS	MBIT
Top Input	Control Input	Control Input	Control Input	Control Input
Middle Input	—	—	Not Used	Set to One
Bottom Input	State of Bit In = 1	State of Bit In = 1	Not Used	Not Used
Top Node	0XXXX, 4XXXX	0XXXX, 4XXXX	3XXXX, 4XXXX, MAX. 1600	3XXXX 4XXXX Max. 1600
Middle Node	—	—	0XXXX, 1XXXX 3XXXX, 4XXXX	0XXXX 4XXXX
Bottom Node	Max. 100	Max. 100	Max. 100	Max. 100
Top Output	Copy of Top Input	Copy of Top Input	Copy of Top Input	Copy of Top Input
Middle Output	—	—	State of Bit Sensed.	Bit Disabled (if discrete)
Bottom Output	State of Bit Out = 1	State of Bit Out = 1	Pointer > Matrix or Pointer = Zero	Pointer > Matrix or Pointer = Zero

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SECTION 10
SPECIAL FUNCTIONS

This section covers the special functions that can be accessed by pressing the SPECIAL software label key. These functions include:

- Skip
- Monitor OK Status of User Variable
- Get Controller I/O Status
- Single to Double Precision Conversion
- Double to Single Precision Conversion

10.1 SKIP (SKP)

FUNCTION
The SKIP function allows the logic in a group of networks to be skipped, and thus not solved, in order to reduce scan time. The SKIP function can be used to bypass seldom used program sequences or to create subroutines.



FUNCTION BLOCK
This function block contains one section. It contains the symbol SKP and a constant up to 255, or a 4XXXX holding register reference. If a 4XXXX reference is used it should be unique to this function block to avoid mishaps (for example, using the same register to hold a counter value, etc.). The value specifies the number of networks to be skipped. To skip the remainder of the networks in the program, a value of zero is entered into the function block.

NOTE

The Skip function cannot pass the boundary of a program. Regardless of how many networks were programmed to be skipped, the function stops when it reaches the end of a program.

INPUT
When the top, and only input, receives power, the remainder of the current network and the remaining number of specified networks are skipped over by the controller's scan. The network in which the skip block is located is counted as the first network to be skipped.

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OUTPUT
There is no output with this function.

NOTE

Power flow shown on the P190 screen for skipped networks is invalid. To prevent misinterpretation of the data, the message "POWER FLOW INVALID" appears on the P190 screen.

EXAMPLE
The following paragraph provides a detailed explanation of the logic used in Figure 10-1.

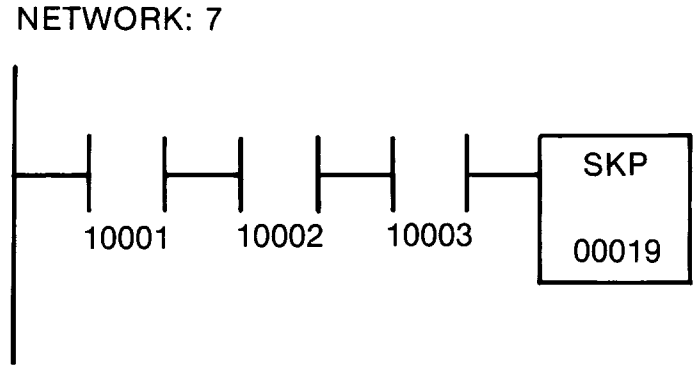
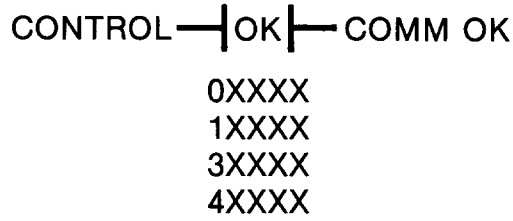


Figure 10-1. SKIP

When the Skip function block's input receives power, the remainder of the network containing the block (if any) is skipped and the next eighteen networks are skipped. If network 7 contains the Skip function, the remainder of network 7, and all of networks 8 through 25 are skipped. If there are only five networks left in the program, the operation stops after the fifth network.

10.2 MONITOR STATUS OF USER VARIABLE (0K)

FUNCTION
This function allows you to monitor the "health" status of all your references. It determines if the I/O Module, sending data to or receiving data from this reference number, is in active and normal communication with the 884 PC.



FUNCTION BLOCK

- This function block contains only one section. It contains the symbol OK and any available reference:

  a 0XXXX logic coil,
  a 1XXXX discrete input,
  a 3XXXX input register,
  a 4XXXX output/holding register,

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NOTE

If a legal variable, not mapped to an I/O Module, is monitored using this function, it will always be reported as "healthy" (output on).

INPUT
- The top and only input is the control input. When it receives power, the user variable reference is checked.

OUTPUT
- The top and only output passes power when the top input receives power and the user variable status is OK.

EXAMPLE
The following paragraph provides a detailed explanation of the logic used in Figure 10-2.

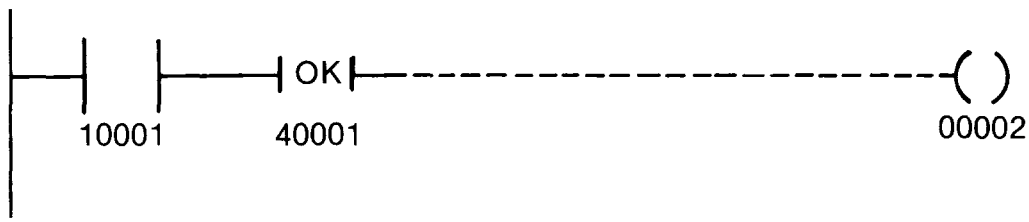
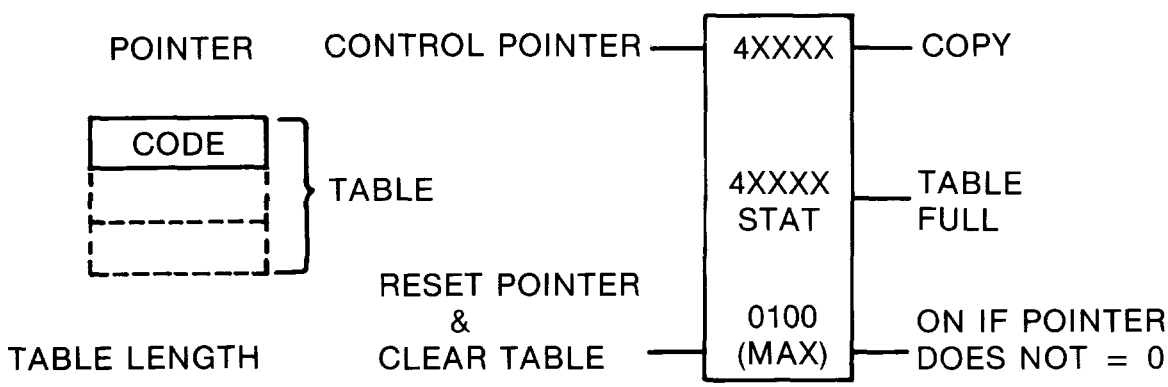


Figure 10-2. Status OK Logic

When contact 10001 is energized, the OK contact receives power. The controller checks to see if reference 40001 is OK to use. If the status is OK, coil 00002 is energized.

10.3 GET CONTROLLER I/O STATUS (STAT)

FUNCTION
This function allows monitoring the I/O status of all the I/O channels or the racks/slots within a specific channel. The status information is placed in a table.



FUNCTION BLOCK
- The top section contains a 4XXXX holding register reference which holds the pointer value. This pointer value indicates the total number of entries in the table.

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- The middle section contains a 4XXXX holding register reference. This register holds the value which determines if the overall I/O channel status is monitored or the rack/slot status of a particular channel is monitored. A zero specifies all channels; a non-zero number specifies a particular channel. The table containing the status information begins at 4XXXX + 1; its size is defined in the bottom section.

- The bottom section contains the symbol STAT and the numerical value that specifies the table length. This constant can range from 1 to 100.

INPUTS

- The top input controls the operation. When it receives power, the status table is generated. As each entry is made, the pointer is increased.

- The bottom input resets the pointer and destination table to zero.

OUTPUTS

- The top output passes power when the top input receives power.

- The middle output passes power when the table is full, pointer equals table length.

- The bottom output passes power when the pointer is not equal to zero.

EXAMPLE

The following paragraphs provide a detailed explanation of the logic used in Figure 10-3.

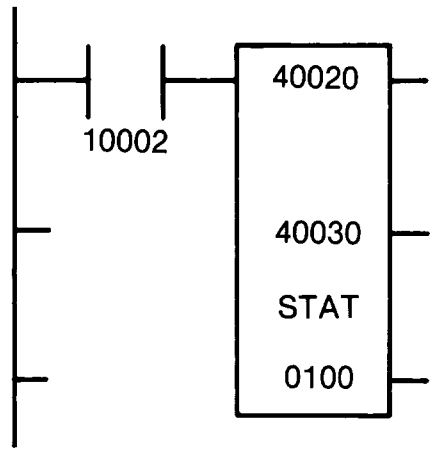


Figure 10-3. Get Controller I/O Status

If contact 10002 is ON, the STAT table is generated. If the table is full (POINTER = SIZE), all outputs are ON and no further checking is done. If the table is not full, checking continues and the appropriate number of unhealthy I/O is placed in the table and the pointer is incremented. Testing continues until no more bad I/O STAT are found, or until the table is full.

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NOTE

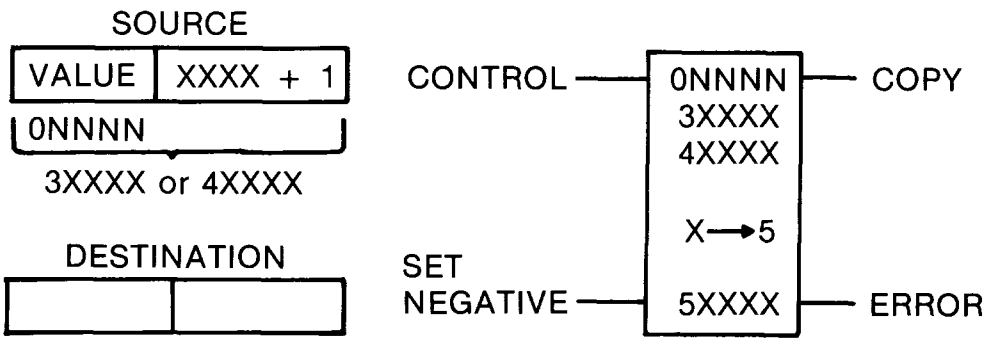
When monitoring all channels, each table entry indicates the failed channel. The channel number is stored in Binary and displayed in Decimal. When monitoring a single channel (rack/slot) each table entry indicates the failed module in the channel being monitored. It will be displayed as

Rack #	Slot #
2 digit DEC rack #	2 digit DEC slot #

10.4 SINGLE TO DOUBLE PRECISION CONVERSION (X→5)

FUNCTION

This function converts two single precision unsigned values from input or holding registers into a signed double precision value in a 5XXXX double precision register.



FUNCTION BLOCK

- The top section contains the source. It can be a constant up to 9999, a 3XXXX input register reference, or a 4XXXX holding register reference. If a reference is used, the next consecutive reference 3XXXX + 1 (or 4XXXX + 1) is implied.

NOTE

Do not use implied references anywhere else.

- The bottom section is the destination. It is a 5XXXX double precision register reference.

INPUTS

- The top input controls the operation. When it receives power, the top value, if a constant, is copied into a 5XXXX register. If a register reference is in the top, the value in that register (e.g., 40021) is multiplied by 10000, added to the value in the next consecutive register (e.g., 50022), and placed in a 5XXXX register.

- The bottom input, when receiving power, places a negative sign in the 5XXXX double precision register. If this input is not receiving power, the value in the 5XXXX register is positive.

OUTPUTS

- The top output passes power when the top input receives power.

- The bottom output passes power when either, or both, registers in the top node are greater than 9999. Error condition: operation not performed.

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EXAMPLE

The following paragraph provides a detailed explanation of the logic used in Figure 10-4.

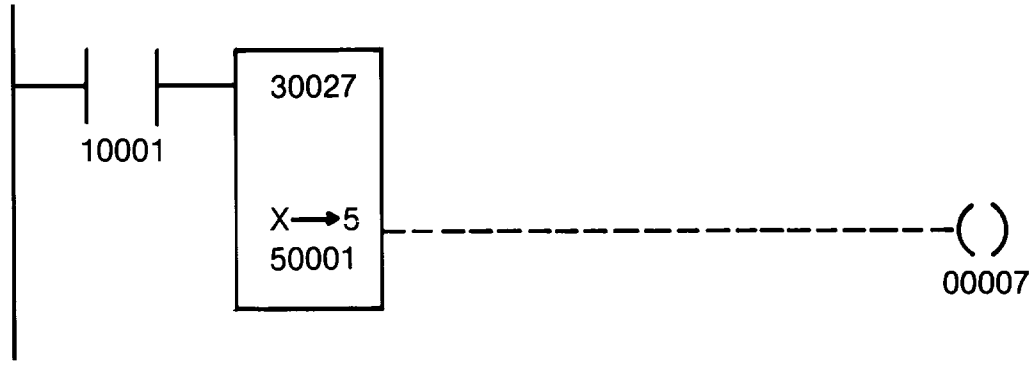


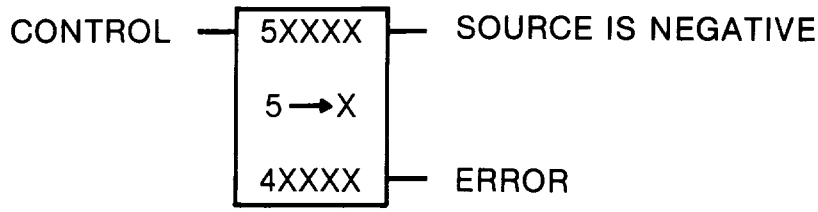
Figure 10-4. Single to Double Precision Conversion

When input 10001 is energized, the top input receives power. The value in register 30027 is multiplied by 10,000 and added to the value in register 30028. The result is placed in register 50001 as a positive number because the bottom input is not receiving power.

10.5 DOUBLE TO SINGLE PRECISION CONVERSION (5→X)

FUNCTION

This function converts a double precision signed value from a 5XXXX double precision register to two single precision unsigned values in two holding registers.



FUNCTION BLOCK

- The top section contains the source. It is a 5XXXX double precision register reference.
- The bottom section contains the destination. It is a 4XXXX holding register reference. The next consecutive holding register is implied (4XXXX + 1).

INPUT

- The top input controls the operation. When it receives power, the top value is split into two 4-digit values. The high order portion is placed in the 4XXXX register. The low order portion is placed in 4XXXX + 1.

OUTPUTS

- The top output passes power when the 5XXXX double precision register has a negative sign.
- The bottom output passes power when the operation is performed and the value in the top node is greater than 99999999..

NOTE

If the bottom output passes power, the top output cannot pass power, even if the 5XXXX register has a negative sign.

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EXAMPLE
The following paragraph provides a detailed explanation of the logic used in Figure 10-5.

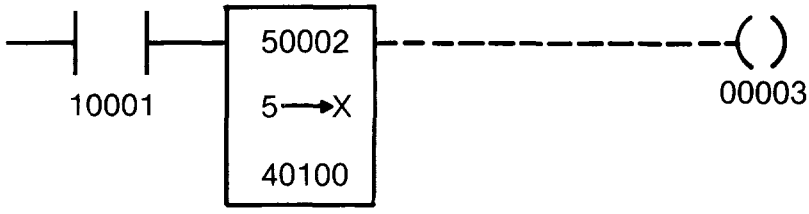


Figure 10-5. Double to Single Precision Conversion

When input 10001 is energized, the top input receives power. The value in register 50002 is split into two 4-digit values. The high order portion is placed in register 40100. The low order portion is placed in register 40101. If the double precision signed value is negative, the top output passes power to energize coil 00003.

10.6 SUMMARY OF SPECIAL FUNCTIONS

	SKIP	OK?	STAT	X→5	5→X
Top Input	Control Input	Control Input	Control Input	Control Input	Control Input
Middle Input	—	—	—	—	—
Bottom Input	—	—	Reset	Negative Sign	—
Top Node	4XXXX or Max. 255	0XXXX, 1XXXX, 3XXXX, 4XXXX	4XXXX	3XXXX, 4XXXX, or Max. 9999	5XXXX
Middle Node	—	—	4XXXX	—	—
Bottom Node	—	—	Max. 100	5XXXX	4XXXX
Top Output	Not Used	Top Input Receives Power and Status is OK.	Copy of Top Input	Copy of Top Input	Sign of 5XXXX is Negative
Middle Output	—	—	Pointer = Table Length	—	—
Bottom Output	—	—	Pointer not = Zero	Top Node Register > 9999	Operation performed and Top Node > 99999999

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10.7 LOGIC EXAMPLE

10.7.1 Subroutine

The Skip function can be used to create subroutines within a program. This is useful when a routine needs to be performed every third, or fourth scan, etc. It is also useful to perform a specific routine several times within a function. The Skip functions allow the routine's logic to be written once and performed as many times as necessary.

The following example uses the SKIP function to allow a different routine to take place each scan for a limited sequence.

On three consecutive scans, three different functions can be performed, one function each scan.

Network 3 contains a Skip block with a holding register, not a constant,

Network 5 contains a function, the first of three,

Network 6 contains a function, the second of three,

and Network 7 contains a function, the third of three.

The last network (i.e., 10) in the program contains an ADD block which adds a one to the holding register (i.e., 40031) used in network 3's Skip block.

On the first scan, at network 3 the controller skips to the end of the program because 40031 contains zero. In network 10, a one is placed in 40031. On the next scan at network 3, the controller skips to network 5. The first function is performed. At the end of network 5 is a Skip block containing zero. The controller skips to the end of the program, network 10, and adds a one to 40031, increasing it to two.

On the next scan at network 3, the controller skips to network 6. The second function is performed. At the end of network 6 is a Skip block containing zero. The controller skips to the end of the program and adds a one to register 40031, increasing it to three.

On the next scan at network 3, the controller skips to network 7. The third function is performed. At the end of network 7 is an ADD block which places a zero in register 40031. The controller solves the rest of the logic in the program. At network 10 a one is placed in register 40031.

On the next scan, the process starts all over again. The only difference is that the controller skips to network 3 on this scan. It does not have to skip to the end of the program first because there is already a one in register 40031.

NOTE

The logic in the last network of the program is performed every scan. Logic which is common to three functions can be placed in this network to avoid repeating the same logic three times in the program.

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APPENDIX A
884 PC ERROR CODES

The P190 screen includes an error line for reporting the various P190/884 PC or Modbus communications error conditions. The error codes which may appear, and their meanings, are listed in this appendix.

The P190 reports three distinct classes of errors: Panel, PC Link and PC Command errors.

Type 1, Panel Error, are Modbus communications errors detected by the P190's software. Both transmitted and received Modbus communications packets are examined. Sometimes the communication attempt is repeated several times before an error is declared.

TYPE 1- ERROR: PANEL = XXX COMMUNICATION ERROR DETECTED

001	Loss of Data Set Ready on Port 1
002	Packet length exceeds maximum allowed to send
003	No response from PC after retries count exhausted
004	No valid response received from PC due to CRC error after retry count exhausted
005	No valid response received from PC due to transmission of framing error after retry count exhausted
006	I/O command is not valid to send to PC
007	The response from PC was legal but not valid for the current I/O command
008	PC response to command was busy after retry count exhausted
009	PC reponse was not legal for the current I/O command
010	PC data received greater than panel memory allocated for receive buffer
011	PC response is busy to a poll command after retry count exhausted
012	PC response to a poll is not valid
013	PC sequence byte incorrect, reset link, error recovery accomplished
014	Message size to send to PC is greater than PC maximum
015	PC packet number not in sequence or not equal to expected value for current operation

TYPE 2 - ERROR: PCL = XXX COMMUNICATION ERROR REPORTED

001	Command function not supported by PC
002	Reserved
003	Reserved
004	PC CPU is not operating
005	Reserved
006	Reserved
007	Reserved
008	Reserved
009	Reserved
010	Reserved
011	Message size is greater than PC receive maximum
012	New message started before previous message completed. Previous command aborted
013	PC reports current packet not next in sequence. Message aborted
014	Sequence error detected, error recovery successful
015	PC response message is greater than amximum message, message aborted

All other codes are reserved.

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TYPE 3 - ERROR: PC = XXX PC INDICATES USER ERROR

001	Another user is logged in
002	Invalid password received
003	Search failed
004	Not on running PC
005	Memory is protected
006	Running PC
007	PC is not running
008	Cannot start from state
009	User is not logged in
010	PC cannot support function
011	Coil is already used
012	Latch is already used
013	Network out of range
014	User logic overflow
015	User logic overflow or replace
016	Network skipped
017	Not an 884 network
018	PC is corrupt
019	PC boundary violation
020	Scan interval is too large
021	Feature is not implemented

022 to 068 are error code numbers not used at this time

069	Function is not supported
070	Access is denied
071	Maximum number of references is exceeded
072	Invalid reference type
073	Invalid reference type
074	Discrete not disabled
075	Data is illegal
076	Cannot write input registers
077	PPE not even
078	PPE invalid row
079	No Start of Network (SON) node
080	Invalid opcode
081	Too many columns
082	Missing nodes
083	Unexpected elements
084	Row contact mismatch
085	Embedded coil
086	Illegal constant
088	Must be a 16 boundary
089	Data length mismatch
090	Hook not configured
091	Not configurable
092	Read only table
093	Invalid table offset

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TYPE 3 - ERROR: PC = XX PC INDICATES USER ERROR (cont'd)

095	Bad table data
096	Bad memory type
097	Bad memory address
098	Comm parameters invalid
099	Zero references requested
100	Invalid IOP
101	Invalid drop
102	Invalid rack
103	Invalid data
104	Illegal comm setting

105 to 125 are error code numbers not used at this time.

126	Invalid constant index

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APPENDIX B
PC MEMORY ERROR

If the PC encounters an error, the PC Memory Error screen appears. If the error occurs during the initial loading of the programmer and configurator tape, press the ALL MEMORY software label key. This initializes all PC memory.

If, however, this is not the initial loading, follow the recommended directions displayed on the screen:

INITIALIZE TABLES TO CLEAR MEMORY: C

Enter "C" and press the INIT TABLE software label key. The next screen to appear displays two software label keys: PROCEED and CANCEL. If the CANCEL software label key is pressed, the current operation will not be completed and you will be returned to the previous menu.

If the PROCEED software label key is pressed, the current operation will be performed, and the Power-up and Attach screen reappears. Press the ATTACH software label key and the PC Operations Menu screen appears.

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APPENDIX C
PASSWORD OPERATIONS

C.1 PASSWORD OPERATIONS (PASSWD OPS)

Press PASSWD OPS software label key to display the Password Table.

The 884 PC and P190 use passwords to protect the 884 PC's memory. The use of a password is optional. If you do not enter a password, the system defaults to Level 3. If a password has been entered it can only be changed by someone logged on with Level 3 privleges. If you try to ATTACH to a password protected P190/884 PC and do not know the password, turn the Memory Protect key (on the P190) to the UNLOCK position to proceed from the Password screen. There are four password levels, each allowing a higher memory access than the previous. Level 0 does not require a password. The password can contain a maximum of eight alphanumeric characters.

Level 0 — allows you to read any of the 884 PC's memory except the password table. If you ATTACH to a password protected P190/884 PC and do not know the password, turn the Memory Protect key on the P190 to the UNLOCK position to proceed from the Password screen. Memory cannot be altered.

Level 1 — allows you to write references, enable or disable coils and discrete inputs and start, stop or clear the PC.

Level 2 — allows you to enter new networks and/or alter existing logic. Also the scan rate and Modbus port parameters can be set.

Level 3 — allows you to configure the 884 PC's I/O specifications. It also allows the user to read and change the password table.

Access to any given level implies access to all the lower levels without use of the associated passwords.

The password table is entered the first time the PC is configured. To enter passwords, press the PSWD OPS software label key. The following software label keys appear on the screen:

		DELETE 1 ENTER 1	DELETE 2 ENTER 2	DELETE 3 ENTER 3			PREV MENU

C.1.1 Enter Password

A prompt appears on the screen: ENTER PASSWORD (MAX. 8 CHARACTERS), THEN PRESS DESIRED LEVEL.

Type in the password and press the appropriate software label key (i.e., ENTER 2, enters a level 2 password. When a password is entered into level 1, levels 2 and 3 receive the same password if they were previously blank, or if they contained the same password.

When a password is entered into Level 2, level 3 receives the same password if level 3 is blank or had the same password as level 2.

NOTE

Blanks (spaces) will not be accepted. Only printable characters are allowed.

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C.1.2 Delete Password

To delete a password or passwords, press the shift key and appropriate software label key: DELETE 1, DELETE 2, or DELETE 3.

If the level 3 password is deleted, and a level 2 password exists, the level 2 password is automatically displayed in level 3 as well as in level 2.

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APPENDIX D
GLOSSARY

Address: A numeric value used to identify a specific I/O channel and/or module.

AND (Logical): A mathematical operation between two bits. The result of the logical AND will be a one (ON) bit only if both bits are one bits; otherwise, the result will be a zero (OFF) bit. This operation can be performed between bits with each pair of bits, one from each, examined by their relative location within each.

Arithmetic Function: A type of logic used to add, subtract, multiply, or divide two numeric values. The status of the output is governed by the result of the arithmetic operation: additional overflow; comparisons (greater than, equal to, or less than); and illegal division.

ASCII: A 7-bit digital coding of standard alphanumeric characters as established by the American National Standards Institute. ASCII stands for the American Standard Code for Information Interchange.

B

Baud: A unit of data transmission speed equal to the number of code elements (bits) per second.

BCD (Binary-Coded Decimal): A system of numbers representing decimal digits (0-9) using four binary digits (1 or 0). BCD is a recognized industrial standard; BCD input (e.g., thumbwheels) and output (e.g., numerical displays) are readily available.

Binary: A numeric system wherein values are represented only by numbers 1 and 0 (ON/OFF). Also called "base 2". This system is commonly employed in modern electronic hardware since circuits can be economically designed for ON/OFF status.

Bit: Contraction of binary digit. A single number whose value can be either a ONE or a ZERO. The smallest division of a PC word.

Bit Modify Function: This function allows individual bits in a matrix to be altered. Only one bit per scan can be affected by this function; all other bits retain their state. Bits can be either set to a one (ON) condition or cleared to a zero (OFF) condition.

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Bit Rotate Function:

This function allows a series of bits to be rotated or shifted through a matrix. If the function is enabled for a number of scans (e.g., five), all bits in the matrix will be rotated the same number of bit locations (e.g., five). Provisions are made to select the direction of rotation, left or right.

Bit Sense Function:

This function allows individual bits in a matrix to be examined, but not altered. An output is used to indicate a one (ON) bit with power flow and a zero (OFF) bit without power flow. The status of only one bit can be obtained each scan.

C

Cascade Function:

Connecting two or more functions together to control one output. For example, timers and counters can be cascaded to produce results that cannot be achieved by one counter or one timer.

Channel:

A group of I/O modules that are separately connected to the mainframe. For example, a channel of I/O can contain up to 128 input points and 128 output points.

Coil:

A discrete logical conclusion to a series of logical operations performed by the programmable controller. The results can be output to the real world via an output module to activate motor starters, solenoids, relays or pilot lamps. Coils are turned OFF when power is removed from the mainframe. (See Latch.)

Counter:

A type of logic that is used to simulate the operation of external counters. In relay panel hardware, an electromechanical device which can be wired and preset to control other devices according to the total cycle of one ON or OFF function. In a PC, a counter is internal to the processor, which is to say it is an electronic function controlled by a user programmed instruction.

Cursor:

Visual movable pointer used on a CRT or programming panel by the programmer to indicate where an instruction is to be added to the ladder diagram. The cursor is also used for editing functions.

D

Data Transfer Block:

A PC function block used in data transfer (DX) programming.

Data Transfer (DX) Function:

A technique of moving and manipulating data within the controller under control of DX logic.

Data Transfer Line:

A line of ladder logic containing data transfer (DX) functions.

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Digital:

Having discrete states. Digital logic can have up to 16 states. However, most digital logic is binary logic with two states, ON or OFF.

Disable:

The capability to disconnect a logic coil or a discrete input from its normal control, and force it unconditionally ON or OFF. (See Force.)

Discrete Reference:

A reference that can be either ON or OFF. A discrete reference can be an input, output, or internal logic element.

Double Precision Function:

The technique of storing a single numerical value in two consecutive registers. Since each register can store up to four digits (maximum value 9,999), double precision allows magnitudes of up to 99,999,999 to be stored. In the 884 PC, 5XXXX registers are used to store double precision values.

DX (See Data Transfer):

A type of function block used to control the internal transfer of data. DX functions available include Block, Move, Bit Shift Right, Bit Shift Left, Table to Register, and Register to Table Functions.

E

Edit:

To deliberately modify the user program.

Element:

The basic building block of the PC ladder logic. An element can be a relay contact, horizontal short, vertical short, fixed numeric value, register reference, coil, or function block. Sometimes refered to as a logic element.

Enable:

To reconnect a logic coil or discrete input after it has been disabled. The opposite of "Disable."

Exclusive OR (XOR):

A mathematical operation between two bits. The result of the exclusive OR will be a one (ON) bit only if either bit is a one bit. Only if they are both zeros (OFF) or both ones (ON) will the result be a zero.

F

Force:

The function that can be used to change the state of a disabled reference. The reference can be changed from OFF to ON or ON to OFF. This allows the user to energize or de-energize any input or output by means of the program panel independent of the PC program.

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H

Hexadecimal:

The numbering system that represents all possible ON/OFF combinations of four bits with sixteen unique digits (0-9 then A-F).

I

Inclusive OR:

A mathematical operation between two bits. The result of the inclusive OR will be a one (ON) bit if either bit is a one bit or both bits are ones; only if both bits are zeros (OFF) will the result be a zero. This operation can be performed between groups of bits with each pair of bits examined by their relative location within each.

Input:

A signal that provides information to the controller; can be either discrete input (pushbutton, relay contacts, limit switches, etc.) or numeric input (thumbwheel, external solid-state device, etc.)

Input Devices:

Devices such as limit switches, pressure switches, push buttons, etc., that supply data to a programmable controller. These discrete inputs can have a common return or an individual return (referred to as isolated inputs). Other inputs include analog devices and digital encoders.

L

Ladder Diagram:

An industry standard for representing control logic relay systems with logic lines representing rungs on a ladder. It expresses the user programmed logic of the controller in relay equivalent symbology.

Ladder Listing:

A hardcopy listing of the user's logic program.

Latch:

The type of coil that is retentive upon power failure. Can be used similar to a latching relay. Normally, coils are reset to OFF conditions upon powerup; those coils selected by the user as latched (L) will not be altered and thus retain their previous condition (ON or OFF).

Logic:

A systematic interconnection of digital switching functions, circuits, or devices, as in electronic digital computers.

Logic Diagram:

A graphic description of logic functions and conditions. It is used to find the result of an addition of the contents of two registers; a logical compare of two matrices; as well as other arithmetic operations.

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Logic Element:

Any one of the elements that can be used in a ladder logic diagram. The elements include relays, coils, shunts, timers, counters, arithmetic functions, and DX functions.

Logic Line:

A line of user logic used to construct the unique logic for the application.

M

Matrix Function:

Matrices are defined as sequential registers, each as 16 bits, up to a maximum of 100 registers (1600 bits). A group of consecutive registers referred to by logic, such that individual bits can be utilized in lieu of numerical values. Bit operations that can be performed include: COMPARE, MODIFY, SENSE, SHIFT, and ROTATE.

Memory:

Storage area for binary data and programs.

Memory Protect:

The hardware capability to prevent a portion of the memory from being altered by an external device. This hardware feature is under keylock control.

Millisecond:

One thousandth of a second.

Move Function:

A DX capability which allows data to be transferred without modification within the controller. Data can be transferred from a register to a table, from a table to a register, or from a table to a table.

N

Network:

A group of logic elements that are connected together to perform a specific function (e.g., a motor starter control circuit).

Node:

The smallest possible programming increment in a ladder logic diagram. (Most logic elements require only one node, others require two or more nodes.)

O

One-Shot:

A discrete reference, typically a logic coil, that is energized (valid) for exactly one scan of the controller's logic.

Output:

A signal provided from the Controller to the "real world"; can be either discrete output (e.g., solenoid valve, relay, motor starter, indicator lamp, etc.) or numeric output (e.g. display of values stored within the controller).

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Output Devices:

Devices such as solenoids, motor starters, etc., that receive signals from the programmable controller.

P

Parity:

Method of verifying the accuracy of recorded data.

Parity Bit:

An additional bit added to a memory word to make the sum of the number of "1's" in a word always "even parity" or "odd parity."

Port:

An I/O connection on a processor or peripheral device.

Preset:

The upper limit specified for a counter or timer function. When the specified preset value is reached, an output is energized indicating the status of a counter or timer.

Program:

A sequence of instructions to be executed by the PC to control a machine or process.

Programmable Controller (PC):

A solid-state control system which has a user programmable memory for storage of instructions to implement specific functions such as: I/O control logic, timing, counting, arithmetic and data manipulation. A PC consists of a central processor, an input/output interface, memory, and a programming device that typically uses relay equipment symbols. PC is purposely designed as an industrial control system that can perform functions equivalent to a relay panel or a wired solid-state logic control system.

Programming Panel (Programmer):

Device for inserting, monitoring, and editing a program in a PC.

R

Ready Light:

A light located on the front of the PC indicating that, when lit, the controller's components are functioning properly.

Reference Numbers:

Numbers which identify the elements of the relay ladder logic. References can be either discrete (logic coils, inputs, or sequencer steps) or register (input or holding).

Register:

A location within the controller allocated to the storage of numerical values. All holding registers are retentive on power failure. There are three types of registers: input whose contents are controlled by the "real world" outside the controller; holding registers whose contents are controlled from within the controller; and output registers, which are special holding registers since their contents can also be provided to the "real world".

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Relay:

An electromagnetic device operated by a variation in conditions of an electric circuit. When so operated, it controls other devices such as switches.

Relay Element:

A logic symbol used to simulate the effect of a relay. Contacts can be normally open, normally closed, or transitional contacts.

Run Light:

A light located on the front of the PC indicating that, when lit, logic is being processed or solved.

S

Scan:

The technique of examining or solving logic networks one at a time in their numeric order. After the last logic network is solved, the next scan begins at network one; logic is always solved in this fixed cyclic process.

Scan Time:

The time it takes to completely execute the entire PC program once.

Skip Function:

This function allows a group of consecutive networks to be skipped or omitted in the scanned logic solution. The status (ON/OFF) of all coils and the contents of registers controlled by these networks are not altered when they are skipped.

T

Table:

A group of consecutive registers used to store numerical values.

Timer:

PC logic used to measure and record the time of an event or sequence of events. Timers can accumulate time in either seconds, tenths of seconds, or hundredths of seconds depending on the PC.

Traffic Cop:

A portion of the PC executive that controls how input and output data is interpreted relative to its channel number and address index position.

Transitional Contact:

A contact which passes power for exactly one scan whenever the coil or discrete input to which it is referenced is switched from OFF to ON, or ON to OFF (depending upon the transitional type selected).

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COURSE DESCRIPTION

ABSTRACT

The 884 controller, system hardware capabilities, installation, troubleshooting, configuration, operation and programming techniques, along with utilization of the P190 programmer are presented. Hands-on programming labs are provided.

AUDIENCE

This course is primarily designed for control systems design or maintenance personnel who desire expertise in 884 programmable control system capabilities, programming and maintenance.

PREREQUISITES

Students should have an understanding of electro-mechanical controls, electrical circuits and basic relay ladder diagrams. Course M100 (Introduction to Programmable Control) is designed to meet these prerequisites.

OBJECTIVES

Provided the prerequisites are met, the student completing this course will be able to implement and maintain the full capability of the 884 system.

The student will be able to install and power-up the system, attach the appropriate I/O and programming device, and also write, input and debug programs using the following programmable control functions:

- Coils and contacts
- Counters, timers and latches
- Standard math functions: add, subtract, multiply, divide, test
- Double precision, signed math; add, subtract, multiply, divide; signed load/unload
- Sequencer and drum control
- Data transfer instructions
- R → T, T → R, BLKM
- Bit handling instructions
  -Bit shift (left, right)
  -Bit sense, Bit modify
- I/O monitoring
- Scan optimizing

The student will be able to troubleshoot systems using the above control functions, recognize fault symptoms, and correct system faults to the following hardware level by replacement of the failed assembly:

- Power Supply
- Controller Module
- Input/Output Module
- Module Housing
- Interconnecting Cable
- User Load Device

TOPICAL OUTLINE

1. Introduction to 884
2. Hardware Identification
3. System Hardware Configuration
4. 884 MODBUS Configuration
5. 884 Theory of Operation
6. P190 Programmer
7. Configuring the 884 PC
8. Introduction to Ladder Logic and Programming
9. Basic Programming Functions
10. Data Transfer (DX) Move and Sequencer Functions
11. Data Transfer (DX) Matrix Functions
12. Special Functions
13. Tape Loader Operations
14. Troubleshooting and Repair

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