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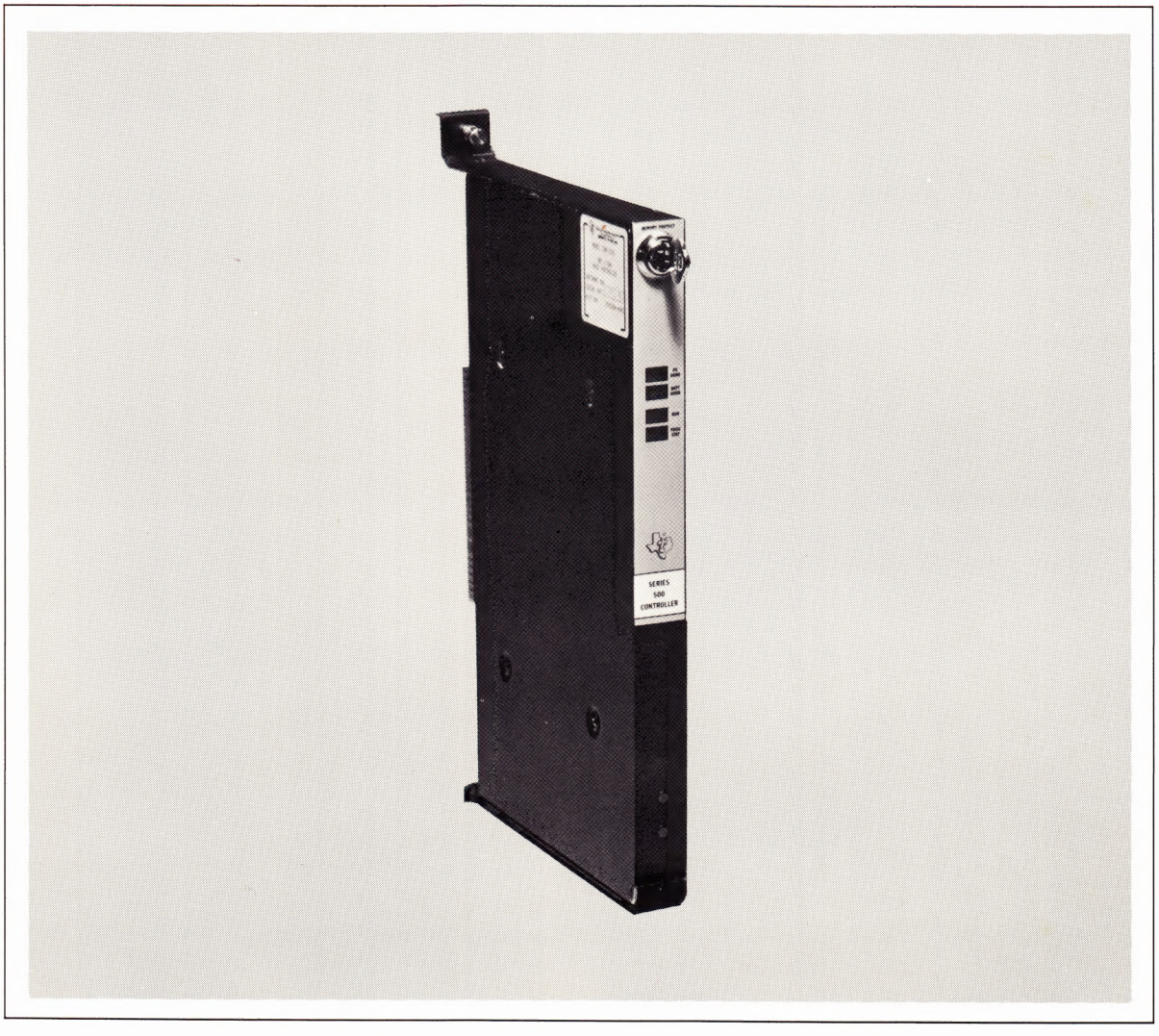
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SERIES 500
520C/530C PROGRAMMABLE CONTROLLER

Original Issue August 1985



Hardware Reference Guide

Manual No. 530-8108

TEXAS INSTRUMENTS

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MANUAL PUBLICATION HISTORY

520C/530C HARDWARE REFERENCE GUIDE
Order Manual Number 530-8108

EVENT	DATE	DESCRIPTION
Original Issue	7/85	Original Issue (2491840-0001)

Refer to this history in all correspondence and/or discussion about this manual.

LIST OF EFFECTIVE PAGES

This publication consists of the following 127 pages.

Page No.	Description	Page No.	Description
Cover/	Original		
Copyright			
History/	Original		
Effective Pages			
i — vi	Original		
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1: INTRODUCTION

1.1 THE 520C/530C PROGRAMMABLE CONTROLLERS

The model 520C/530C is a second generation in the Series 500 family of Programmable Controllers (P/C). In this series, Texas Instruments has designed controllers that use the compiled code method of executing ladder logic programs instead of a separate boolean processor and an interpreter. The ''compiler'' receives the input program and translates it into machine language.

This manual describes the hardware of the 520C/530C series of Programmable Controllers. It contains the following:

- A description of the 520C/530C P/C
- A description of the 520C/530C EPROM Function
- A description of the Power Supply Module
- A description of the Series 500 I/O Modules and Bases
- Installation and Start-up Procedures
- Maintenance and Troubleshooting Procedures

Figure 1-1 shows the main components of the 520C/530C P/C. See table 2-1 for a list of components and their functions.

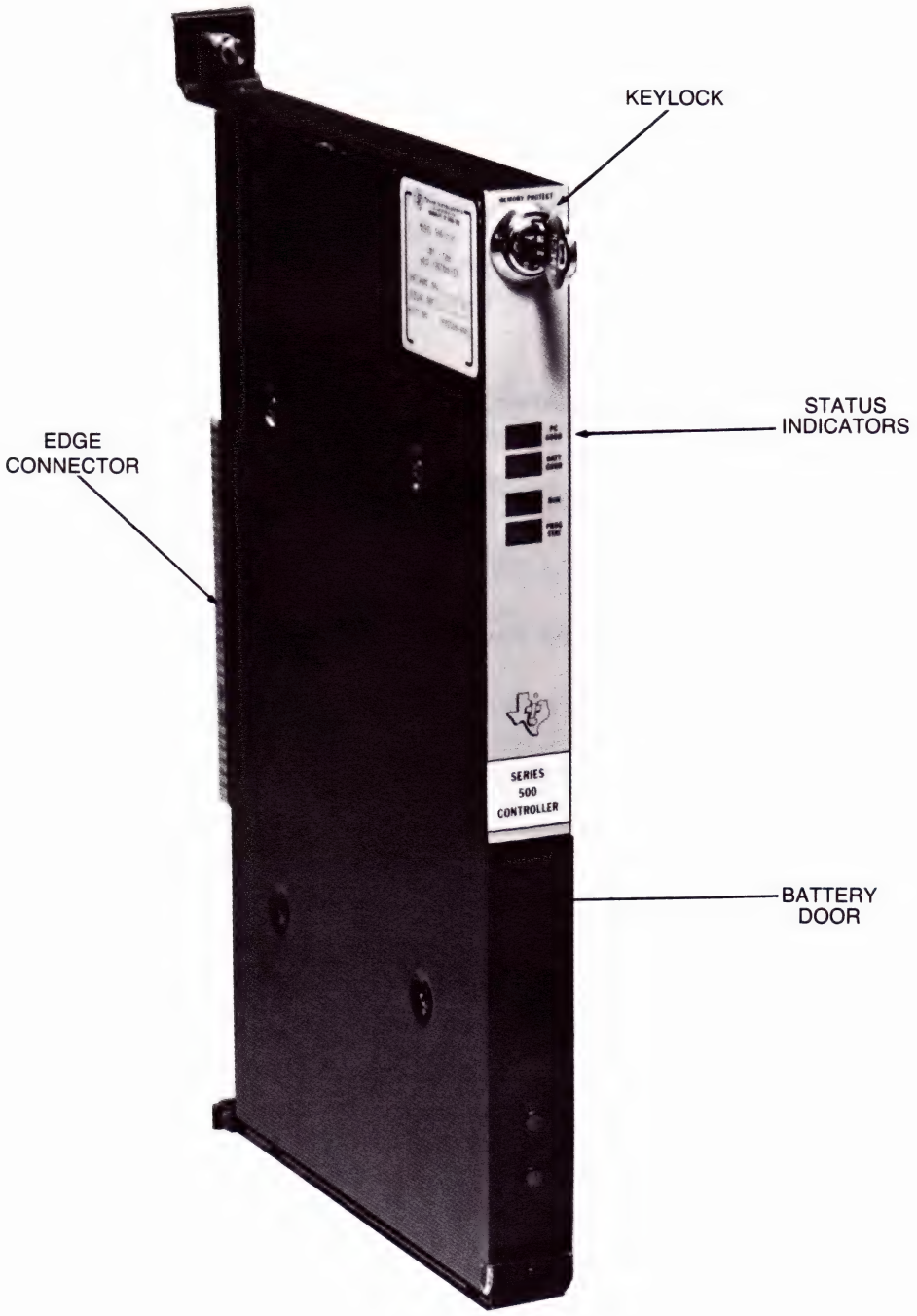
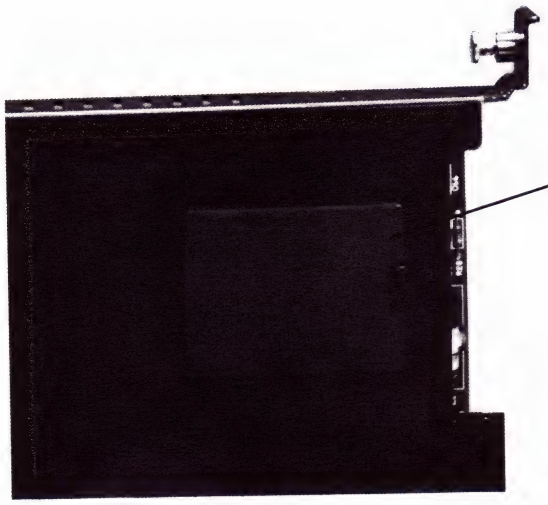
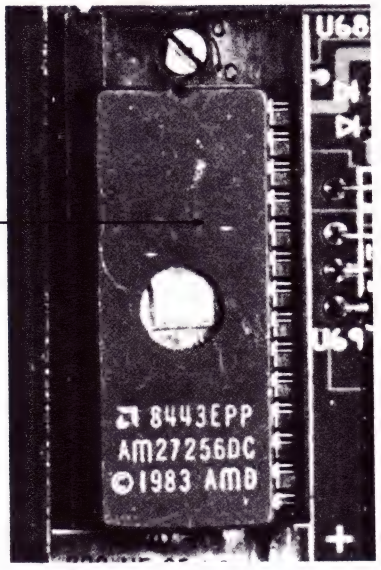
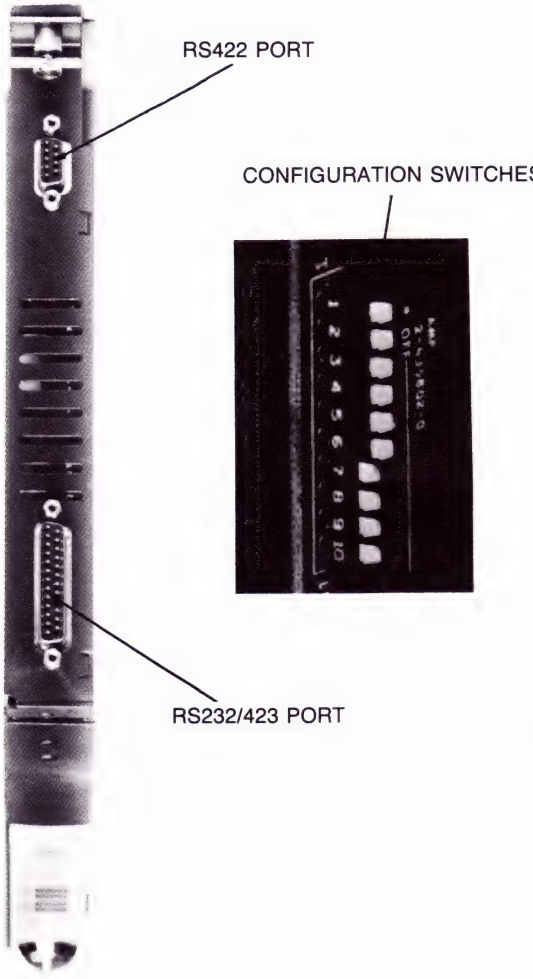


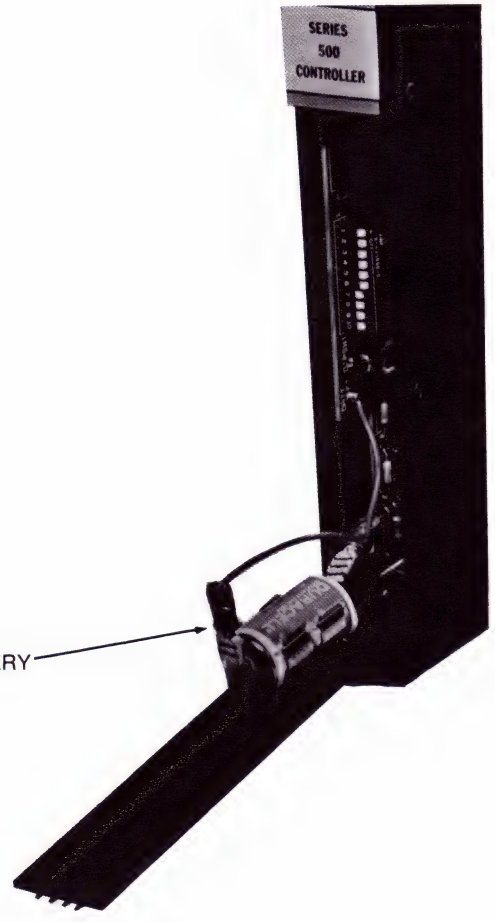
Figure 1-1 520C/530C Main Components


EPROM
DOOR


EPROM
SOCKET
U68
U69
8443EPP
AM27256DC
©1983 AMD


RS422 PORT
RS232/423 PORT

CONFIGURATION SWITCHES


SERIES
500
CONTROLLER
BATTERY

Other manuals that should be referenced along with this manual are listed below:

- 520/530/520C/530C VPU200 PROGRAMMING GUIDE (manual no. 530-8109)
- 520/533/520C/530C PROGRAM DESIGN GUIDE (manual no. 530-8110)

2: 520C/530C PROGRAMMABLE CONTROLLER

2.1 INTRODUCTION

The following section describes the Model 520C/530C P/C. It includes a definition of the P/C, a listing and description of the P/C components and functions, as well as a specification table for the P/C. This section is designed to aid the personnel responsible for installing, programming, and/or operating a Model 520C/530C P/C.

This section is divided into the following categories:

- P/C Basics and Specifications
- Indicators
- P/C Switches
- P/C Memory
- Status Words
- Program Entry
- Program Execution

Table 2-1 lists the illustrated components of the 520C/530C and their functions.

Table 2-1 The 520C/530C Components and Functions

Components	Functions
Battery Door	Provides easy access to battery and configuration switches as well as the EPROM programmer toggle switch.
Battery	Protects P/C from memory loss during power failure (type A Mercury Cell Battery, NEMA 1200M).
RS232/423 Communications Port	Provides connection to Video Programming Unit (VPU) or other 520C/530C peripherals.
RS422 Communications Port	Provides connection for CVU 5000 at extended distances. Not available on the 520C-1101.
Configuration Switches	Provide switches to: turn battery on or off retain or download preset values, select communication baud rates, and to select the highest numbered I/O base to be accessed.
EPROM Door	Provides access to the EPROM.
EPROM Socket	Provides socket for user-supplied EPROM.
Keylock	Protects user program from unauthorized changes.
Status Indicators	When lit, indicate that the P/C is operating without diagnosing a fatal error, battery voltage is sufficient to protect memory, P/C is in RUN Mode, and indicates current status of the EPROM programmer.
Edge Connector	Provides connection to the local I/O base assembly.

2.1.1 P/C Definition.

The P/C is a microprocessor-based controller for solving relay ladder logic functions. It's program design contains a set of 45 instructions which are discussed in detail in the 520/530/520C/530C PROGRAM DESIGN GUIDE (manual no. 530-8110). The P/C communicates directly with the Series 500 I/O system and a programming device.

The model 520C/530C programmable controllers are a second generation in the Series 500 group. The main characteristic that differentiates these P/Cs from the 520/530 models is the use of the compiled code method of executing ladder logic programs instead of a separate boolean processor and an interpreter. This method allows for features in the 520C/530C that include the ability to accommodate high density input and output modules and greatly reduce panel space requirements. These P/Cs (except for the 520C-1101) also have the capability to download a program from RAM into an EPROM internally, without the use of a separate EPROM burner. There are two models of the 520C and three models of the 530C. Table 2-2 lists the features of the five versions of the 520C/530C.

Table 2-2 520C/530C P/C Features.

FEATURE	520C MODELS		530C MODELS		
	1101	1102	1104	1108	1112
Physical I/O Points	512 (Local Only)*		1023 (Local/Dist)		
RS232/423 Ports	1				
RS422 Port	0	1			
Timers/Counters	60	128		256	400
Drum Instruction	15	30			
One Shot Instr.	60	128		256	400
Bit Shift Regs./ Word Shift Regs. Instr.	15	30	45	60	75
Shift Stages	1023				
Move Word to Table/Move Word from Table Instr.	15	30	45	60	75
Jump (Nested)	8				
Master CR (Nested)	8				
Skip Forward to Label Instr.	16	255			

* The 512 Physical I/O Points for these two models are for a system that uses 32-point modules in an adapted Series 500 16-slot base. In a system that uses 32-point modules in a Model 500-5848 base, the physical I/O points would be equal to 448.

Figure 2-1 illustrates the 520C/530C P/C system.

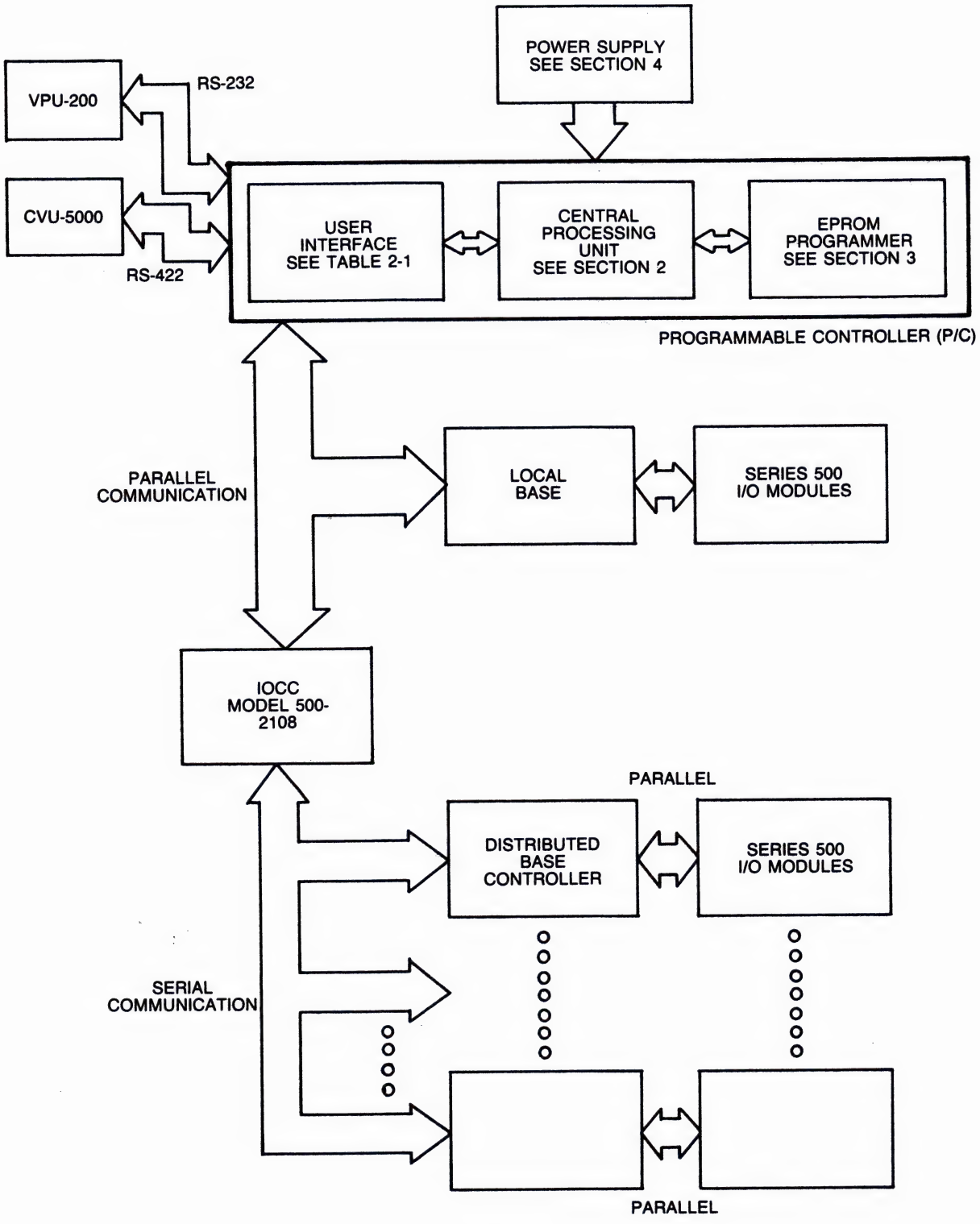


Figure 2-1 520C/530C System Block Diagram

2.2 Functional Description

The P/C is the decision maker of the 520C/530C system. It accepts and stores programs in memory, then executes a program to control the system according to your design. The P/C compares electrical inputs from controlled devices and sensors with the programmed instructions. Then the P/C produces the electrical outputs which control these devices. The entry, storage, and execution of your program is detailed later in this section. The 520/530/520C/530C PROGRAM DESIGN GUIDE and the 520/530/520C/530C VPU200 PROGRAMMING GUIDE lead you through a detailed description of programming.

2.2.1 Specifications.

Table 2-3 lists the specifications for the 520C/530C and a summary of controller operations.

SPECIFICATIONS	
INPUT POWER (Supplied by Power Supply Module, Model 500-2151)	
Input Voltage Requirements	+5 VDC and −5VDC
Voltage Range	+2 % of +5VDC/−5VDC (11 watts/+5VDC, 0.3 watts/-5VDC)
Maximum Power	11.3 watts
ENVIRONMENTAL Operating Temperature	0°C to 60°C (32°F to 140°F)
Relative Humidity	5% to 95% noncondensing
Vibration	NAVMAT P9492, Navy Mfg. Screening Program
Immunity to Electrical Interference:	
Conducted:	NEMA ICS 2-230.45, IEEE 472 MIL STD-461A;CS01,CS02,CS06 FCC Docket 20780, Class A
Radiated:	MIL STD-461A;RS01,RS02,RS03 FCC Docket 20780, Class A
MECHANICAL	
Dimensions	36.8 cm H × 2.8 cm W × 21.9 cm D (14.5 in. H x 1.1 in. W x 8.6 D)
Weight	Maximum 8.8 kg (4 lb)
USER MEMORY	
Capacity	1K to 12000 words of ladder memory, depending on the model. See Table 2-5.
Options	EPROM ladder memory capacity is equal to ladder memory capacity of 520C/530C model, see Table 2-5. Memory/Feature capacity may be increased with upgrade kits.
Scan Time (nominal)	See Scan Time Table in the Program Design Guide.

SUMMARY OF CONTROLLER OPERATIONS

CONTROLLER VARIABLE

MODES	DISCRETE IR IN	DISCRETE IR OUT	WORD IR IN	WORD IR OUT	CONTROL RET	RELAY N RET	TMR/CTR DRUM PRESETS
POWER UP COLD START	RESET	RESET	NOTE 1	NOTE 1	NOTE 1	RESET	NOTE 2
COMPLETE WARM START	RESET	RESET	RESET	RESET	RESET	RESET	DOWN-LOAD
PARTIAL HOT START	RESET	RESET	No CHANGE	NO CHANGE	NO CHANGE	RESET	NO CHANGE
PROGRAM	FOLLOW INPUTS	NO CHANGE	FOLLOW INPUTS	NO CHANGE	NO CHANGE	NO CHANGE	N/A
RUN	FOLLOW INPUTS	PROGRAM CONTROL	FOLLOW INPUTS	PROGRAM CONTROL	PROGRAM CONTROL	PROGRAM CONTROL	N/A

NOTE 1 = No change if the battery is good, otherwise reset.

NOTE 2 = Dependent on user selectable switch, memory type, and battery condition.

2.3 INDICATORS

The 520C/530C P/C has four status indicators located as illustrated in Figure 2-2. The following list defines the indicators.

PC GOOD — lights if P/C is operating without diagnosing a fatal error.

BATTERY GOOD — lights if battery voltage is sufficient to back-up memory and battery switch is on.

RUN MODE — lights if P/C is in Run Mode.

EPROM PROGRAMMER STATUS — indicates EPROM programmer operation and result of EPROM programming.

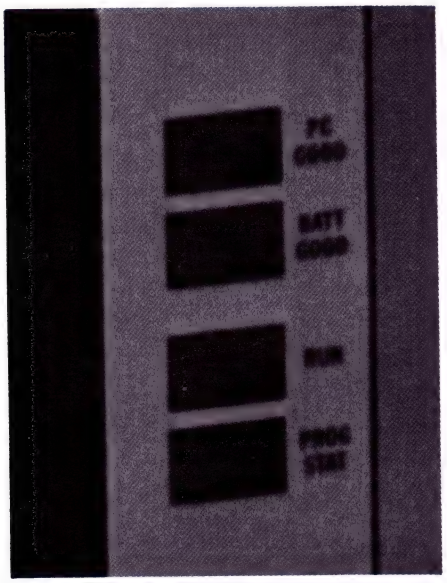


Figure 2-2 520C/530C Status Indicators

In addition to these indicators, there is a keylock switch located at the top of the P/C. This lock is provided to ensure protection of your program. When the key is in the MEMORY PROTECT ON position, you cannot change a program using a programming device that connects through the communication ports on the P/C. The keylock switch does not provide protection if the programming device uses a communication port on a module that is attached to an I/O base. The keylock only protects your program; it does not prevent forcing I/O, changing variable memory or switching the P/C from PROGRAM to RUN Mode.

2.4 P/C SWITCH SETTINGS

As illustrated in Figure 2-3, there are ten switches (numbered 1 through 10) located inside the P/C battery door. If an individual switch is all the way to the right side of the switch, then the switch is set in the ''OFF'' mode. If the switch is resting against the left side of the switch toward the numbers, then the switch is set in the ''ON'' mode.

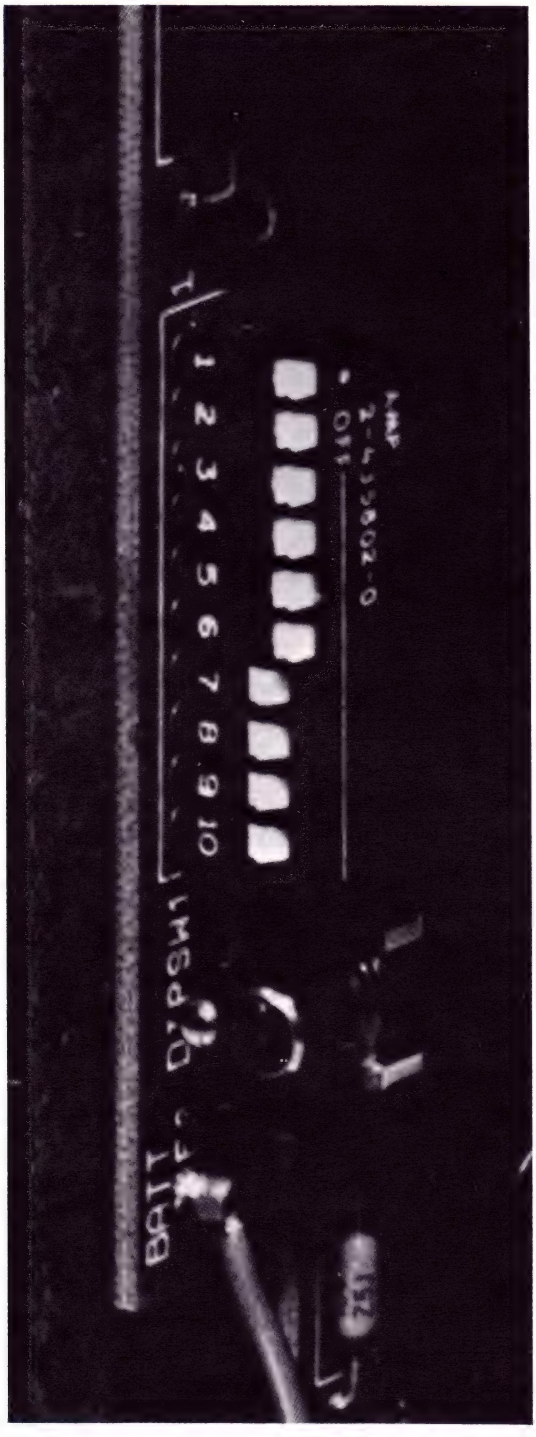


Figure 2-3 520C/530C Configuration Switches

Table 2-4 lists the configuration switches and their functions.

Table 2-4 Configuration Switches and Functions

SWITCH POSITION	ASSIGNMENT	FUNCTION/STATUS
1	Battery Status	Closed = On = Battery Back-up Enabled Open = Off = Battery Back-up Disabled
2	Download Presets	Closed = On = Retain Presets Open = Off = Download Presets
3,4	RS232 Baud Rate	Selects the Communication Baud Rate (Baud Rate Status defined below)
5,6	RS422 Baud Rate	Selects the Communication Baud Rate
7,8 9,10	I/O Configuration	Selects the highest numbered base to be used (Defined Below)

SWITCH POSITIONS

Both Communication Port Baud Rates are as follows:

RS232 PORT

BAUD RATES	SWITCH 3	SWITCH 4
9600	ON(closed)	ON(closed)
2400	OFF(open)	ON(closed)
1200	ON(closed)	OFF(open)
300	OFF(open)	OFF(open)

RS422 PORT

BAUD RATES	SWITCH 5	SWITCH 6
9600	ON(closed)	ON(closed)
2400	OFF(open)	On(closed)
1200	ON(closed)	OFF(open)
300	OFF(open)	OFF(open)

The I/O Configuration Switches are defined as follows:

SWITCH #	10	9	8	7
BASE 0	0	0	0	0
BASE 1	0	0	0	1
BASE 2	0	0	1	0
BASE 3	0	0	1	1
BASE 4	0	1	0	0
BASE 5	0	1	0	1
BASE 6	0	1	1	0
BASE 7	0	1	1	1
BASE 8	1	0	0	0
BASE 9	1	0	0	1
BASE 10	1	0	1	0
BASE 11	1	0	1	1
BASE 12	1	1	0	0
BASE 13	1	1	0	1
BASE 14	1	1	1	0
BASE 15	1	1	1	1

Indicates the Highest Numbered I/O Base for the P/C to Access.

0 = ON = Closed

1 = OFF = Open

2.5 P/C MEMORY

The 520C/530C P/C contains memory that is used for the operation of the programmable controller. This memory is divided into two main sections: operating system memory and user memory. The operating system memory contains information that monitors the program and is not open to user control or access.The user memory is space that is reserved for you to use in order to control your system. This section is limited to a discussion of the user memory. Storage space is provided for the status of the process being monitored, and the specific amount of space allocated varies according to the model in question. For a detailed breakdown of the user memory, refer to Table 2-5.

Table 2-5 520C/530C P/C Memory.

FEATURE	520C MODELS		530C MODELS		
	1101	1102	1104	1108	1112
Ladder Logic Memory Words	1024	2048	4096	8192	12000
I/O Table Words	256				
Variable Memory Words	512	1024	2048	4096	5120
Discrete X/Y Image Register (IR) Points	1023 points (64 words)				
Word WX/WY IR Points	1023 points (1023 words)				
X/Y Force Points	1023 points (64 words)				
WX/WY Force Points	1023 points (64 words)				
Non Retentive Control Relay (C) IR Points	127 (C1 thru C127)/ 8 words	255 (C1 thru C255)/ 16 words			511 (C1 thru (C511)/ 32 words
Retentive Control Relay (C) IR	128 (C128- C255)/ 8 words	256 (C256 - C511)/ 16 words			512 (C512- C1023)/ 32 words
Control Relay Force Points	255/ 16 words	511/ 32 words			1023/ 64 words
Timer Counter Preset Words	60 words	128 words		256 words	400 words
Timer Counter Current Words	60 words	128 words		256 words	400 words
Drum Step Preset Words	15 words	30 words			
Drum Step Current Words	15 words	30 words			
Drum Counter Preset Words	240 words	480 words			
Drum Counter Current Words	15 words	30 words			
Status Words	11 words		18 words		
Total User Memory	3455 words	5444 words	8523 words	14923 words	20107 words

One feature of the Series 500 520C/530C P/Cs that deals with user memory is the ability to map the physical I/O points of your system into the Image Register (IR). This way you can assign the physical I/O points any number you wish. The only restriction is in the first I/O base. The first addressable I/O slot is the third slot. Bases 5892-5848 are wired so that the first two slots are automatically assigned to the power supply module. Therefore, numbering starts with the first point of the third slot.

With bases 5864-5828, the adapter base 5840 holds the P/C, power supply and Input/Output Channel Controller (IOCC), leaving you 8 and 16 slots for I/O modules.

If your system includes an IOCC, it takes the first slot with the power supply taking slots 2 and 3. The 530C models will default and number the points in the third slot as 1 through 8 even though they are unaccessible. In this case the first addressable I/O point will be 9. The P/C will default to a sequential numbering system and will not recognize any high density I/O modules if you fail to assign I/O addresses.

In the default sequential numbering system, the P/C assumes that all of the I/O module slots contain 8 I/O points. The P/C numbers the I/O points consecutively starting with the first point in the third slot in the first base. The local base assembly to the P/C is designated as base 0 and base 1. Base 0 contains slots 1 through 8 (I/O points 1 through 64); base 1 contains slots 1 through 8 (I/O points 65 through 128).

_.5.1 Image Registers.

The Series 500 520C/530C P/Cs contain areas in memory called Image Registers. Image Registers are areas of memory that contain a copy of the status of all of the inputs and outputs that the P/C controls in order to keep track of the process being monitored. The 520C/530C provide both discrete and word image registers; these are discussed in the following paragraphs.

2.5.1.1 Discrete Image Register.

The Discrete Image Register (Figure 2-4) provides a single-bit storage location for the status of each discrete input (X) and discrete output (Y) in a program. Storage space is provided for the status of 1023 discrete I/O points. Inputs (Xs) and outputs (Ys) with the same number use the same discrete image register status bit. Unused discrete I/O points (points with no corresponding discrete I/O module), may be used as non-retentive control relays.

NOTE

Any unused discrete I/O used as a control relay must be labeled as an output (Y).

2.5.1.2 Discrete Force Register.

The Discrete Force Register (Figure 2-4) is the actual memory location that is responsible for executing the forcing or unforcing of each discrete input (X) and output (Y). The register provides single-bit storage for the force (forced or unforced) status of each discrete input and output. Storage space is provided for the force status of 1023 discrete points. Bear in mind that if you number your I/O points and use the same number for more than one point, if you force one point, you force all of the points that share that number. For information and descriptions of forcing and unforcing I/O points, refer to the 520/530/520C/530C PROGRAM DESIGN GUIDE.

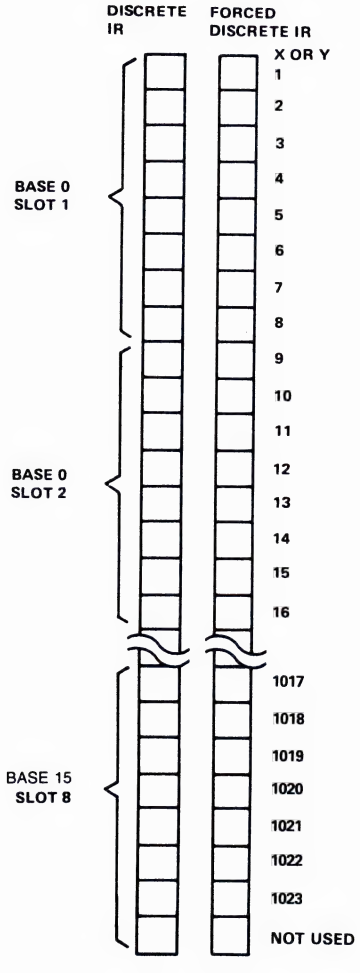


Figure 2-4 Default Discrete and Forced Image Registers

2.5.1.3 Word Image Register.

The Word Image Register (Figure 2- 5) provides a storage location for the value of each word input (WX) and word output (WY) in the user program. Storage space is provided for the values of 1023 word I/O points. Unused word I/O points (points with no corresponding analog or word I/O module) may be used as scratch memory.

NOTE

Any unused Word IR location used as scratch memory must be labeled as the appropriate WX or WY of that location.

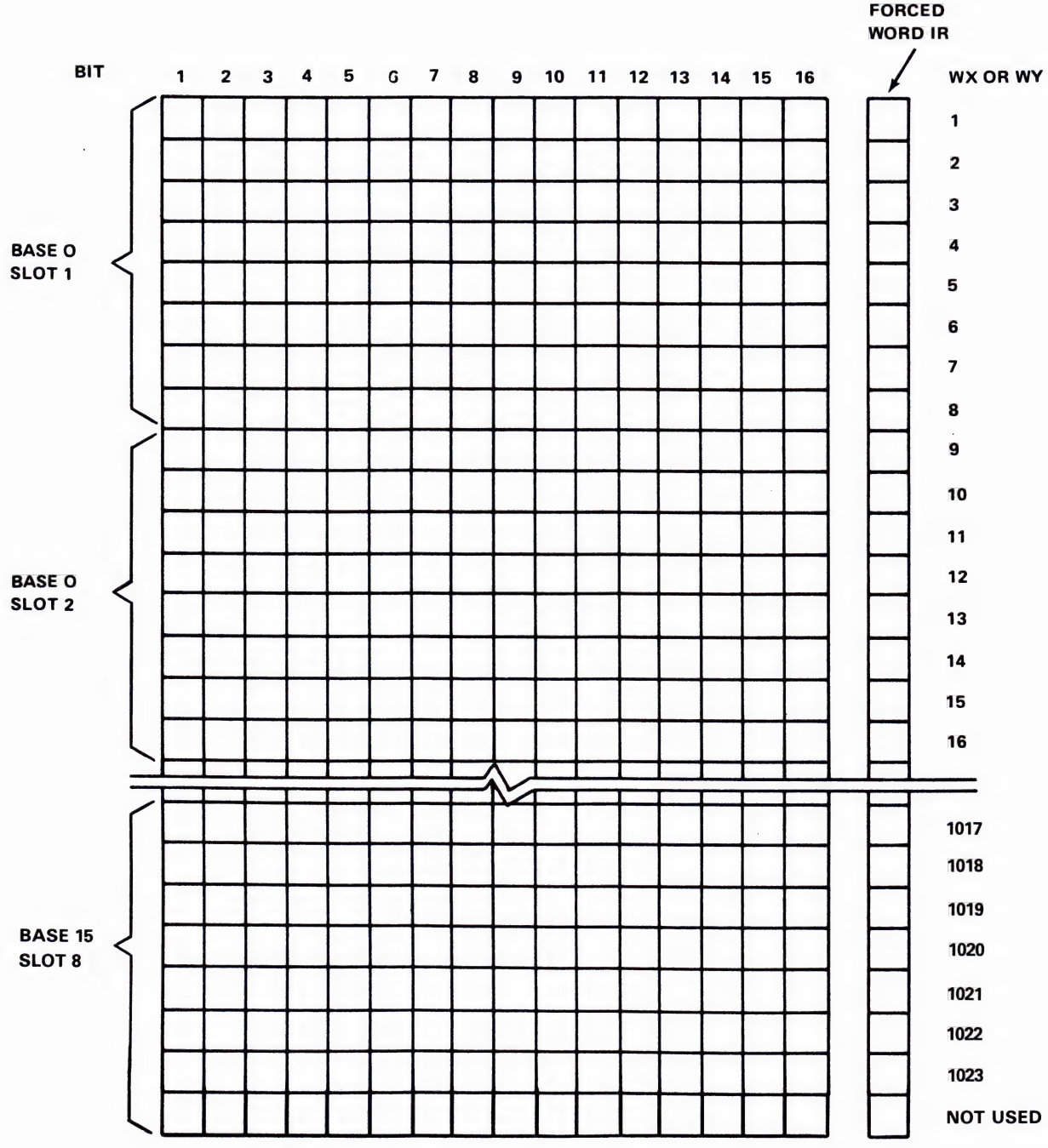


Figure 2-5 Default Word and Forced Word Image Registers

2.5.1.4 Word Force Register.

The Word Force Register (Figure 2-5) provides a single-bit storage location for the force status (forced or unforced) of each word input (WX) or output (WY). Storage space is provided for 1023 I/O force points.

Word I/O locations are forced to specific values, not on or off. If a word I/O point force status is "ON " or "FORCED", then the word retains its value and cannot be changed until unforced. See the Program Design Guide for descriptions of forcing and unforcing.

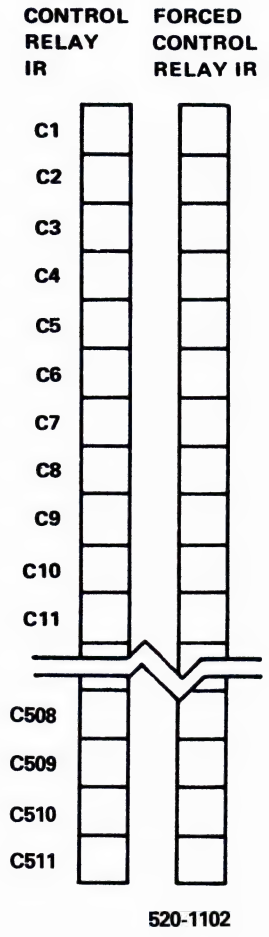


Figure 2-6 Default Control Relay and Forced Control Relay Image Registers

2.5.1.5 Control Relay (C) Image Register.

The Control Relay Image Register (Figure 2-6) provides a single-bit storage location for the status of each control relay (C). The specific number of control relays depends on the model you are working with and is listed in the Features table (see Figure 2-5).

There are two types of control relays; retentive and non- retentive. Non-retentive control relays are cleared of all values when the scan is interrupted by a P/C power cycle unless they have been forced. If forced, they retain

their current status when the scan was interrupted. Retentive control relays assume the status that they had at the end of the last completed scan before the P/C lost power.

2.5.1.6 Control Relay Force Register.

The Control Relay Force Register provides a single-bit storage location for the force status (forced or unforced) of each control relay (C). Storage space is provided for the force status of all of the control relays.

2.5.2 Drums and Timer/Counters.

There is a set number of drums and timer/counters for your particular 520C/530C model. You may have any combination of drums/event drums as long as the combined amount does not exceed the amount designated for your model. This is also true for timer/counters. Refer to Table 2-5 to find the number of drums and timer/counters designated for your model. The following paragraphs describe the operation of the drums and timer/counters. Drums/event drums assigned the same number use the same memory location and timer/counters assigned the same number use the same memory location. Unused storage locations can be used as additional scratch memory.

2.5.3 Preset Value Storage.

The drum and timer/counter memories have reserved sections of memory where preset times and counts are stored as words outside of the ladder logic program space. The storage space provided for the drum and timer/counter presets depends on the 520C/530C model you are programming and is listed in Table 2-5.

Presets are ''downloaded'' (transferred from program memory to preset memory) under the following conditions:

- ''Cold'' start with battery back-up and download switch on.
- ''Cold'' start with EPROM program memory and no battery back-up.
- ''Warm'' start.
- The first scan (for newly programmed drums/event drums/ timers/counters.)

2.5.3.1 Drum Step Preset (DSP) Storage.

The DSP (Figure 2-7) storage area provides a storage location used to store a preset step position (number) for each drum and event drum instruction. The preset steps can only be numbered from 1 to 16.

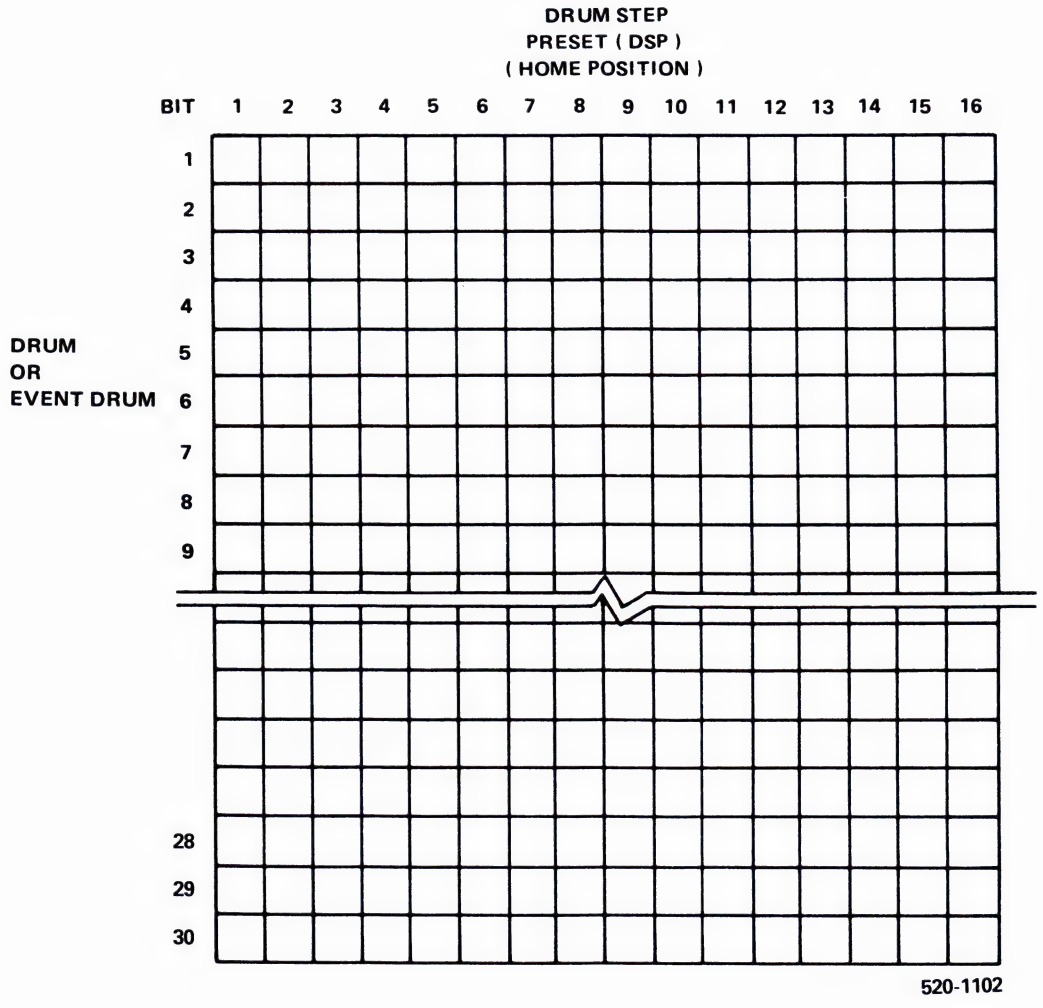


Figure 2-7 Drum Step Preset (DSP) Memory Map

2.5.3.2 Event Drum Count Preset (DCP) Storage.

The DCP (Figure 2-8) memory provides a count preset storage location for each DCP value. Storage is provided for 16 steps of the event drum instructions.

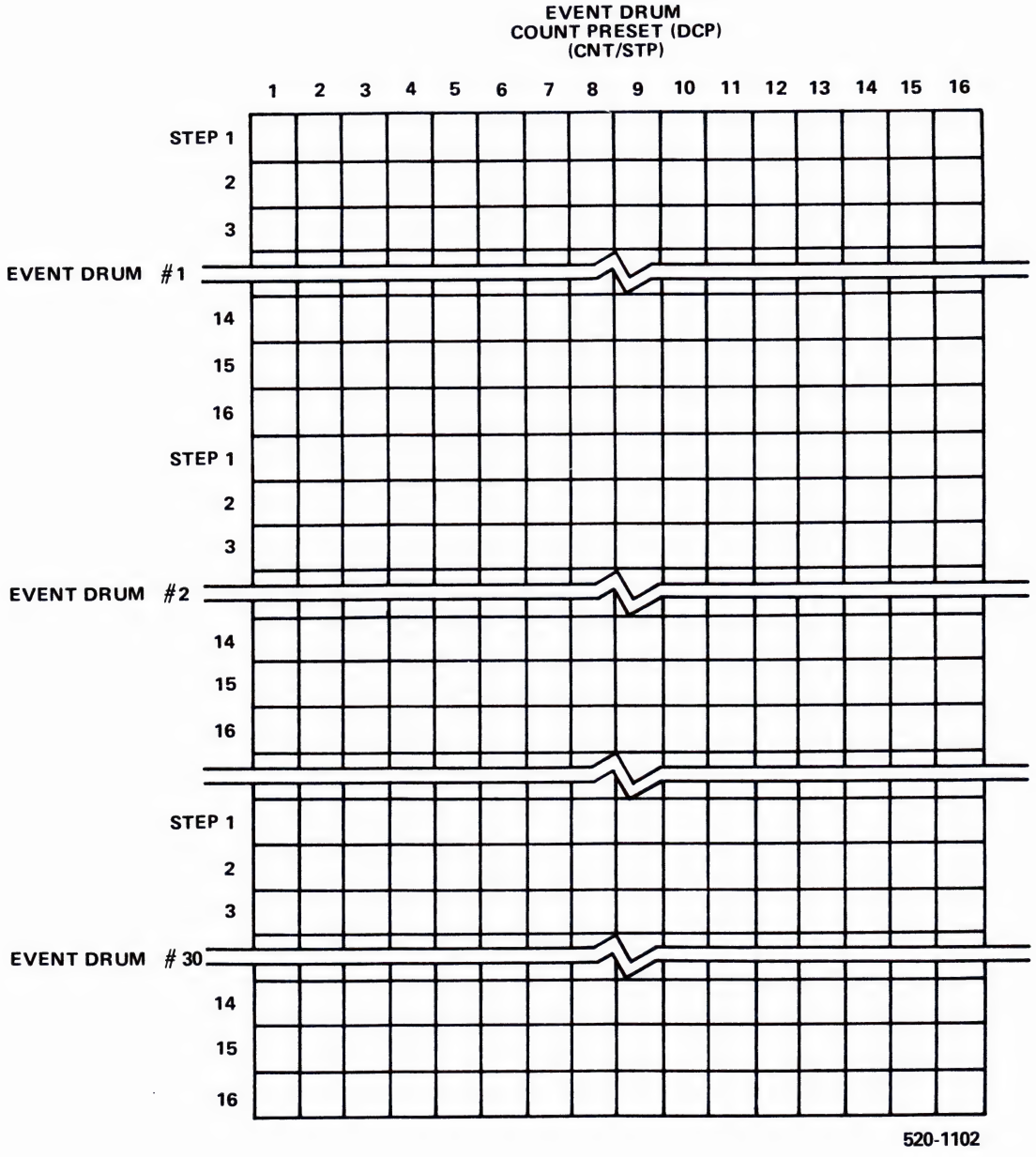


Figure 2-8 Event Drum Count Preset (DCP) Memory Map

2.5.3.3 Timer/Counter Preset (TCP) Storage.

The TCP (Figure 2- 9) memory provides a storage location for each preset value. Storage space is provided for the preset value (1 to 32,767) for each timer or counter in the program.

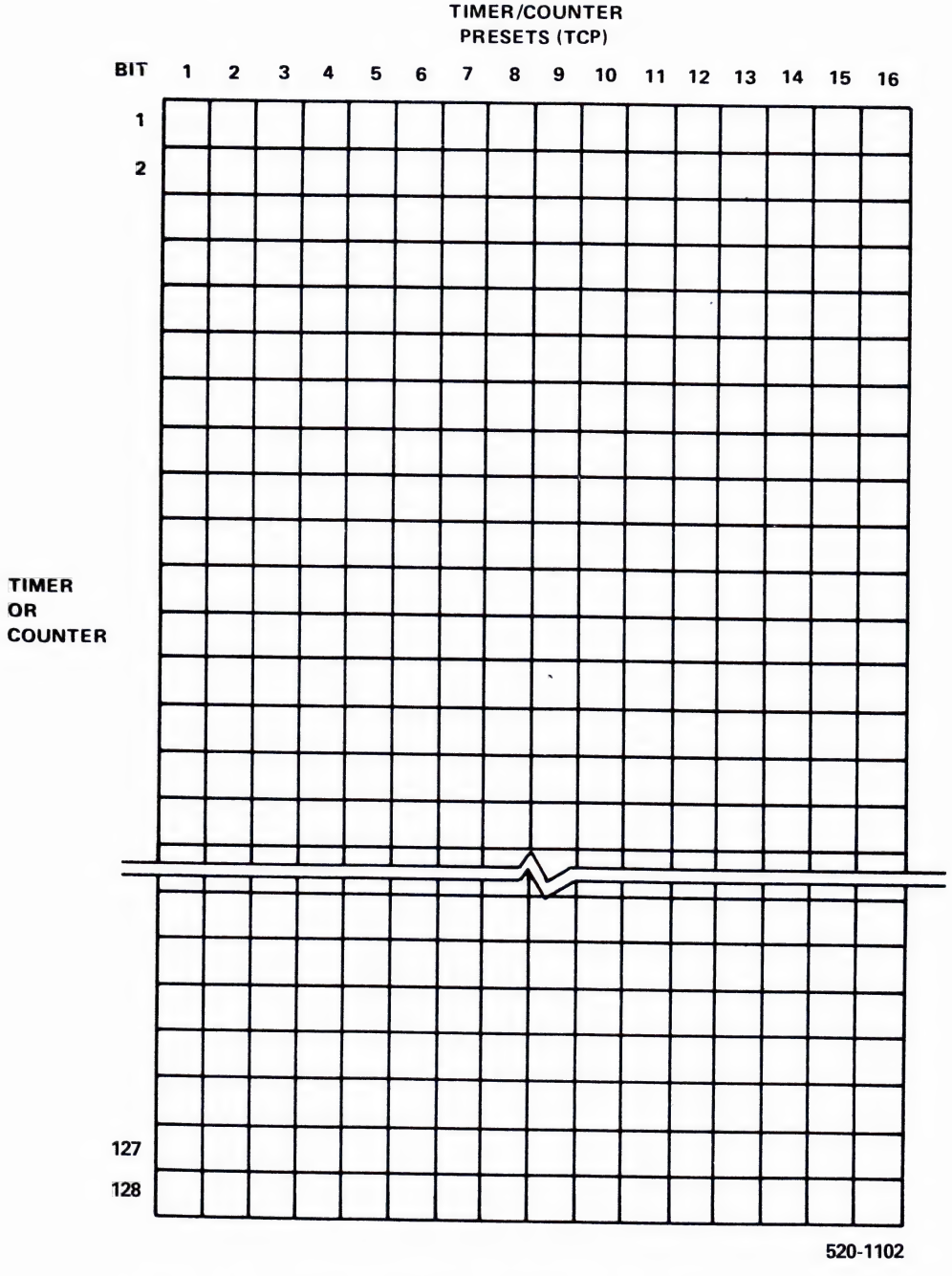


Figure 2-9 Timer/Counter Preset (TCP) Memory Map

2.5.4 Current Value Storage.

Besides the preset value storage, the drum and timer/counter have current memories which are reserved sections of memory where current count and time values are also stored as words outside of ladder logic program space. The following paragraphs describe the operation of each.

2.5.4.1 Drum/Event Drum Step Current (DSC) Storage.

The DSC (Figure 2-10) memory provides storage for the current step number for each drum instruction (or event drum instruction or any combination) contained in your program. The contents of each DSC memory location can only be a number from 1 to 16.

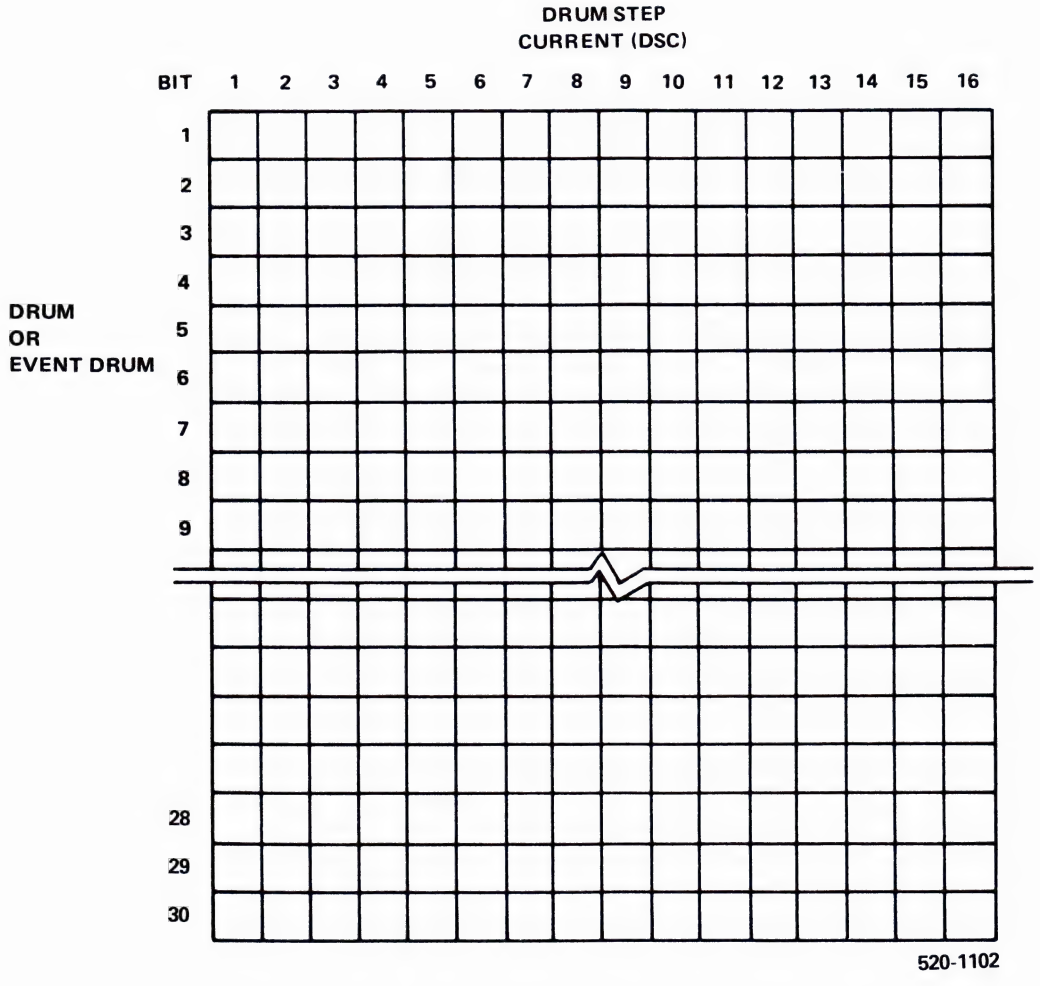


Figure 2-10 Drum Step Current (DSC) Memory Map

2.5.4.2 Drum/Event Drum Count Current (DCC) Storage.

The DCC (Figure 2-11) memory provides storage for the current value of the drum timer for each drum instruction, event drum instruction or any combination of the two.

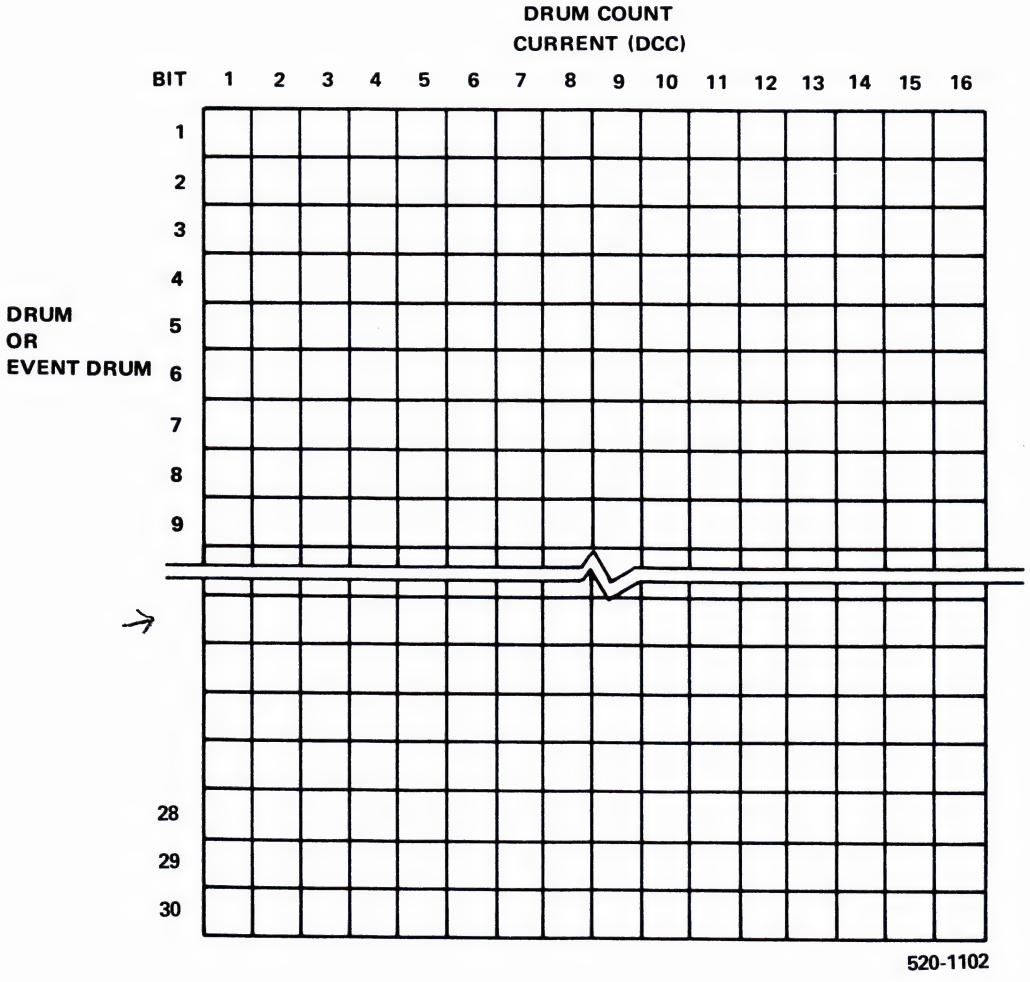


Figure 2-11 Drum Count Current (DCC) Memory Map

2.5.4.3 Timer/Counter Current (TCC) Storage.

The TCC memory provides a storage location for the current value of the timer or counter as it executes in the program.

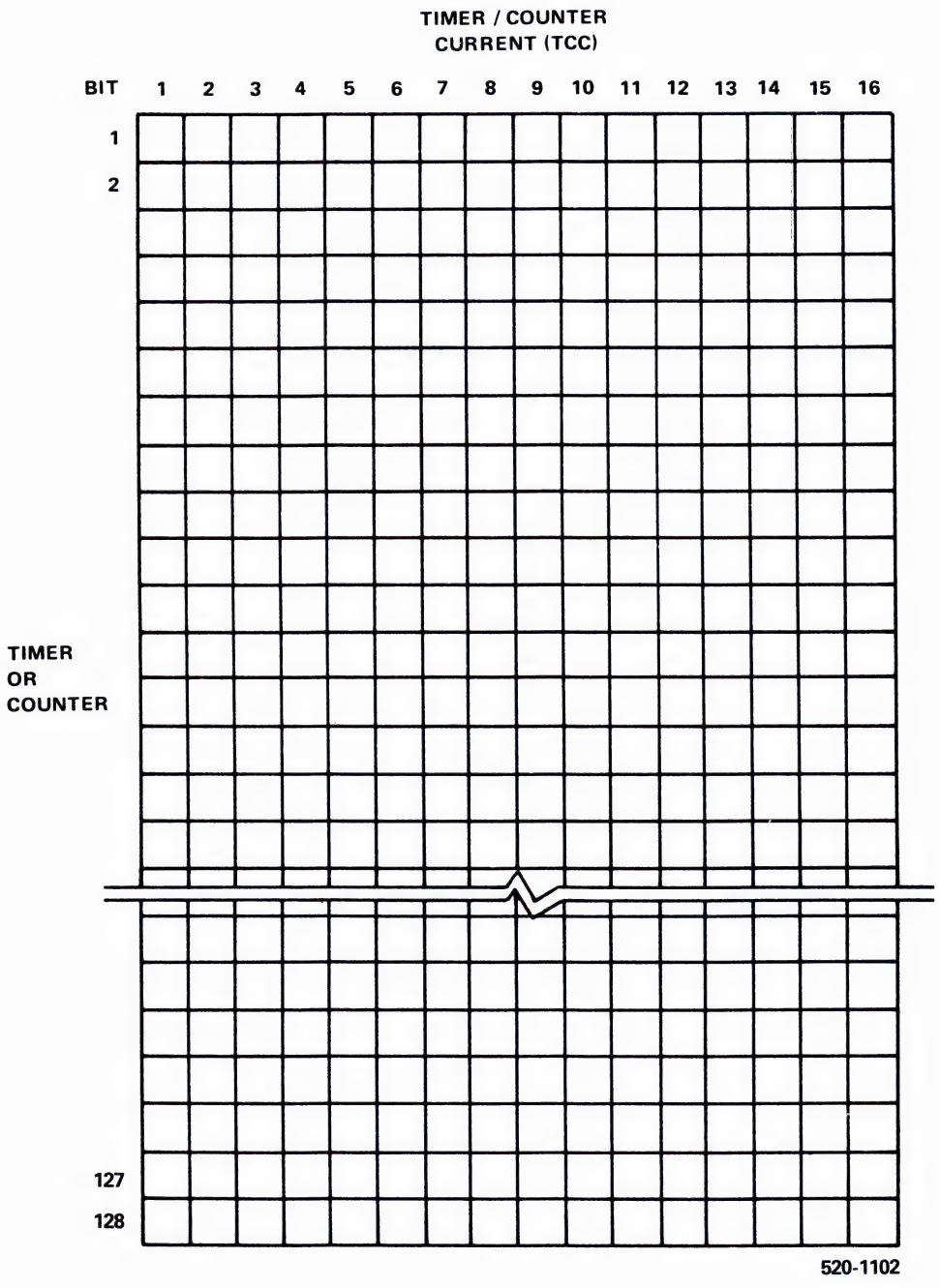


Figure 2-12 Timer/Counter Current (TCC) Memory Map

2.6 STATUS WORDS

Each Series 500 520C/530C P/C is equipped with status words that contain essential information about the P/C, I/O modules and the bases. Status words 1 through 18 are available for the 530C models and status words 1 through 11 are available for the 520C models. Of these status words, 03, 04, and 05, are not used by the system. The following paragraphs describe each of these status words.

2.6.1 Status Word One (STW01).

STW01 provides information in the format shown in Figure 2-13.

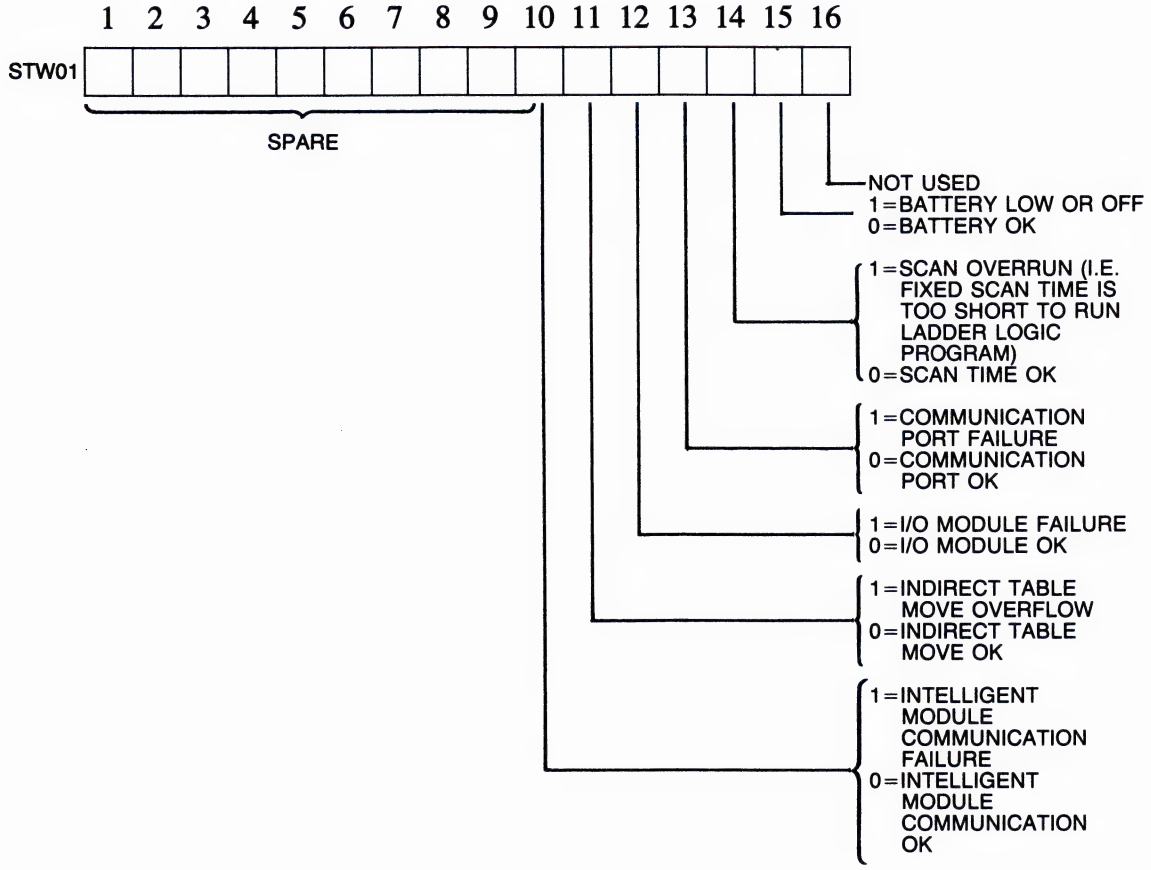


Figure 2-13 Status Word 01

As Figure 2-13 illustrates, STW01 shows the status of the P/C battery, scan, communication port, I/O modules, indirect table moves, and special function modules by indicating either a 1 or 0 in the corresponding bit position.

2.6.2 Status Word Two (STW02).

As illustrated in Figure 2-14, STW02 shows the status of up to 16 bases. From right to left, each bit represents a base (from 0 to 15). STW02 indicates a 1 in the corresponding bit position if a base fails or is not present or a 0 if a base is good.

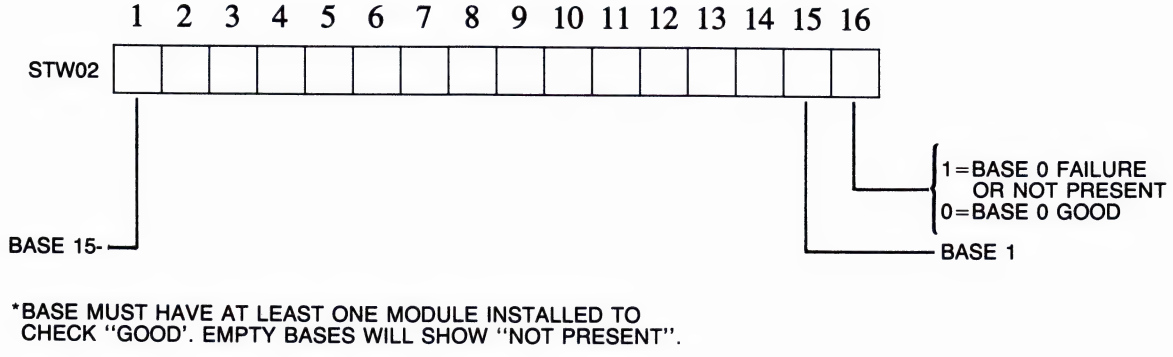


Figure 2-14 Status Word 02

2.6.3 Status Word Six (STW06).

STW06 shows the status of EPROM programming information when the EPROM programmer is invoked. Only one bit at a time is set with a message. Figure 2-15 illustrates the status information found in STW06.

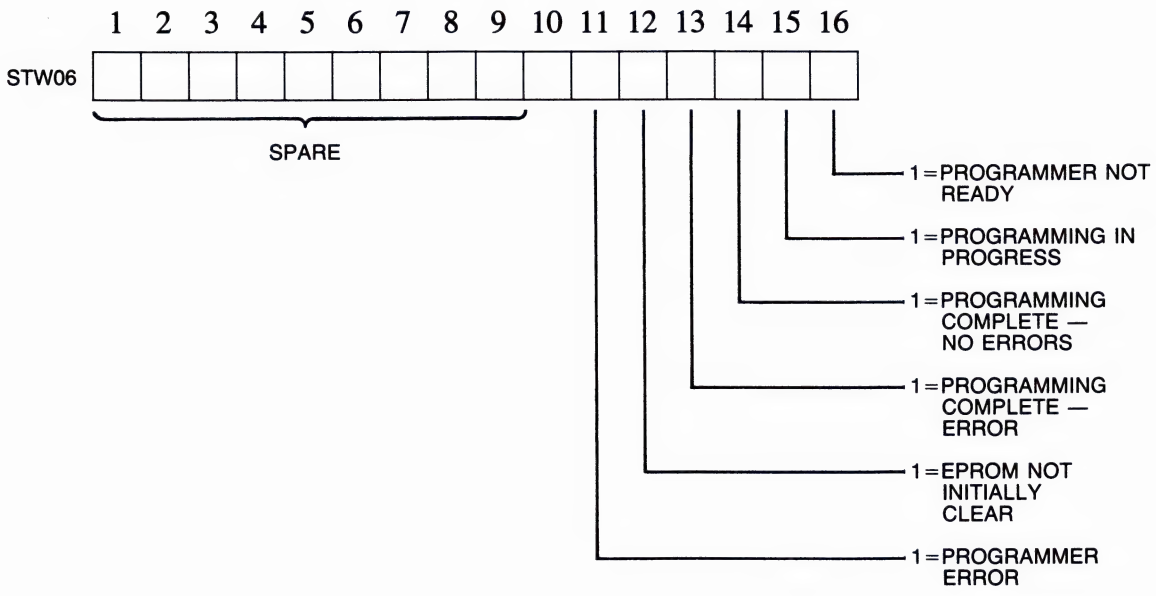


Figure 2-15 Status Word 6

STW06 contains the EPROM programming error status.

2.6.4 Status Word Seven (STW07).

STW07 gives the absolute address of the first error encountered while attempting to program the EPROM. The value given is the memory address of the EPROM memory.

2.6.5 Status Word Eight (STW08).

STW08 shows the checksum generated from your ladder logic program that was stored in EPROM. The checksum is a numerical representation of the sum of the data in your ladder logic program. This number is unique and serves as a way to identify your program.

2.6.6 Status Word Nine (STW09).

STW09 shows the checksum generated from the EPROM. The checksum is a numerical representation of the sum of all the data stored in your EPROM. The sum includes what is contained in your ladder logic program combined with information contained in the I/O table memory. This number, like STW08, is unique and serves as a way to identify your EPROM.

2.6.7 Status Word Ten (STW10).

STW10 provides the P/C scan time in binary code. The displayed integer value of the word is the program scan time in milliseconds. The P/C updates the word each scan. STW10 provides this information as illustrated in Figure 2-16.

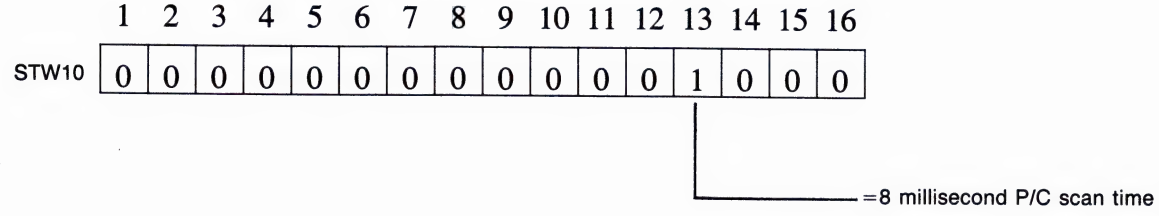


Figure 2-16: Status Word Ten

2.6.8 Status Word Eleven (STW11).

STW11 shows the status of the I/O modules contained on bases number 0 and 1. These two bases add up for a total of 14-16 possible modules. The status word is made up of 16 bits, allowing one bit per module for the two bases covered by this one word. The word is configured right to left as illustrated in Figure 2-17. If the modules are in proper working order or there is no module occupying a noted slot, the corresponding bit registers a 0. If there is a module occupying a slot and that module is malfunctioning, then the corresponding bit will show a 1.

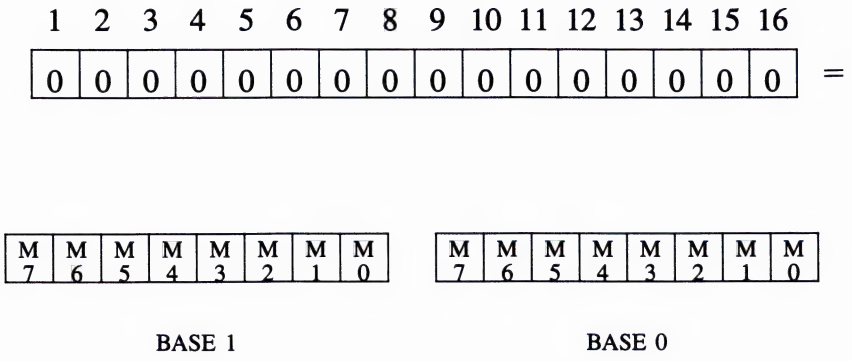


Figure 2-17 Status Word 11

2.6.9 Status Words Twelve thru Eighteen. (STW12, STW13, STW14, STW15, STW16,STW17,STW18).

These remaining status words provide you with the status of each I/O module contained on bases 2 through 15. They will always show zero in the 520C models 1101 and 1102 because these P/Cs do not have the capacity to support distributed bases. Each status word covers two I/O bases. These status words are listed below:

- STW12 shows the status of I/O modules on bases 2 and 3.
- STW13 shows the status of I/O modules on bases 4 and 5.
- STW14 shows the status of I/O modules on bases 6 and 7.
- STW15 shows the status of I/O modules on bases 8 and 9.
- STW16 shows the status of I/O modules on bases 10 and 11.
- STW17 shows the status of I/O modules on bases 12 and 13.
- STW18 shows the status of I/O modules on bases 14 and 15.

2.7 LADDER LOGIC STORAGE

The ladder logic memory (Figure 2-18) is a block of volatile read/write (RAM) memory. The size of the memory block varies according to which model 520C/530C you are using. The RAM memory can be lost only if the primary power is removed and there is no battery (or the battery is discharged) in the system (or if you download your program into an EPROM). Each ladder logic instruction in your program is stored as a word. For information concerning the transference of RAM memory to EPROM memory, refer to the EPROM section of this manual.

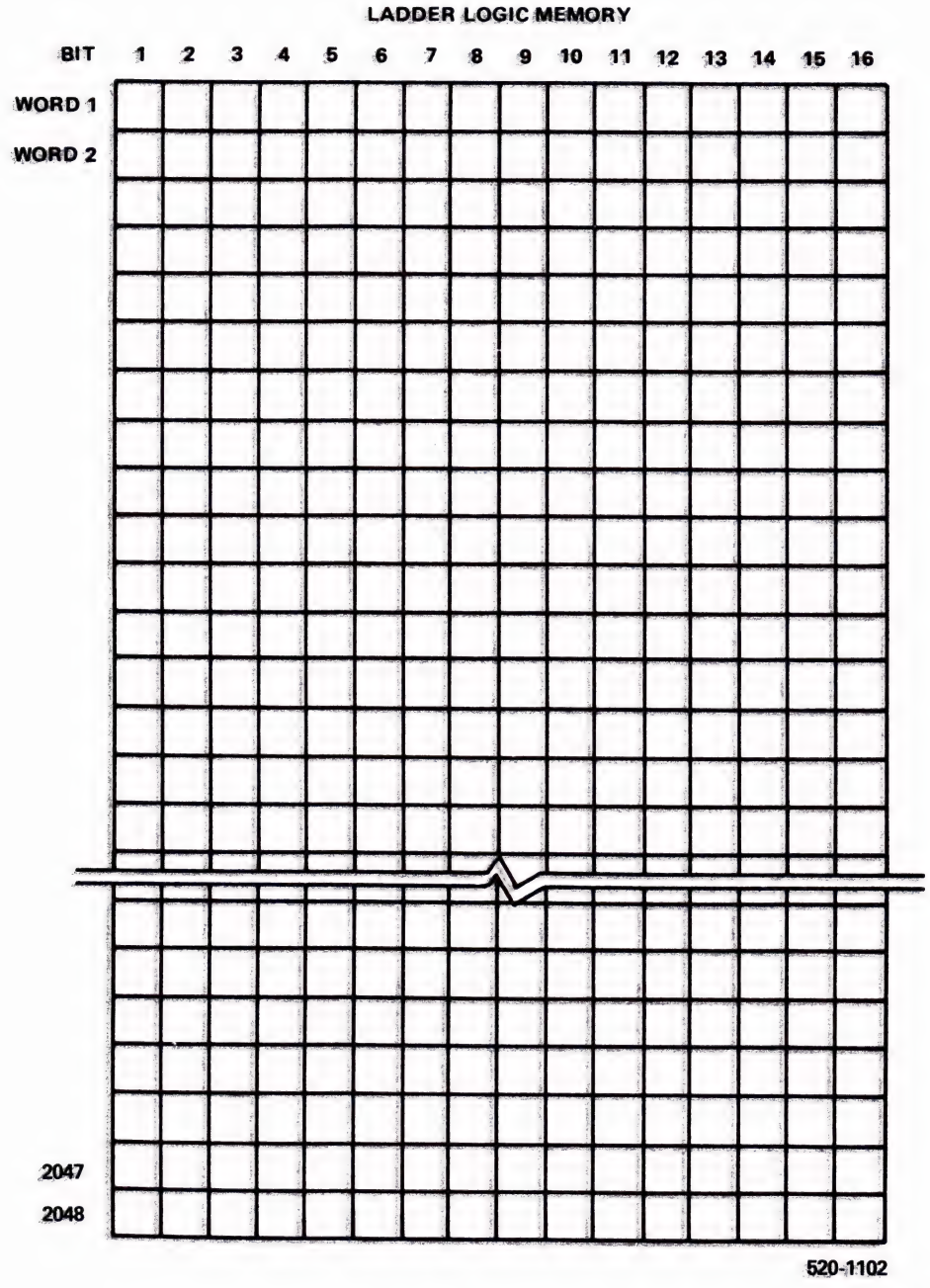


Figure 2-18 Ladder Logic Memory

2.7.1 User Variable (V) Memory.

The V memory (Figure 2-19) is memory used as a storage area for values for math instructions, data tables, etc. Battery backup power for memory provides protection if a power failure occurs. The P/C will clear the values stored in V memory on power-up with battery low.

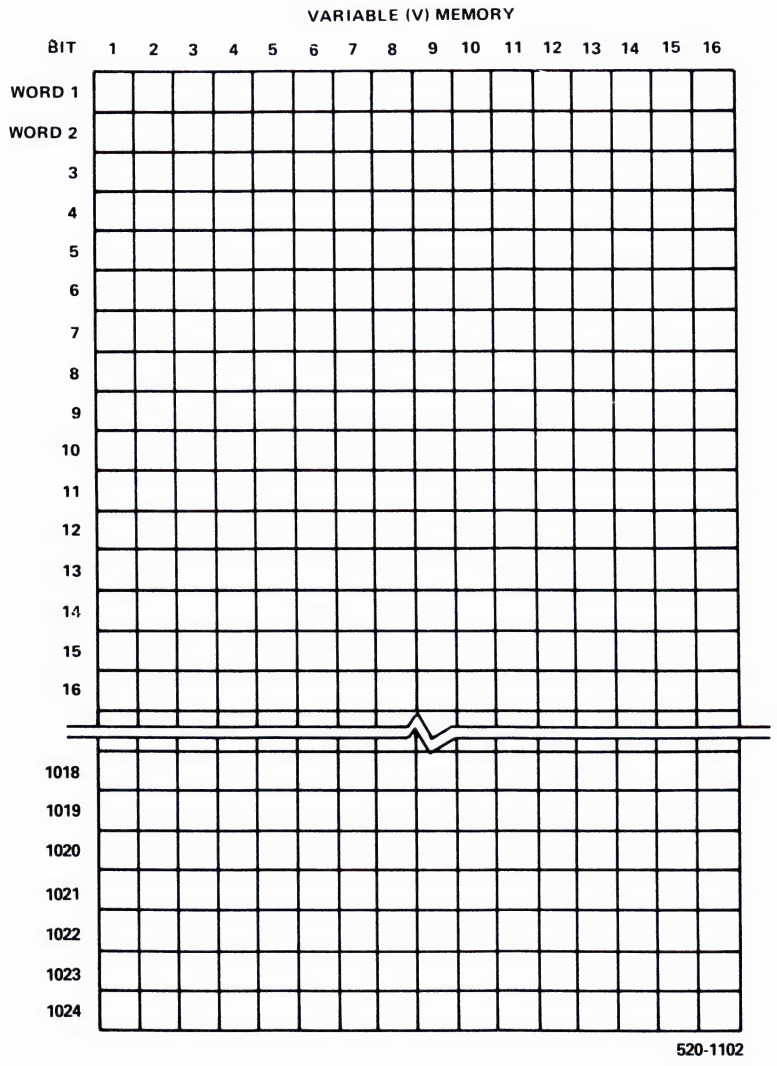


Figure 2-19 Variable (V) Memory

You can enter values directly into V memory by using a programming device. You can indirectly enter values into V memory by executing the ladder logic instructions, which request the V memory to accept values.

To use the values stored in V memory, it is necessary to program instructions into ladder memory. Refer to the 520/530/520C/530C PROGRAM DESIGN GUIDE. and the 520/530/520C/530C VPU200 PROGRAMMING GUIDE for a detailed discription of entering values into V memory and using values stored in V memory.

2.8 PROGRAM ENTRY

The initial ladder program can be entered into the P/C by using the VPU200. See the 520/530/520C/530C VPU200 PROGRAMMING GUIDE for detailed entry procedures.

Programs can also be stored in EPROM. Refer to the EPROM section of this manual for further details.

Programs can also be entered into the P/C by computer through the use of task codes. For information on computer-entered programs call your TI field representative or the Technical Response Center in Johnson City, Tennessee (615) 461-2501.

2.9 PROGRAM EXECUTION

The following paragraphs describe how the P/C executes the ladder logic programs.

2.9.1 Ladder Logic Execution.

Your program instructions in the ladder logic memory contain the ladder logic instructions described in the SERIES 500 520/530/520C/530C PROGRAM DESIGN GUIDE. When the program is being executed, the ladder logic instructions are individually processed by examining the input point instruction word in the ladder logic. Then the operation defined by the instruction is performed and the appropriate output(s) are turned on or off based on the results of the instruction operation.

For example: if a timer is to be executed, the P/C reads the appropriate inputs in the IR, selects the timer parameters from the TCP and TCC memory, and completes the function. The preset value (1 to 32,767) is downloaded from the User Program memory to the TCP memory section just prior to the first scan (for a newly programmed timer/counter) or upon powerup if the P/C dipswitch 2 is in the ''download'' presets position and the battery is good or the program is in EPROM. Otherwise, these values are cleared. The timer preset value in the TCP memory does not change

as the timer executes. The timer current count in the TCC memory decrements toward 0 as the timer executes. When the timer current count in the TCC memory counts down to 0, the output coil of the circuit turns on, the output (Y) point in the discrete IR is set to 1, and power is applied to the user equipment on the next scan.

2.10 SCAN TIMES

Scan time is defined as the time in milliseconds required to execute one program execution cycle. The 520C/530C P/C executes the complete user logic program once each scan time. The scan cycle is made up of blocks of time devoted to specific tasks. Figure 2-20 illustrates a typical 520C/530C P/C scan.

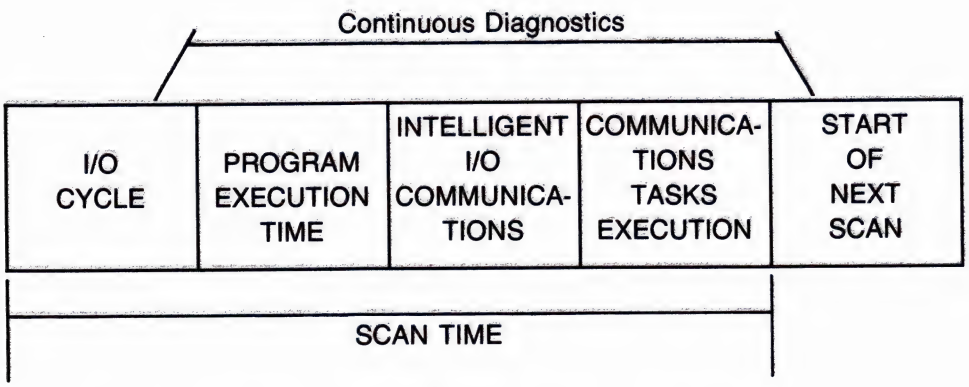


Figure 2-20 Model 520C/530C Typical P/C Scan

2.10.1 Scan Modes.

Variable- and fixed-scan modes are available to you. In the variable scan mode,a time slice is allocated to handle processing of tasks from the communication ports. These two scan modes are discussed in the following paragraphs.

2.10.1.1 Variable-Scan Mode.

Only the time required to read installed inputs, solve programmed logic, update installed output status, and perform intelligent module communications is used by the P/C. In this scan mode, the task execution cycle will be given at least two but not more than three milliseconds. When servicing completes or at the end of the communication slice, the P/C starts the next scan.

2.10.1.2 Fixed-Scan Mode.

A programming device is used to select a fixed-scan mode. The fixed scan time may be set from 5 milliseconds to 255 milliseconds in 1-millisecond steps. The P/C reads inputs, solves programmed logic, updates output status, and performs intelligent module communications with any remaining time allocated to processing tasks from the communication ports. If a scan overrun occurs (i.e., program is too long for scan to complete), bit 14 of STW01 indicates a fault and the system completes the scan with a time slice of no more than 2 milliseconds allocated to processing communications tasks. The P/C starts the next scan after processing tasks from the communication ports.

You are allowed to specify a fixed scan time of 5 to 255 milliseconds. This enables the communications task execution cycle to be allotted more than two milliseconds of microprocessor time provided that the other scan jobs are executed in less than 253 milliseconds.

2.10.2 Scan Cycle.

Listed below is the sequence of the scan cycle followed by an explanation of each step in the process.

- Read input status and write output status (if valid).
- Solve programmed logic by executing user instructions.
- Access any special function modules and perform communications.
- Process/execute task requests from the communication ports.
- Begin next scan.

2.10.2.1 I/O Cycle Time.

The I/O cycle time is determined by the type and quantity of I/O modules installed in the system. Once the cycle starts it will continue until all I/O modules are updated. This cycle has a time limit of 500 milliseconds +/- 2%. If the time limit is exceeded, the P/C will go into the fatal error mode.

2.10.2.2 Program Execution Time.

The program execution time is determined by the size of your program and the type of instructions in the program. Once execution starts it will continue until the entire program is executed. This cycle has a time limit of 500 milliseconds +/- 2%. If the time limit is exceeded, the P/C will go into the fatal error mode.

2.10.2.3 Special Function Access Time.

The special function access cycle time is determined by the type and quantity of Special Function modules installed in the system. Once the cycle starts it will continue until all modules are accessed. There is no specified time limit for this cycle and your system supports up to 16 special function modules.

2.10.2.4 Task Execution Time.

The task execution time is determined by whether a task request has been received from one of the communication ports, what type of task is being requested, what type of scan the P/C is running, and what the fixed scan time is. Once execution is started it continues until either the allotted time expires or the task is completed.

If the scan time is fixed, then whatever time is left before the fixed scan time elapses is allotted to task execution. At least two milliseconds will be allotted if the fixed scan time expired before the task execution job is invoked (only if there is a task available for execution).

In all cases when the allocated time has elapsed, task execution is suspended and another scan cycle begins. The suspended task will resume execution in the next allotted task execution cycle. This process will continue until the task has completed.

2A: 520C-1101

2A.1 THE 520C-1101 PROGRAMMABLE CONTROLLER

The 520C-1101, while it shares many characteristics with the 520C/530C models, differs in a few areas that bear listing.

- The 520C-1101 memory can not be upgraded and does not have a RS422 port.
- It lacks the ability to download a program from RAM into EPROM.
- The 520C-1101 runs a compiled version of a program stored in EPROM and executes from RAM along with all user accessable memory (i.e. timer counter current memory, timer counter preset memory, etc.). The installed EPROM has been programmed by another 520C/530C P/C.
- Like the 520C-1102, the 1101 can not support a distributed I/O system.

Because this hardware manual covers all 520C/530C models, the information included may not necessarily pertain to the 520C-1101.

3: EPROM PROGRAMMING

3.1 INTRODUCTION

The series 500 520C/530C P/Cs offer the option of saving your ladder logic program in a non-volatile form. Through the use of an Erasable Programmable Read Only Memory (EPROM) integrated circuit, you can protect your program in case of power loss without requiring a battery to be installed. The EPROM only protects your program. Other memory (variable, etc.) is not protected if you power cycle without a battery. The 520C/530C P/Cs contain a feature that allows you to program your EPROM by downloading from Random Access Memory (RAM) instead of a separate programming device. The ultraviolet-erasable EPROM fits into an allotted space on the main board in your P/C.

The following section describes the 520C/530C EPROM programming option. It includes a definition of the EPROM with its uses and features, a description of the installation procedures, and a discussion of loading and programming guidelines. The section is divided into the following areas:

- EPROM Description and Features
- EPROM Installation
- EPROM Program Loading

3.1.1 Description.

The Series 500 520C/530C models use a 256K EPROM (TI Part Number 500-1610). Once these EPROMs are programmed, they are interchangeable in all of the 520C/530C models. The only limitation is program size. The amount of memory features contained in the EPROM must be compatible with the memory allocation of your P/C.

WARNING

The EPROM used with the TI 520 and 530 machines is not compatible with the Series 500 520C/530C P/Cs. Attempting to exchange EPROMS between any Series 500 520C/530C P/C and any TI 520 or 530 P/C may cause injury to personnel and damage to machinery due to unexpected operation.

The EPROMS can be programmed by downloading a program from RAM through the use of the P/C toggle switch. The only exception to this rule is in the 520C-1101. This machine does not have EPROM programming capability. The EPROM must be programmed before it is inserted in the 520C-1101. For more information on programming, refer to the 520/530/520C/530C PROGRAM DESIGN GUIDE (manual no. 530-8110). Downloading programs to EPROM is discussed in the EPROM Program Loading portion of this section.

3.1.2 EPROM Features.

The use of an EPROM to protect the program in your P/C has many advantages. It is a permanent way to store your program and it is easily transportable. The 520C/530C models have a built-in memory safeguard system that consists of checksums in ladder logic memory, EPROM memory and compiler memory. The checksum generated from the EPROM is shown through STW09. This checksum includes what is contained in your ladder logic program combined with information contained in the I/O table memory.

3.2 EPROM INSTALLATION

Each 520C/530C has a side door that allows easy access to the EPROM socket, as illustrated in Figure 3-1.

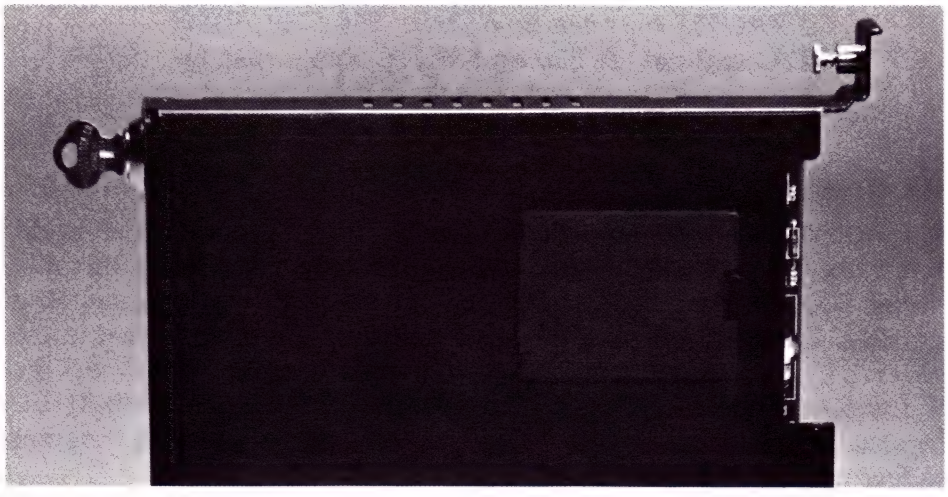


Figure 3-1 EPROM Access Door

The EPROM socket is a zero insertion force socket; no pressure is required to insert the 28 pin EPROM. A small, flat-bladed screwdriver is required to loosen and/or tighten the socket. Figure 3-2 illustrates the socket and the EPROM. Notice that the screw at the top of the socket matches the notched edge of the EPROM when the EPROM is inserted properly. Make sure the socket is loose before attempting to insert an EPROM.

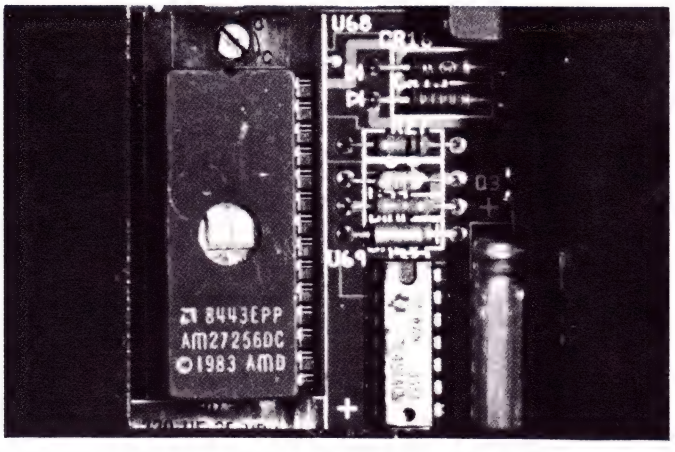


Figure 3-2 EPROM and Socket

In order to install an EPROM, your P/C must be off. Before you power down, make sure there is a battery installed in order to protect the program in RAM. When you power down, make sure the P/C is in the PROGRAM mode. In most cases the P/C will power-up in the same mode it was in when it powered down. In every model except the 520C-1101, place the toggle switch in the ''OFF'' position. The following paragraphs outline the procedures for installing an EPROM in most cases.

NOTE

Any time you have a non-blank EPROM installed in your P/C and you power-up or switch from PROGRAM to RUN mode, the P/C will attempt to run from the EPROM and may alter RAM memory.

3.2.1 Installing an Unprogrammed EPROM.

After you have powered down your P/C, open the EPROM access door and insert the EPROM. Make sure the notched edge of the EPROM is aligned with the screw in the socket (see Figure 3-2). Once the EPROM is secure and the toggle switch is in the ''OFF'' position, power-up the unit, making sure it is in the PROGRAM mode. .

If the toggle switch is in the ''ON'' position when you power-up in the PROGRAM mode or the RUN mode, the P/C will ignore it and you will have to switch the toggle to ''OFF'' and back to ''ON'' in order to load your program into EPROM.

3.2.2 Installing a Preprogrammed EPROM.

Installing an EPROM that has been programmed through another machine follows the same procedures outlined above.

WARNING

The Series 500 520C/530C P/Cs are designed to run out of an EPROM if one is installed. Powering-up with a programmed EPROM installed without first checking the program in EPROM may result in injury to personnel and damage to machinery due to unexpected operation. If you are not completely sure that the program you have downloaded into the EPROM is correct, disconnect the P/C from any I/O and controlled machinery before you power-up.

After the EPROM is installed and you have disconnected the P/C from any I/O, power-up the P/C, switch it to the PROGRAM mode and check your program for errors. After ascertaining the status of your program, switch from PROGRAM mode to RUN mode in order to begin operation out of EPROM.

NOTE

Because RAM is cleared when the P/C runs out of EPROM, it is recommended that you save a copy of your program to disk in a VPU. This way, you will always have a backup copy of your program.

3.3 EPROM LOADING

When you have completed your programming by using a VPU200 or other programming device, verify the data to be programmed. At this point you are ready to download your program to the EPROM. The following paragraphs outline the steps necessary to program an EPROM.

NOTE

The 520C-1101 does not have the capacity for EPROM programming. For this machine to operate, you must install a preprogrammed EPROM.

The four basic steps to loading an EPROM are listed below.

1. Verify the data to be programmed and place the P/C in PROGRAM mode.

2. Toggle the EPROM switch from ''OFF'' to ''ON''.

3. Wait for the status LED to indicate that EPROM programming is finished. (This may take several minutes, depending on the size of your program.)

4. Toggle the EPROM switch to the ''OFF'' position. The P/C will now go to the RUN mode and execute the program in EPROM.

5. If you want to program more than one EPROM, then do not toggle the switch to the ''OFF position. After EPROM programming is finished, remove power from the P/C (make sure your battery is good, it will protect your program in RAM). Remove the programmed EPROM and install a clear EPROM. Reconnect the power and toggle the switch from ''ON'' to ''OFF'' and back to ''ON''.

3.3.1 Data Verification.

For information on this process refer to the 520/530/520C/530C VPU200 PROGRAMMING GUIDE (manual no. 530-8109).

3.3.2 EPROM Programming.

Figure 3-3 shows the EPROM toggle switch as it appears the 520C/530C P/C models.

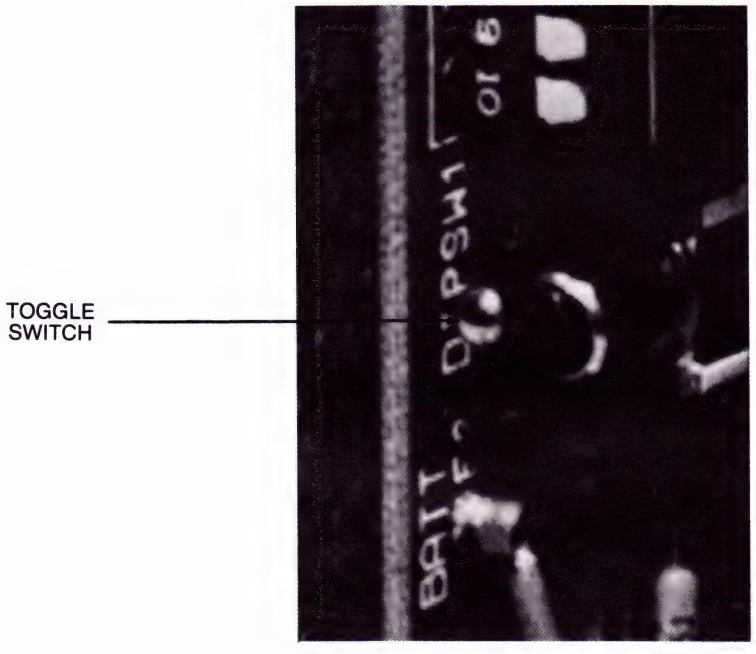


Figure 3-3 EPROM Toggle Switch

The EPROM toggle switch supplies the means to transfer or load your program from RAM to EPROM. To begin the programming cycle, toggle the switch to the ''ON'' (up) position with the P/C in the PROGRAM mode. Once the switch has been toggled to start the cycle, leave the switch in the ''ON'' position in order to monitor the status of the programming cycle. The status of the programming cycle can be monitored from a front panel mounted light-emitting diode (LED).

WARNING

Once you have turned the toggle switch from ''OFF'' to ''ON'' in order to load your program, leave the switch in the ''ON'' position. If you toggle the switch back to the ''OFF'' position, the P/C will go directly into RUN mode upon sucessful completion of the programming.

This will not give you a chance to verify the program EPROM. If the program is incorrect, this may result in injury to personnel and damage to machinery due to unexpected operation.

3.3.3 EPROM Status LED.

There are four LED status indicators located on the front of your P/C (see Figure 3-4). The bottom LED indicates EPROM programmer operation and the result of EPROM programming. The rate at which the LED flashes indicates the status of your programming. Once you have toggled the switch to begin the programming cycle, the first thing the P/C does is check whether the EPROM is clear. If it is clear, the programming cycle will begin and the LED will start flashing at a rate of approximately 4 Hz (about four times per second). If the EPROM is not clear or a programming error occurs, the LED will illuminate without flashing and the P/C enters an error mode. At this point, you have to power cycle (power down and then power back up) in order to "clear" the LED.

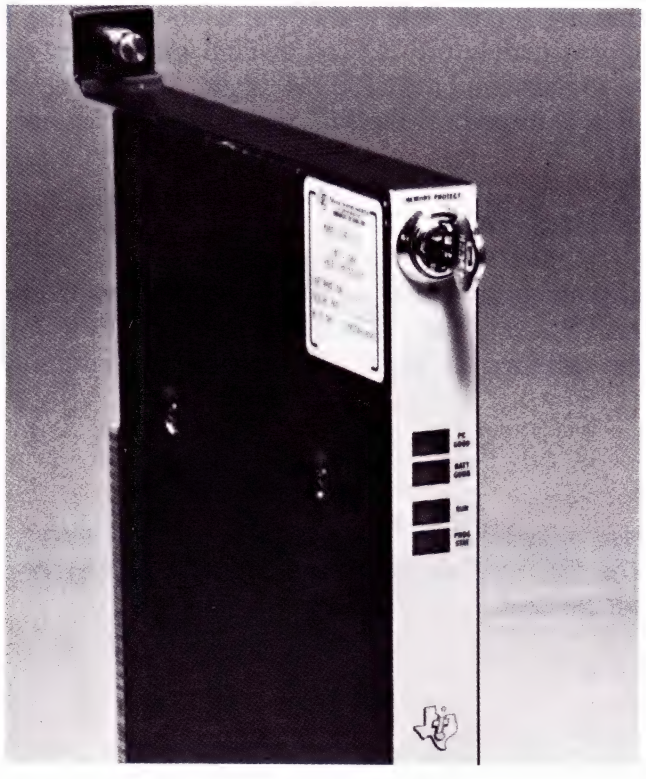


Figure 3-4 EPROM Status LEDs

NOTE

Make sure your P/C battery is good before you power cycle. If the battery is not good and you cycle power, you will lose the program stored in RAM.

Once you cycle power, you can check STW06 through your VPU200 to determine the cause of the error.

NOTE

Once you have an interrupted program cycle, you must erase the EPROM before attempting to program again.

3.3.4 Program Completion.

When programming is complete and contains no errors, the LED flashes at a rate of approximately 0.5 Hz (on and off once every two seconds). It will continue to flash until the EPROM toggle switch is turned off. When the toggle switch is turned off the P/C will go to RUN mode and operate out of EPROM.

3.3.5 EPROM Status Reporting.

EPROM programming information is recorded in status words that can be accessed by the VPU200. The status words represent EPROM programming information gathered on the last completed programming cycle.

NOTE

While the EPROM programming cycle is active, the P/C will not communicate with any external devices.

The status words can be read any time except when you are in the process of programming. Attempting to communicate to the P/C while you are programming results in an error code and "ILLEGAL COMMUNICATION TASK CODE" is displayed on the VPU200 screen. The EPROM status words are listed below.

STW06 programming status for the EPROM. The content is as follows:

WHERE:
0001 = PROGRAMMER NOT READY
0002 = PROGRAMMING IN PROGRESS
0004 = PROGRAMMING COMPLETE - NO ERRORS
0008 = PROGRAMMING COMPLETE - ERROR
0016 = EPROM NOT INITIALLY CLEAR
0032 = PROGRAMMER ERROR

STW07 Absolute address of the first error encountered in EPROM

STW08 Contains the ladder logic checksum value

STW09 Contains the EPROM checksum value

Figure 3-5 EPROM Status Words

4: POWER SUPPLY MODULE

4.1 POWER SUPPLY

All power for the 520C/530C Programmable Controllers is provided by the Power Supply Module, Model 500-2151 (Figure 4-1). This is a double-wide module which normally occupies slots 1 and 2 of the I/O base with the electrical connection through slot 1. In configurations requiring a Distributed I/O Channel Controller the Power Supply module resides in slots 2 and 3 with the electrical connections through slot 2. The power supply module converts supplied power (either 110 or 220 volts AC) to outputs of +5 and -5 DC volts.

The front of the module contains an indicator labeled ''DC GOOD''. This indicator remains lit when the module is producing DC power within specifications. When either output is out of regulation, the indicator light goes out. The Power Supply module has built-in safety features that prevent damage to your system from incorrect voltage.

For additional information about this module, refer to the 110/220 VAC POWER SUPPLY MODULE INSTALLATION (manual no. 500-8111).

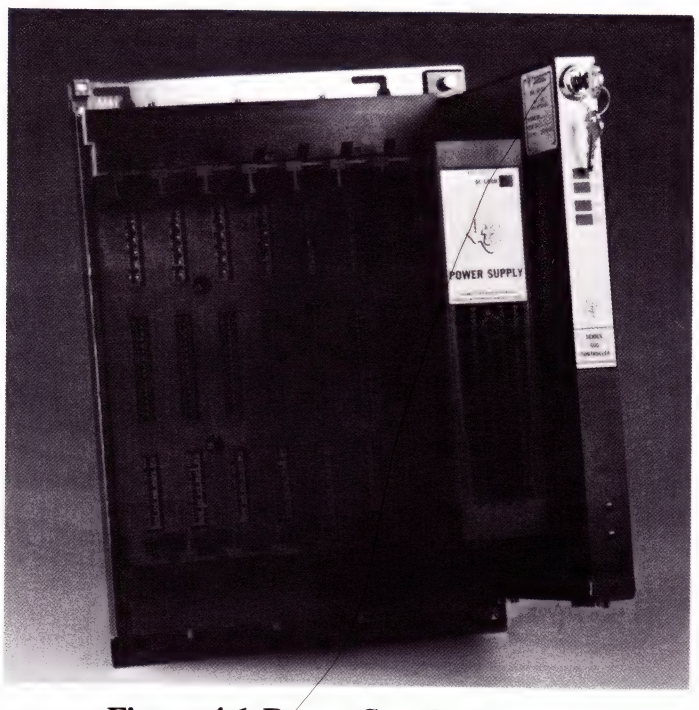


Figure 4-1 Power Supply Module

5: DISTRIBUTED I/O CHANNEL CONTROLLER

5.1 INTRODUCTION

A Distributed I/O Channel Controller is a unit that provides the interface between a programmable controller and its distributed I/O subsystem. The Model 500-2108 Distributed I/O Channel Controller (IOCC) is designed to be compatible with the 530C Programmable Controllers (see Figure 5-1).

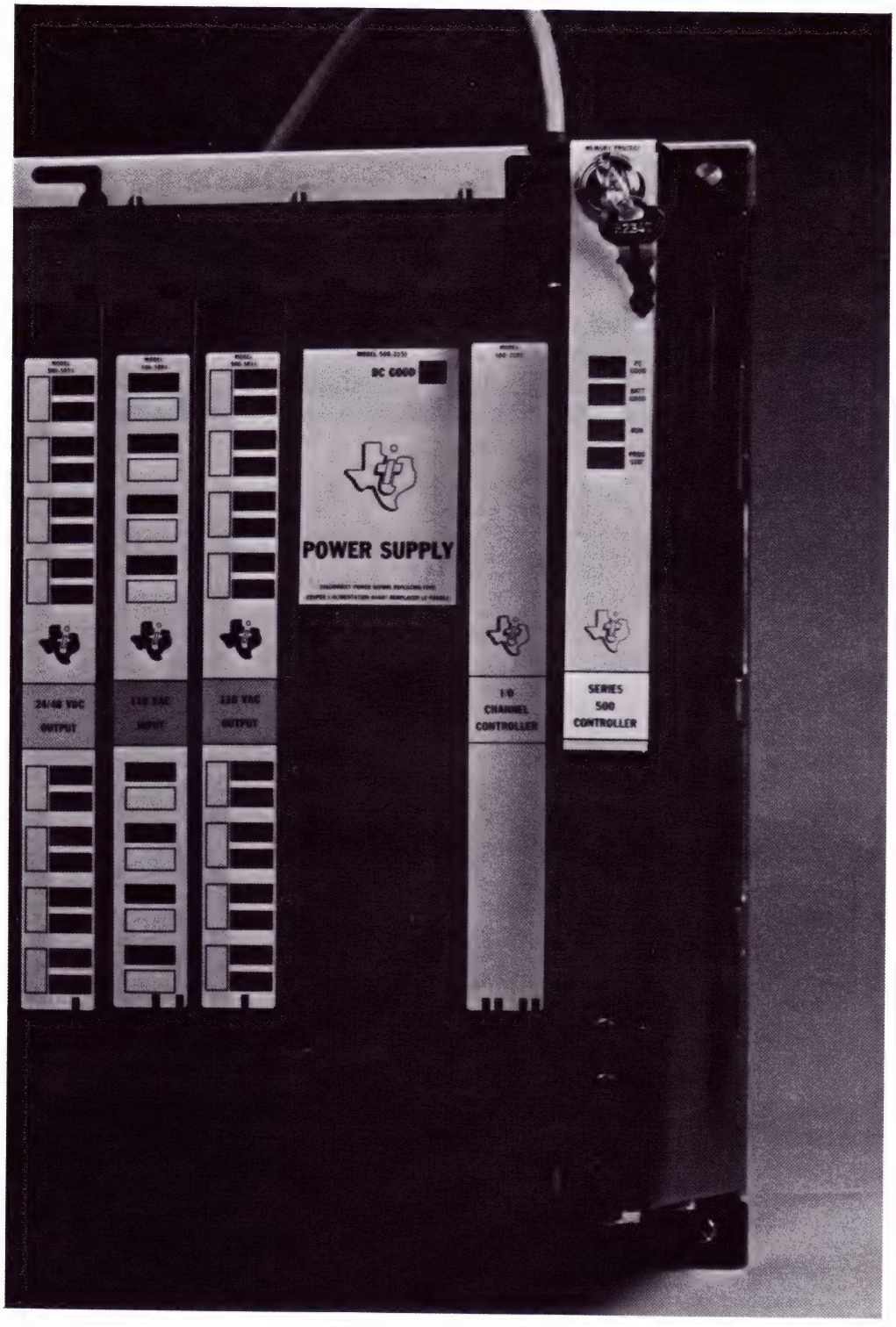


Figure 5-1 Model 500-2108 Distributed I/O Channel Controller (IOCC)

The IOCC transfers data and status both to and from the P/C. It receives information from the P/C in parallel form, converts the data into serial form and transmits the information to your Series 500 Distributed Base Controller (DBC). The IOCC performs the reverse when it receives information concerning your system's distributed I/O from a Distributed Base Controller.

5.1.1 Communication Ports.

The transmissions are sent to and received from the DBC through a single shielded twisted pair cable (part number 2458450-0001, or 2458450-0002). Distributed bases may be located up to 1000 feet from the IOCC, connected to either connector of the IOCC if -0002 cable is used. The maximum combined cable length is 2000 feet for the -0002 or 500 combined feet for the -0001. If more than 10 feet of the -0001 cable is used the maximum total cable length is 500 feet.

There are two ports for serial communication. The IOCC initiates all communications and is controlled by the parallel port from the P/C.

5.1.2 Diagnostics.

The IOCC performs self-diagnostics that are communicated to the P/C it is connected to. If the IOCC fails to read data from the DBC, it will send an error code to the P/C and the I/O modules on the distributed bases will cease operation. The P/C retains the last data it received from the DBC through the IOCC and the I/O modules freeze in the state they were in when the shutdown occurs.

5.1.3 Installation.

The IOCC is connected to the Series 500 530C system through the first slot of Models 500-5848 and 500-5892 I/O bases (see Figure 5-2). If you are using a Model 500-5840 Adapter Base, the IOCC fits into the first slot after the P/C (see Figure 5-3).

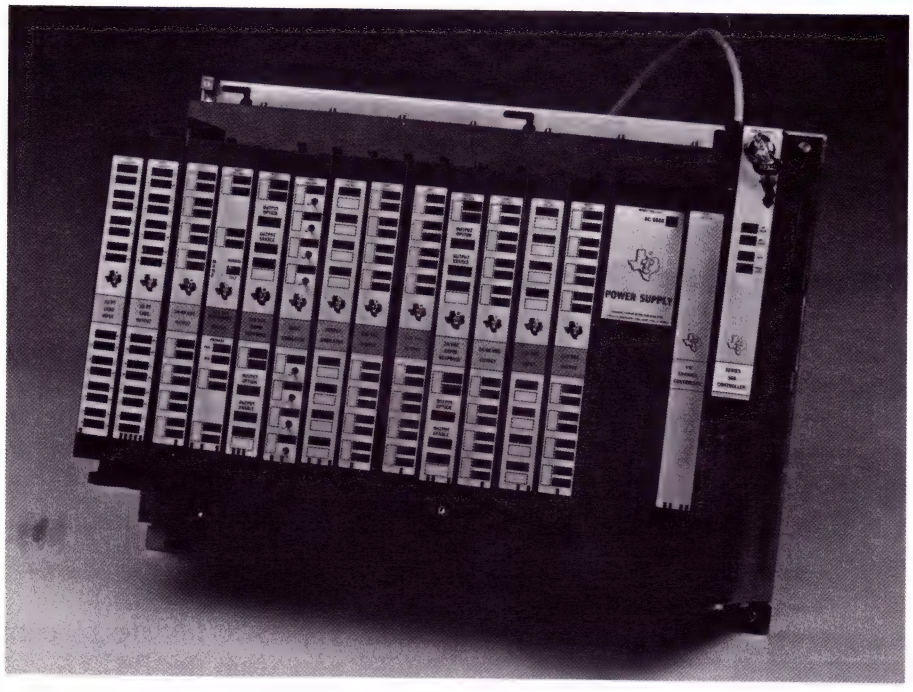


Figure 5-2 IOCC Connection to a Model 500-5892 Base

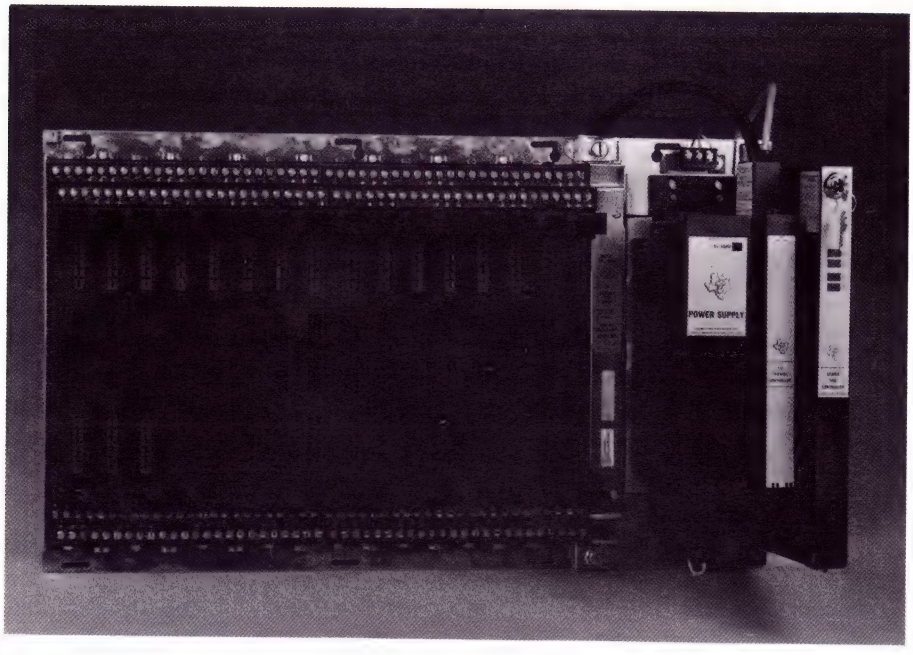


Figure 5-3 IOCC Connection to a Model 500-5840 Base

6: SERIES 500 I/O MODULES AND BASES

6.1 INTRODUCTION

All Series 500 I/O Modules are compatible with the 520C/530C Programmable Controllers. This section provides a brief description of the Series 500 I/O system, possible configurations, the I/O numbering system and the Series 500 I/O Modules available at this time.

This section is designed to introduce you to the Series 500 I/O System and to serve as a reference to the personnel responsible for installing, using or maintaining your system.

The section is divided into the following areas:

- Series 500 I/O System
- I/O Numbering System
- Series 500 I/O Modules

6.2 SERIES 500 I/O SYSTEM

The information discussed in the following paragraphs relates to your I/O system and possible configurations. Included are descriptions of the local I/O base and the distributed I/O base concept.

6.2.1 Description.

The Series 500 I/O system provides you with an I/O capability of up to 1023 I/O points, depending on your 520C/530C model. These I/O points allow:

- All discrete inputs
- All discrete outputs
- All word/analog inputs
- All word/analog outputs(limited by the number of I/O modules)
- High density modules
- Intelligent I/O modules

The I/O will also allow any combination of the above that falls within the limitations for your P/C and the power supply budget. The Series 500 I/O system consists of the following components:

- Either Model 500-5892 or 500-5848 base assemblies (or Model 500-5828 or 500-5864 bases with the Model 500-5840 Adapter Base).
- I/O Modules with up to 32 I/O points per module.
- Distributed I/O Channel Controller (IOCC).
- Distributed Base Controller.

These components support local or distributed I/O bases which are discussed in the following paragraphs.

6.2.2 Local I/O.

Figure 6-1 shows the typical configurations for local I/O placement.

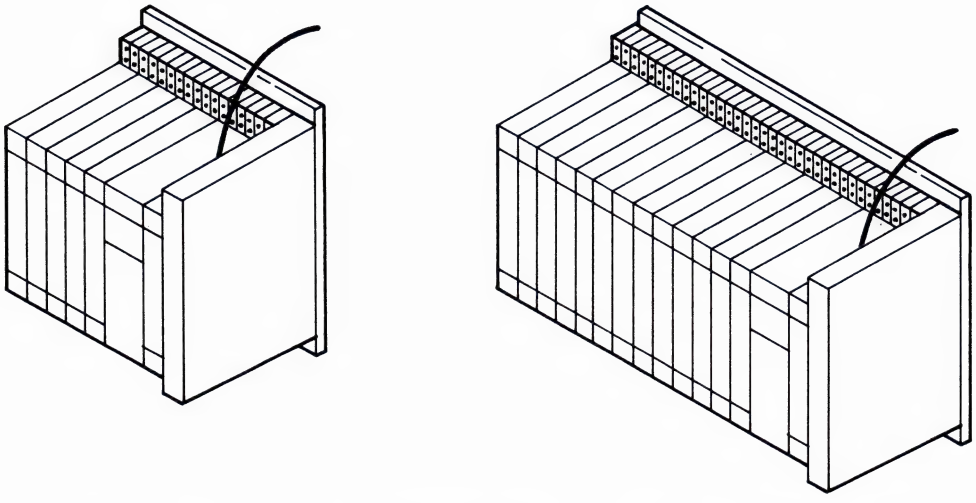


Figure 6-1 Typical Configurations for Local I/O Base Design

As Figure 6-1 illustrates, there are several possibilities for local I/O base configurations. Not all possibilities are shown. The local I/O base configuration is limited to a maximum 512 I/O points contained in 16 I/O slots when using the adapter base 5840.

6.2.3 Distributed I/O.

I/O bases may be remotely distributed in a multidrop fashion up to 300 meters (1000 feet) total with twinax cable. The distributed I/O can address up to 1023 I/O points. You can install any Series 500 I/O modules in any slot of any distributed I/O base. Figure 6-2 shows two possible configurations for a distributed I/O system.

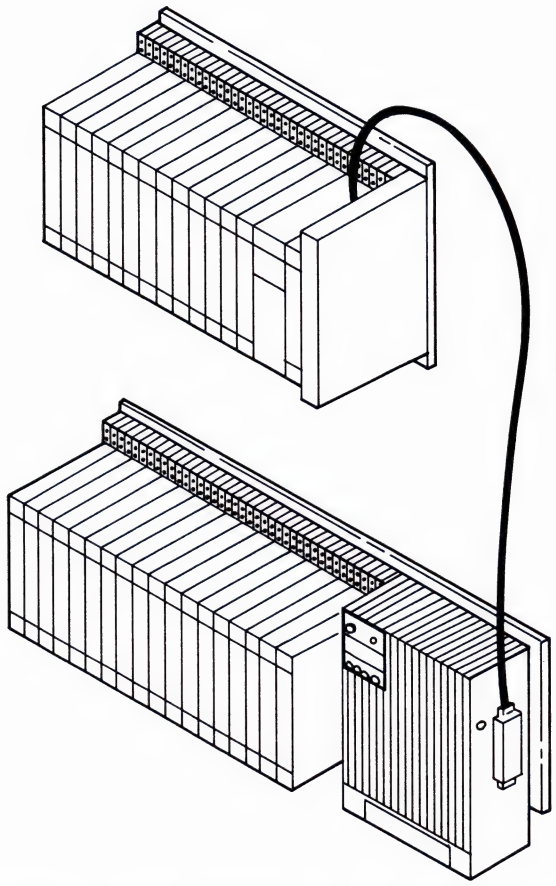


Figure 6-2 Typical Configurations for Distributed I/O base Design

6.2.4 I/O Bases.

There are three Series 500 I/O bases specifically made to accommodate the 520C/530C P/Cs. Model 500-5892 base holds up to 6 I/O modules and the Model 500-5848 base holds up to 14 I/O modules, as well as your P/C and Power Supply Module. The P/C fits into the right side of the base through its edge card connecter and captive screws. If you plan to use an IOCC, it fits into the first slot on the base and is followed by the double-wide Power Supply Module otherwise the Power Supply Module connects through the first slot of the base. Because the Power Supply Module is a double-wide module, it will physically cover two slots though it only connects through one. If you plan to use an adapter base (Model 500-5840), then the P/C, Power Supply Module, and IOCC fit on the adapter base and are connected to a Model 500-5828 or 500-5864 I/O base.

If your system includes an IOCC used with a Model 500-5892 or 500-5848 base, be aware that the first I/O slot is unavailable. The IOCC fits next to the P/C and is followed by the double-wide Power Supply Module. Even though the Power Supply Module only connects through one slot, it will cover two.

Most discrete I/O wires connect to the I/O base rather than the I/O module. For information on I/O wire connection, refer to the manuals that accompany your I/O modules. The discrete I/O wires for high density modules connect to the module itself. The maximum number of bases for the Series 500 I/O system is two local I/O bases and 14 distributed I/O bases.

6.3 I/O NUMBERING SYSTEM

The Series 500 I/O is designed as a series of ''building blocks'' that can be expanded from the P/C with the first local base (Base 0) containing up to 256 I/O points (depending on model base used) to the full system (Base 0 through Base 15) with 1023 I/O points. The full system consists of a P/C connected to the first local base assembly and 14 additional bases, with each base containing a maximum of 32 points per slot. The number of points per base depends on the power requirements of your I/O modules. The following paragraphs describe the numbering of the I/O bases, slots, and points.

6.3.1 I/O Base Numbering.

The first local base assembly (Figure 6-3) contains base 0 and base 1. All other bases may be labeled with any number from 2 through 15, according to your I/O map.

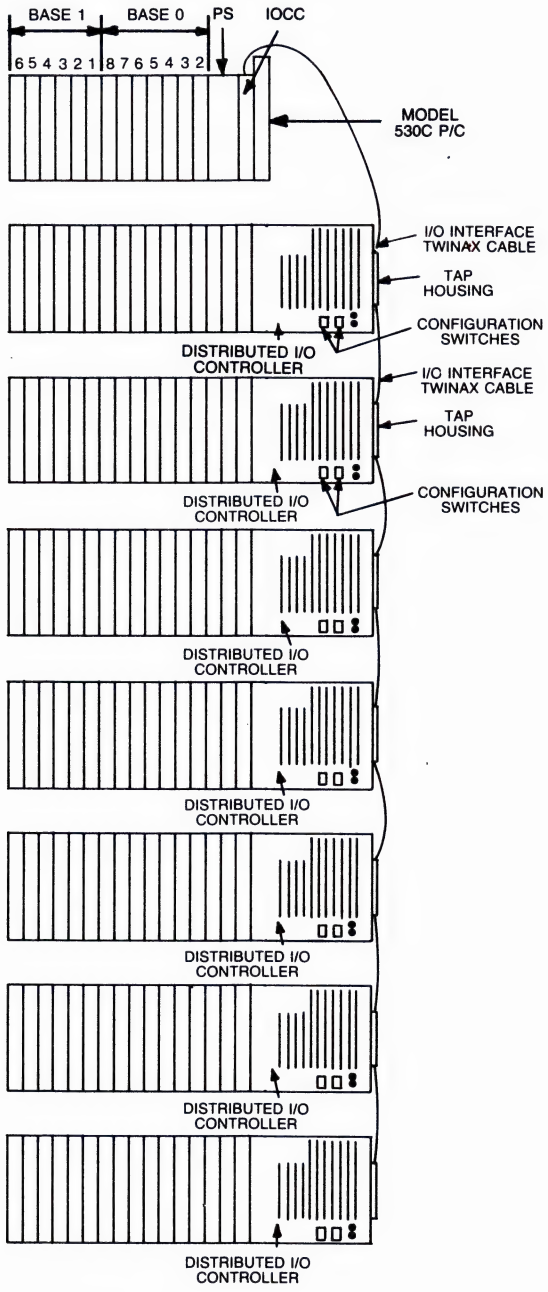


Figure 6-3 Series 500 I/O System Layout

The base address select switches (see Figure 6-4) on the base controllers for bases 2 through 15 select the base numbers. Each half of a two-base assembly may be assigned any base number between 2 and 15. In a one-base assembly both base address select switches must be set to the same assigned base number. Once a base number is assigned, the I/O slot/point numbering becomes fixed.

NOTE

Make sure you do not assign the same number to more than one base unless you plan to number the I/O points individually. If you assign one number to two bases, the P/C will automatically duplicate the slot numbers.

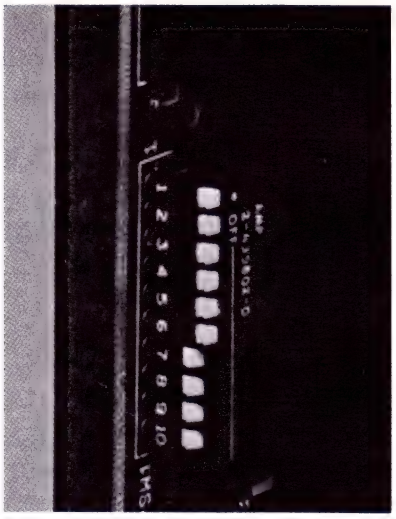


Figure 6-4 Base Address Select Switches

Although bases can be numbered out of sequence, it is not recommended. Numbering bases in sequence makes it easier to distinguish real I/O points from those used as control relays.

6.3.2 I/O Slot/Point Numbering.

The 520C/530C P/Cs allow you to configure your I/O points. You may duplicate I/O point numbers but the P/C counts each point and will not allow you to assign more than 1023 I/O points. If you choose not to assign specific numbers to I/O points, the P/C will default to the sequential numbering system discussd in the following paragraphs. Once the P/C has defaulted and numbered your I/O points, you can go in and assign numbers to individual slots. If you chose to go in and assign numbers after the P/C has assigned the default numbering, the rest of the I/O points will be set as if you had individually assigned numbers to them. The P/C will no longer adjust the slot numbering if you switch I/O modules.

NOTE

If you choose to use the 520C/530C default numbering system, the numbering system does not allow for any modules containing more than 8 points.

The local base assembly to the P/C (Figure 6-5) is designated as base 0 and base 1. Base 0 contains slots 1 through 8 (I/O points 1 through 64). This is true whether you use the new bases or the standard bases. Base 1 using the 500-5848 contains six I/O slots while base 500-5828 contains eight I/O slots. It does not matter which base you use for base 1; the P/C numbers for eight I/O slots. If you are using the 500-5892 base and plan to use the default numbering system, be aware that the P/C will assign I/O points 113-128 to the two nonexistent slots.

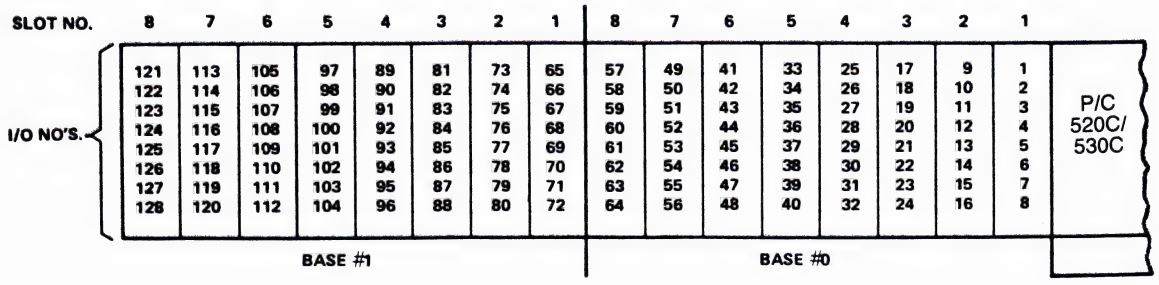


Figure 6-5 Base Number 0 and 1 I/O Slot/Point Numbering

The remaining bases may be numbered from 2 through 15, but the I/O point and slot numbers maintain a fixed format corresponding to the base number, regardless of where the base is located. For example; Base 2 must contain I/O slots 1 through 8 and I/O points 129 through 192, regardless of the assigned location. Figure 6-6 illustrates the I/O point numbers with the base numbers to which they must always be assigned.

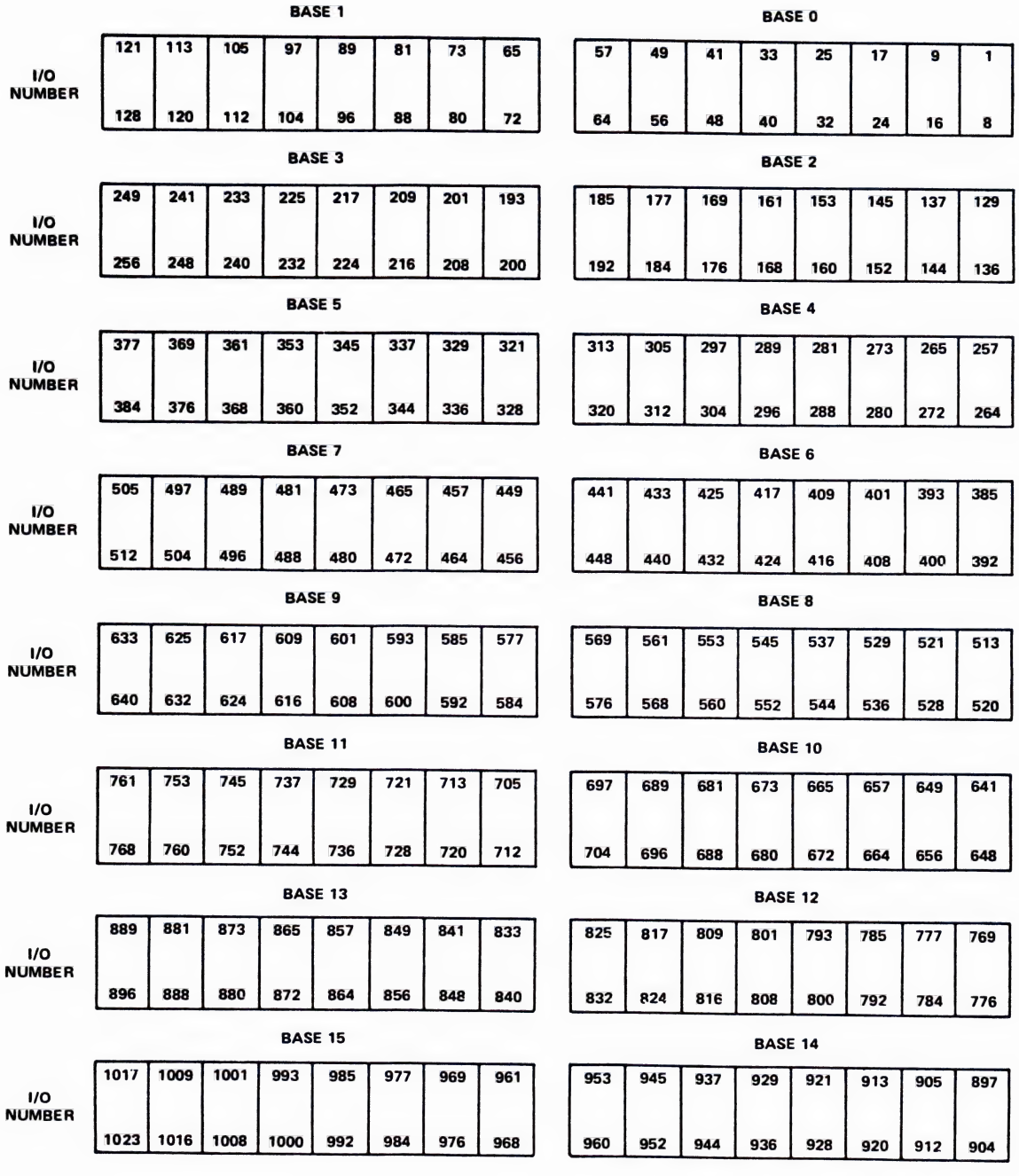


Figure 6-6 I/O Points and Base Numbering

6.4 SERIES 500 I/O MODULES

All of the Series 500 I/O modules are compatible with the 520C/530C Programmable Controllers. The following paragraphs provide a brief description of each Series 500 I/O module available at this time. For more information about any of the modules, please refer to each I/O module manual.

6.4.1 Non-intelligent I/O Modules.

Non-intelligent I/O modules convert signals between the P/C and field wiring. Normal communication is through discrete inputs/outputs and word inputs/outputs based on how the module logs into the I/O map.

6.4.2 Intelligent I/O Modules.

There are I/O modules that have the ability to take control action on their own and these modules are called Intelligent I/O modules. When intelligent I/O modules are used with your P/C you actually have parallel processing occurring on the I/O base; the module and controller conduct concurrent processing activities. The fact that intelligent I/O modules are capable of processing independently of the P/C does not necessarily imply the use of a microprocessor.

Intelligent I/O modules can be further defined into two categories. They are divided with respect to the type of communication they have with the P/C and are discussed below.

6.4.2.1 Normal Intelligent I/O Modules.

Normal intelligent I/O modules are I/O modules which communicate via the Image Register and are designed to update on a scan-by-scan basis. They communicate the same way that non-intelligent I/O modules do with the added capability of being able to act on their own.

6.4.2.2 Special Function I/O Modules.

Special Function I/O Modules are I/O modules which can communicate to parts of the P/C that can not be accessed by Normal I/O modules. These parts include variable memory and ladder logic memory. They also can communicate the same way normal I/O modules do.

6.5 SERIES 500 DISCRETE AC OUTPUT MODULES

There are two types of the Discrete AC output module. Each module has eight output circuits to control the ON/OFF status of user devices such as pilot lamps, motor starters, or solenoids. The module switches an externally supplied AC voltage,(four output circuits per AC supply), to control the user devices. The modules differ in the amount of output voltage they switch. The Discrete AC Output Modules are listed below:

- 110 VAC Output Module (85-132 VAC), Model 500-5011
- 220 VAC Output Module (170-260 VAC), Model 500-5012

6.6 SERIES 500 DISCRETE HIGH DENSITY MODULES

The Series 500 Discrete High Density modules are input modules and output modules, each consisting of 32 circuits. The input modules have 32 input circuits to accept the ON/OFF status of user devices such as pushbuttons and limit switches. The output modules have 32 output circuits to control the ON/OFF status of user devices such as pilot lamps, motor starters, or solenoids. The modules switch an externally supplied voltage to control user devices. The modules differ in the amount and type of voltage they switch. The High Density Modules are listed below:

- 24 VDC High Density Input Module (15-30 VDC), Model 500-5030
- 24 VDC High Density Output Module (20-30 VDC), Model 500-5031
- 110 VAC High Density Input Module (79-132 VAC), Model 500-5055
- 110 VAC High Density Output Module (85-132 VAC), Model 500-5056

6.7 SERIES 500 DISCRETE DC OUTPUT MODULE

The Series 500 Discrete DC Output Module is an 8-point module. The total module output current is 8 A maximum, and it contains eight outputs. These output circuits are identical and control the ON/OFF status of user devices such as pilot lamps or solenoids.

- 24/48 VDC Output Module (11-56 VDC), Model 500-5013

6.8 SERIES 500 DISCRETE INPUT MODULES

There are six types of the Discrete Input Module available at this time. Each module contains eight identical input circuits to accept the ON/OFF status of user devices such as pushbuttons and limit switches. The modules differ in the amount and type of input voltage. The Discrete Input Modules are listed below:

- TTL Input Module, Model 500-5007
- 24 VDC Input Module, Model 500-5008
- 24 VAC/DC Input Module, Model 500-5005
- 48 VAC/DC Input Module, Model 500-5006
- 110 VAC Input Module, Model 500-5001
- 220 VAC Input Module, Model 500-5002

6.9 SERIES 500 ANALOG INPUT MODULES

There are two types of the Analog Input Module available at this time. Each module converts an analog signal into an equivalent digital word for the programmable controller it is associated with. The two differ in a number of areas.

The four channel module has a resolution of 12 bits and it offers four selectable voltage ranges.

The eight channel module has a resolution of 10 bits and it offers one voltage range. The Analog Input Modules are listed below:

- 4 Channel Analog Input Module, Model 500-5009
- 8 Channel Analog Input Module, Model 500-5037

6.10 SERIES 500 ANALOG OUTPUT MODULE

There are two types of the Analog Output Module available at this time. Each module converts a digital word into an equivalent analog signal. They vary in the areas discussed in the following paragraphs.

The two channel module has a resolution of 12 bits and it offers two selectable voltage ranges.

The eight channel module has a resolution of 10 bits and it offers one voltage range. The Analog Output Modules are listed below:

- 2 Channel Analog Output Module, Model 500-5016
- 8 Channel Analog Output Module, Model 500-5047

6.11 SERIES 500 PARALLEL WORD INPUT MODULE

The Series 500 Parallel Word Input Module is designed to accept eight 16-bit parallel words of data in binary code and transmit that data to the P/C for processing. This module provides the capability of interfacing the P/C to such devices as thumbwheel switches, analog to digital converters, and any other device that provides a multi-bit, parallel word code.

- 8 Channel (Multiplexed) Parallel Word Input Module, Model 500-5018

6.12 SERIES 500 PARALLEL WORD OUTPUT MODULE

The Series 500 Parallel Word Output Module is designed to take binary data from the P/C, and transmit eight 16-bit parallel words to the field devices. This module provides the capability of interfacing the P/C to such devices as seven segment displays, digital-to-analog converters, and other devices that use a multi-bit, parallel word code.

- 8 channel (Single or Multiplex) Parallel Word Output Module, Model 500-5019

6.13 SERIES 500 DUAL COMM PORT MODULE

The Series 500 Dual Comm Port Module is a special funtion module designed to serve two purposes. First, it serves as a troubleshooting tool by allowing communication to a P/C from a remote I/O base. Second, the module provides the extra communication ports necessary to connect additional

peripheral devices (usually operator interface devices) to your system. The module has two RS232/423 ports which work independently and permit simultaneous communication.

- Dual Comm Port Module, Model 500-5029

6.14 SERIES 500 TIWAY PEERLINK MODULES

The Peerlink modules are special function modules and are components for the Peerlink local area network. The modules provide high speed transmission of relatively small amounts of data from any Series 500 P/C on the network to all other P/Cs on the network. These modules are designed for transfer line applications or sequential processes which require interlocking between P/Cs.

The Redundant TIWAY Peerlink module offers two communcation cards in the event that media loss is a problem in your system. The TIWAY Peerlink module with active and passive monitors is recommended for applications in which media loss is not a problem but continued operation in the event of any station failure is required. The Peerlink modules are listed below:

- TIWAY Peerlink Module, Model 500-5053
- Redundant TIWAY Peerlink Module, Model 500-5054

6.15 SERIES 500 REDUNDANT OUTPUT MODULE

The Series 500 Redundant Output Module is designed to provide redundancy in its outputs. It contains four 110 VAC output channels, with each channel containing two identical output circuits. In the event the main (primary) output circuit fails, the backup (secondary) circuit will take over. Typical applications would be in situations where downtime is critical. In the event a circuit does fail, you could simply replace the faulty module at the next regularly scheduled maintenance audit.

- 110 VAC Redundant Output Module (85-132 VAC), Model 500-5041

6.16 SERIES 500 NETWORK INTERFACE MODULES

There are three types of the Network Interface Modules. These special function modules provide the communication interface that allows a 520, 530, 520C, or 530C sequencer to be connected to a TIWAY I network. This double-wide module provides the electronic hardware and software necessary to perform programmable controller to TIWAY I interface functions. Each module has two communication ports. The modules differ in the channels used for the two variations of network media: local line or modem or any combination of the two. The Network Interface Modules are listed below:

- Network Interface Module, Model 500-5038
- Network Interface Module, Model 500-5039
- Network Interface Module, Model 500-5040

6.17 SERIES 500 PROGRAMMABLE BASIC MODULE

The Series 500 Programmable BASIC Module is a special function I/O module that contains its own memory which allows it to operate parallel to the P/C and to take control on its own. The module operates both under the control of the P/C and asynchronously of it to avoid interfering with the P/C scan cycle. It is used in applications where complex mathematical evaluations are needed, machine diagnostics are required, or operation with specialized devices is desired.

- Programmable BASIC Module, Model 500-5035

6.18 SERIES 500 OUTPUT RAPID RESPONSE MODULES

There are three types of the Rapid Response Module. Each module provides two physically separate and isolated channels with each channel consisting of an input and corresponding output (2 inputs and 2 outputs per module). The modules have a faster response time than other I/O modules due to the fact that once they are enabled by the P/C, the modules responses are independent of the P/C's scan and I/O update. The Rapid Response modules are listed below:

- 24 VDC Output Rapid Response Module, Model 500-5026
- 110 VAC Output Rapid Response Module, Model 500-5027
- 120 VDC Output Rapid Response Module, Model 500-5028

6.19 SERIES 500 HIGH SPEED PULSE INPUT MODULE

The Series 500 High Speed Pulse Input Module is an intelligent I/O module that is capable of counting pulses up to 50 kHz and making its own decisions for the control of its outputs based on the total count values. It provides an input interface to multiple devices which produce pulse trains that the P/C can not accurately count or react to during its scan time. There are six modes of operation that allow you to configure multiple tasks.

- High Speed Pulse Input Module, Model 500-5023

6.20 SERIES 500 ASCII MESSAGE OUTPUT MODULE

The Series 500 ASCII Message Output Module is a special function I/O module that works asynchronously of the P/C scan but under the overall supervision of the P/C. The ASCII module performs specialized functions without using the P/C's memory or slowing down the scan cycle. Some of the module's capabilities include message programming, message storage, and printing of messages. The module provides up to 512 messages and outputs in the standard ASCII character format.

- ASCII Message Output Module, Model 500-5022

6.21 SERIES 500 SERVO AXIS CONTROLLER MODULE

The Servo Axis Controller Module allows Series 500 P/Cs to perform point-to-point positional control of servomotors in a closed loop mode. It can be interfaced to four-quadrant drive amplifiers and uses a resolver as a feedback device tool. The Servo Axis Controller Module is a single axis device; however, multiple axis of motion may be coordinated through stepped synchronization of each axis.

- Servo Axis Controller Module, Model 500-5024

7: INSTALLATION AND STARTUP

7.1 INTRODUCTION

This section of the HARDWARE REFERENCE GUIDE deals with the installation and start-up of your 520C/530C system. Included are procedures for installing a Programmable Controller, Power Supply Module, Series 500 Bases and I/O Modules, as well as safety recommendations. This section concludes with a detailed sample installation which steps you through the procedure of installing a ''typical'' Series 500 520C/530C system. The topics are divided as follows:

- Safety Considerations
- Installation
- Start-up
- Sample System Installation

Due to the many options available to the 520C/530C user as well as the different requirements, it would be impossible to cover every system variation in this manual. Therefore, the system used as an example is a ''typical'' configuration.

7.2 SAFETY CONSIDERATIONS

Control devices can fail in an unsafe condition. This means there is a possibility that certain types of device malfunctions could lead to sudden equipment start-up, unless proper safeguards are incorporated by the equipment manufacturer. Such a start-up could result in property damage and/or severe physical injury to the equipment operator.

If you plan to use your P/C to control equipment which requires an operator or attendant, be aware that the above-mentioned potential safety hazard exists; you should take the appropriate precautions. The following safety recommendations generally apply to installation of solid-state programmable control devices and they are included in the guidelines for installation of P/Cs as recommended in the National Electrical Manufactures Association (NEMA) ICS-3-304 Programmable Controller Standards.

WARNING

ICS 3-304.81 SAFETY RECOMMENDATIONS

Consideration should be given to the use of an emergency stop function which is independent of the programmable controller.

Where the operator is exposed to the machinery, such as in loading or unloading a machine tool, or where the machine cycles automatically, consideration should be given to the use of an electromechanical override or other redundant means, independent of the programmable controller, for starting and interrupting the cycle.

If provision for changing programs while the equipment is in operation is required, consideration should be given to the use of locks or other means of assuring that such changes can be made only by authorized personnel.

These recommendations are intended as safeguards against the failure of critical components and the effects of such failures or the inadvertent errors that may be introduced if programs are changed while the equipment is in operation.

NOTE

The ICS 3-304.81 Safety Recommendations are reproduced by permission of the National Electrical Manufacturers Association from NEMA ICS 3-304, Programmable Controller Standards.

7.2.1 Installation Precautions.

Installation procedures should include consideration of personnel safety hazards during a system failure. The equipment connected to a 520C/530C system should include interlocks and safety switches to prevent operation

during a system failure. Although the specific design steps depend on your systems application, one or more of the following precautions should be included in your system program design.

SAFETY SWITCH SHUTOFF

- A means of disconnecting power from the output loads when the machine is not operating or when it is necessary for the operator to reach into the machine should be provided. Power must be removed by a non-semiconductor switch or hardwired relay contact placed to interrupt power to the output load. It is not sufficient to rely solely on the P/C system for this function (see Figure 7-1).

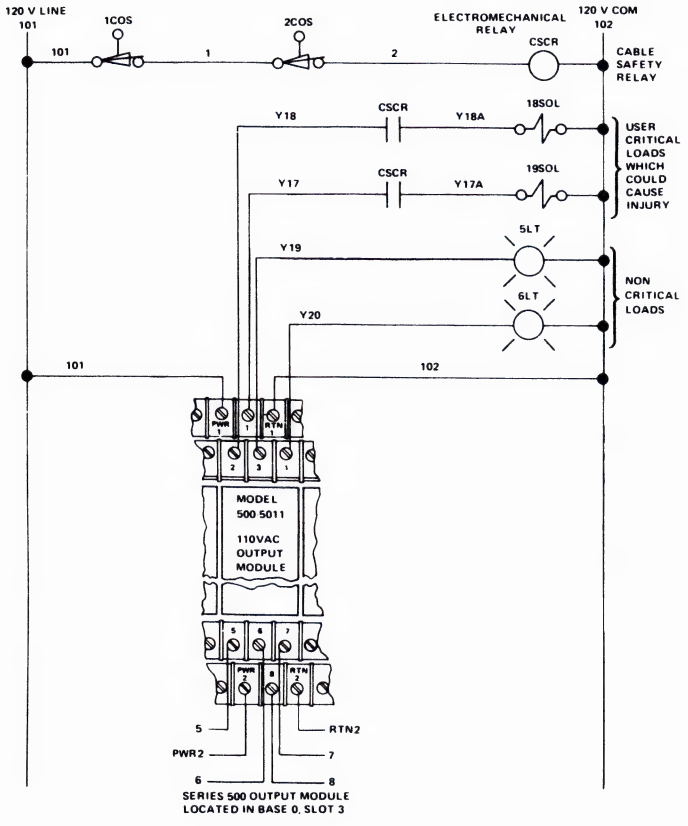


Figure 7-1 Typical Operator Safety Switch Shutoff

JOG/INCH SWITCH

- Bypassing your system with an external JOG or INCH switch during machine loading or set-up operations is a suggested precaution (see Figure 7-2).

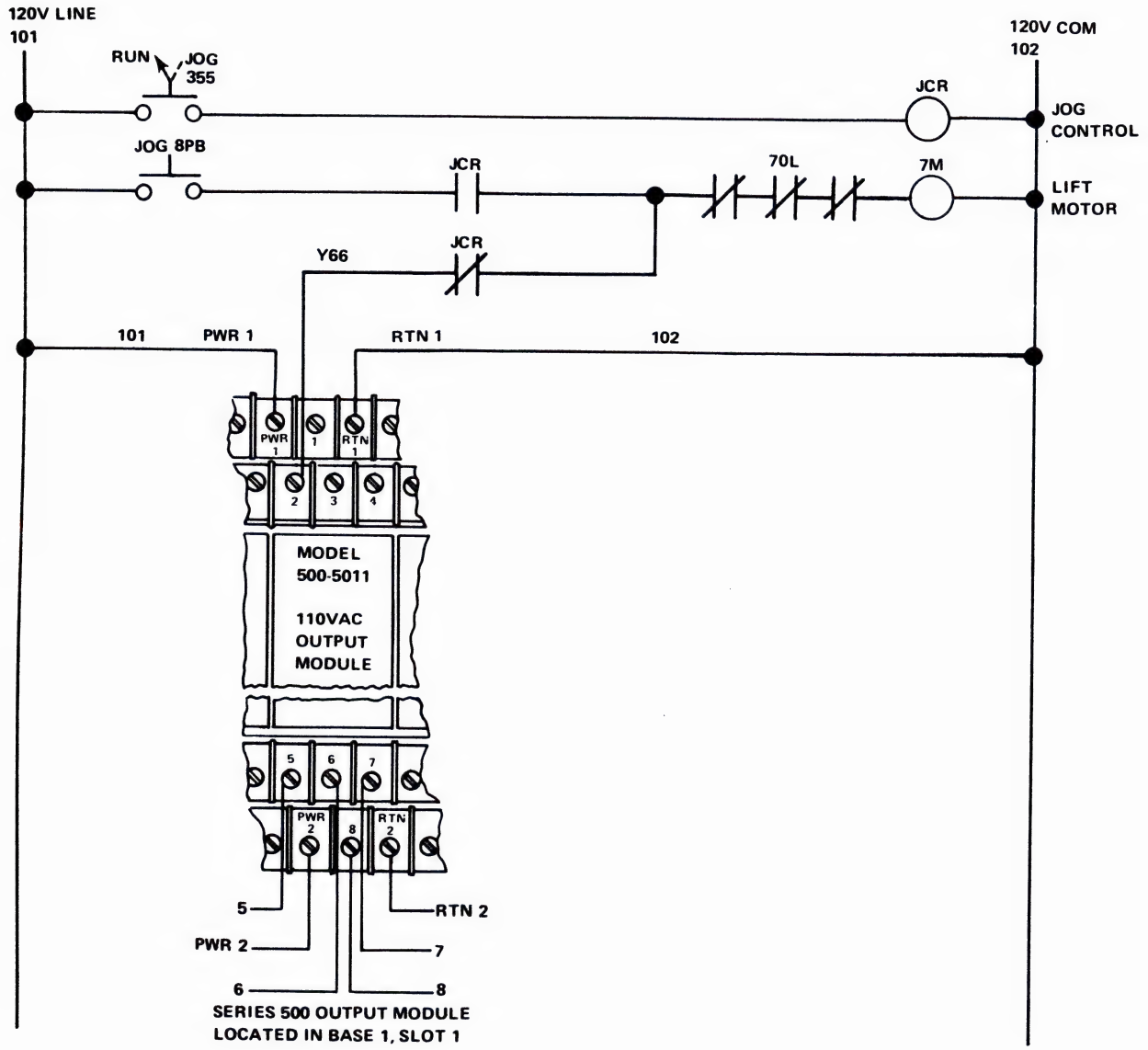


Figure 7-2 External JOG Switch

MASTER STOP SWITCH

- Another suggested precaution is including a Master Stop switch circuit on the AC power line side of the controlled output devices. Figure 7-3 shows this type of circuit without a built-in time delay.

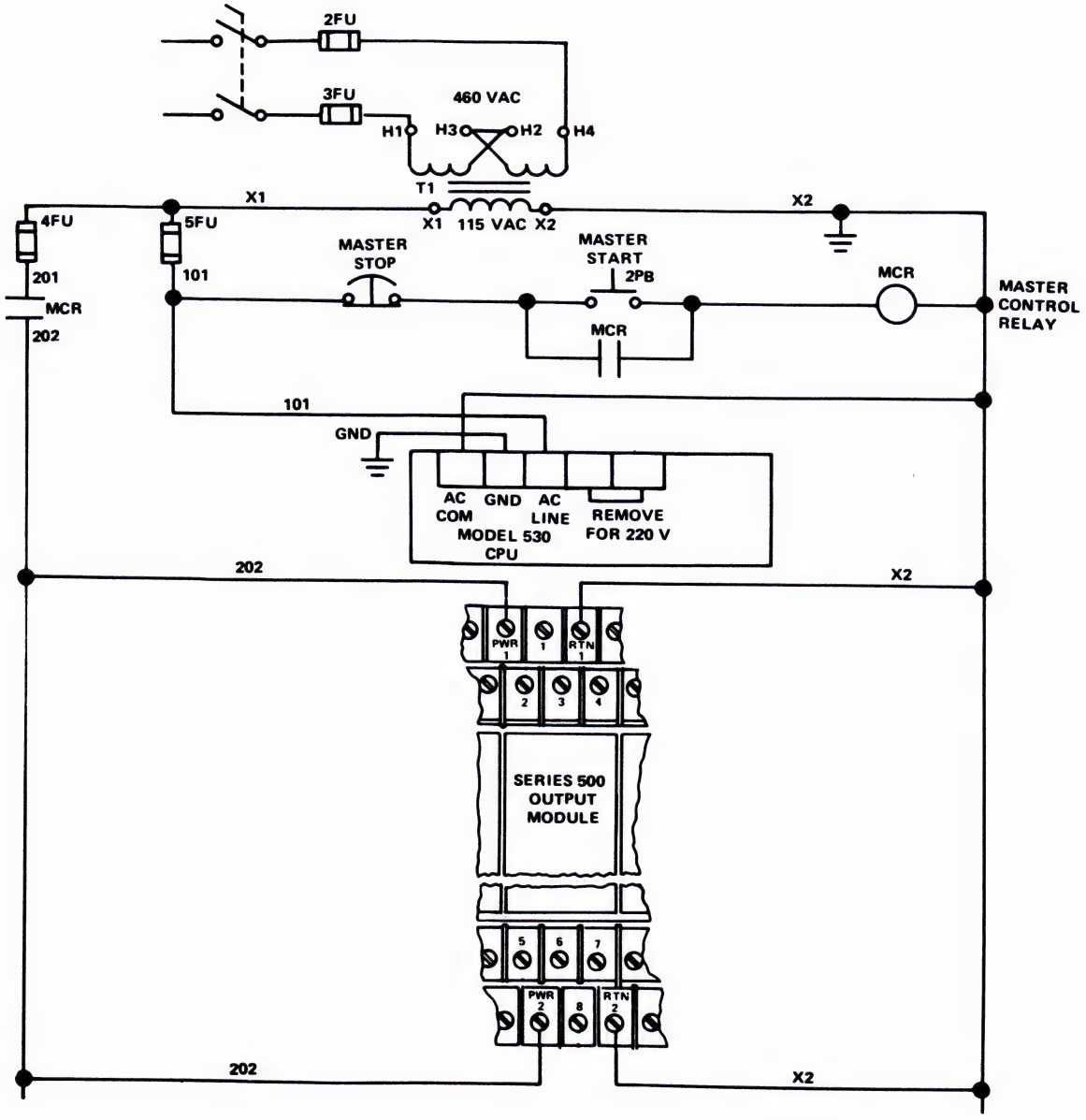


Figure 7-3 Master Stop Switch

7.3 INSTALLATION

The following paragraphs outline the installation procedures for the Series 500 520C/530C P/C system. Because of the possible system variations, the information discussed should be used as a guide and includes the major considerations that must be examined during equipment installation. For more detailed instructions on specific procedures, refer to the ''Sample System Installation'' portion of this section.

7.3.1 Installation Planning.

The planning phase of your system's installation consists of three basic steps. The first step is defining your control requirements. Control requirements consist of the number and type of Series 500 inputs and outputs necessary to direct your application process. Once the control requirements have been defined you can use the information to determine what equipment you need. Choosing the number of P/Cs, I/O modules and mounting bases is the second step in installation planning. The third step involves using the information gathered through the first two steps to determine the power requirements and mounting space. Once you have decided on the number and type of equipment necessary to control your process, the equipment specifications will aid you in designing an installation layout.

7.3.2 Thermal Considerations.

As temperatures rise in electronic devices, the devices become prone to different types of failures. When you are planning your installation, adequate air flow for cooling should be a major consideration. Unless ambient temperatures are extremely high, precautions such as fans or air-conditioned cooling will not be necessary to maintain the 520C/530C models below their maximum rated temperature of 60° Celsius. There are two major guidelines to follow when you design your panel.

First, the natural convective cooling designed into the 520C/530C system components should not be hindered. Common installation practices that aid this mechanism are:

- Mounting the P/Cs in an upright position so that the cooling vents are at the top and bottom of the device rather than the sides. (This assures proper air flow through the P/C.)

- Housing the P/Cs in a cabinet that affords enough clearance to allow for a sufficient amount of cool air to build up. (If your housing is barely larger than the P/C, no cool air builds up and a ''hot box'' is created.)

To meet the temperature specifications listed in the CPU section of this manual, mounting bases must be mounted on a vertical panel. This allows maximum convective air flow around the module heat sinks.

Second, your system's electronic devices should not be operated at the low end of their input power voltage rating for extended periods of time. When input voltage is low, current input is forced higher to provide the device with the required power. Additional current means additional heating. When a system is to be installed where long brownouts are known to occur, it is advisable to supply the system with power from a voltage regulating transformer. Use of this type of transformer will provide normal voltage to the devices and keep current within the normal range. For information about AC power considerations for your power supply module, refer to the 110/220 VAC POWER SUPPLY MODULE INSTALLATION MANUAL.

7.3.3 Electrical Noise Considerations.

Electrical noise can cause problems within your system. The prevention of electrical noise should be a major consideration when you plan your installation. Although many potential problems are presented in the following paragraphs, the chances are very slim that any of them will be encountered in an actual application using a suitably installed 520C/530C, even in a relatively harsh industrial noise environment. This is due to the fact that noise suppression techniques have been built into the 520C/530C P/Cs to enhance system noise immunity.

Special attention should be given to field wiring and your system should be mounted using appropriate grounding techniques (grounding techniques are explained later in this section). When you plan your systems installation, you should plan to keep all AC lines separated from low-level DC lines. Low-level DC I/O lines should not be routed in the same wireway in parallel with AC lines. AC power lines of different voltages should be routed separately.

The predominant effect of noise on the 520C/530C system results in a "soft failure." Soft failures are those which do not damage the system, but do cause it to function improperly. The two main types of soft failure that are most often encountered are:

- Image register alteration
- Momentary I/O failure

If the logic memory is altered by noise, a fatal error is logged, the PC GOOD light turns off, all outputs are disabled and the CPU stops scanning. In this case, the I/O points are all frozen in the state they were in when the error occured. Image register and temporary I/O failures normally result only in nuisance failures, such as operation in the wrong mode or machine ''glitches.'' Programmed safety logic and system safety sensors can be designed to automatically detect and correct such failures.

7.3.4 Grounding.

A proper grounding system is essential to any electrical system and should be one of the most important considerations in planning your installation. For correct operation of any 520C/530C system, it is imperative that a low-impedance path to earth ground exist. All filtering devices internal to the 520C/530C CPU require a good earth ground return.

NOTE

The structural ground present in many industrial environments does not provide an adequate ground return. A supplementary driven grounding rod should be used to reduce the impedance of the earth ground return when direct-wire connection to the power system is not feasible.

As a minimum, a No. 12 AWG stranded copper wire should be used to connect the copper grounding rod. Minimum wire sizes, color coding and general safety practices should comply with the American National Standards and the National Electrical Code.

The entire mounting surface should be connected to a low- impedance ground reference point. The connection (Figure 7-4) should exhibit very low DC resistance (0.05 ohm) and low high- frequency impedance (such as a connection through copper lugs). All Series 500 devices with an external chassis or external ground terminal on their power connectors should have that terminal wired to the subpanel control ground bus bar connection (Figure 7-5).

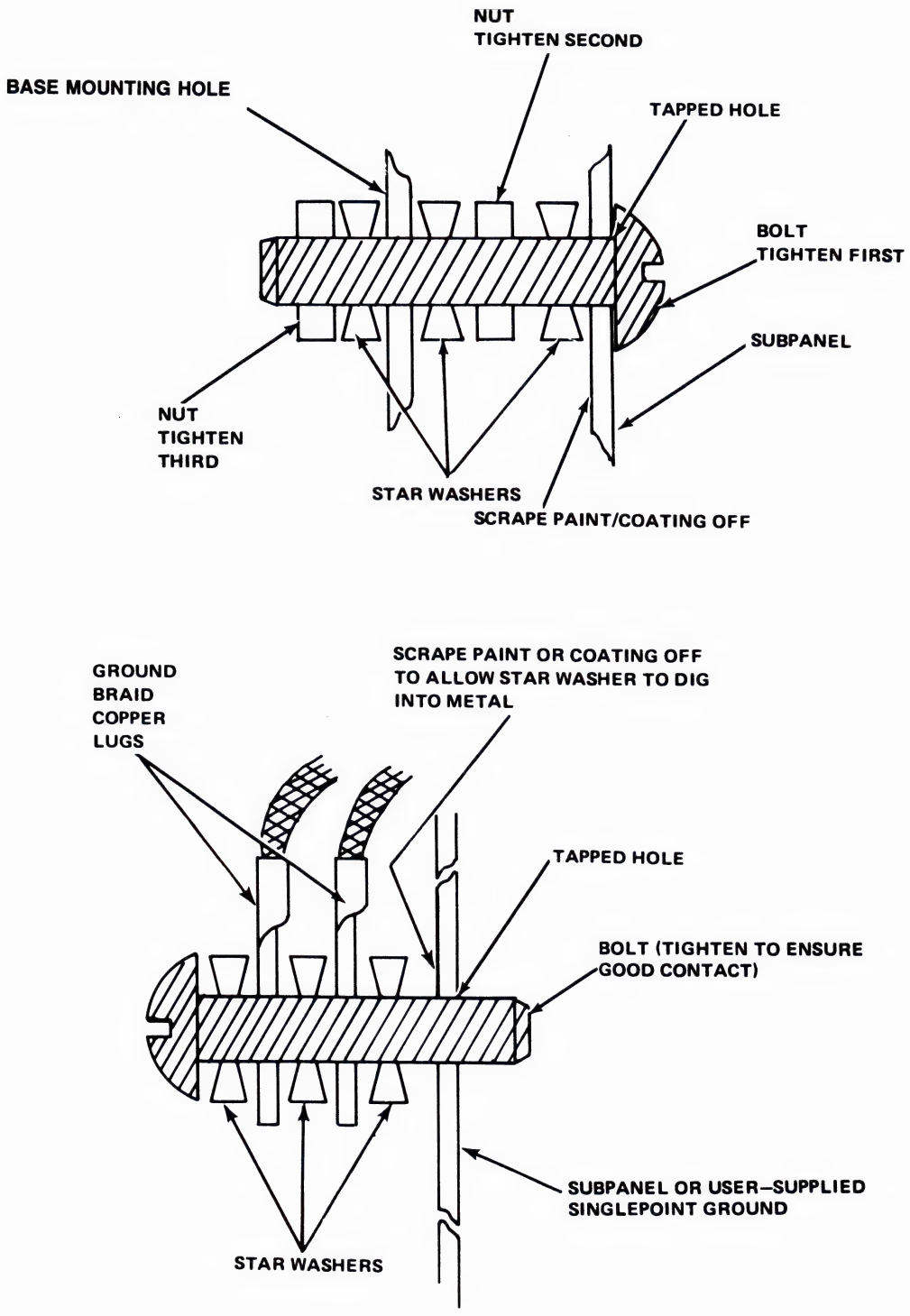


Figure 7-4 Sample Ground Connections

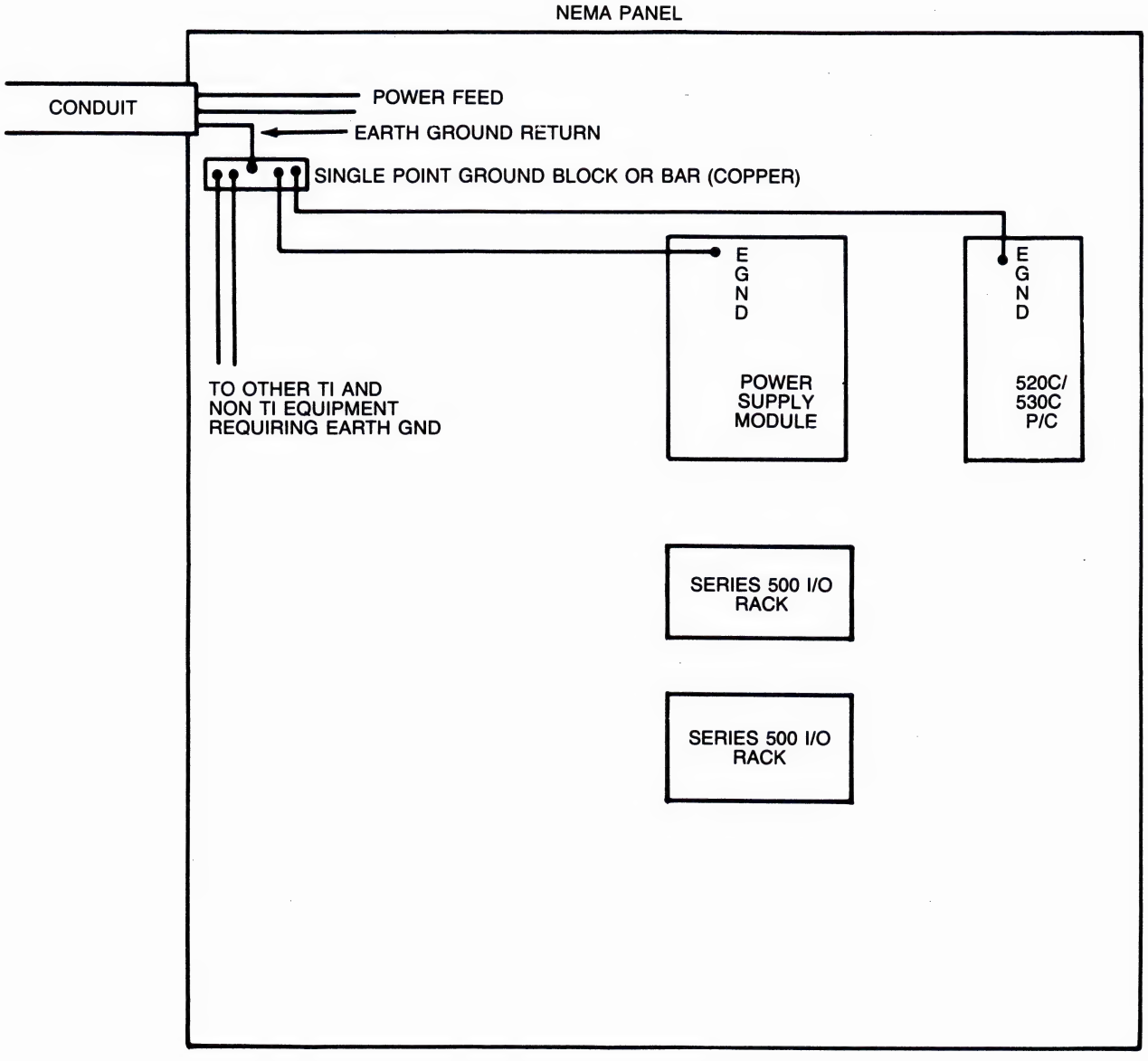


Figure 7-5 Typical Ground Layout for 520C/530C Installation

7.3.4.1 Metallic Mounting Surfaces.

If a conductive metallic mounting surface such as a NEMA enclosure subpanel is used for system components, it can serve as the earth ground reference, with these important considerations:

- Electrical connection of the component chassis to the subpanel should exhibit very low DC resistance (0.02 ohm) and low high-frequency impedance. This can be accomplished by removing the anodized finish from all connection points and using outside star washers.

- The entire mounting surface should be connected to a good earth ground reference point, such as a copper grounding stake driven into the earth. This connection should be made with a copper ground braid. The connection should exhibit very low resistance (0.05 ohm) and low high-frequency impedance (such as a connection to copper lugs, studs, nuts, etc.). The termination of the ground stake ground braid at the subpanel serves as both the subpanel ground and the system electrical ground point. All components with an external chassis or external ground terminal on their power connectors should have that terminal wired to the subpanel ground connection.

Other earth ground sources are not as desirable as a copper ground stake. Green wire earth grounds (safety grounds) brought into a control system from plant power distribution networks tend to be very noisy. In most plants, the green earth ground system is characterized by ground loops, multiple terminations to different references and long wire runs adjacent to motor power and other high-power wiring. Conduit as an earth ground has even more problems. Though many installations use these ground references successfully, the practice should be avoided.

7.3.4.2 Nonmetallic Mounting Surfaces.

If a nonconductive mounting surface is used, you need to provide a single-point ground (e.g., copper bus bar) to a good earth ground reference. The metal casing of component (and its external chassis or external ground terminal, if applicable) should be connected to this single-point ground, using its own ground braid. The single-point will be the center of a ''star'' configuration. To achieve low impedance from component to single-point termination, a 0.64-cm (1/4 in.) or larger ground braid should be used. A good rule of thumb is to require less than 0.05 ohm of DC resistance between the component and the single-point ground.

7.3.4.3 General Guidelines for Ground Connections.

Particular care must be exercised in establishing the type of ground connections. The following techniques will help in establishing good electrical connections and increasing system noise immunity:

- Grounding braid and ground wires should be terminated at both ends with copper eye lugs to provide a good contact surface. Lugs should be crimped and soldered.

- Fasteners providing electrical connections to the single-point ground should be No.10 copper bolts (or equivalent). This applies to component mounting bolts and braid termination bolts for subpanel and the single points you supply. Tapped holes for these fasteners are better than nut-bolt arrangements.

- Paints, coatings and corrosion can all prevent good electrical contact at ground points. Make sure that the area of contact is free of these obstructions. The use of external toothed lockwashers (star washers) will also ensure a good connection. This practice should be used for all terminations (i.e., lug-to-subpanel, component-to-lug, component-to-subpanel, subpanels-to-conduit, etc,). A grounding lug is provided on each base for your convenience.

7.3.5 Enclosure Selection.

We recommend an enclosure for your P/C to protect it from atmospheric contaminants including oils, moisture, conductive dust and particles and corrosive agents.

The enclosure should be mounted in a position that permits its doors to be fully opened for access to the P/C's wiring and other components for measurements and testing. The enclosure must provide a minimum of 25.40 cm (10 in.) depth from the mounting panel to the inside surface of the enclosure door.

NEMA has defined enclosures by type, based on the degree of protection the enclosure is designed to provide. Your 520C/530C should be mounted in a NEMA Type 12 enclosure or other NEMA Type dusttight and driptight enclosure dictated by the environment where the equipment is to be mounted. Information concerning NEMA standards can be obtained by writing to the following address:

National Electrical Manufacturers Association
2102 L Street NW
Washington, D.C. 20037

7.3.6 Wireway Layout.

Figures 7-6 through 7-9 show the proper layout for installing a 520C/530C.

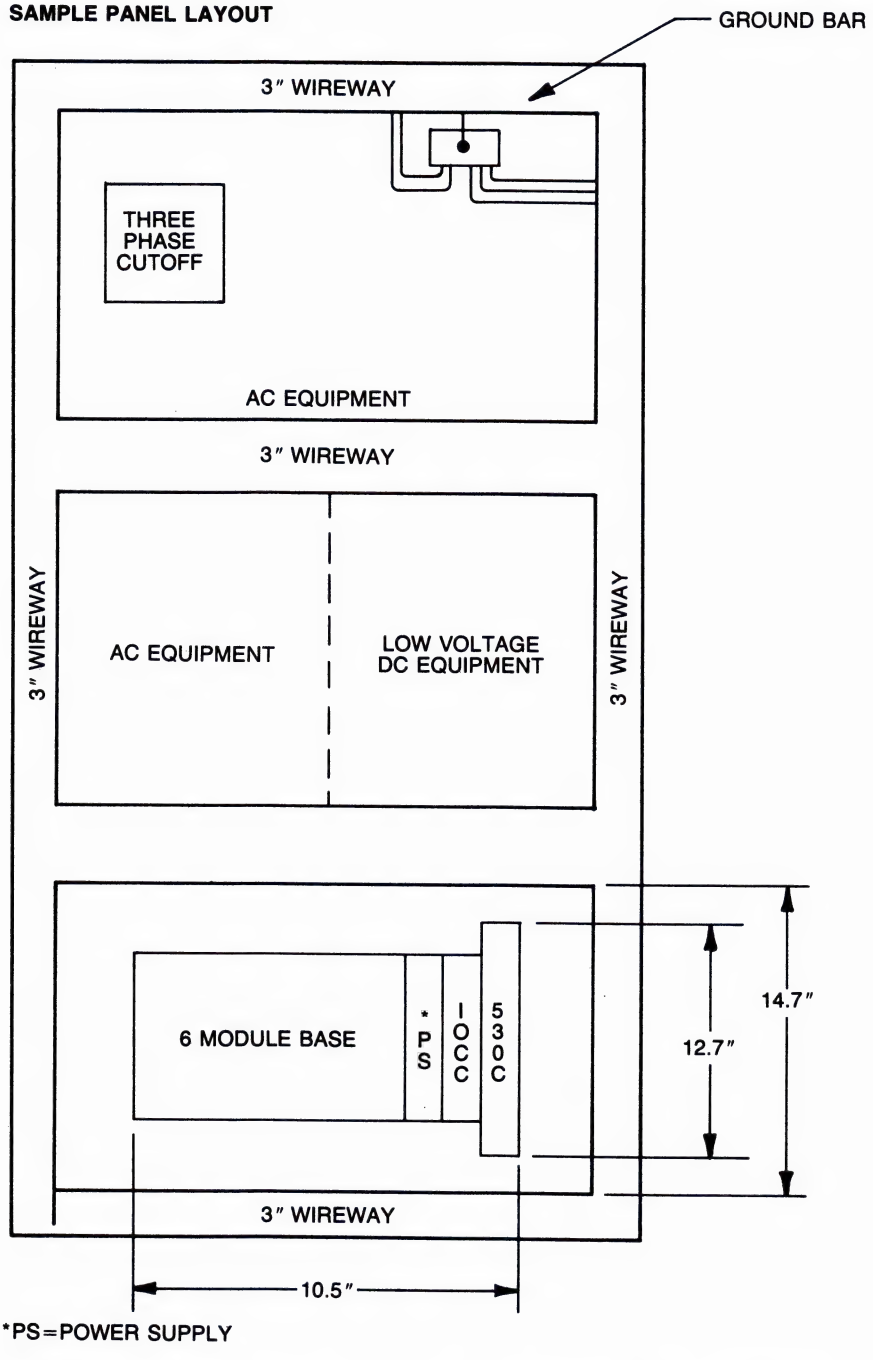


Figure 7-6 Wireway Layout for Model 500-5892 Base Assembly

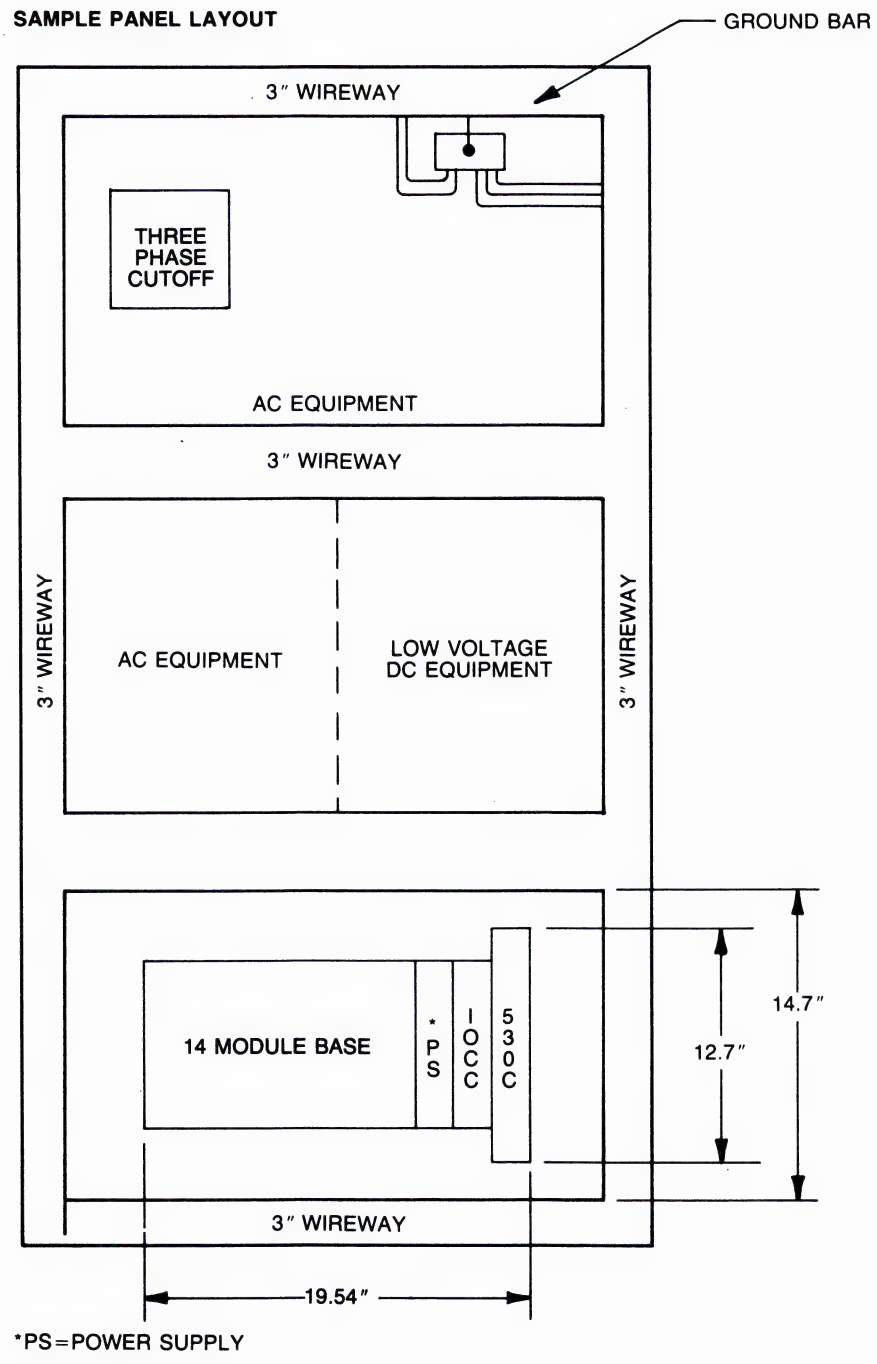


Figure 7-7 Wireway Layout for Model 500-5848 Base Assembly

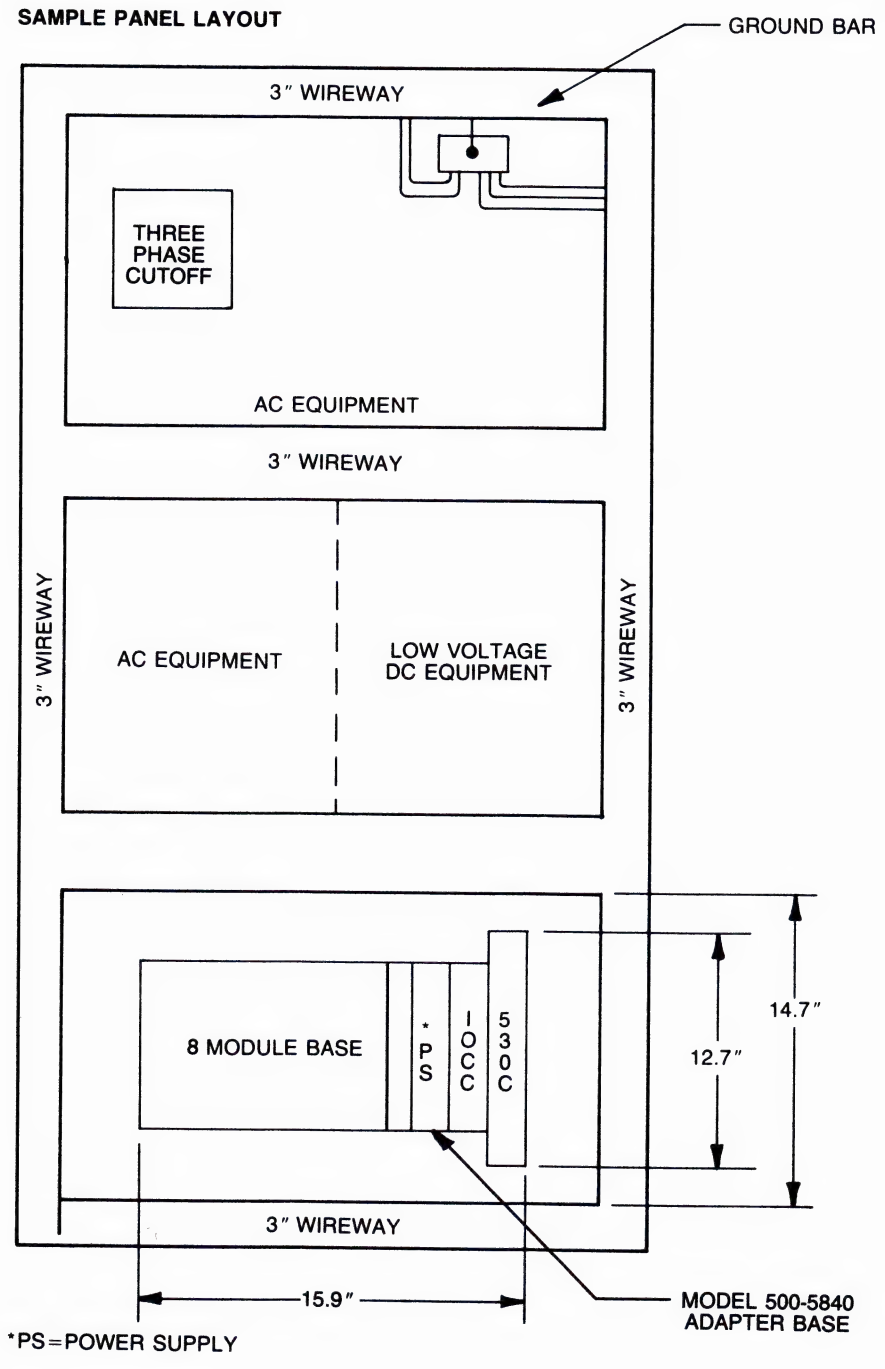


Figure 7-8 Wireway Layout for Model 500-5864 Base Assembly with Adapter Base

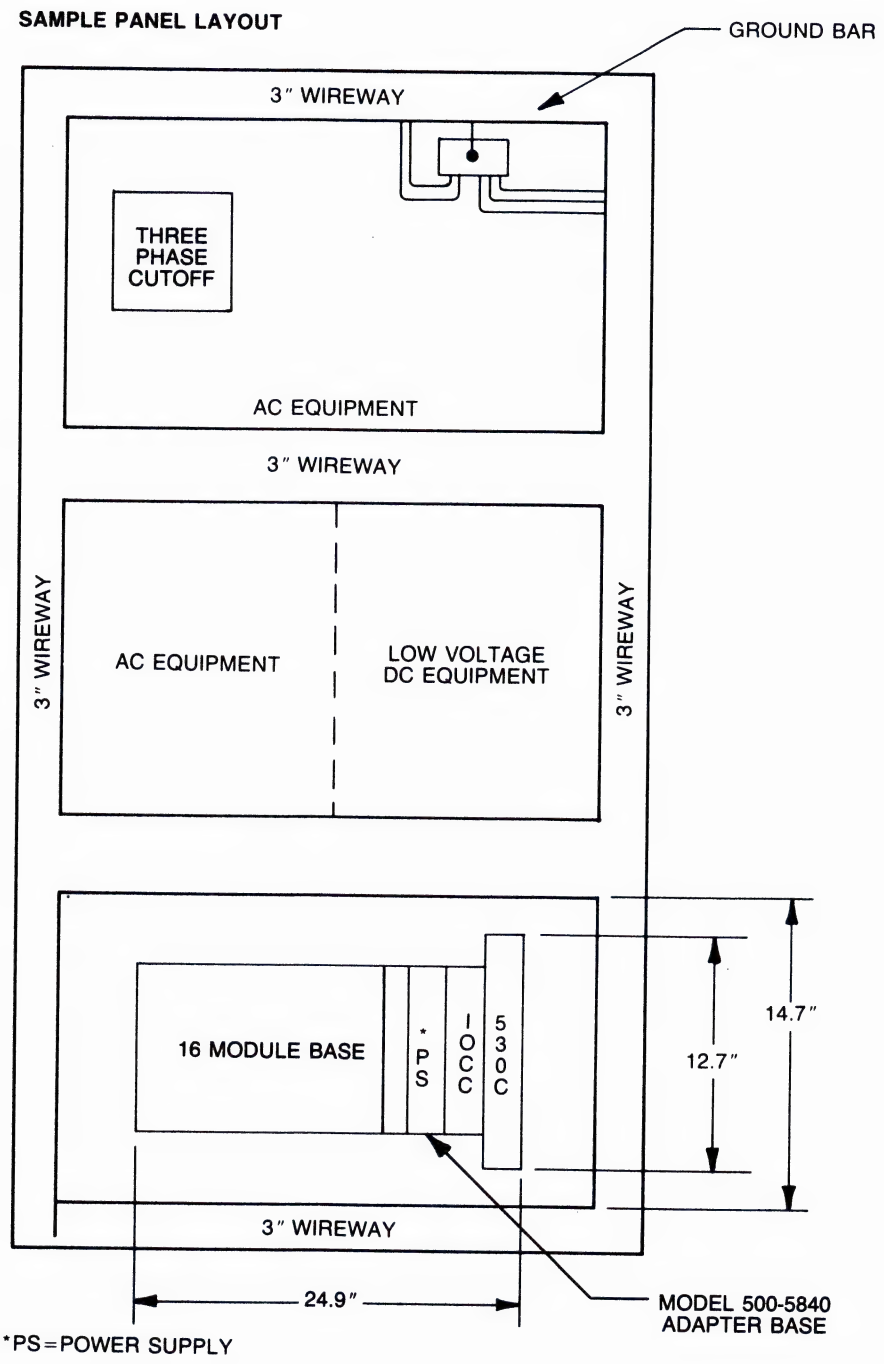


Figure 7-9 Wireway Layout for Model 500-5828 Base Assembly with Adapter Base

7.3.7 Mounting Dimensions.

The 520C/530C P/Cs mount directly onto their base assemblies, or in the case where you are using an adapter base to modify 500-5864/500-5828 bases, the P/Cs mount onto the adapter base, which in turn is mounted with the base. Figures 7-10 through 7-12 show the mounting dimensions for installation of the Model 500-5892 base and the Model 500-5848 base as well as the adapter base.

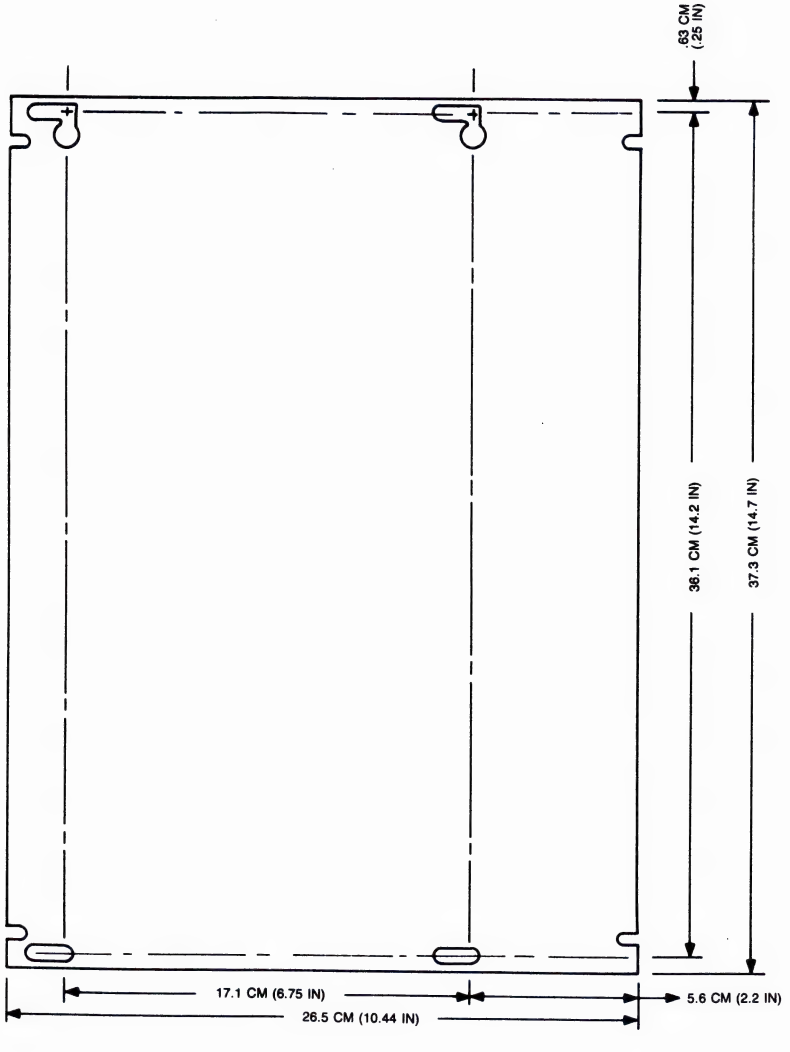


Figure 7-10 Mounting Dimensions for Model 500-5892 Base Assembly

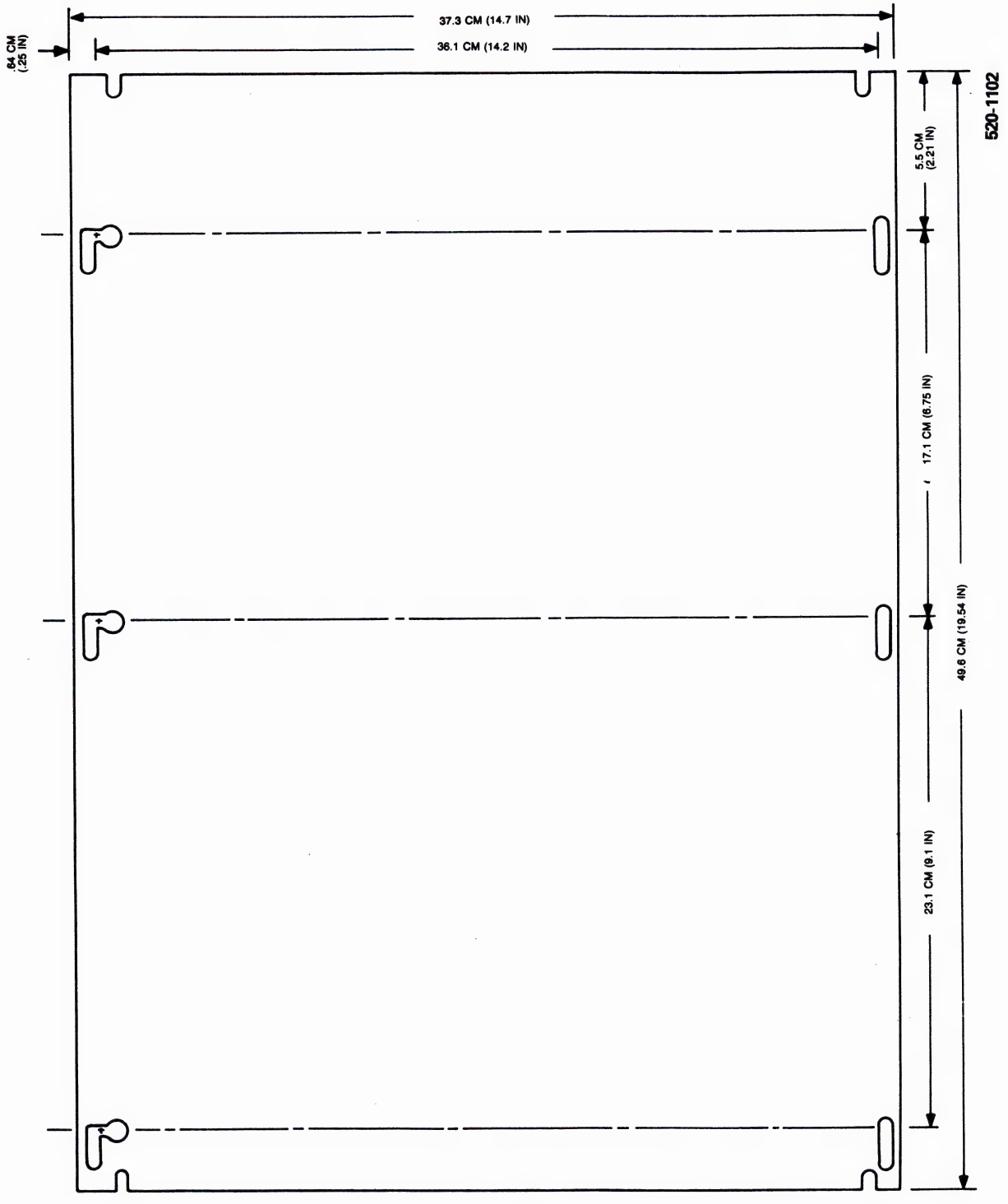


Figure 7-11 Mounting Dimensions for Model 500-5848 Base Assembly

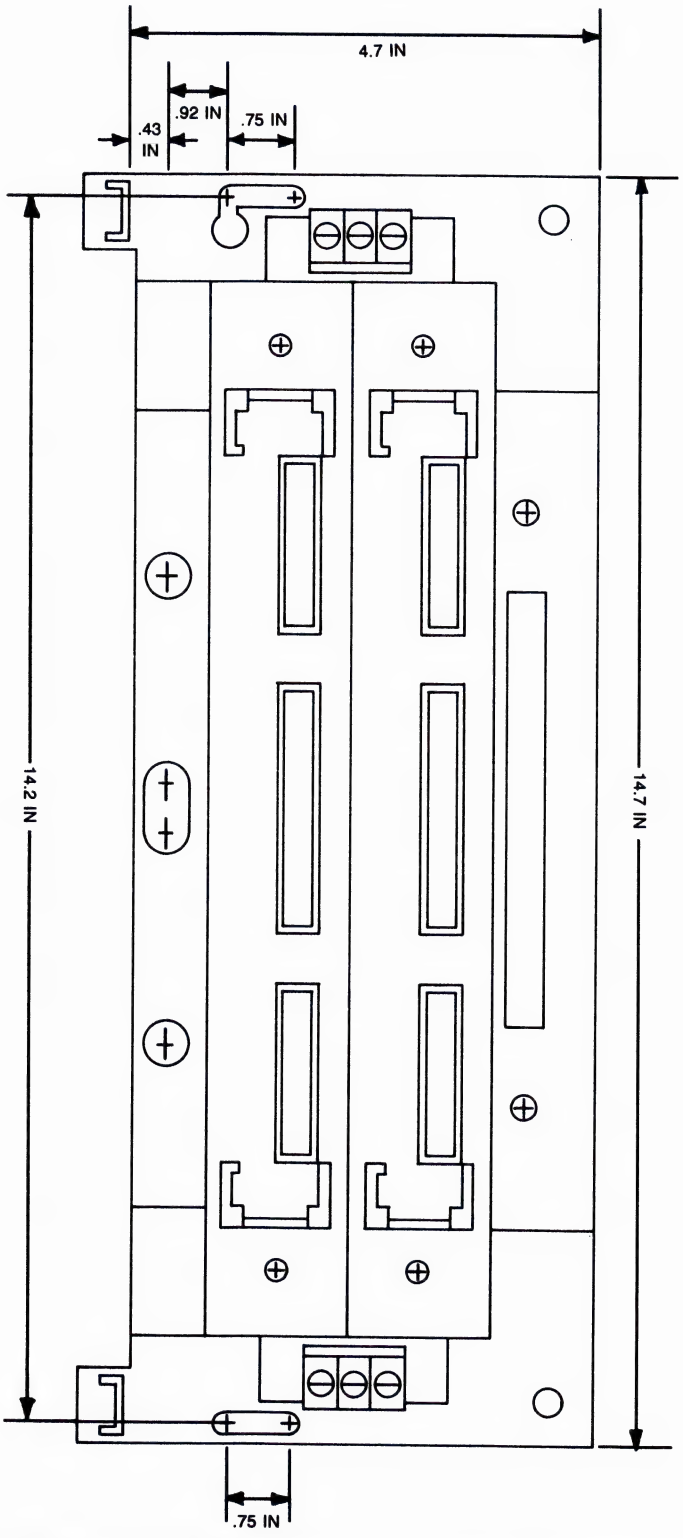


Figure 7-12 Mounting Dimensions for Adapter Base Assembly (500-5840)

7.3.8 Mounting Procedures.

The following listings contain mounting procedures for the 520C/530C P/Cs, I/O bases and the adapter base. If you are using the adapter base to modify an existing I/O base, refer to your P/C User's Manual for removal procedures.

P/C and I/O Base Mounting Procedures

1. Locate the base assembly on the panel subplate.
2. Locate mounting screw positions.
3. After all screw holes have been located, drill and tap for 10-32 screws. Subplate thickness should be at least .093 inches thick in order to provide at least three full threads for proper support.
4. Start top screws.
5. Attach units with top screws in appropriate slots.
6. Start bottom screws.
7. Insert your P/C module into the I/O base by sliding the edge card into the edge card connector and tightening the captive screws.
8. Insert your Power Supply module (refer to the 110/220 VAC POWER SUPPLY MODULE INSTALLATION MANUAL, 500-8111). (See Figure 7-14)
9. Tighten all mounting screws.
10. Connect power and I/O wires.

Adapter Base Mounting Procedures

1. Locate the adapter base on the panel subplate.
2. Locate the mounting screw positions where the inside mounting screws (nearest the top latches of the base assembly) are 12.45 cm (4.9 in.) to 12.95 cm (5.1 in.) apart (see Figure 7-11).

3. Locate the other screws at slot centerline distances apart. This permits an I/O base or the adapter base to be removed for repairs without disturbing the adjacent units.

4. Allow at least 2.5 cm (1 in.) between the vertical wireway and the I/O base or the adapter base. This permits the unit to slide to one side for removal.

5. After all screw holes have been located, drill and tap for 10-32 screws. Subplate thickness should be at least .093 inch thick in order to provide at least three full threads for proper support.

6. Start top screws.

7. Attach units with top screws in appropriate slots.

8. Start bottom screws.

9. Place top and bottom latches over tab on adapter base.

10. Turn screw on latch clockwise and pull the I/O base and the adapter base together.

11. Tighten all mounting screws.

12. Insert the Power Supply Module and the P/C module in the appropriate slots (see Figure 7-12).

13. Connect power and I/O wires.

7.3.9 Removal Procedures.

The following steps contain removal procedures for your 520C/530C P/C:

1. Remove power from the P/C.

2. Loosen the captive screws and pull the P/C out of its base.

The following steps contain removal procedures for the I/O base and the adapter base:

1. Remove power from base and I/O modules.

2. Remove the bottom screws from the base.

3. Loosen the top screws securing the I/O base. It is unnecessary to remove these screws if the mounting instructions were followed.

4. Slide the base to the left and lift up and out.

5. If you have an adapter base, turn the screws on the top and bottom latches counterclockwise to release the I/O base from the adapter base. Then slide the I/O base to the left and lift up and out.

7.3.10 External AC Power Connection.

For information on installation procedures for external AC power connections, refer to the 110/220 VAC POWER SUPPLY MODULE INSTALLATION MANUAL, 500-8111.

7.3.11 I/O Terminal Connections.

As shown in Figure 7-13, there are six terminals at the top and six terminals at the bottom of the base for each I/O module. The top terminals include a power terminal, a return terminal, and input or output terminals. The bottom terminals include a power terminal, a return terminal and input or output terminals.

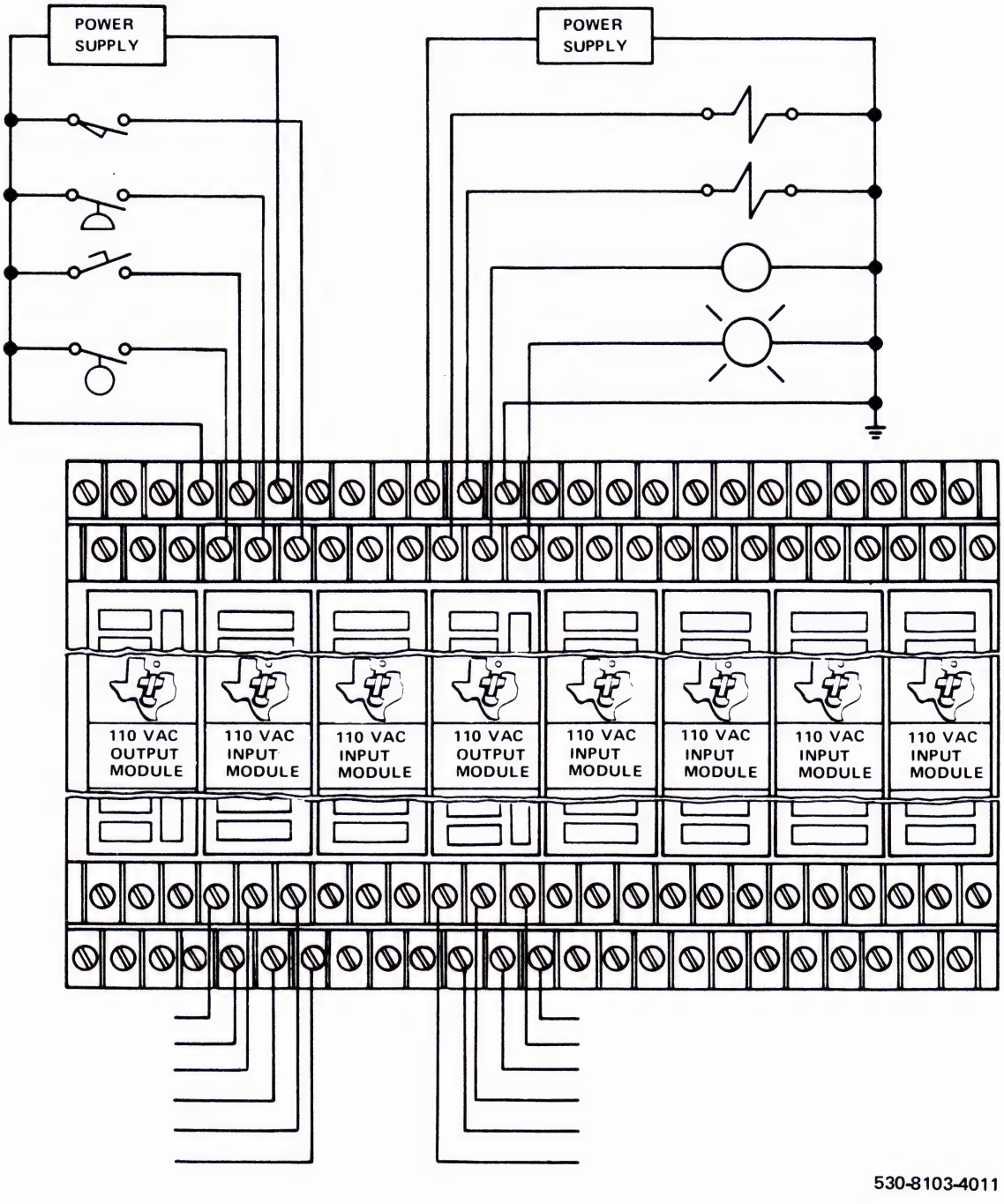


Figure 7-13 I/O Terminal Connections

7.3.12 I/O and Power Supply Module Installation.

The procedures for I/O and Power Supply module installation (see Figure 7-14) are listed below:

1. Check the I/O modules for proper keying (refer to the documentation that accompanies each module).

2. Align the I/O module with the I/O slot.

3. Slide the I/O module into the guided slot.

4. Push the module against the base until the latches snap into position.



Figure 7-14 I/O-Power Supply Module Installation

7.4 START-UP PROCEDURES

Start-up procedures are outlined below:

1. Measure the input AC power for proper voltages before energizing (refer to the documentation that accompanies the Power Supply Module).

2. Check for proper wiring for the I/O terminations.

3. Check for correct settings of P/C configuration switches.

4. Check the wiring to all field connected devices.

CAUTION

The first time the P/C is powered up, the battery must be disabled or the unit may get a fatal error from bad data set in the memory.

5. Enable the battery by attaching the quick connect of the red wire to the battery terminal marked positive(+).

6. Apply power to the P/C.

WARNING

When the P/C is powered-up with a programmed EPROM installed it will automatically be in the RUN mode. Precautions should be taken to prevent accidental damage to personnel or machinery.

7. Hook up your programming device to a communication port of the P/C.

8. Enter your ladder program. Refer to the 520/530/520C/530C VPU200 PROGRAMMING GUIDE (manual no. 530-8109) and the 520/530/520C/530C PROGRAM DESIGN GUIDE (manual no. 530-8110) for information on programming procedures.

9. Use your programming device to JOG motors, solenoids, or other positioning devices one at a time to establish correct rotation or position. Providing that your program is debugged, the system should be ready to control the process or machines.

10. To start operation, use your programming device to put the P/C into the RUN mode.

WARNING

Adequate safety precautions should be taken during machine/process start-up to prevent accidental damage to personnel or machinery.

7.5 SAMPLE SYSTEM INSTALLATION STEPS

This section is designed to help you in the considerations and procedures involved in installing your system. As stated earlier, there are too many possible system combinations to cover completely in one example so the system described is a typical application. Bear in mind that your system will have unique characteristics and this example is intended only as a general guide.

7.6 APPLICATION

The system to be controlled is located in a manufacturing facility in the loading area. The machines to be handled by this system include a conveyor and a palletizer. The conveyor moves three different size boxes to the palletizer where the boxes are stacked, banded and shrink-wrapped. This area is relatively dust free and well ventilated so no special enclosure considerations are needed. The only possible exception is the ambient temperature which exceeds 100 °F at times.

7.6.1 System Requirements.

In addition to controlling the sorting and wrapping of the boxes, there are certain requirements that call for specific equipment. These requirements are a major factor in determining what equipment is needed to best handle the application and are discussed in the following paragraph.

The two machines to be controlled are located in different areas but need to be run by the same controller. Each machine needs a way to set limits on packaging as well as conveying the boxes. The process needs to be closely monitored and reported and the system must have room for expansion. And we want to get the most performance out of the equipment at the lowest cost.

7.6.2 Equipment.

Now that the control needs have been ascertained, the necessary equipment has been determined and purchased. This equipment is listed below:

- 1 Series 500 530C Programmable Controller, Model 1104
- 1 110 VAC Power Supply Module, Model 2151
- 1 Series 500 I/O Base, Model 5848
- 1 Distributed I/O Channel Controller (IOCC), Model 2108
- 1 Distributed Base Controller, Model 2103
- 1 Series 500 I/O Base, Model 5864
- 1 Series 500 I/O Base, Model 5848
- 1 Series 500 Programmable BASIC Module, Model 5035
- 1 24 VDC High Density Input Module, Model 5030
- 1 24 VDC High Density Output Module, Model 5031
- 1 8 Channel (Multiplexed) Parallel Word Input Module, Model 5018
- 1 24 VDC Output Rapid Response Module Model 5026
- 4 4 Channel Analog Input Modules, Model 5009
- 4 24 VAC/DC Input Modules, Model 5005
- 4 24/48 VDC Output Modules, Model 5013
- 2 NEMA 12-type enclosure, 4 X 8.

7.7 SYSTEM LAYOUT

The P/C is located at the palletizer and the Distributed Base Controller is at the motor control center for the conveyor. Both controllers are mounted in a NEMA enclosure with the access through the front door. Since the ambient temperature exceeds 100 F., a fan is installed to promote air circulation and cooling. The fan is a standard ''muffin'' fan connected to a 110 VAC line. The fan is located in the top of the cabinet, pulling air upward through the cabinet. There is a filtered vent located in the bottom of the enclosure to allow for proper air circulation. Figure 7-15 illustrates the system layout for the local and remote base.

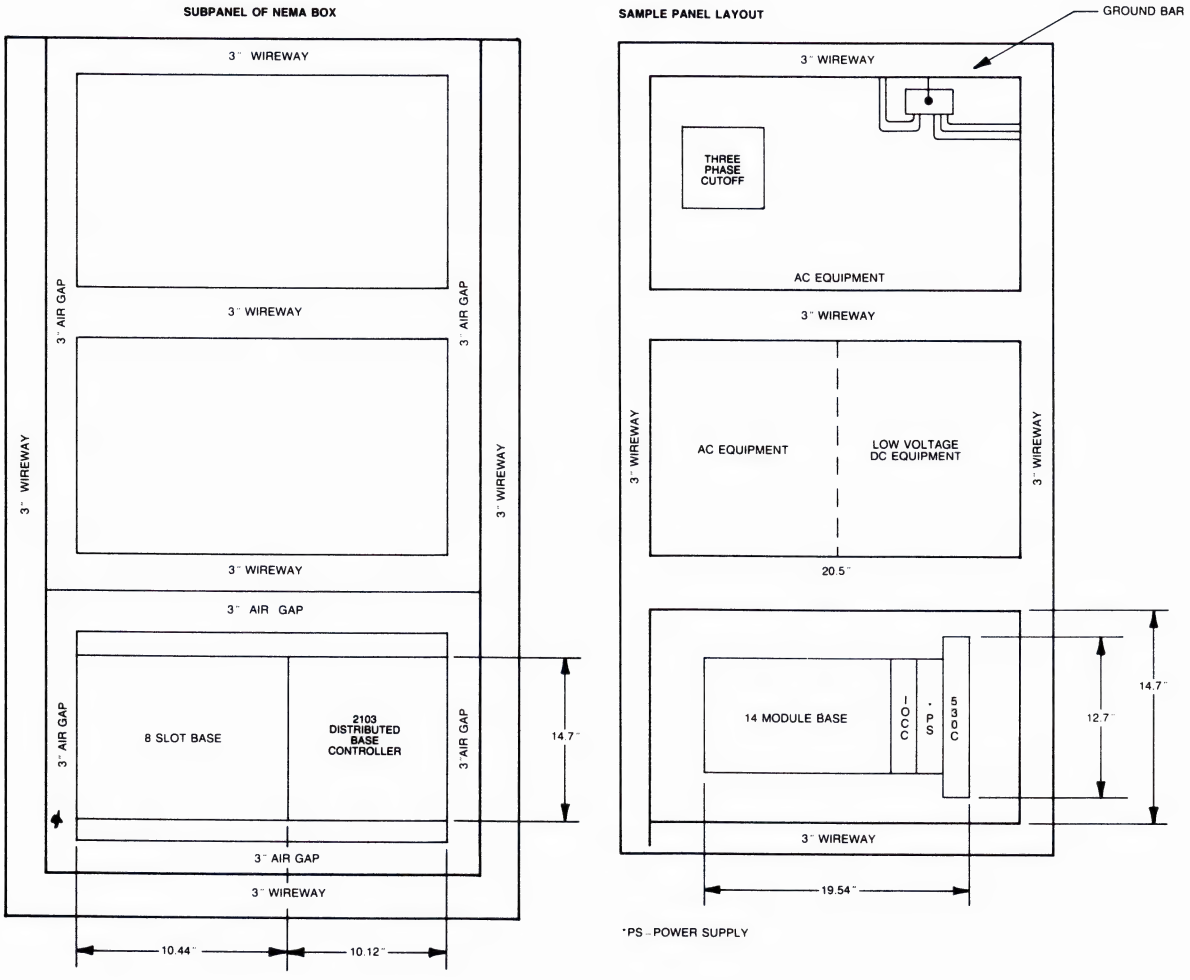


Figure 7-15 Sample System Layout

7.7.1 Installation.

Following the mounting procedures found in the Installation and Startup section of this manual, the bases are mounted within the enclosures. The system is grounded using a single-point grounding scheme (a single wire to the P/C from where the distributed earth ground connects to the sub-panel via 12 AWG stranded wire).

The AC power used to run the P/C is the same three-phase AC power that is used to run the motors of the conveyor and the palletizer and the switching on and off of the motors makes the AC power prone to distortion. To correct this, a a line conditioning step down transformer is used to clean up the power (another option would be to use a separate 110 volt branch current instead of the transformer).

A single ground wire to the controller is used since the NEMA 12 has a metallic subpanel providing a ground to the I/O base sheilding. At this point all field wiring is connected to the I/O bases. This includes all jumpers for the module options.

7.7.1.1 Panel Installation.

At this point, the P/C, IOCC, and the Power Supply module are installed in the local base and the Distributed Base Controller is installed in the distributed base - according to the instructions found in the Installation and Startup section of this manual.

The cable for distributed I/O to IOCC communication is connected via the terminal strip (blue wire to the terminal marked ''B'', clear wire to the terminal marked ''W'', and shield wire to the terminal marked ''G'') and then to the tap housing on the Distributed Base Controller.

Following the instructions found in the Installation and Startup section, all of the I/O modules are installed in the local and distributed bases. It is essential at this point to verify the I/O wiring. The final installation step is the application of AC power.

8: MAINTENANCE AND TROUBLESHOOTING

8.1 INTRODUCTION

This section is designed to provide you with maintenance and troubleshooting procedures for your 520C/530C Programmable Controller and your Series 500 I/O system. It contains general guidelines for maintenance as well as checks when you troubleshoot. The contents of this section are divided into the following areas:

- Maintenance
- Troubleshooting
- Spare Parts

8.2 MAINTENANCE

You can minimize process downtime by following sound preventive maintenance procedures. We recommend that a 10% surplus of the types of I/O modules used be carried as backup stock.

Each 520C/530C is shipped with the battery installed. The following list outlines the steps to replacing the battery.

1. Ensure power is ON. Changing battery with power OFF results in memory loss.
2. Open battery door (see Figure 8-1).
3. Disable battery by setting battery configuration switch to "OFF".
4. Remove battery from battery clip.
5. Insert new battery into battery clip with negative(-) and positive(+) terminals properly aligned.
6. Set battery switch to "ON".
7. Close battery door.

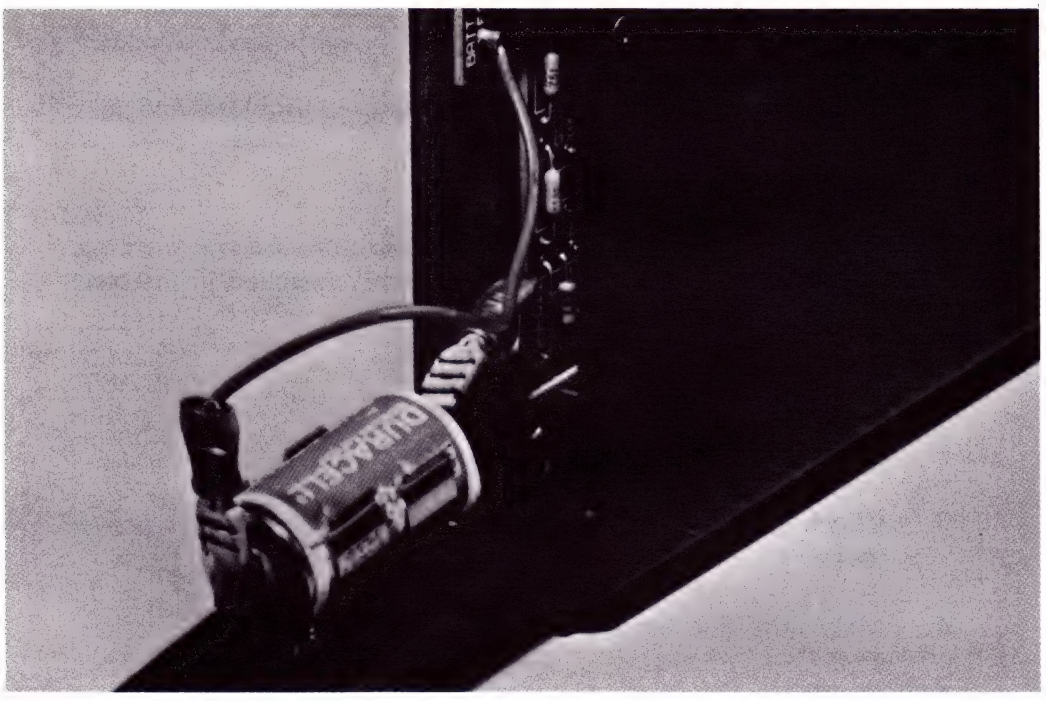


Figure 8-1 CPU Battery

8.3 TROUBLESHOOTING

The following paragraphs contain lists of the troubleshooting tools offered by the 520C/530C P/C and give examples of troubleshooting procedures

8.3.1 Troubleshooting Tools.

The Series 500 520C/530C P/Cs contain a number of tools that aid you in troubleshooting. These tools are listed below.

1. CPU Indicators
2. I/O Module Indicators
3. Status Words - accessed through your VPU
4. High-Level Instructions (Matrix, Move, Bit)
5. The capacity to program in diagnostics to tell if a limit switch has failed.

8.3.2 Troubleshooting Examples.

The following paragraph offers you some examples of problems and possible solutions.
If an output is always off:

1. Check your I/O modules. If their indicators are not working:
   a. Ensure that the module is firmly installed in the base.
   b. Check the field wiring.
   c. Check the power supplies.
   d. Check the output device.

2. Ensure that the CPU indicators are lit.

3. Check to make sure that the configuration switches are set properly.

4. Make sure that the AC power is good.

5. Check your program for possible errors.

6. Ensure outputs are not unintentionally forced.

7. Check for bent or mashed connector pins in the I/O base (particularly around keyed connector pins).

8.4 EPROM TROUBLESHOOTING

The EPROM option offered with your 520C/530C P/C contains its own troubleshooting tools. If you utilize the EPROM option, you can avoid problems by following these guidelines:

- The EPROMs used in other programmable controllers ARE NOT compatible with the 520C/530C P/C.

- If you transfer an EPROM from one 520C/530C model to another, make sure the program contained in EPROM is compatible with the new machine.

- If the program you have loaded into RAM fails to download to EPROM, check the toggle switch position.

- Make sure you have a back up copy of your program copied to disk in case of an accidental erasure of your program in RAM before you download to EPROM.

8.5 SPARE PARTS

As noted in the Maintenance section of this chapter, we recommend that you keep on hand a 10% surplus of your system's I/O modules. The following is a list of other recommended spare parts.

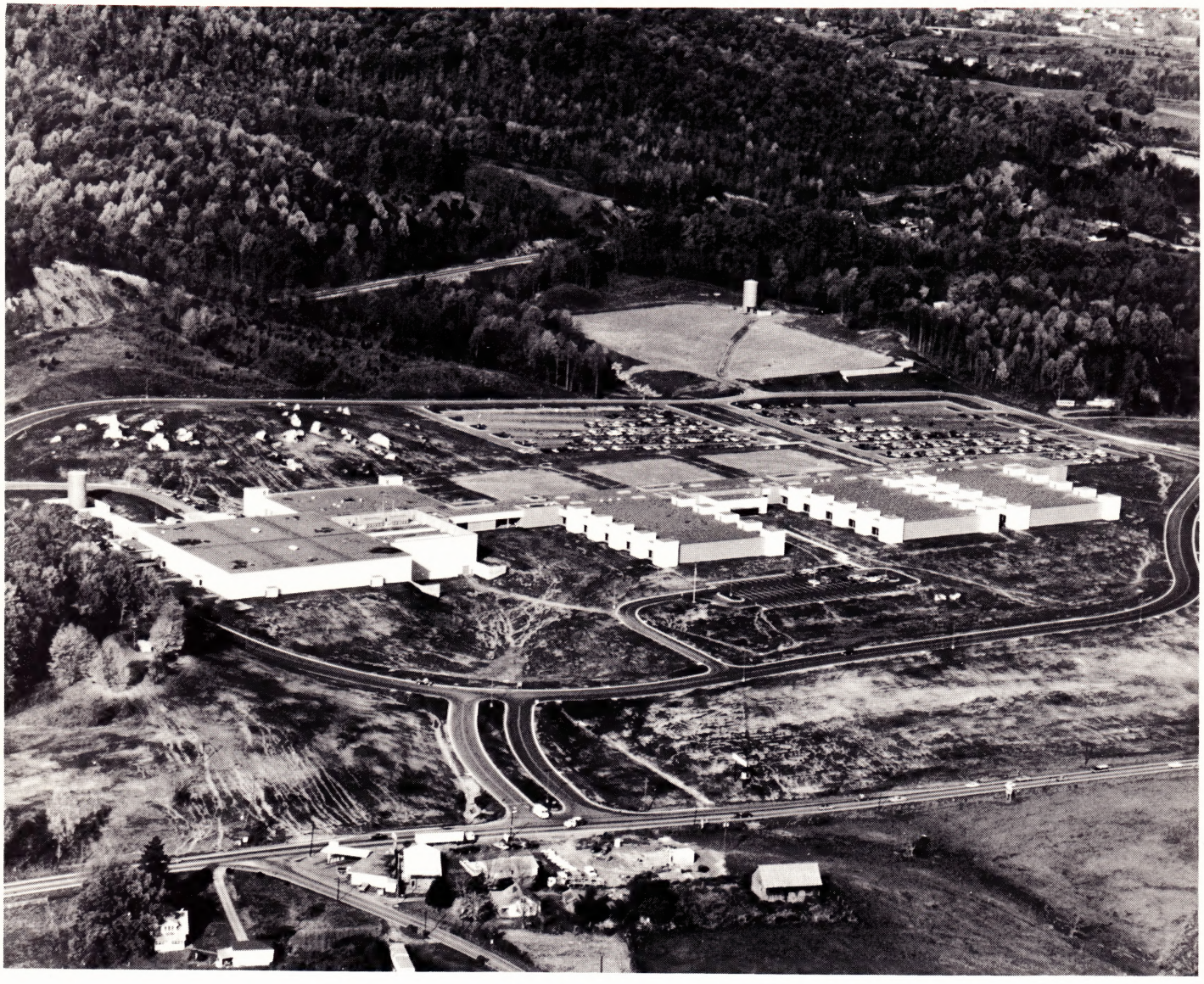
1. 1 14-Slot I/O Base, Model 500-5848
2. 1 16-Slot I/O Base, Model 500-5828
3. 1 Power Supply Module, Model 500-2151
4. 1 Type A Mercury Cell Battery, NEMA 1200M
5. 1 EPROM, Model 500-1610
6. High Density Module Terminals
7. Analog/Word Module Terminals

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