WANG

Wang Computer System

WANG

Wang Computer System

Models:	CS	CS-N
	CS-D	CS/386
	CS/386 Turbo	

COMPANY PROPRIETARY STATEMENT

Product Maintenance Manual   **741-1769-A**

PREFACE

This document is the Product Maintenance Manual (PMM) for the Wang Computer System Models CS, CS-N, CS-D, CS/386, and CS/386 Turbo systems. This manual is organized in accordance with the Customer Service Documentation PMM outline and reflects the maintenance philosphy selected for these products.

This manual provides the Wang-trained Customer Engineer (CE) with information to install and troubleshoot the various CS models and their option board configurations in the field.

Note: These products are designed to be serviced by a trained Wang customer service representative only. Services required as a result of attempted repair by persons other than Wang customer service representatives are not covered under Wang's product warranties or service agreements.

Second Edition (January, 1992)

This manual incorporates and obsoletes the Wang Computer System manual 741-1769 and associated PUBs: 741-1769-1, 741-1769-2, and 741-1769-3. Use of the information in this document is authorized only for the purpose stated in the Preface, above. Updates and/or changes to this document will be published as either Publication Update Bulletins (PUBs) or as full revisions.

WARNING

Do not open the switching power supply under any circumstance. Extremely dangerous voltage and current levels (in excess of 300 volts DC and unlimited current) are present within the power supply.

Do not attempt to repair the switching power supply; it is field replaceable only.

After powering the unit down and disconnecting the AC power connector from the power source receptacle, allow one minute before removing the power supply to provide adequate time for any residual voltage to drain through the bleeder resistors.

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SECTION 1 CONTENTS

SECTION 1
INTRODUCTION

1.1 Scope and Purpose

The scope and purpose of this Illustrated Manual (IM) is to provide the Wang Customer Engineer with the information necessary to install, troubleshoot, and repair the Wang CS in the field. Familiarity with the Wang 2200 product line is recommended for effective use of this IM.

The Wang Computer System (CS) is an interactive, multi-user, multi-task, disk-based computer system, utilizing VLSI (Very Large Scale Integration) technology. The CS supports up to 16 terminals and 16 jobs (partitions) concurrently as well as a wide range of peripheral devices, such as printers, plotters, disk drives, tape drives, and TC devices. Disk drive sharing for up to 15 additional CPUs is also available as an option.

By utilizing VLSI, the CS processor design is incorporated into a single chip. This allows the CPU, control memory, and user memory to reside on a single PC board. The CS is available in the following models:

Model	CPU Memory	Control Memory
CS-2	128KB	32KB
CS-5	512KB	32KB
CS-10	1MB	32KB
CS-20	2MB	32KB
CS-40	4MB	32KB
CS-80	8MB	32KB

● END

1.2 Organization and Layout

The IM is divided into twelve sections numbered 1 through 12. Each section describes a separate maintenance-related function and is arranged to minimize cross-referencing to other sections.

All or most of the information pertaining to a specific task is presented on a single sheet (frame) or on sequentially numbered multi-frames. Each frame, in turn, contains illustrations, numbered steps, and/or text describing the logical sequence of events required to complete that task.

All frames except the last of a multi-frame procedure have a "➡NEXT" designation in the lower-right area which indicates that the additional information follows on the next frame. The last frame of each multi-frame procedure is identified as such by the "● END" designation. Referencing to frames in another procedure or section is done parenthetically by means of an arrow followed by the section number (➡X.X.X).

Steps within a frame are sequentially numbered around various illustrations. Each section is preceeded by the section number and a section table of contents. The sections and corresponding frames are arranged in numerical order from left-to-right and top-to-bottom on the individual microfiche cards.

● END

SECTION 2 CONTENTS

SECTION 2
IDENTIFICATION

POWER ON/OFF SWITCH

COOLING FANS

LOCAL
COMMUNICATION
OPTION BOARD

TC
CONTROLLER
BOARD

MOTHERBOARD

BLANK PANEL

DC CABLE
HARNESS
ASSEMBLY

4-PORT
CONTROLLER
BOARD

4-PORT
CONTROLLER
BOARD

CPU BOARD

TRIPLE
CONTROLLER
BOARD

POWER SUPPLY
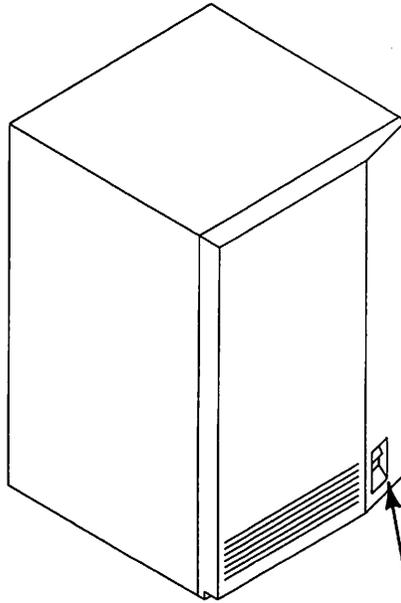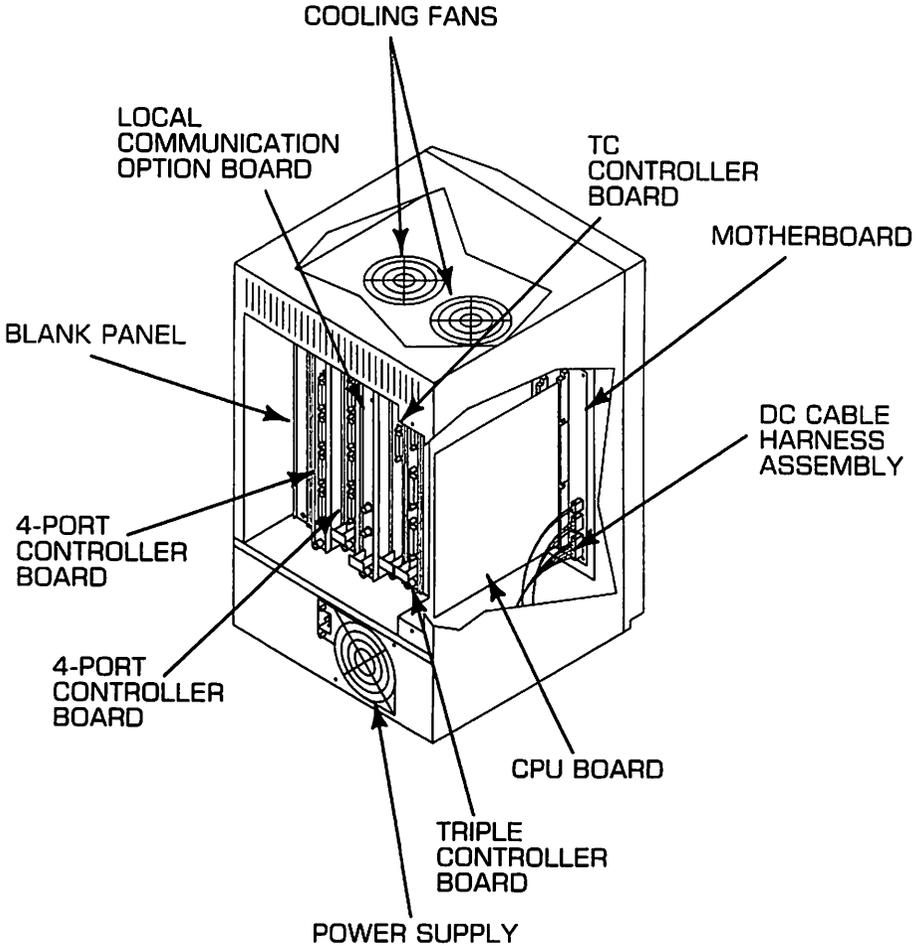
● END

SECTION 3 CONTENTS

SECTION 3
CONTROLS AND INDICATORS

CONTROLS AND INDICATORS

3.1   Operator Controls

Item	Name	Type and Function
1	Power On/Off Switch	Rocker-type switch; "1" position applies ac power to CS, initiates B.I.T. power-up diagnostics, and Initial Program Load (provided diagnostics pass). "O" position removes ac power from CS.

3.2.1   2236MXE 4-Port Terminal Controller Board Controls
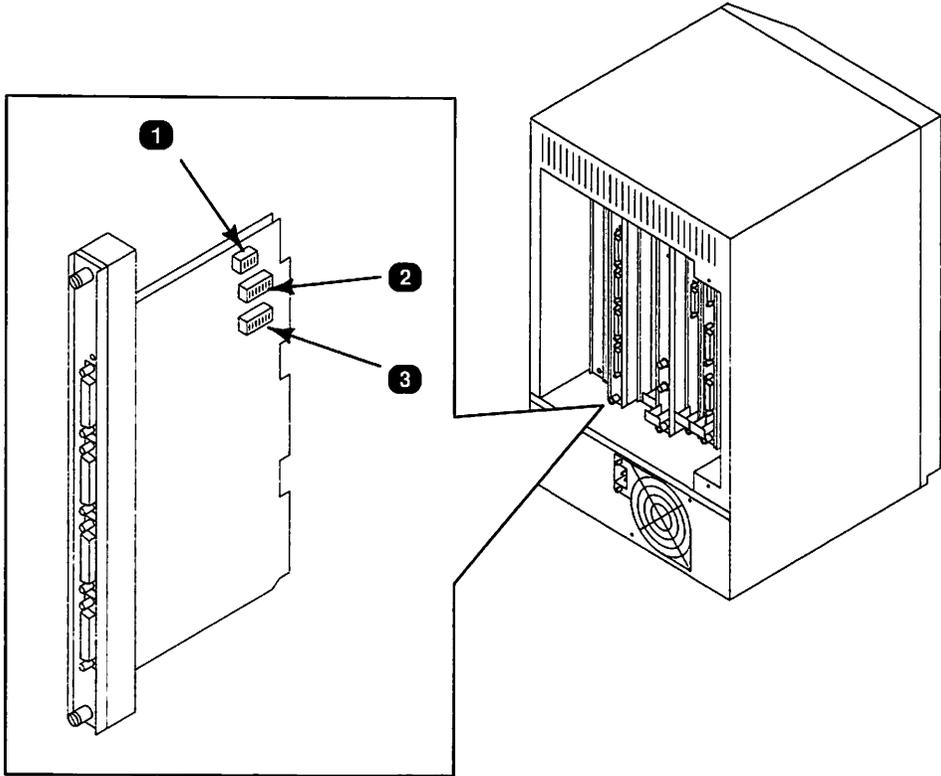
Item	Name	Type and Function
1	Device Address Switch SW1	Rocker-type 4-bit switch bank; selects address of this particular controller. Up to three controllers may be used with the CS.
2	Ports 3 & 4 Baud Rate Switch SW2	Rocker-type 8-bit switch bank; selects baud rate for ports 3 and 4.
3	Ports 1 & 2 Baud Rate Switch SW3	Rocker-type 8-bit switch bank; selects baud rate for ports 1 and 2.

3.2.2   2258 Local Communications Board Controls
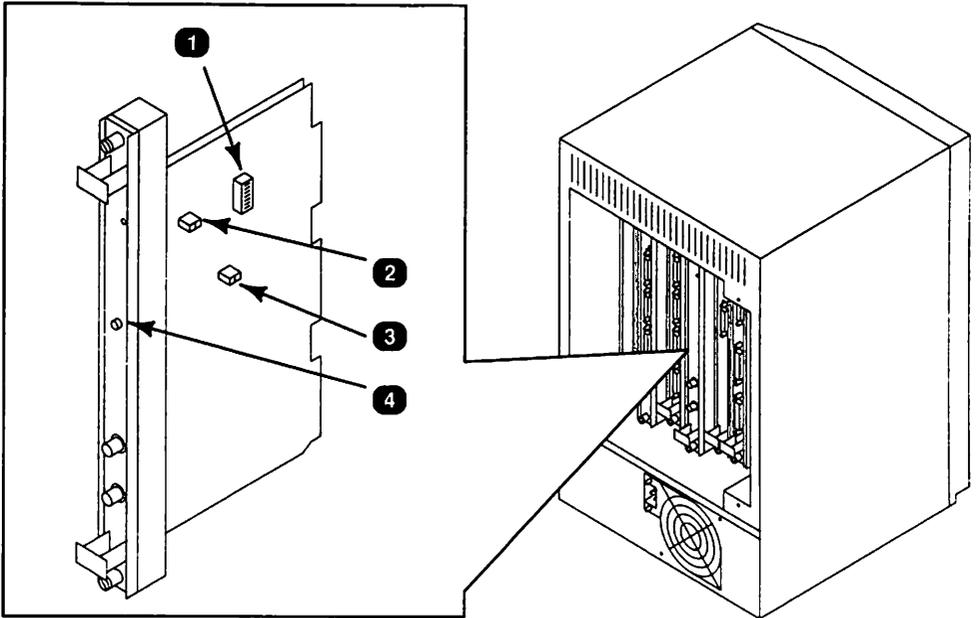
Item	Name	Type and Function
1	Communications/ Disk Address Switch SW1	Slide-type 8-bit switch bank; SW1 and SW2 select disk address. SW3 thru SW8 select option board communications address.
2	Clock Enable Jumper J1	3-Pin Jumper Header; enables on-board clock for normal operation; disables on-board clock to allow substitution of external clock pulses during board repair.
3	Diagnostic Enable Jumper J2	3-Pin Jumper Header; enables board repair diagnostics to be executed on the Local Communications Board.
4	Restart Pushbutton	Recessed pushbutton; when pressed, clears the local communications board and generates a software power-up reset.

3.2.3   2228B TC Controller Board Controls

Item	Name	Type and Function
1	Device Address Switch	Slide-type 8-bit switch bank; selects device address of this 2228 TC Controller.

3.2.4   22C32 Triple Controller Board Controls

Item	Name	Type and Function
1	Disk Address Switch	Slide-type 8-bit switch bank; selects address of disk drive interfaced to the CS.
2	Printer Address Switch	Slide-type 8-bit switch bank; selects address of printer interfaced to the CS.
3	Terminal Address Switch	Slide-type 5-bit switch bank; selects address of workstation interfaced to the CS.

3.2.5 Optional 2275MUX Board Controls
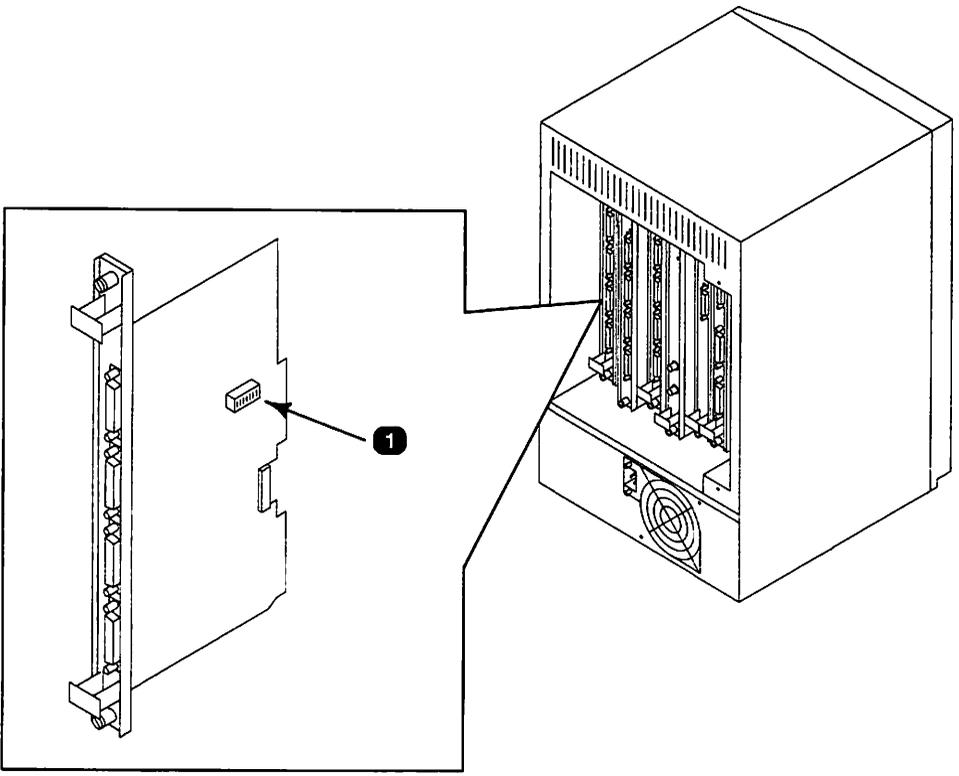
Item	Name	Type and Function
1	Disk Address Switch	Slide-type 8-bit switch bank; selects address of disk drive interfaced to the CS as either 310, 320, or 330.

3.2.6 Optional 2275MUXE (Expansion) Board Controls
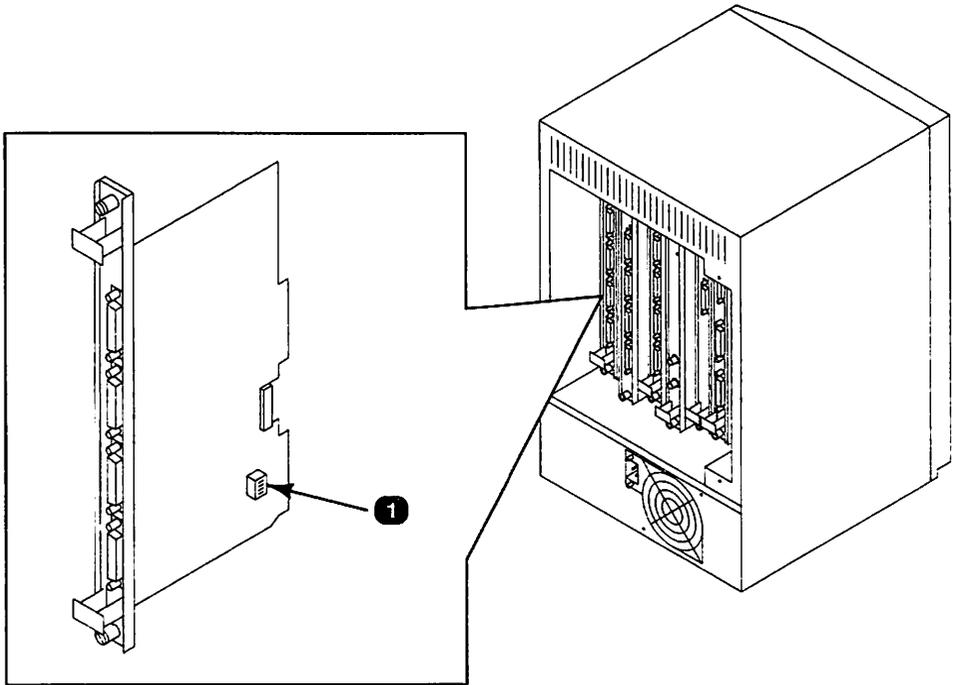
Item	Name	Type and Function
1	PC Board Address Switch	Slide-type 4-bit switch bank; selects address that this PC board will respond to as either 1, 2, or 3. Up to three 2275MUXE Boards in addition to the 2275MUX Board may be installed into the CS to allow up to 15 additional CPUs to also access the system disk drive.

3.2 CONTROLS AND INDICATORS
Service Controls

3.2.7 Power Supply AC Voltage Select Switch
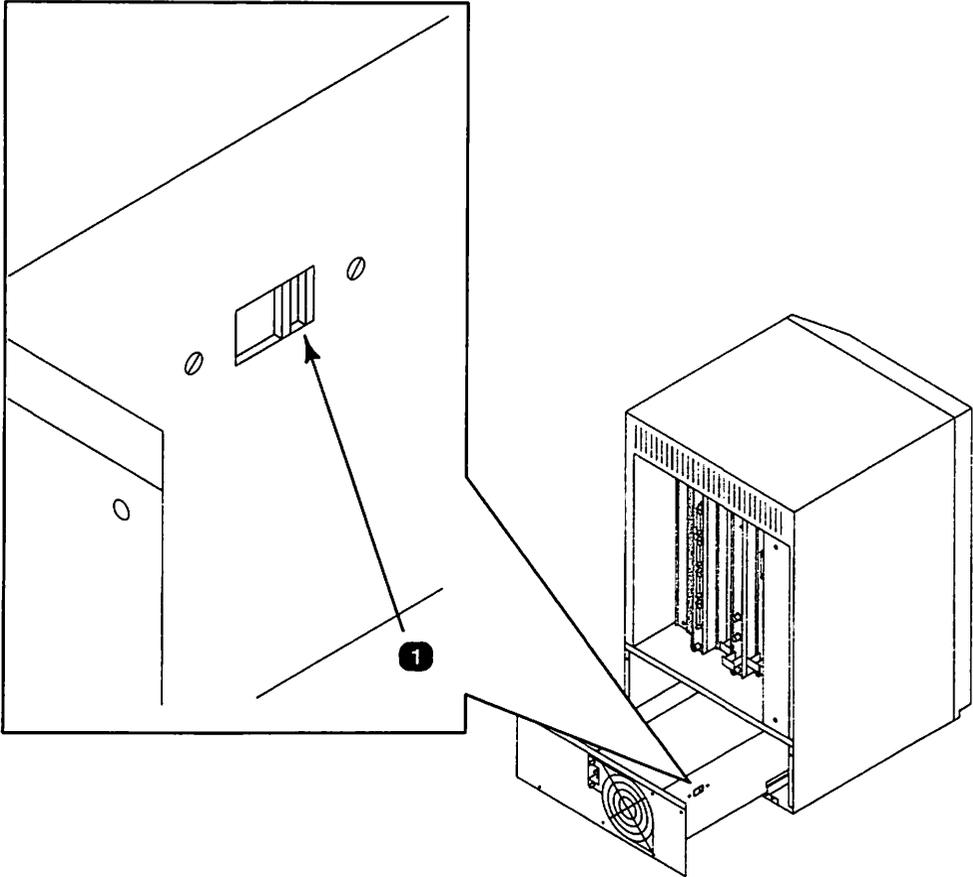
Item	Name	Type and Function
1	AC Voltage Select	Slide-type switch; selects power supply AC operating voltage as either 115V, 60Hz; or 220V, 50Hz.

3.3.1   Motherboard Test Point Indicators
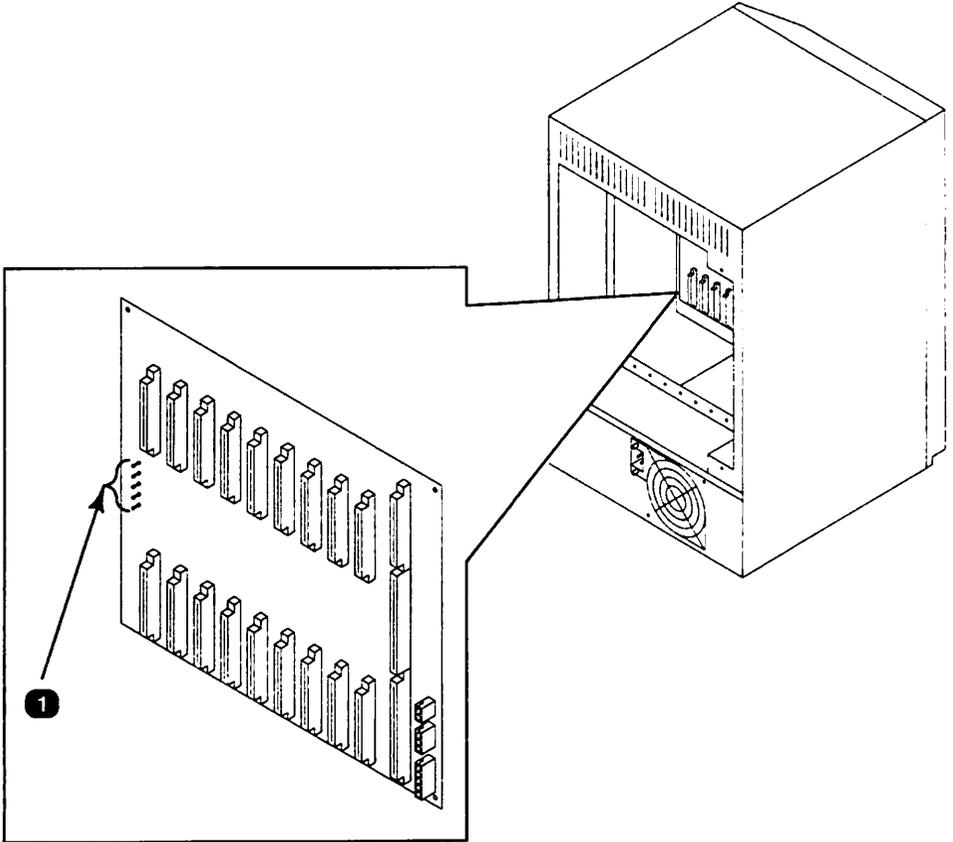
Item	Name	Type and Function
1	Voltage Test Points TP1 - TP5	Terminals; voltage test points for checking CS dc voltages.

3.3.2   2258 Local Communications Board Indicator
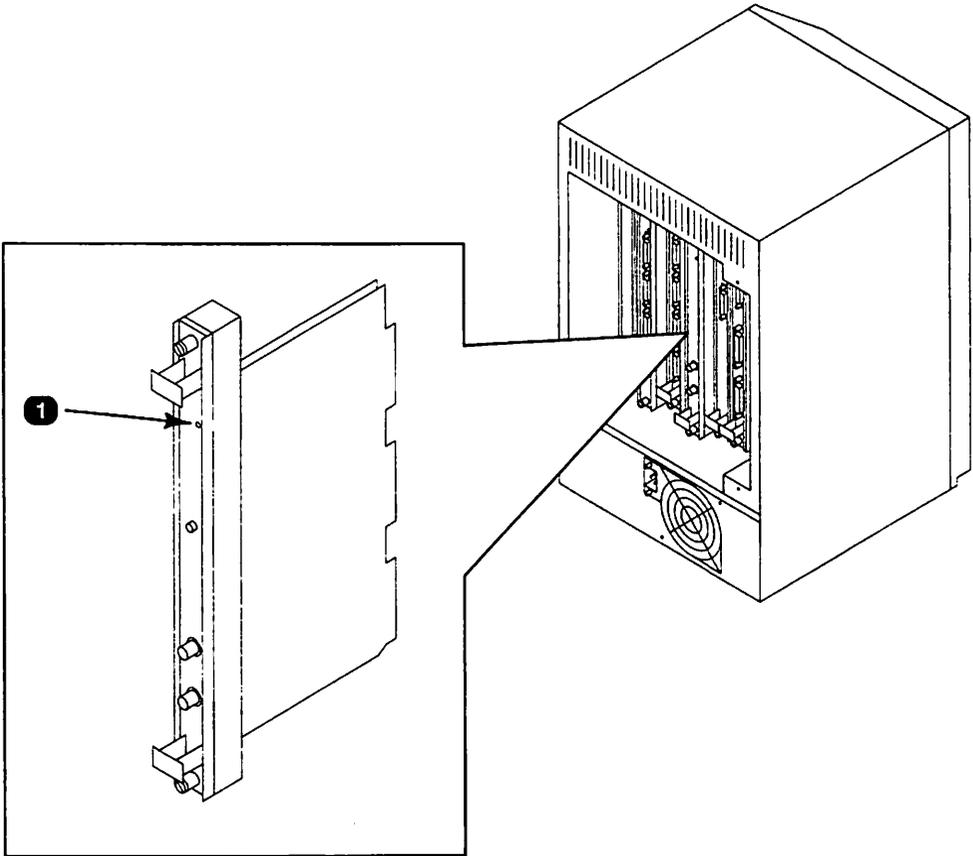
Item	Name	Type and Function
1	Diagnostic Indicator	LED; red; illuminates when CS is powered-on and BIT test is running. Illuminates during normal operation to denote parity error.

3.3.3   2236MXE 4-Port Terminal Controller Board Indicator
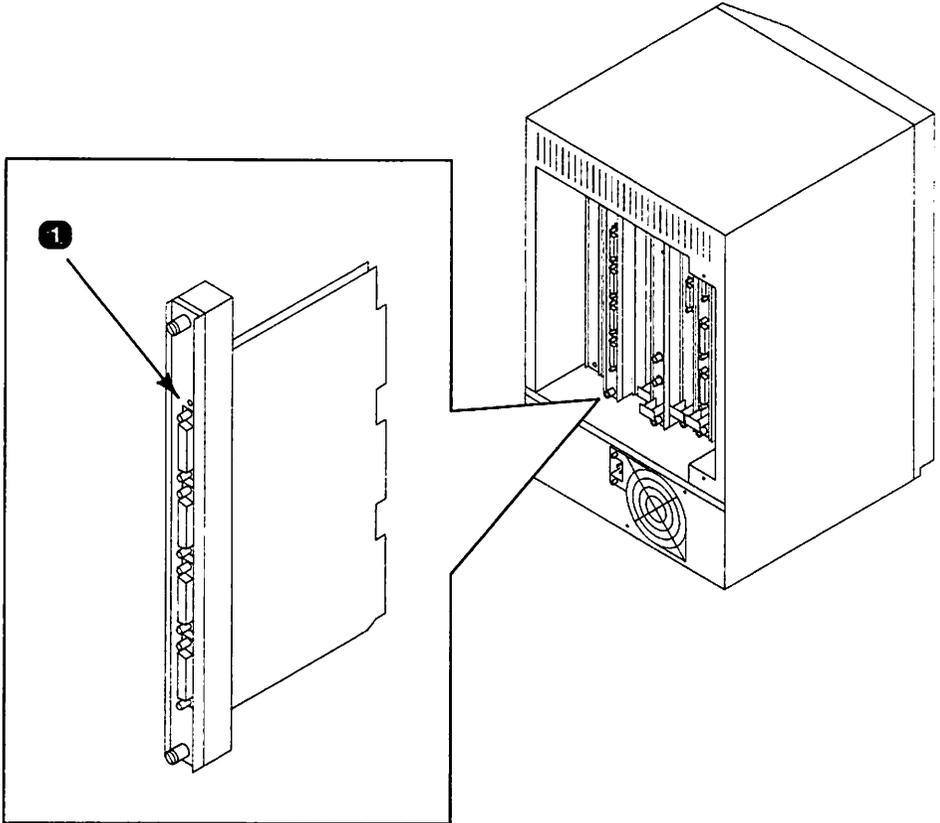
Item	Name	Type and Function
1	Diagnostic Indicator	LED; red; illuminates when CS is powered-on & BIT test is running. After 6 seconds, extinguishes to indicate successful completion of BIT tests. Catastrophic failure indicated if indicator stays on or comes on during normal operation.
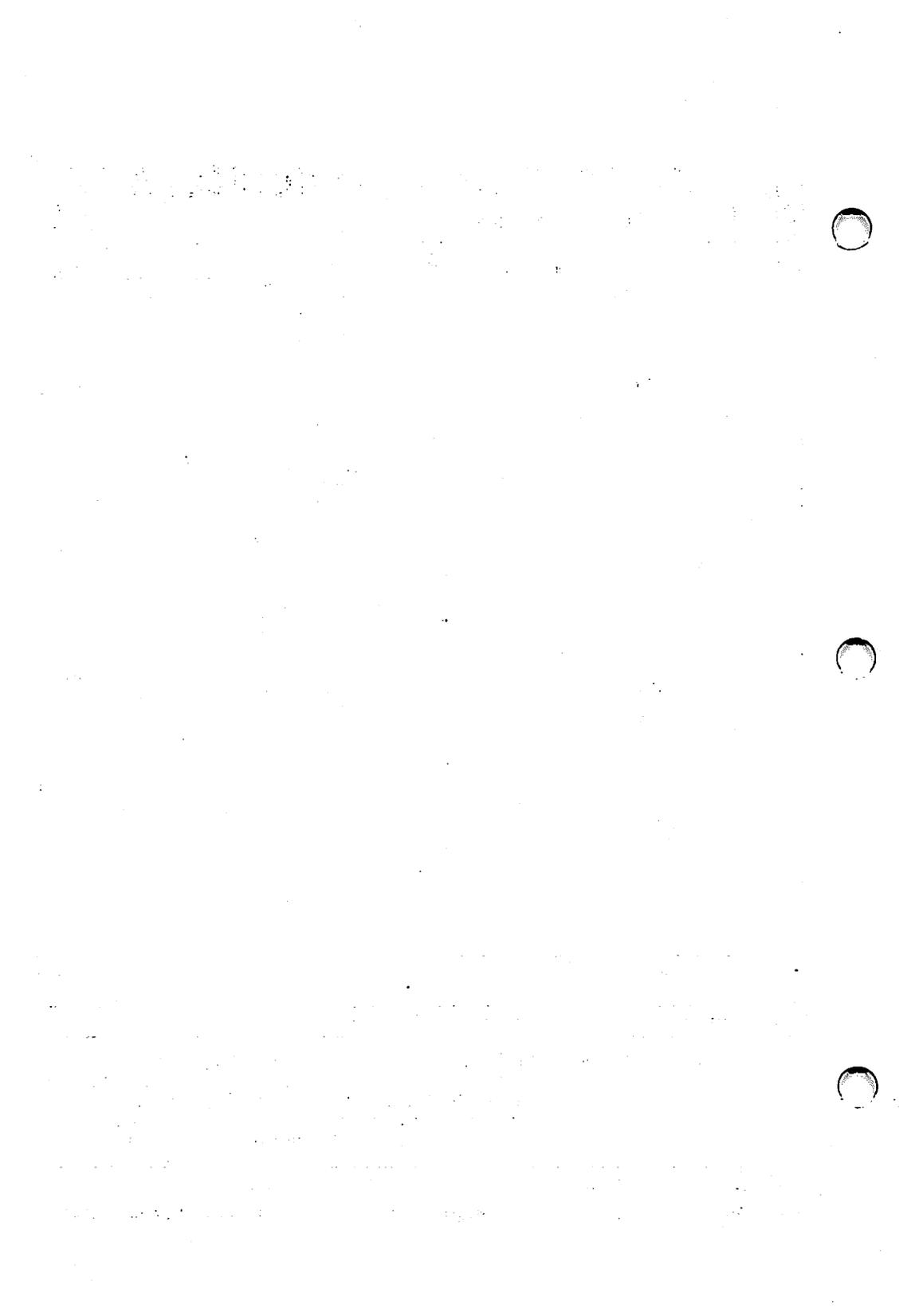
SECTION 4 CONTENTS

SECTION 4
OPERATION

2 Set AC Power On/Off Switch to On position.
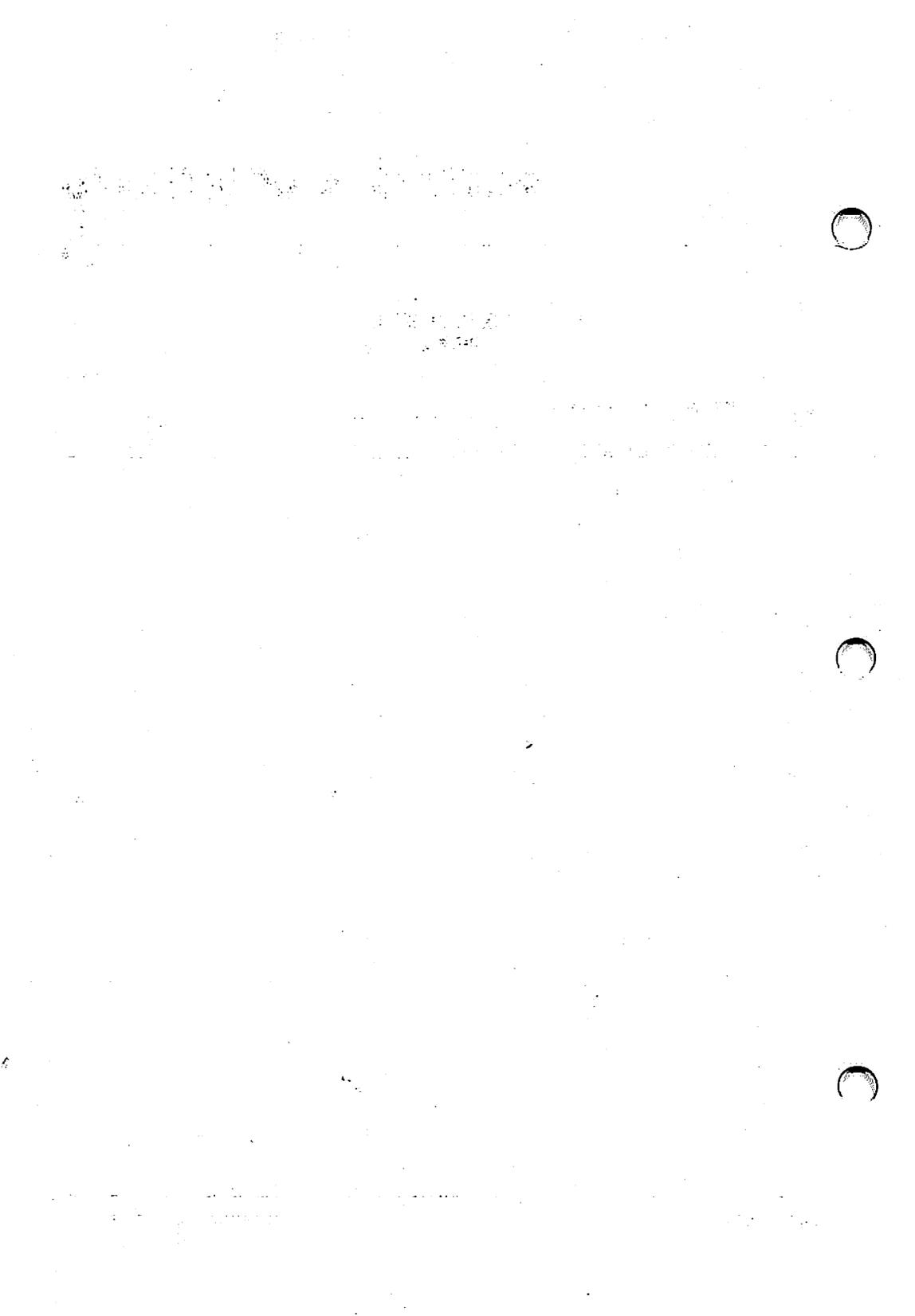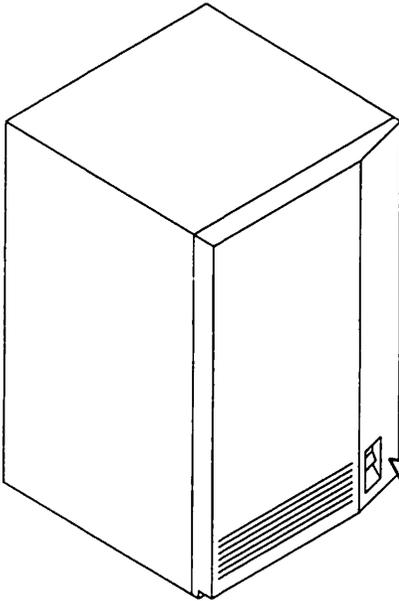
1 Power-on System Terminal 1.
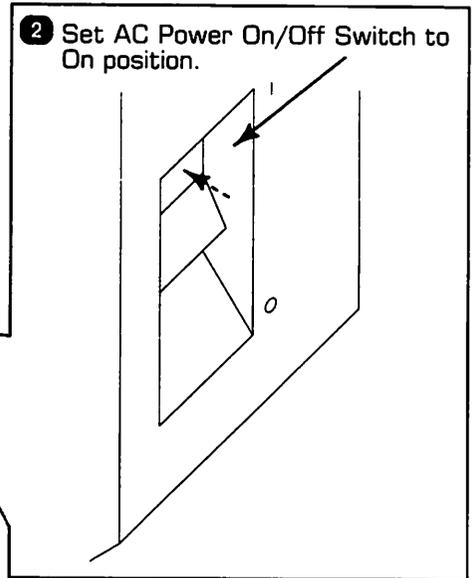
3 Power-on system disk drive.

4 Power-on remaining system peripherals.

OPERATION

❸ Set AC Power On/Off Switch to Off position.
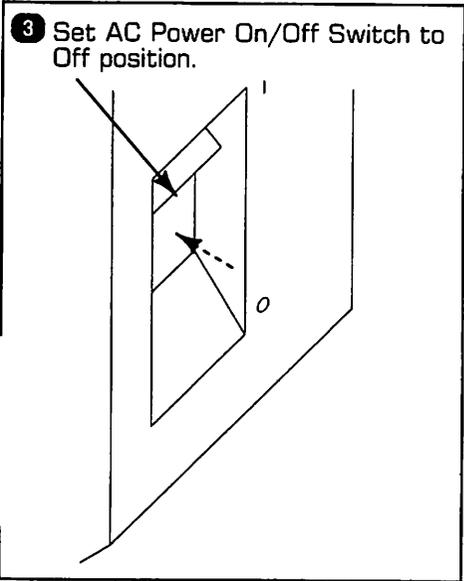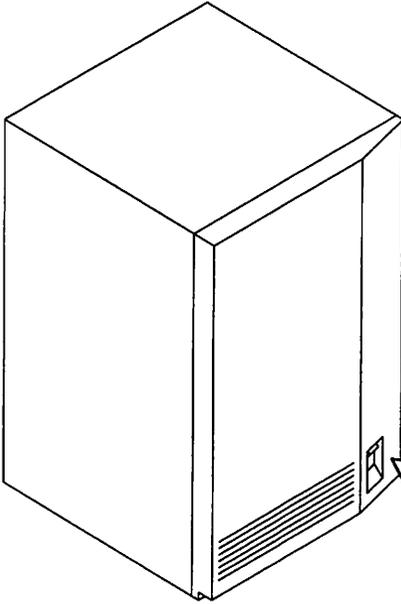
❶ Ensure all users have logged-off the system.

❷ Power-down system disk drive and any other drives configured into the CS.

❹ Power-off remaining system peripherals.

❺ Power-off System Terminal 1.

SECTION 5 CONTENTS

SECTION 5
PREVENTIVE MAINTENANCE
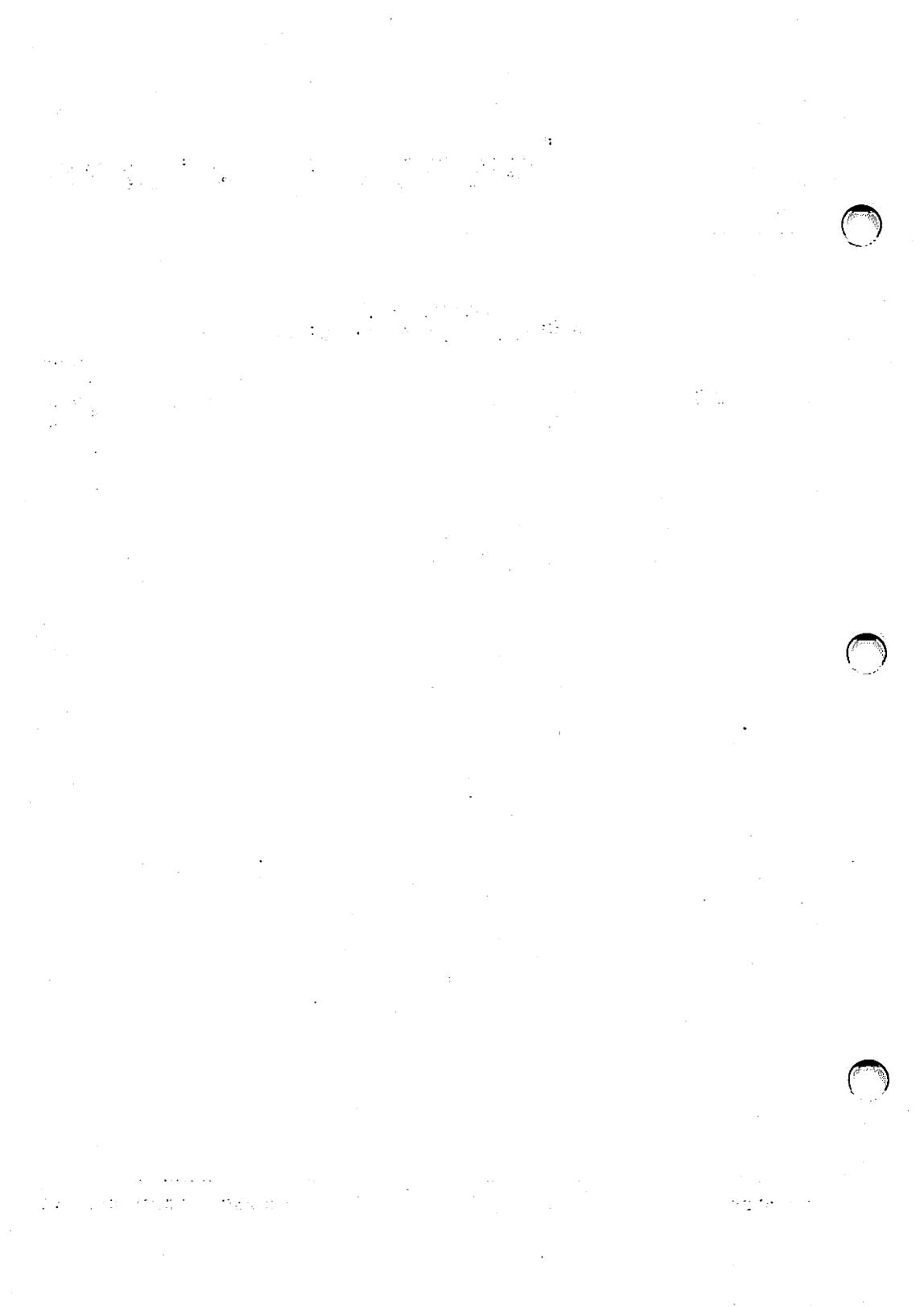
5.1 PREVENTIVE MAINTENANCE
Visual Inspection

The Wang CS does not require scheduled Preventive Maintenance other than a visual inspection of cooling fan operation and I/O cable integrity during site visits.

SECTION 6 CONTENTS

SECTION 6
TROUBLESHOOTING

6.1 Tools and Equipment

Tools and equipment required to troubleshoot the CS consist of a standard CE Tool Kit and a Fluke DVM (or equivalent).

Microcode Diagnostics and Peripheral Device Diagnostics are available for the CS through Diagnostic Package No. 195-2956-0.

(Start)

Power-up the CS
[➡ 4.1].

Power supply fan on? — NO → Wall AC outlet OK? — YES → (A) 3

↓ YES   ↓ NO

Both cabinet fans on? — NO → Either fan on ? — NO → (E) 4

Repair as required.

↓ YES   ↓ YES

Wait 20 seconds.

Replace defective fan [➡ 7.2.5].

System Terminal 1 displays "MOUNT SYSTEM PLATTER PRESS RESET" ? — YES → Press RESET key on System Terminal 1. → System Terminal 1 displays "KEY SF" ? — NO → (C) 2

↓ NO   ↓ YES

(B) 2

At System Terminal 1, press SF key for disk address that contains operating system:
"SF" Key 0   310/D11
"SF" Key 1   B10/D10
"SF" Key 2   320/D21
"SF" Key 3   B20/D20
"SF" Key 4   330/D31
"SF" Key 5   B30/D30

→ System Terminal 1 displays "2200 SYSTEM MENU" ? — NO → (D) 2

↓ YES

Load the operating system or load & run diagnostics.

➡NEXT

B
1

Does System Terminal 1 display any part of the message ?

NO →

Does System Terminal 1 pass power up diagnostics ?

YES →

Check:

1. CS DC voltages (➡ 6.3).

2. CPU/Memory Bd. (➡ 7.2.1).

3. Workstation Controller Board (➡ 7.2.2).

4. Workstation I/O Cable.

YES

Replace the CPU/ memory bd. (➡ 7.2.1) and retry.

NO

Troubleshoot System Terminal 1.

C
1

→ System error appears ? **NO** →

Check:

1. Defective RESET key (kybd., wkstn.)

2. Defective wkstn. controller.

3. Defective I/O cable.

4. Defective CPU/ memory bd. (➡ 7.2.1).

YES

Troubleshoot according to error listing(➡ 6.8).

D
1

"KEY SF" repeats ? **NO** →

I/O error message ? **NO** →

Verify software O/S disk/floppy.

YES

• Verify SF key
• Check disk cont. address sw. setting (➡ 9.4).

YES

Troubleshoot disk subsystem.

A

1

117VAC at TB1-1 and TB1-4 ? — NO → 117VAC at power supply AC input ? — NO → Check AC outlet and AC cord.

YES ↓

117VAC at power supply AC input ? — YES ↓

Set AC power on/off switch to ON. → 117VAC at TB1-2 and TB1-3 ? — YES → Replace power supply (➡ 7.2.4).

NO ↓

Check AC switch and wiring.

FROM AC WALL OUTLET

117VAC

TB1

SWITCHING POWER SUPPLY

BLUE — 4 — BLUE
117VAC
BLUE — 1 — BLUE

TWISTED PAIR

AC SWITCH

TWISTED PAIR

BROWN — 2 — BROWN
117VAC (SWITCHED)
BROWN — 3 — BROWN

➡NEXT

E
1

Disconnect power supply connectors J4/P4, J5/P5, & J6/P6. → Measure voltages per figure below at P4, P5, and P6. → DC voltages OK? —YES→ F 5

NO ↓

Replace power supply (➡ 7.2.4).

DC WIRING HARNESS AND POWER DISTRIBUTION

FAN — P7 — 2 1 — J7 — +12V ±0V

FAN — P8 — 2 1 — J8 — +12V ±0V

MOTHERBOARD

SWITCHING POWER SUPPLY							
±0V	P4	J4	1	P24	1	J24	TP1 → ±0V
±0V			2		2		TP2 → -5V
±0V	P5	J5	1	P23	1	J23	TP3 → +5V
-5V (REG)			2		2		TP4 → +12V
±0V			3		3		TP5 → -12V
-12V	P6	J6	1	P22	1	J22	
+12V			2		2		
+5V (REG)			3		3		
+5V (REG)			4		4		
+5V (REG)			5		5		

➡NEXT

F
4

Perform ohmmeter check of DC pigtail harness per figure below.

1. Reconnect harness.
2. Remove CPU board & all I/O controllers from CS (➡ 7.2.1, 7.2.2).

1. Re-install PCBs one at a time until voltage drops (➡ 7.2.1, 7.2.2, 7.2.3).
2. Replace board causing over-load. (➡ 7.2.1, 7.2.2, 7.2.3).
3. Replace "soft" power supply. (➡ 7.2.4).

DC pigtail harness OK? — YES

DC voltages OK? — YES

NO

NO

Replace harness.

Replace motherboard (➡ 7.2.7).

DC WIRING HARNESS AND POWER DISTRIBUTION

FAN — P7
FAN — P8

2 1
J7

2 1
J8

+12V   ±0V   +12V   ±0V

MOTHERBOARD

SWITCHING POWER SUPPLY						
±0V	P4	J4	1	P24	J24	TP1 → ±0V
±0V			2			TP2 → -5V
±0V	P5	J5	1	P23	J23	TP3 → +5V
-5V (REG)			2			TP4 → +12V
±0V			3			TP5 → -12V
-12V	P6	J6	1	P22	J22	
+12V			2			
+5V (REG)			3			
+5V (REG)			4			
+5V (REG)			5			

● END

WARNING

Do not open the switching power supply under any circumstance. Extremely dangerous voltage (in excess of 300 volts DC) and unlimited current are present within the power supply. Do not attempt to repair the supply; it is field replaceable only.

① Obtain a Fluke DVM (or equivalent).

② Power-down the CS (➡ 4.2).

③ Remove left-most blank panel, or PC board from that slot (➡ 7.2.2).

④ Locate motherboard voltage test point indicators (➡ 3.3.1).
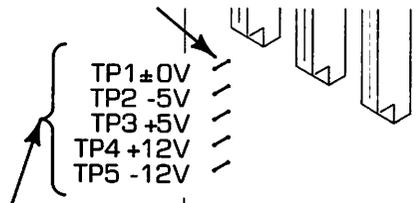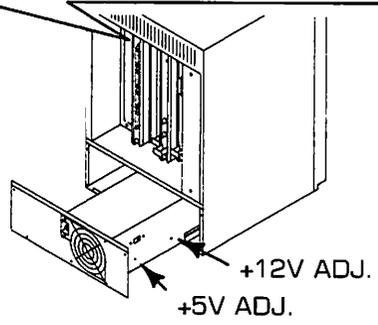
NOTE

It may be necessary to remove a second PC board or blank panel to access the test points.

⑤ Power-up the CS (➡ 4.1).

⑥ Connect common lead of DVM to TP1 on motherboard

TP1 ± 0V
TP2 -5V
TP3 +5V
TP4 +12V
TP5 -12V

⑦ Connect DVM to TP1 - TP5 on motherboard to verify DC limits.

Test Point	Voltage	Limits (VDC)
TP2	-5V(fixed)	-4.95V to -5.05V
TP3	+5V(adj) (see fig.)	+4.95V to +5.05V
TP4	+12V(adj) (see fig.)	+11.95V to +12.05V
TP5	-12V (fixed)	-11.95V to -12.05V

+12V ADJ.

+5V ADJ.

There are three classes of diagnostic tests available for the CS: Bootstrap, Microcode, and Peripheral Device. The Bootstrap Diagnostic is a program resident in the CS CPU hardware while the Microcode and Peripheral Device Diagnostics are available through Diagnostic Package No. 195-2956-0.

Microcode Diagnostics test the hardware components of the system and attempt to pinpoint any malfunction. Peripheral Device Diagnostics test system peripheral devices. A brief discussion of each follows in this section.

6.5.1   General

The Bootstrap Diagnostics are resident diagnostics loaded in three 1024 x 8-bit Intel 2708 PROMs. The purpose of the Bootstrap is to handle Master Initialization (Power-On), handle Reset (Initiated by depressing the RESET key on the keyboard), detect parity errors in Control and Data memory, and load the desired system software (i.e. diagnostics, or BASIC-2) from disk and initiating their execution. The Bootstrap diagnostics run automatically whenever the system is powered up, and verify basic CS functions such as the CPU, Control Memory, Data Memory, and Registers. When these diagnostics have successfully completed, the following message will appear on the screen:

MOUNT SYSTEM PLATTER
PRESS RESET

Three types of errors and five possible error messages can be reported by BOOTSTRAP. The three types of errors - initialization, reset, and system, are discussed below (➡ 6.5.2 through 6.5.6).

6.5.2   Initialization Errors (Sheet 1 of 2)

The first type of error is the initialization error. If, during BOOTSTRAP master initialization, the above message fails to display, a CPU related error or an I/O related error is indicated. The displaying of each letter in the above message corresponds to the successful completion of certain diagnostic tests. The following pages provide a breakdown of each letter's meaning and also gives guidelines for troubleshooting failures.

NOTE

Due to the small number of field-replaceable items in the CS, and the complexity of the CPU/Memory Board, virtually all error codes encountered will require that the CPU/Memory Board be replaced.

CRT Display	Sequence of Operations	Possible Failures
Blank	Power on Trap to 8003	Hardware Trap Failure. Branch Instruction Failure.
Blank	Enable CRT, Clear Screen and Display "M".	CRT Address is wrong. I/O Register Failure. I/O Lines are Bad. CIO Instruction Failure.
"M"	Tests 24-Bit Parity Trap. Execute IC 800F which has Bad Parity.	Parity Checking Logic Failure. Hardware Trap Failure. TSP Instruction Failure (IC + 1 stored in stack). PCs may not hold IC retrieved from Stack. Compare Instruction Failure.
"MO"	Test Subroutine Branch and Subroutine Return Instructions.	Subroutine Branch Instruction Failure. Subroutine Return Instruction Failure. Stack Failure.
"MOU"	Clear CH, CL Parity Bits.	Write/Read Data Memory Failure.
"MOUN"	Check File Registers.	Register Instruction Failure. Register Chip Failure. Compare Instruction Failure.

6.5.2 Initialization Errors (Sheet 2 of 2)

CRT Display	Sequence of Operations	Possible Failures
''MOUNT''	Check PC Incrementing on the A-Bus	PC Chip Failure. LPI Instruction Failure. Register Instruction Failure. A-Bus Increment Hardware Failure. Compare Instruction Failure.
''MOUNT S''	Test Auxiliary Registers.	Auxiliary/Stack Chip Failure. PC Chip Failure. Auxiliary Register Instruction Failure.
''MOUNT SY''	Test Binary ALU.	Binary ALU Failure. AC, ACX, AI, SC, or SCX Instruction Failure.
''MOUNT SYS''	Test Stack.	Auxiliary/Stack Chip Failure. PC Chip Failure. Stack Instruction Failure. Compare Instruction Failure.
''MOUNT SYST''	Test Decimal ALU.	Decimal ALU Failure. DAC, DACI, DACX, DSC, DSCI OR DSCX Instruction Failure. Compare Instruction Failure.
''MOUNT SYSTE''	Test Binary Multiply.	Multiply Hardware Logic Failure. M or MI Instruction Failure. Compare Instruction Failure.
''MOUNT SYSTEM''	Test Shift.	Shift Logic Error. Compare Instruction Failure.
''MOUNT SYSTEM''	Verify PROM.	PROM Chip Failure.
''MOUNT SYSTEM P''	Zero 8-Bit Data Memory.	SR Failure. Bad IC's.
''MOUNT SYSTEM PLATTER''	System Loops, diagnosing data and control memory.	
''PRESS RESET''	All Diagnostics have passed. Press RESET to start system operation.	

6.5.3 Reset Errors

Reset Errors are errors which occur while attempting to respond to the prompt "Key SF'". Possible causes of this type of error are:

• The Special Function Key was not depressed sufficiently.

• The 2236DE/DW, 2336DE/DW or 2236MXE may be defective.

• The Special Function Key which was depressed was undefined.

● END

6.5.4   System Errors

System Errors are error conditions
which are reported to the operator via
a SYSTEM ERROR message on the
CRT. Memory errors and Disk errors
are common examples of system errors.
A breakdown of each of these follows
(➡ 6.5.5 and 6.5.6).

6.5.5   System Errors (Memory Errors)

Should a system memory error be detected, the following screen will appear:

```
*** SYSTEM ERROR MMMM XXXX ***
PRESS RESET
```

In these cases:

MMMM - PEDM = Parity Error Control Memory

        PEDM = Parity Error Data Memory

        VECM = Verify Error Control Memory

        VEDM = Verify Error Data Memory

XXXX - Various error information pertinent to the type of error.

In both Data Memory & Control Memory, one bit has been set aside for parity error detection. In Control Memory, when a parity error has been detected during an instruction fetch, a branch is made to Control Memory address 8000 (Hex), located in the bootstrap proms. The Bootstrap then performs its designated error routine and displays a PECM error on the screen as follows:

```
*** SYSTEM ERROR (PECM aaaa
dddddd) ***
```

Bad parity may be the result of:

● the dropping of bits by Control/ Bootstrap Memory.

● the picking up of bits by Control/ Bootstrap Memory.

● writing bad parity to Control Memory.

● defective parity checking logic.

It may be possible, after encountering this error, to resume execution of the currently loaded system program. However, if the error occurs again a Control Memory diagnostic should be run. If a failure occurs, the CPU/ Memory Board should be replaced.

In Data Memory, when a parity error has been detected, a branch is made to Control Memory address 8002 (Hex), located in the bootstrap proms. The Bootstrap then performs another error routine and displays a PEDM error as follows:

```
*** SYSTEM ERROR (PEDM
ss.aaaa) ***
```

This error implies that the bad parity was detected during a read of Data Memory. The same causes listed above for Control Memory may be applied to Data Memory as well. Again, it may be possible to resume execution of the currently loaded system program, unless the error is reported again. In this case, a Data Memory diagnostic should be run. Again, if a failure occurs, the CPU/Memory Board should be replaced.

VECM and VEDM are verify errors which imply that attempts to load either Data or Control memory were unsuccessful. If these errors occur, the operator should attempt to reload BASIC-2. However, should successive failures be reported, appropriate memory diagnostics should be run to determine if there are any defective memory chips.

6.6.1 General

The Microcode Diagnostics are diagnostics which perform in depth testing of the hardware components of the system. These diagnostics reside on the system disk and are accessed in the following manner:

1 Apply power to the system and verify that the screen on terminal 1 appears as below.

```
MOUNT SYSTEM PLATTER
PRESS RESET
```

2 Place the system platter disk/diskette into the system drive and press the RESET key on the keyboard. (Press RESET if the terminal is model #2336DE and SHIFT RESET if the terminal is model #2336DW.) Observe the screen shown.

```
KEY SF'?
```

3 Depress the special function key which corresponds to the drive which contains the system disk. The screen will now display:

```
        ****SYSTEM 2200****
Select item with        MEMORY
SPACE & BACKSPACE
xxxxK
Key RUN to execute,     Terminal X
CLEAR or PREV SCRN
for previous screen

        ■ MVP BASIC-2
        _ Diagnostics
```

4 Space down to Diagnostics, and key RUN. The screen now appears:

```
        ****CUSTOMER
    DIAGNOSTIC MENU****
Select item with        MEMORY
SPACE & BACKSPACE
xxxxK
Key RUN to execute,     Terminal X
CLEAR or PREV SCRN
for previous screen

    ■ CPU Instructions
    _ Control Memory
    _ Data Memory
    _ CPU Registers

    _ All of the above
```

5 Following are descriptions of each of these diagnostics (➡ 6.6.2 thru 6.6.5).

6.6.2   CPU Instructions Diagnostics

This diagnostic is designed to test the instruction set of the Central Processor. The test sequence is as follows:

a) Test Immediate Register instructions

b) Test Register instructions

c) Test Extended Register instructions

d) Test Branch instructions

e) Test Immediate Register instructions with Read/Write

f) Test Register instructions with Read/Write

g) Test Mini instructions with Read/Write

h) Return to step "a"

If RESET is pressed during this program, the "KEY SF'?" message shall be displayed.

Should the system be unable to execute a particular instruction, the CRT cursor will stop at XX of the failing instruction. Should the title fail to appear, any of the following could be at fault: ORI, AC, SB, SR, B, BT, BF, BNE, BLER, or BNR.

A normal display is as follows:

```
      ***CPU INSTRUCTIONS
      DIAGNOSTIC*** REV XXXX

(PASS XXXX)     where:
IMMED REG LL    XXXX = Number of
REG INSTR LL    completed loops
X-REG INSTR LL  LL = Microinstruc-
MASK BR LL      tion currently be-
REG BR LL       ing tested(in HEX)
IMMED R/W LL
REG R/W LL
AUX/STACK R/W LL
```

6.6.3   Control Memory Diagnostic

The control memory diagnostic tests
control memory from end-of-program
to end-of-memory for addressing, and a
modified Row Pattern test.

A normal display is as follows:

***CONTROL MEMORY
DIAGNOSTIC*** REV XXXX

Memory Size=xxxxK   No Err's

The following tests are cycled through,
each time incrementing the pass count:

DATA BUS STUCK TEST (PASS XXXX)

DATA BUS SHORTS TEST (PASS
   XXXX)

BANK/PAGE ADDRESSING (PASS
   XXXX)

ADDRESS LINE SHORT TEST (PASS
   XXXX)

ADDRESS LINE/PIN TEST (PASS
   XXXX)

ADDRESS MULTIPLEXER (PASS
   XXXX)

SIMPLE MARCHING 1's/0's (PASS
   XXXX)

24 BIT, MOVING INVERSIONS (PASS
   XXXX)

When RESET is pressed during this pro-
gram, the "KEY SF'?" message will be
displayed.

6.6.4   Data Memory Diagnostic

The data memory diagnostic tests data memory from end-of-program to end-of-memory for addressing, and a modified Row Pattern test.

A normal display is as follows:

```
        ***DATA MEMORY
   DIAGNOSTIC*** REV XXXX
Memory Size=xxxxK      No Err's
```

The following tests are cycled through, each time incrementing the pass count:

DATA BUS STUCK TEST (PASS XXXX)

DATA BUS SHORTS TEST (PASS XXXX)

BANK/PAGE ADDRESSING (PASS XXXX)

PARITY GENERATION TEST (PASS XXXX)

ADDRESS LINE SHORT TEST (PASS XXXX)

ADDRESS LINE/PIN TEST (PASS XXXX)

ADDRESS MULTIPLEXER (PASS XXXX)

SIMPLE MARCHING 1's/0's (PASS XXXX)

9 BIT, MOVING INVERSIONS (PASS XXXX)

When RESET is pressed during this program, the "KEY SF'?" message will be displayed.

6.6.5   CPU Registers Diagnostics

This diagnostic tests registers F0-F7, CH, CL, PH, PL, SL, K, AUX 0-32, and STACK 0-96 (the SH register is not tested due to the ability of the hardware to change bit status).

A normal display is as follows:

```
***CPU REGISTER DIAGNOSTIC***

No Err's   Press 'P' to print Errors
           at /215 ('T' For /204)
```

The following tests are cycled through, each time incrementing the pass count:

8 Bit Registers Test (PASS XXXX)

Aux Memory Test (PASS XXXX)

Stack Memory Test (PASS XXXX)

If "ALL OF THE ABOVE" is chosen from the User Diagnostic Menu, each of the diagnostics mentioned previously will be run. All screens will remain the same with the exception of the Chain Mode Pass Count. This count is the number of passes all of the tests have successfully completed.

Because of the wide range of peripherals available to the CS, it would be impractical to present here a full list of the diagnostics supported for each. All available peripherals are fully documented in their own maintenance publications.

The following section further outlines various error messages which may be encountered during the aforementioned diagnostics. Due to the small number of field-replaceable items in the CS, and the complexity of the CPU/Memory Board, virtually all error codes encountered will require that the CPU/Memory Board be replaced.

TROUBLESHOOTING

6.8.1   AECM Errors (Addressing Error in Control Memory)

This error is displayed as:

AECM aaaa bbbb xxxxxx

Where:

aaaa = the address of the instruction in error.

bbbb = the conflicting address.

xxxxxx = An XOR of the "expected" and "actually read" instruction.

This error indicates that writing to Control Memory location "bbbb" seems to modify location "aaaa". The "1" bits in the "xxxxxx" field of the display indicate which bit(s) have been modified. The error could also occur if a chip at location "aaaa" had a marginal failure.

6.8.2   BECM Errors (Bit Error in Control Memory)

This error is displayed as:

BECM aaaa xxxxxx

Where:

aaaa = the address of the instruction in error.

xxxxxx = An XOR of the instruction "actually read" from memory with the instruction that was "expected" to be there.

This error implies that a bit error was detected while reading from Control Memory. The "1" bits in the "xxxxxx" field of the display indicate which bit(s) are incorrect.

6.8.3   PECM Errors (Parity Error in Control Memory)

This error is displayed as:

          PECM aaaa dddddd

Where:

   aaaa = the address of the instruction
          with the bad parity.

   dddddd = The   instruction   located   at
          "aaaa". The instruction is re-
          read when displayed and thus
          may not be the same as when
          the error occured.

This error implies that bad parity was
detected during execution of the diag-
nostic.

TROUBLESHOOTING

6.8.4 VECM Errors (Verify Error in Control Memory)

NOTE

When memory exceeds 512KB, the address information that is displayed for memory error at boot time is invalid.

This error is displayed as:

VECM aaaa

Where:

aaaa = an address in the section of Control Memory that does not verify correctly.

● END

6.8.5 AEDM Errors (Addressing Error in Data Memory)

NOTE

When memory exceeds 512KB, the address information that is displayed for memory error at boot time is invalid.

The error is displayed as:

AEDM ss.aaaa ss.bbbb xx

Where:

ss= Memory bank containing the error.

aaaa= Address of the data in error.

bbbb= Conflicting Address

xx= XOR of the ''expected'' and ''actually read'' data.

This error indicates that writing to location ''bbbb'' seems to modify location ''aaaa''. The ''1'' bits in the ''xx'' field of the display indicate which bits have been modified. The error could also occur if a chip at location ''aaaa'' had a marginal failure.

● END

6.8.6 BEDM Errors (Bit Error in Data Memory)

NOTE

When memory exceeds 512KB, the address information that is displayed for memory error at boot time is invalid.

The error is displayed as:

BEDM ss.aaaa xxyy

Where:

ss= Memory bank containing the error.

aaaa= Address of the data in error.

xxyy= XOR of the data "actually read" from data memory with the data that was "expected" to be there.

This error implies that a memory error was detected while reading data memory. The "1" bits in the "xxyy" field of the display indicate which bit(s) are not correct. If all the bits are zero, one of the two parity bits associated with the pair of bytes is incorrect.

● END

6.8.7 PEDM Errors (Parity Error in Data Memory)

NOTE

When memory exceeds 512KB, the address information that is displayed for memory error at boot time is invalid.

The error is displayed as:

PEDM ss.aaaa

Where:

ss= Memory bank containing the error.

aaaa= Data Memory Address at the time of the error. This is probably, but not necessarily, the address of the memory location with bad parity.

This error implies that bad parity was detected during a read of an 8-bit User/Data Memory.

● END

6.8.8 REDM Errors (Read Error in Data Memory)

NOTE

When memory exceeds 512KB, the address information that is displayed for memory error at boot time is invalid.

The error is displayed as:

REDM ss.aaaa xx

Where:

ss= Memory bank containing the error.

aaaa= Address of the data in error.

xx= XOR of the data in memory with the data that was expected to be there.

This error implies that a memory error was detected while reading User/Data memory. The "1" bits on the "xx" field of the display indicate which bits are not correct. If all the bits are zero, a bit in the other byte of the pair of bytes is incorrect.

● END

6.8.9 VEDM Errors (Verify Error in Data Memory)

NOTE

When memory exceeds 512KB. the address information that is displayed for memory error at boot time is invalid.

The error is displayed as:

VEDM ss.aaaa

Where:

   ss-- Memory bank containing the error.

aaaa= Address of the data in error.

This error is reported to a system program being given control after loading. or when memory is verified in response to RESET or CLEAR being executed. The area of User/ Data Memory used for storing constants. (BASIC verb tables. math constants, messages) does not verify correctly.

● END

6.8.10   General Registers Error Displays

The error is displayed as either of the two shown below:

Error 1)

REGISTER TEST
 # FFFF
REGISTER TT AND CC ERROR (XX)
#LL

Where:

FFFF = Number of completed loops at time of error.

  TT = Name of register under test.

  CC = Name of conflict register.

  XX = Contents of register CC.

This error is caused when testing register TT, register CC was found not to contain the expected.

Error 2)

    REGISTER TEST
    # FFFF
    REGISTER TT ERROR (XX)
    # LLLL

This error is caused when the register under test fails to hold the test pattern.

6.8.11   Auxiliary/Stack Error Displays

This error is displayed as one of the following:

Error 1)

AUXILIARY TEST
 # FFFF
AUX TT FAILURE (XXXX)
 # LLLL

Where:

FFFF = Number of completed loops at time of error.

TT = Auxiliary register under test.

XXXX = XOR of expected and actual.

This error occurs when the Auxiliary register under test is found not to contain the expected test pattern.

Error 2)

AUXILIARY TEST
 # FFFF
AUX TT AND AUX CC FAILURE (XXXX)
 # LLLL

Where:

CC = Conflict register.

This error is caused when Auxiliary register CC was found not to contain the expected test pattern.

Error 3)

AUXILIARY TEST
 # FFFF
STACK AND AUX TT FAILURE (XXXX)
 # LLLL

This error is caused when a Stack level was found not to contain the expected test pattern.

TROUBLESHOOTING

6.8.12 Stack/Auxiliary Error Displays

This error is displayed as either of the
two shown below:

Error 1)

> **STACK TEST**
> **# FFFF**
> **STACK FAILURE (XXXX)**
> **# LLLL**

Where:

FFFF = Number of completed loops at
time of error.

XXXX = XOR of expected and actual.

This error is caused when a Stack level
fails to maintain the expected pattern.

Error 2)

> **STACK TEST**
> **# FFFF**
> **AUX YY FAILURE (XXXX)**
> **# LLLL**

Where: YY = Auxiliary register.

This error is caused when a particular
Auxiliary register fails to maintain the
expected pattern.

6.8.13   Syntax Error Codes

S10	Missing left parenthesis
S11	Missing right parenthesis
S12	Missing equal sign
S13	Missing comma
S14	Missing asterisk
S15	Missing angle brackets
S16	Missing letter
S17	Missing hex digit
S18	Missing relation operator
S19	Missing required word
S20	Expected end of statement
S21	Missing line number
S22	Illegal PLOT argument
S23	Missing literal string
S24	Illegal expression or missing variable
S25	Missing numeric scaler variable
S26	Missing array variable
S27	Missing numeric array
S28	Missing alpha array
S29	Missing alpha variable

6.8.14   Nonrecoverable Errors

Miscellaneous Errors

A01   Memory exceeded (overlap: text & symbol table)
A02   Memory exceeded (overlap: text & value stack)
A03   Not enough memory (LISTDC, MOVE, COPY)
A04   Stack overflow (operator stack)
A05   Line too long
A06   Program protected
A07   Illegal immediate mode statement
A08   Statement not legal here
A09   Program not resolved

Program Errors

P32   Starting address greater than ending address
P33   Line number conflict
P34   Illegal value
P35   No Program
P36   Undefined line number or CONTINUE illegal
P37   Undefined special function subroutine
P38   Undefined FN function
P39   FN nested too deep
P40   NEXT without FOR
P41   RETURN without GOSUB
P42   Illegal image
P43   Illegal matrix operand
P44   Matrix not square
P45   Operand dimensions not compatible
P46   Illegal microcommand
P47   Missing buffer variable
P48   Illegal device specification
P49   Interrupt table full
P50   Illegal dimensions or variable length
P51   Variable or value too short
P52   Variable or value too long
P53   Noncommon variables already defined
P54   Common variable required
P55   Undefined array
P56   Illegal subscripts
P57   Illegal STR () arguments
P58   Illegal field/delimiter specification
P59   Illegal redimension

6.8.15   Recoverable Errors

Computation Errors

C60	Underflow
C61	Overflow
C62	Division by zero
C63	Zero divided by zero, or zero raised to zero power
C64	Zero raised to negative power
C65	Negative number raised to noninteger power
C66	SQR of negative power
C67	LOG of zero
C68	LOG of negative power
C69	Argument too large

Execution Errors

X70	Insufficient data
X71	Value exceeds format
X72	Singular matrix
X73	Illegal INPUT data
X74	Wrong variable type
X75	Illegal number
X76	Buffer exceeded
X77	Invalid partition reference

Disk Errors

D80	File not open
D81	File full
D82	File not in catalogue
D83	File already catalogued
D84	File not scratched
D85	Index full
D86	Catalogue end error
D87	No end file
D88	Wrong record type
D89	Sector address beyond EOF

I/O Errors

I90	Disk hardware error (X'CO' not received)
I91	Disk hardware error
I92	Disk hardware error (timeout)
I93	Disk format error
I94	Format key engaged
I95	Seek error
I96	CRC error
I97	LRC error
I98	Illegal sector address
I99	Read-after-write error

SECTION 7 CONTENTS

SECTION 7
REPAIR

No special tools or test equipment are
required to repair the CS.   All neces-
sary repair can be accomplished using
the Wang CE Tool Kit (WLI 726-9401).

7.2 Removal Procedures

7.2.1 CPU/Memory Board Removal

1 Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

2 Remove two cover screws.

3 Remove cover and disengage PC board securing brackets.
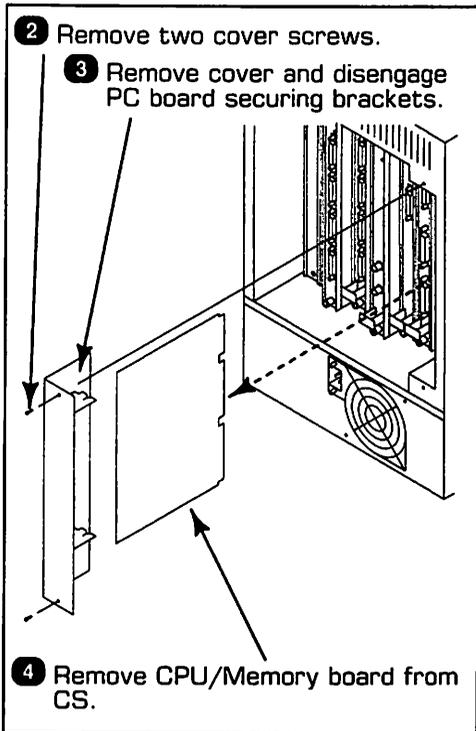
4 Remove CPU/Memory board from CS.

7.2.2 General PC Board Removal

NOTE

Use this general procedure for remov-
ing any PC Board including a single
2275MUX Board (CS without any
2275MUXE Boards).

If the PC Board is part of a 2275MUX
and 2275MUXE combination, those
boards must be removed simultaneous-
ly (➡ 7.2.9).

1 Power-down CS & disconnect AC
power cord from outlet (➡ 4.2).

2 Loosen two screws on each
interface cable connector.
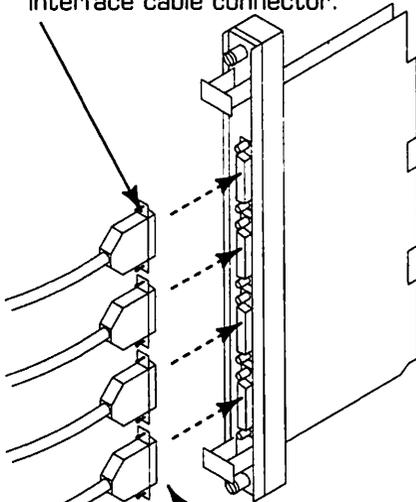
3 Note location and remove each
interface cable connector.

4 Loosen two knurled securing
screws.
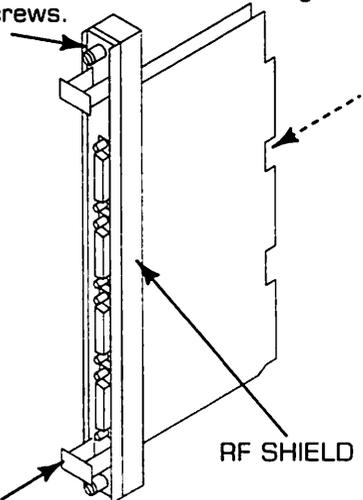
RF SHIELD

5 Grasp PC board by two handles
(or by two knurled screws if
board does not have handles)
and remove.
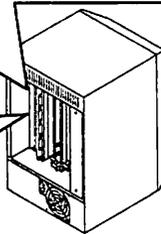
NOTE

When replacing a PC board that has an
RF shield, first remove the shield from
the defective board and reinstall it onto
the new PC board (➡ 7.2.3).

7.2.3   PC Board RF Shield Removal

NOTE

This procedure should only be used when removing the RF shield from a defective board and installing it onto a replacement board.

① Remove the entire PC board and RF shield from the CS (➡ 7.2.2) before removing the RF shield from the PC board..

② Note the orientation of the RF shield and carefully slide it backwards until it completely clears the PC board.
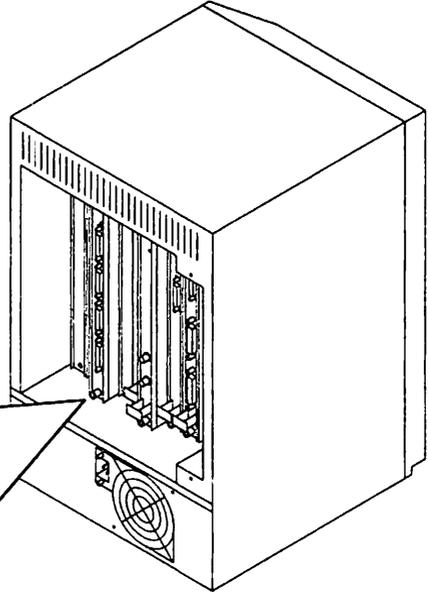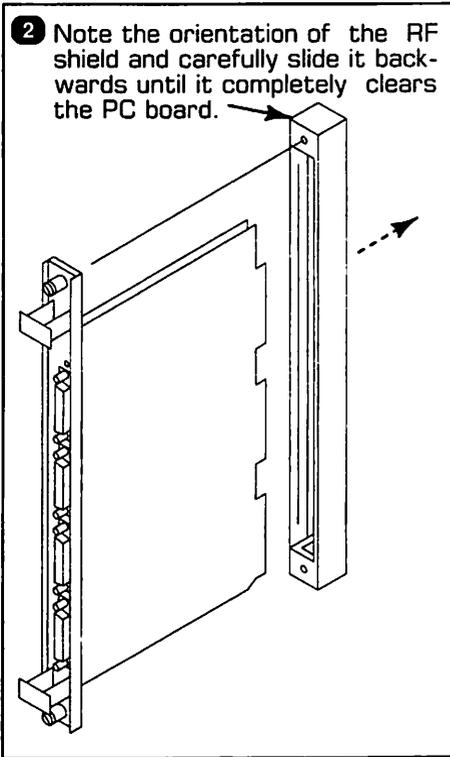
CAUTION

PC board components can be damaged by careless removal of the RF shield.

7.2.4   Power Supply Removal (Sheet 1 of 3)

1 Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

4 Disconnect power supply plugs P4, P5, and P6 from DC pigtail harness connectors J4, J5, & J6.
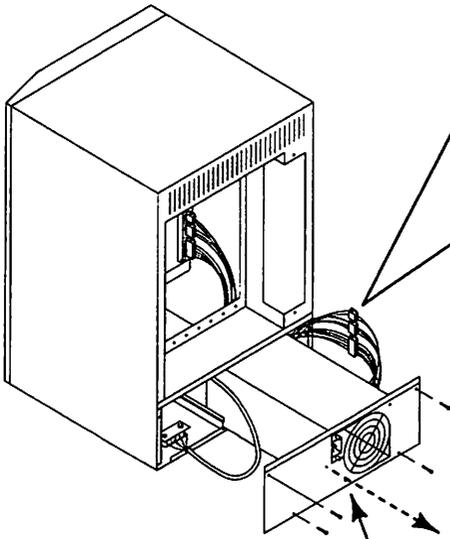
2 Remove four power supply securing screws.

3 Slide power supply out @6 inches.

➡NEXT

7.2.4   Power Supply Removal (Sheet 2 of 3)

5 Slide power supply completely out of CS cabinet.
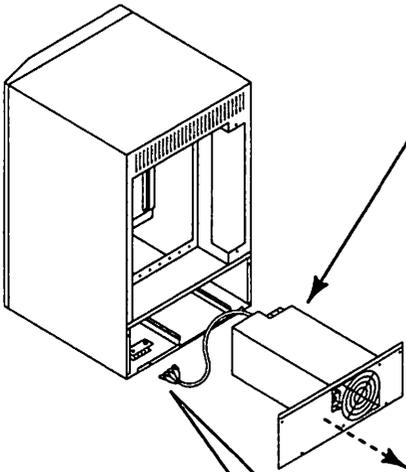
NOTE

Note location of power supply input leads before disconnecting from AC connector block.

6 Disconnect four power supply input leads from AC connector block tabs 1-4.
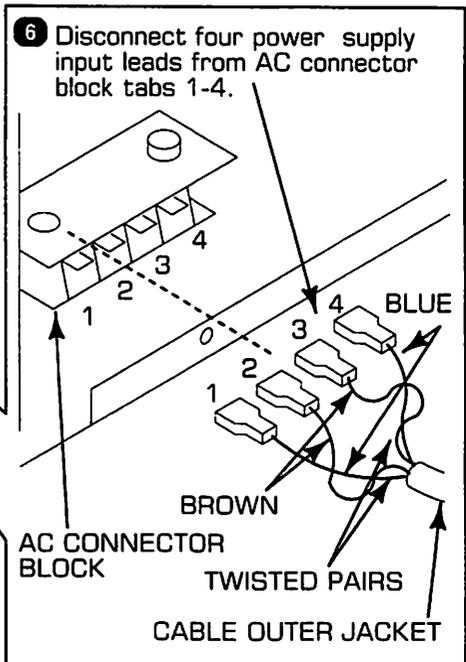
4

3

2

1

4 BLUE

3

2

1

BROWN

AC CONNECTOR
BLOCK

TWISTED PAIRS

CABLE OUTER JACKET

➡NEXT

7.2.4   **Power Supply Removal (Sheet 3 of 3)**

7 Remove two screws and remove panel.

8 Before installing new power supply, set AC voltage select switch to correct voltage available at site.

Set for
220 VAC, 50 Hz
operation

Set for
115 VAC, 60 Hz
operation

● END
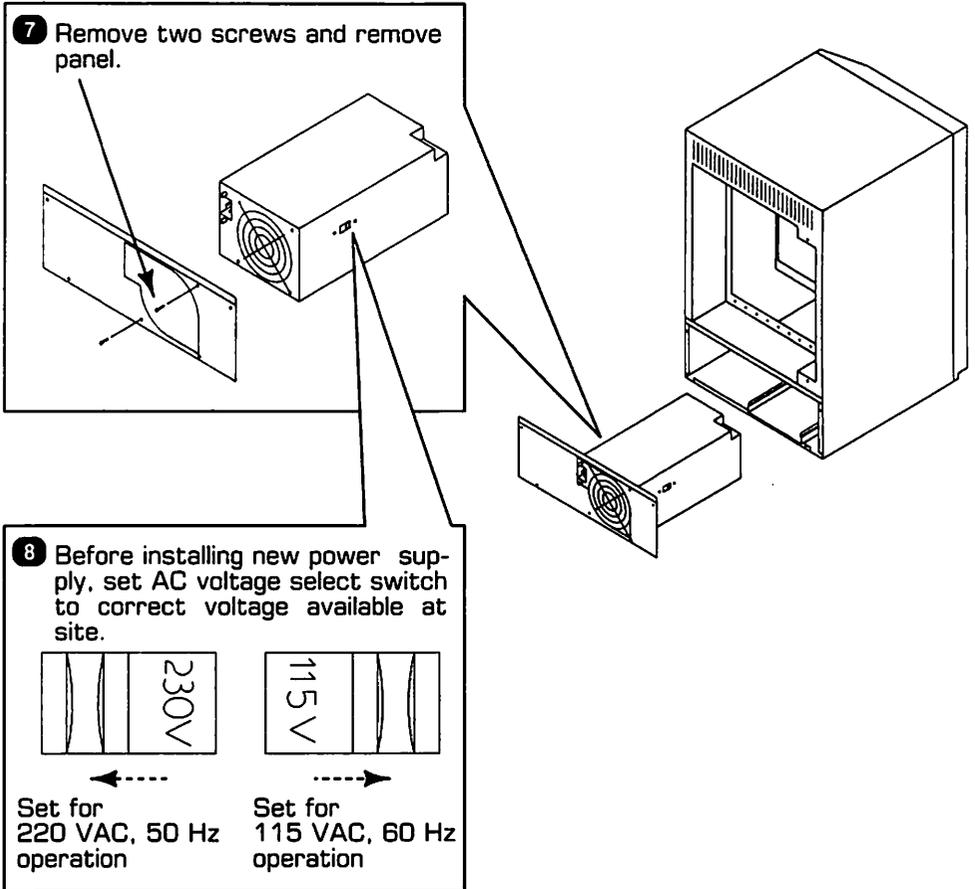
7.2.5 Fan Removal

1 Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

2 Remove CPU/Memory board (➡ 7.2.1).

3 Remove all remaining PC boards from CS (➡ 7.2.2).

4 Unplug DC power cord from defective fan(s).

5 Remove four screws that secure fan, and remove fan.
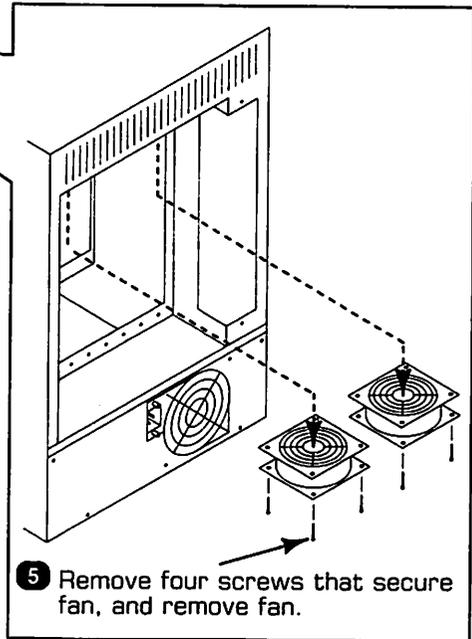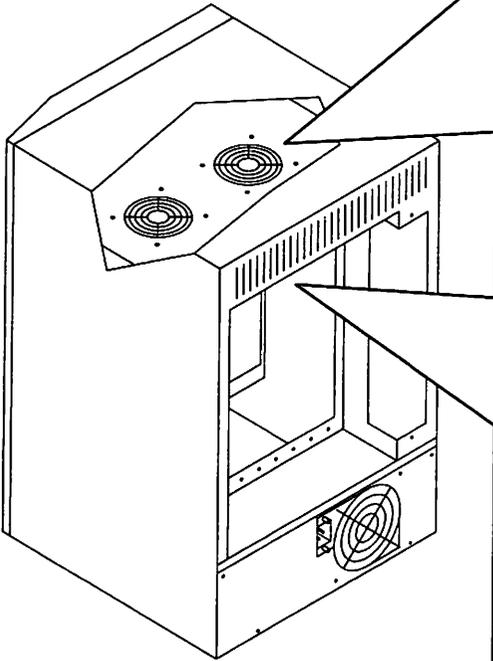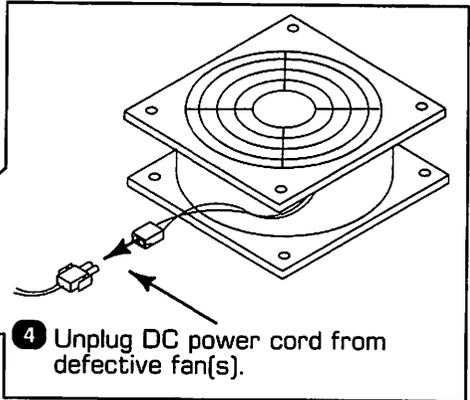
⌐7.2   Removal Procedures

7.2.6   Rear Cover Removal

1 Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

2 Remove CPU/Memory board (➡ 7.2.1).

3 Remove all remaining PC boards from CS (➡ 7.2.2).

4 Remove seven screws that secure rear cover to CS cabinet.

5 Remove rear cover by tilting outward and lifting upward to allow lower lip to clear power supply cover.
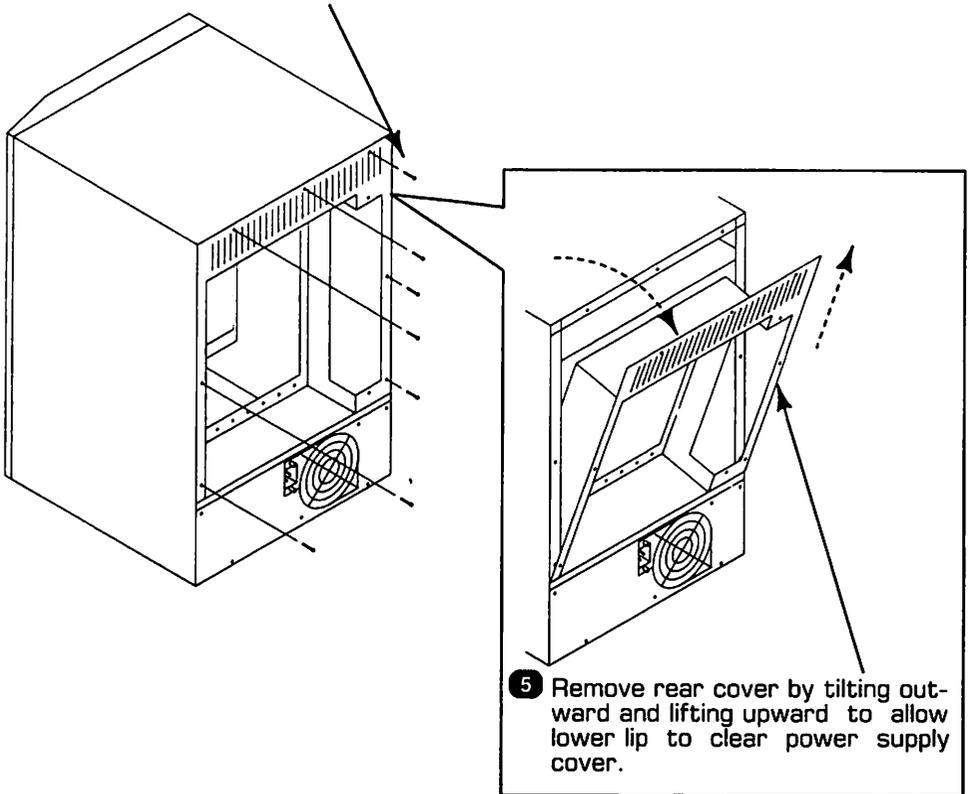
7.2 Removal Procedures

7.2.7 Motherboard Removal

1 Power down CS and disconnect ac power cord from outlet. (➡ 4.2)

2 Remove CPU/Memory board. (➡ 7.2.1)

3 Remove all remaining PC boards from CS. (➡7.2.2)

4 Remove rear cover. (➡7.2.6)

5 Disconnect power cables from motherboard connectors P22/J22, P23/J23, and P24/J24.

Spacers

A
C
E
G
B
D
F
H

6 Remove eight screws securing motherboard to chassis. Remove motherboard. Note: There may be spacers behind the mother-board to raise it.
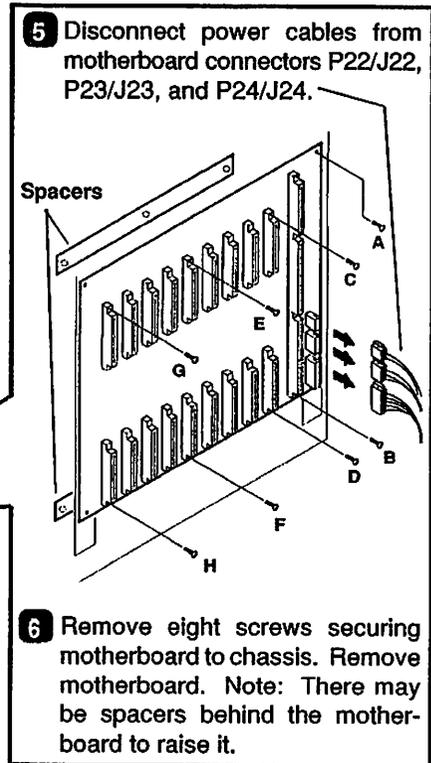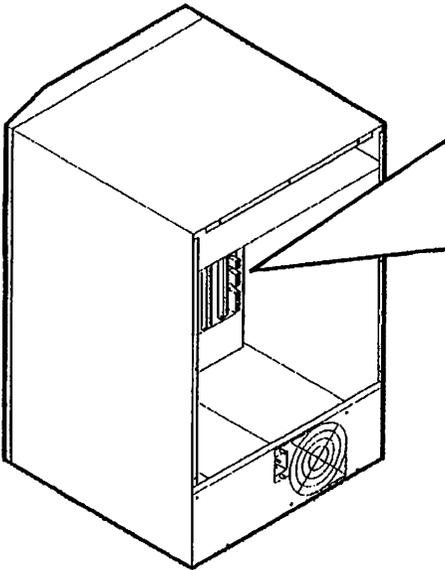
7.2.8   AC Power Switch Removal

1 Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

2 Remove power supply (➡ 7.2.4).

3 Disconnect each connector from slip-on terminals. Note locations for reconnection.

BLUE

BROWN

TWISTED PAIRS
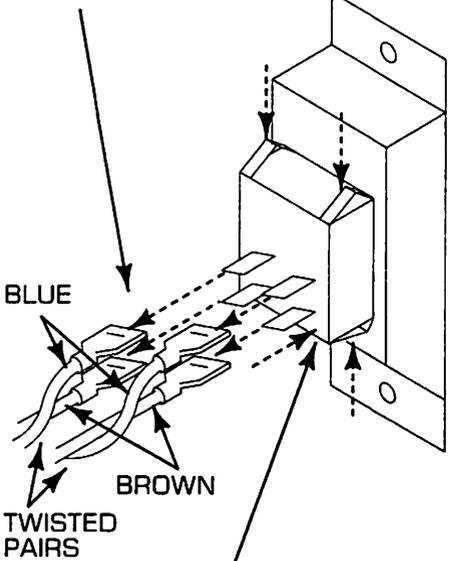
4 Pinch top and bottom switch tabs and remove switch by pushing out through front of cabinet.
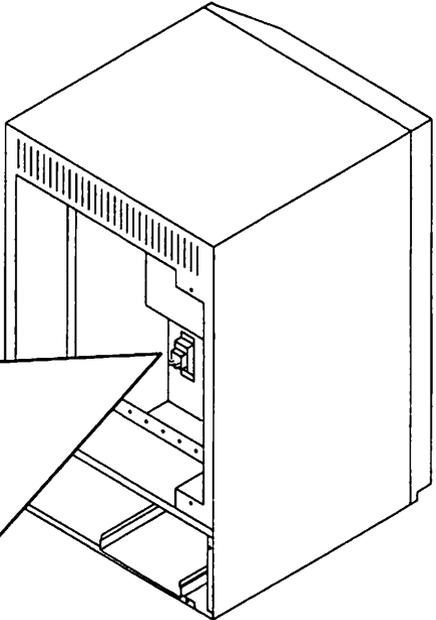
7.2

Removal Procedures

7.2.9 Optional 2275MUX and 2275MUXE (Expansion) Board Removal (Sheet 1 of 2)

NOTE

Use the general procedure (➡ 7.2.2) for removing any single 2275MUX Board (CS with no 2275MUXE Boards).
Use this procedure to remove any PC Board that is part of a 2275MUX and 2275MUXE combination.

CAUTION

There is an interconnecting ribbon cable (220-3588) between the 2275MUX Board and each 2275MUXE Board. These boards must be removed simultaneously from the CS to prevent damage to the cable.

1 Power-down CS & disconnect AC power cord from outlet (➡ 4.2).
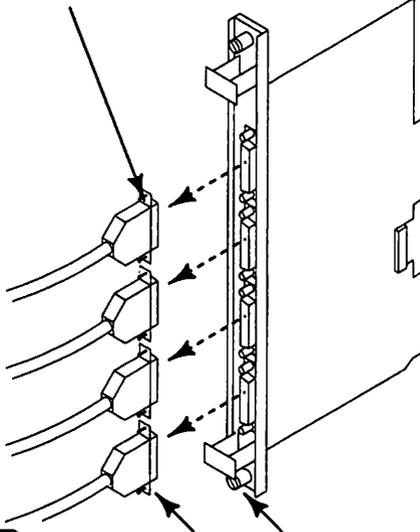
2 Loosen two screws on each interface cable connector.

5 Carefully loosen the 2275MUX Board from its motherboard connectors. Do not remove the board.

3 Remove each interface cable connector.

4 Loosen two knurled securing screws
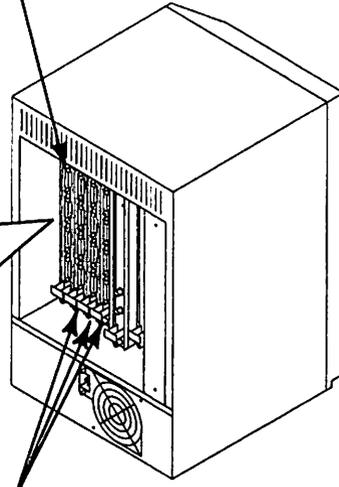
6 Carefully loosen each 2275MUXE Board (up to 3). Do not remove.

➡NEXT

7.2.9   Optional 2275MUX and 2275MUXE (Expansion) Board Removal (Sheet 2 of 2)

7 Simultaneously grasp and remove the 2275MUX and 2275MUXE Boards as if they were a single unit.

8 Remove the ribbon cable from connector J5 on the 2275MUX Board and from connector J5 on each 2275MUXE Board.

● END
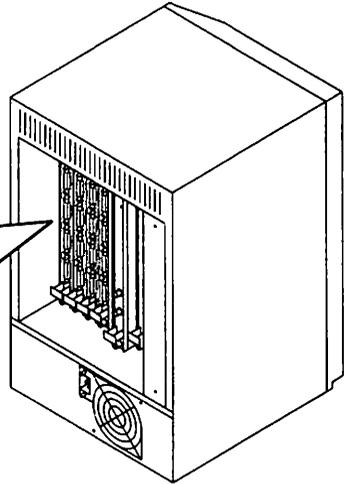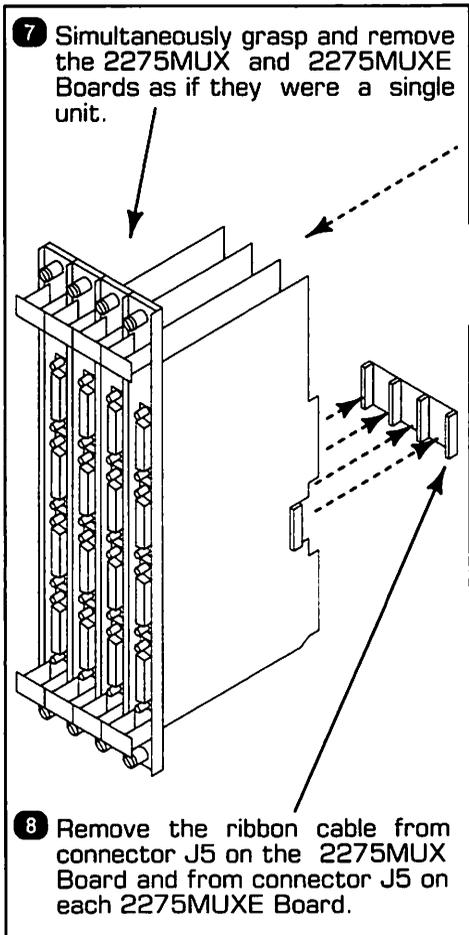
SECTION 8 CONTENTS
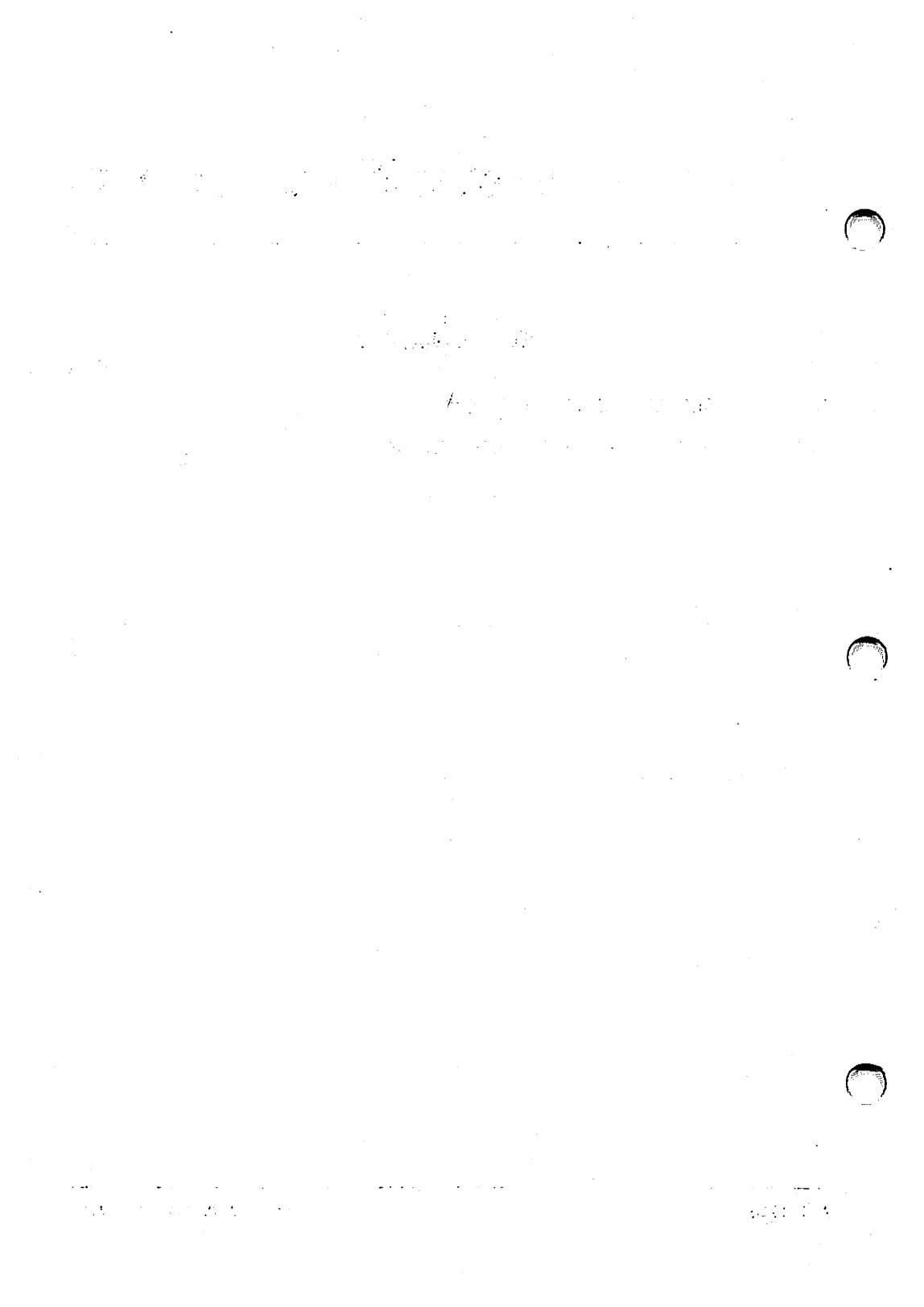
SECTION 8
ADJUSTMENTS

8.1   Tools and Test Equipment

No special tools or test equipment other than a Fluke DVM (or equivalent) are required to perform adjustments on the CS. All necessary adjustment tools are provided in the Wang CE Tool Kit (WLI 726-9401).

WARNING

Do not open the switching power supply under any circumstance. Extremely dangerous voltage (in excess of 300 volts DC) and unlimited current are present within the power supply. Do not attempt to repair the supply; it is field replaceable only.

Tools and test equipment required:

● Fluke DVM (or equivalent).

● Small flat-blade plastic screwdriver.

❶ Power down CS and disconnect AC power cord from outlet (➡ 4.2).

❹ Set AC voltage select switch to correct voltage available at site.

Set for 220 VAC, 50 Hz operation

Set for 115 VAC, 60 Hz operation

❷ Remove four power supply screws.

+12V ADJ.

+5V ADJ.
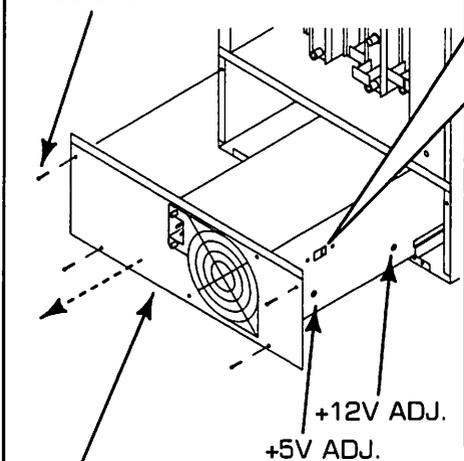
❸ Slide power supply out far enough to gain access to +5V and +12V adjustment pots.
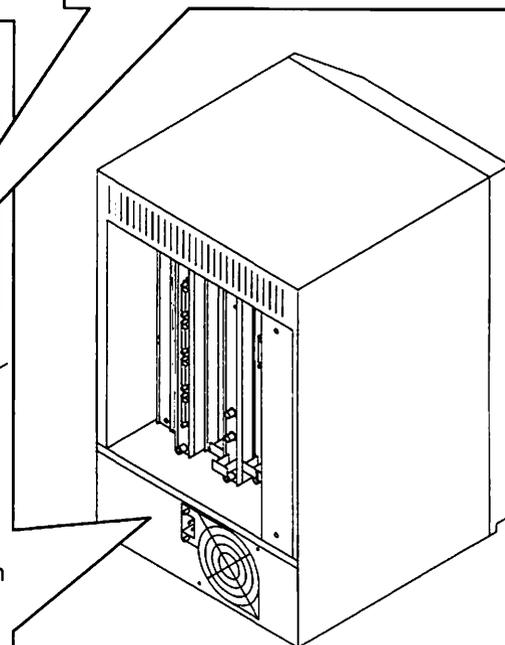
➡NEXT

5 Remove left-most blank panel, or PC board from that slot (➡ 7.2.2).

6 Locate motherboard voltage test point indicators (➡ 3.3.1).

NOTE
It may be necessary to remove a second PC board or blank panel to access the test points.

---

7 Power-up the CS (➡ 4.1).

8 Connect common lead of DVM to TP1 on motherboard

TP1+0V
TP2 -5V
TP3+5V
TP4 +12V
TP5 -12V

9 Connect DVM to TP1 - TP5 on motherboard to verify DC limits.

Test Point	Voltage	Limits (VDC)
TP2	-5V(fixed)	-4.95V to -5.05V
TP3	+5V(adj) (see fig.)	+4.95V to +5.05V
TP4	+12V(adj) (see fig.)	+11.95V to +12.05V
TP5	-12V (fixed)	-11.95V to -12.05V

+12V ADJ.

+5V ADJ.

● END

SECTION 9 CONTENTS

SECTION 9

UNPACKING AND SETUP

Page

SECTION 9 CONTENTS

SECTION 9

UNPACKING AND SETUP (CONT.)

Proper equipment location and site preparation are important for reliable operation of the Wang CS. Actual installation should not begin until all site requirements detailed in the Customer Site Planning Guide (700-5978) and System Installation Guide (741-0907) have been met.

Installation Site Check

A minimum clearance of 12 inches should be provided at the rear of the CS to ensure proper airflow through the fan vents.

Ideally, the area should be easily accessible, relatively dust free, and temperature and humidity controlled.

AC Power Line Requirements

An adequate AC power line, regulated and noise-free to minimize electromagnetic interference should be dedicated to the CS.

The CS draws approximately two amperes at 115 VAC (1 ampere at 230 VAC) during operation.

UNPACKING AND SETUP

- Standard Wang CE Tool Kit
  (726-9401)
- Fluke DVM (or equivalent)

WARNING

Shipping straps are installed under extreme tension. To avoid personal injury, stand well to the side of the shipping carton when cutting straps.

1 Cut each shipping strap in location shown.
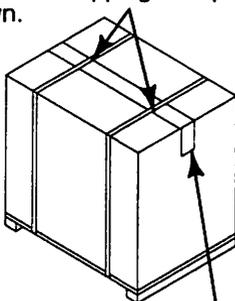
2 Cut carton sealing tape.

3 Open top of carton and remove power cord and manual from tray.
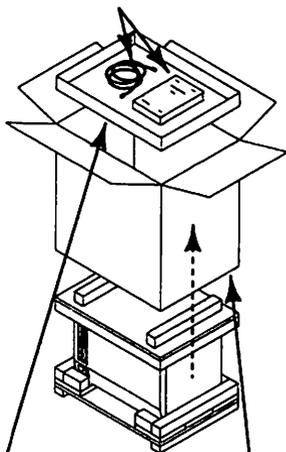
4 Remove tray.

5 Lift carton from pallette.

CAUTION

The CS weighs @63 pounds. Use two people when moving unit.

6 Remove top cushion.
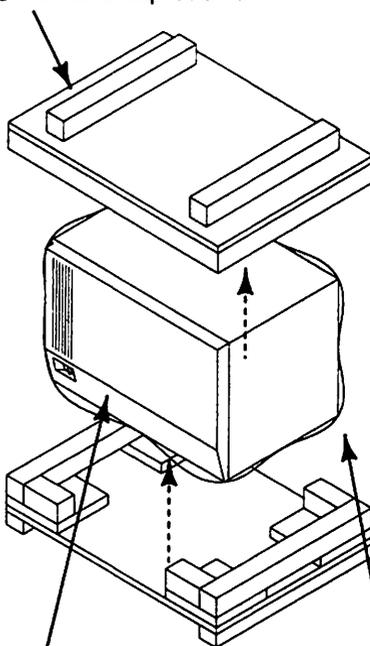
7 Remove CS from bottom palette/cushion.

8 Carefully remove plastic wrap from CS cabinet.

9.4.1 2236MXE 4-Port Terminal Controller Board Switch Settings (Sheet 1 of 3)

1 Remove 2236MXE PC Board (➡ 7.2.2).
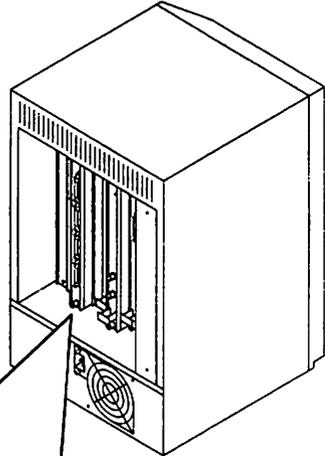
2 Set SW1 to the device address of this particular controller.
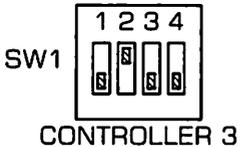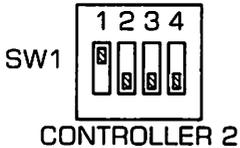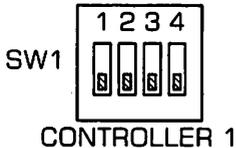
SW1

```
 1 2 3 4
```

CONTROLLER 1

SW1

```
 1 2 3 4
```

CONTROLLER 2

SW1

```
 1 2 3 4
```

CONTROLLER 3

▯ = SWITCH POSITION

9.4.1   2236MXE 4-Port Terminal Controller Board Switch Settings (Sheet 2 of 3)

3 Set SW3 to the desired baud rate for ports 1 and 2 [CH1 & CH2].

	PORT 1	PORT 2
	1 2 3 4	5 6 7 8

19.2K

9600

BAUD RATE (BPS) SETTINGS - SW2/3

U*

4800

U*

*U = UNDEFINED

2400

U*

1200

600

∎ = SWITCH POSITION

300

200

150

134.5

110

● END

9.4.1 2236MXE 4-Port Terminal Controller Board Switch Settings (Sheet 3 of 3)

4 Set SW2 to the desired baud rate for ports 3 and 4 (CH3 & CH4).

PORT 3 | PORT 4

1 2 3 4 | 5 6 7 8

BAUD RATE (BPS) SETTINGS - SW2/3

19.2K

9600

U*

4800

U*

2400

U*

1200

600

300

200

150

134.5

110

*U = UNDEFINED

🖪 = SWITCH POSITION
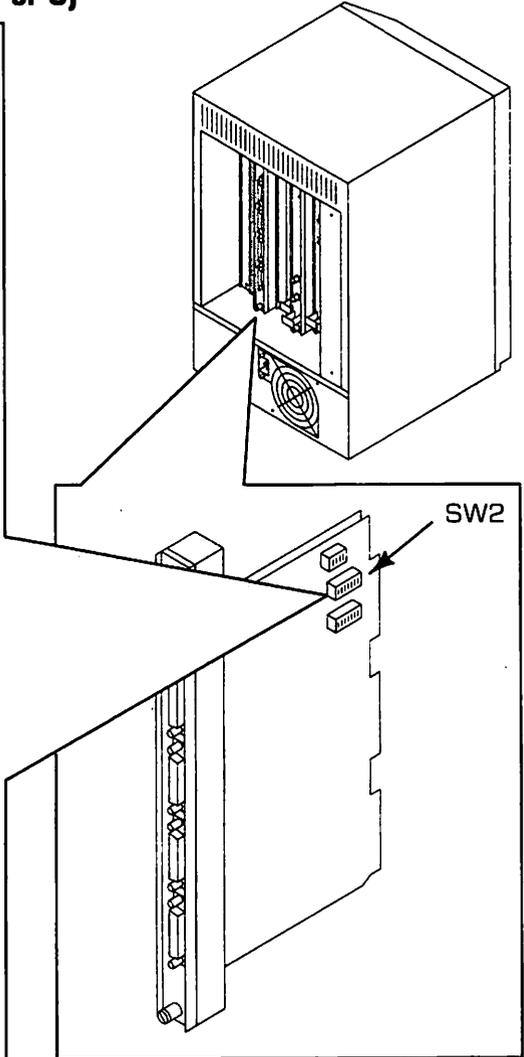
SW2

● END

9.4.2 2258 Local Communications PC Board Switch and Jumper Settings (Sheet 1 of 2)

1 Remove 2258 PC Board (➡ 7.2.2).
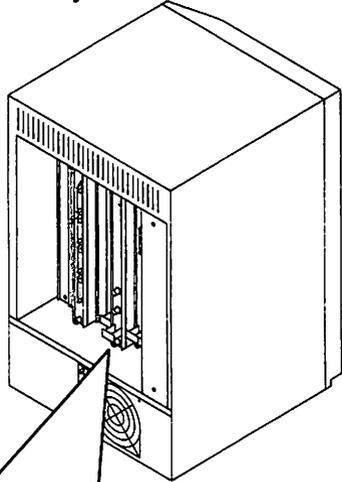
2 Set disk drive address (or no disk) information into SW1 switches 1 and 2.

```
NO
DISK 310 320 330    SW1

          LOW  { 04
        ORDER  { 08
                 10
         HIGH  { 20
        ORDER  { 40
                 80
                     OFF  ON
```

C

7
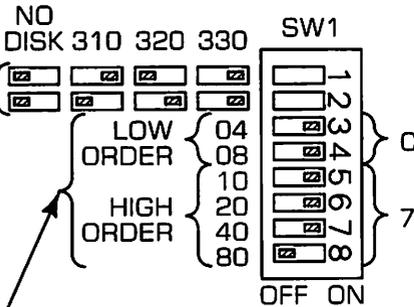
3 Set local communications address into SW1 switches 3 through 8.

▨ = SWITCH POSITION
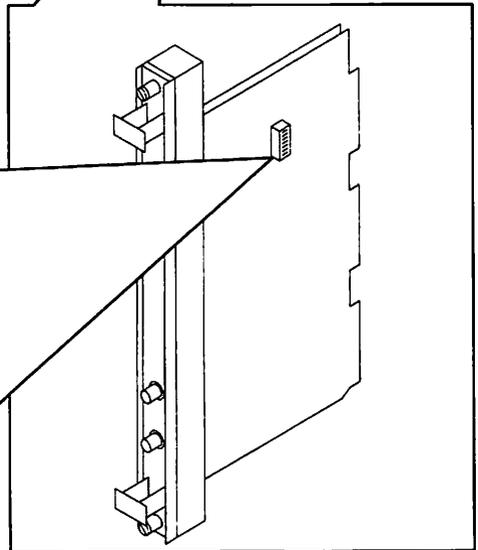
➡NEXT

9.4.2   2258 Local Communications PC Board Switch and Jumper Settings (Sheet 2 of 2)

5 Install Diagnostic Enable Jumper J2.

J2

4 Install Clock Enable Jumper J1.

J1

● END
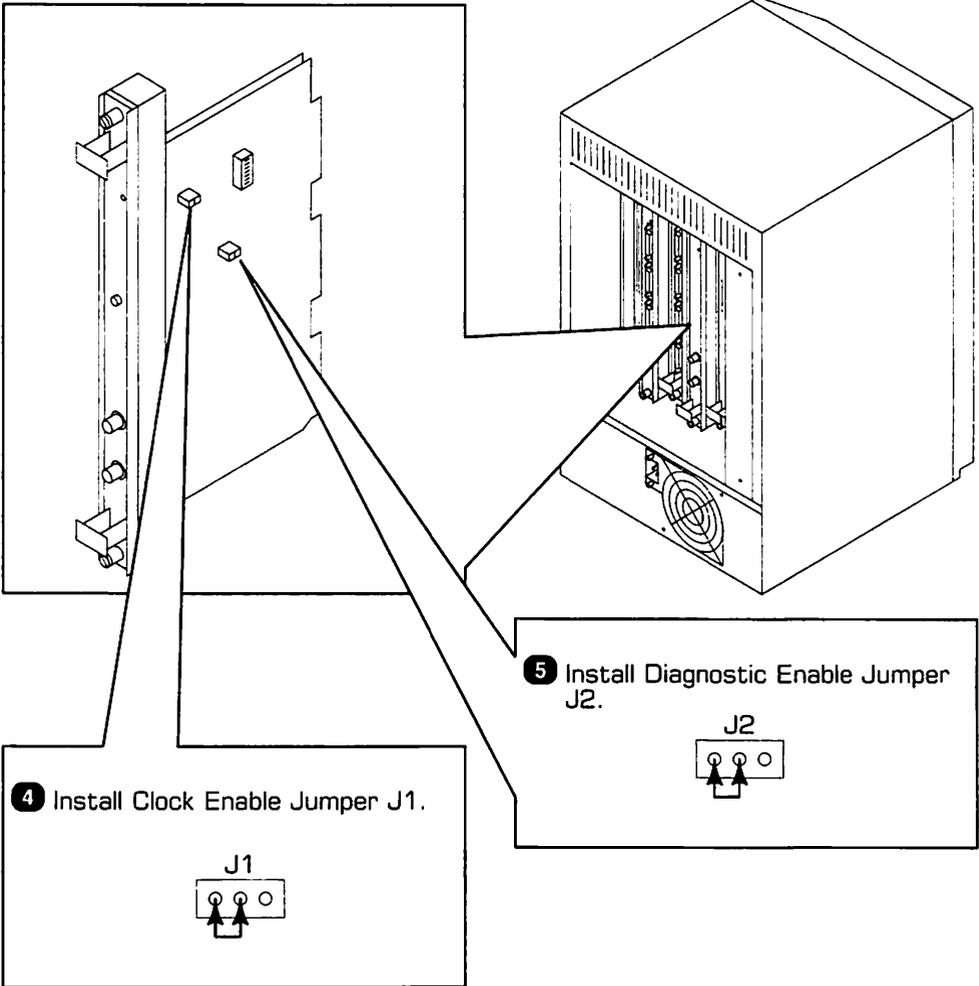
9.4.3 2228B TC Controller Board Switch Settings

1 Remove 2228B PC Board (➡ 7.2.2).
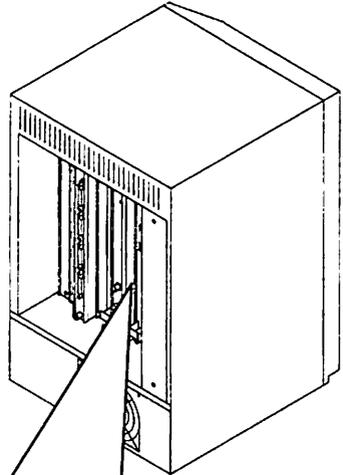
2 Set device address switch to "1C" (first controller) or "1F" (second controller).
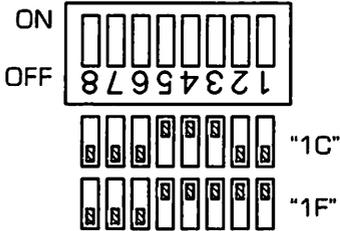
⧄ = SWITCH POSITION
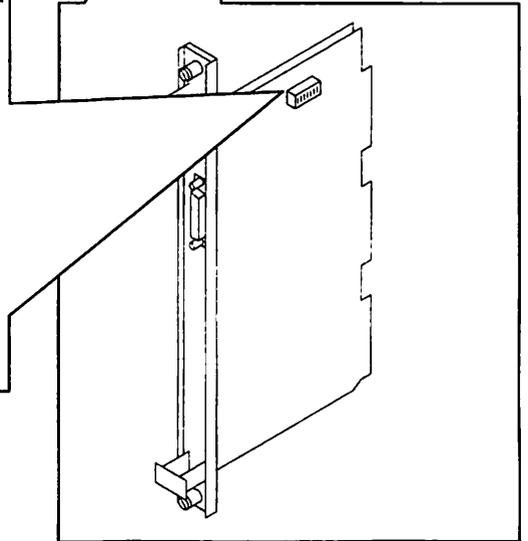
9.4.4 22C32 Triple Controller Board Switch Settings (Sheet 1 of 2)

1 Remove 22C32 PC Board (➡ 7.2.2).

2 Set disk address switch to address of disk drive interfaced to this controller.

```
1 2 3 4 5 6 7 8    HIGH
⊓⊓⊓⊓⊓⊓⊓⊓  ⟋ ORDER
```

310
320
330
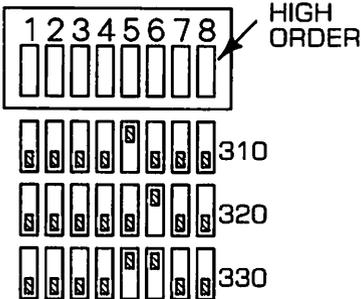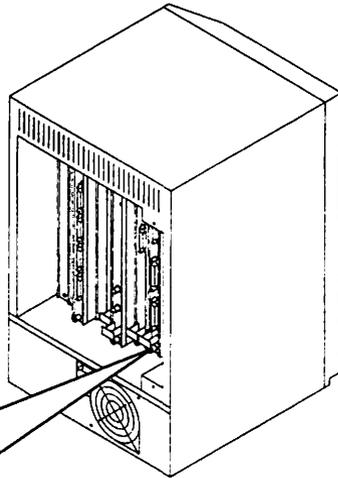
§ = SWITCH POSITION

3 Set printer address switch to address of printer interfaced to this controller.
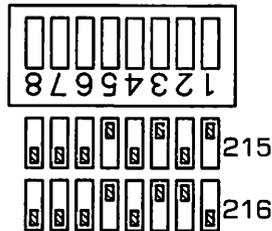
```
12345678
```

215
216

§ = SWITCH POSITION

➡NEXT

9.4.4 22C32 Triple Controller Board Switch Settings Settings (Sheet 2 of 2)
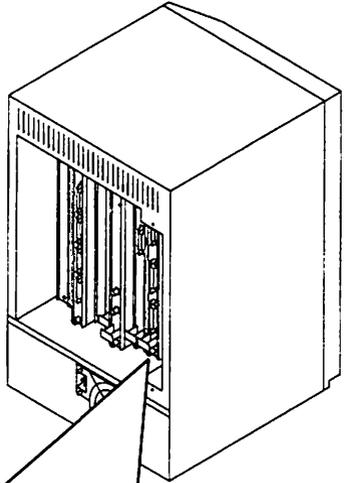
4 Set terminal address switch to address of workstation interfaced to this controller.

Device Address	Terminal
00	NO. 1
40	NO. 5
80	NO. 9
CO	NO. 13
NO TERMINAL CONNECTED	

⊠ = SWITCH POSITION

● END
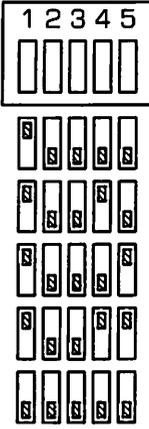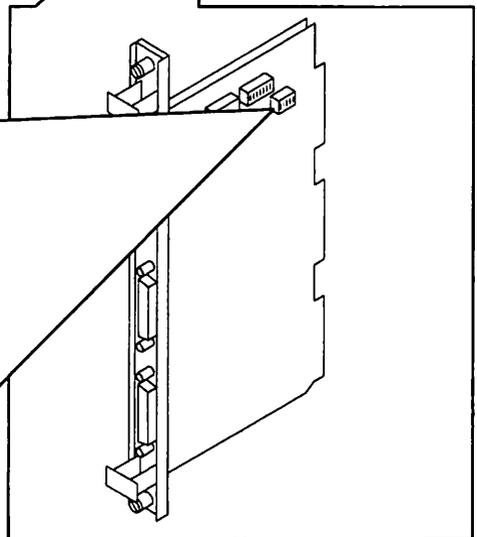
9.4.5 Optional 2275MUX Board Switch Settings

1 Remove 2275MUX PC Board (➡ 7.2.9) if shipped as part of CS system.
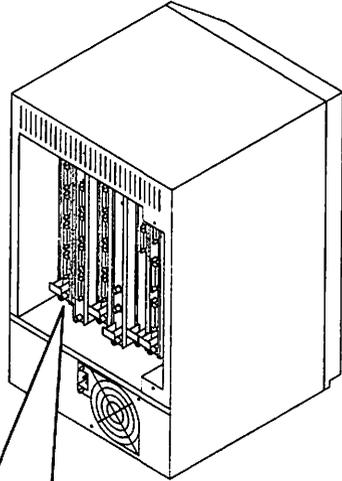
2 Set disk address switch to address of disk drive interfaced to 2275MUX PC board.

```
1 2 3 4 5 6 7 8
```

ADDRESS 310

ADDRESS 320

ADDRESS 330

⊠ = SWITCH POSITION
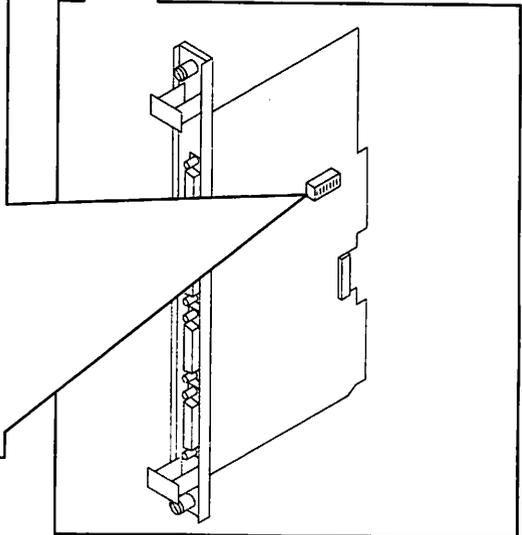
9.4.6 Optional 2275MUXE (Expansion) Board Switch Settings

① Remove 2275MUXE PC Board (➡ 7.2.9) if shipped as part of CS system.
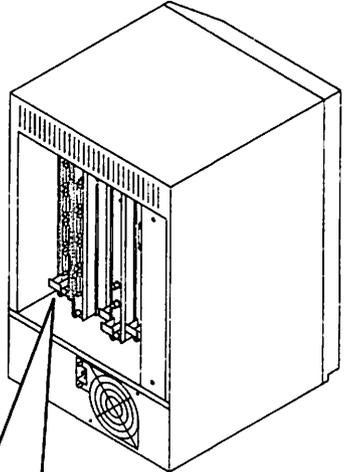
② Set PC board address switch to address of this PC board.

NOTE
No two 2275MUXE boards may have the same address.

ADDRESSES

1   2   3

⊠ = SWITCH POSITION

9.4.7   Additional I/O Controller PC Board Switch Settings (Sheet 1 of 2)

● Each remaining CS peripheral device I/O controller must be assigned a unique address as specified in the table below.

● A configuration with one device in a class will use the first device address for that class.   Additional devices belonging to that class will have addresses sequentially assigned.

● Once an address has been assigned to each peripheral,   the addresses must be inserted into the address switches located   on   each device controller board.

● The   most significant digit of the device address does not have to   be programmed into the device-address switch settings. It is   used   by   the Operating System to identify the device type.

● The last two digits of the device address correspond to the actual peripheral's address.   This address must be manually set on each device controller board in the CS (➡ sh. 2).

Device	Address(es)
Keyboards	001, 002, 003, 004
CRT Units	005, 006, 007, 008
A.C. Tape Drive	018
Tape Cassette Units	10A, 10B, 10C, 10D, 10E, 10F
Printers	215, 216
Disk Units	310, 320, 330
Card Reader	517
Hopper-Feed Card Readers	628, 629
Paper Tape Readers	618
Teletype	019, 01A, 01B Input: 01D, 01E, Output: 01F
Teletype Tape Units	41D, 41E, 41F
Telecommunications Output	219, 21A, 21B Input: 21D Output: 21E, 21F
Parallel I/O Interface	23A, 23C, 23E Input: 23B Output: 23D, 23F
BCD Input Interface	25A, 25B, 25C, 25D, 25E, 25F
Nine-Track Tape Unit	07B, 07D, 07F
Triple Controller	001, 005, 009, 013 (Workstation) 310, 320, 330 (Disk) 215, 216, 217 (Printer)

9.4.7 Additional I/O Controller PC Board Switch Settings (Sheet 2 of 2)

HEX VALUE:
80-
40-
20-
10-
8-
4-
2-
1-

SECOND DIGIT (0 - F)

LAST DIGIT (0 - F)

ON OFF

HEX VALUE:
10-
8-
4-
2-
1-

SECOND DIGIT (0 OR 1)

LAST DIGIT (0 - F)

ON OFF
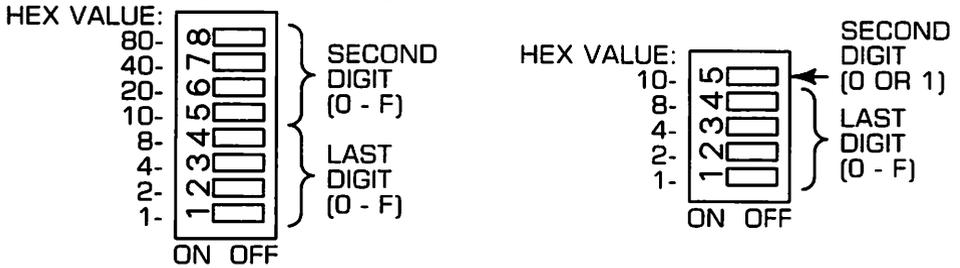
| | Switch Numbers | | | | | | | |
| | Second Digit | | | | Last Digit | | | |
Digit (Hex)	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	0	0	0	1	0
3	0	0	1	1	0	0	1	1
4	0	1	0	0	0	1	0	0
5	0	1	0	1	0	1	0	1
6	0	1	1	0	0	1	1	0
7	0	1	1	1	0	1	1	1
8	1	0	0	0	1	0	0	0
9	1	0	0	1	1	0	0	1
A	1	0	1	0	1	0	1	0
B	1	0	1	1	1	0	1	1
C	1	1	0	0	1	1	0	0
D	1	1	0	1	1	1	0	1
E	1	1	1	0	1	1	1	0
F	1	1	1	1	1	1	1	1

● END

9.5.1   2236MXE 4-Port Terminal Controller Board Connections

NOTE
Use cables supplied with modem or workststion.

❶ Connect interface cable(s) from board to modem and/or work-station.

❷ Tighten cable connector screws.
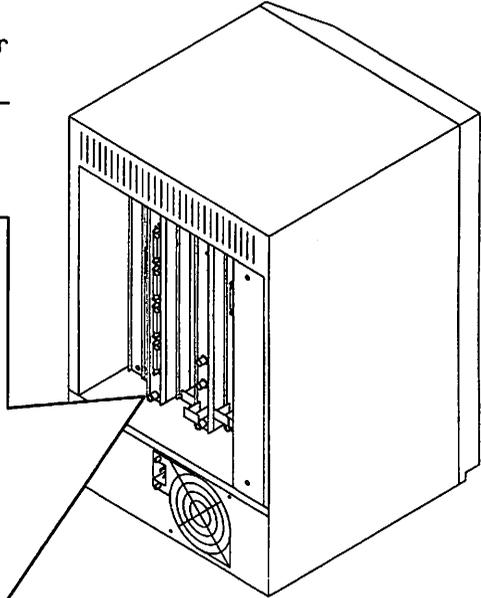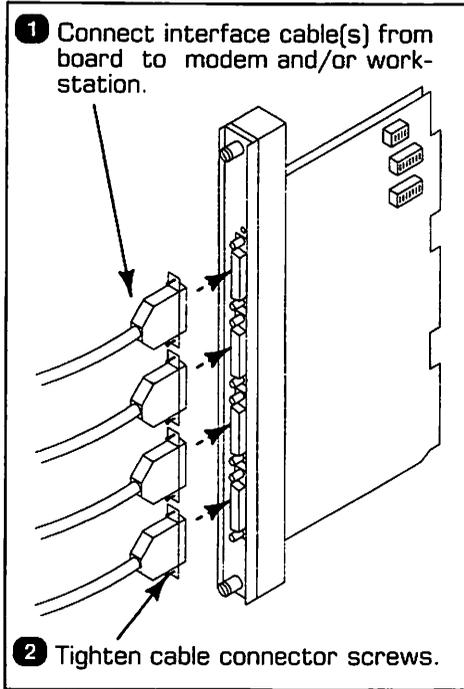
9.5   Connections

9.5.2   2258 Local Communications Board Connections

NOTE

Use cable supplied with electrical APA.

---
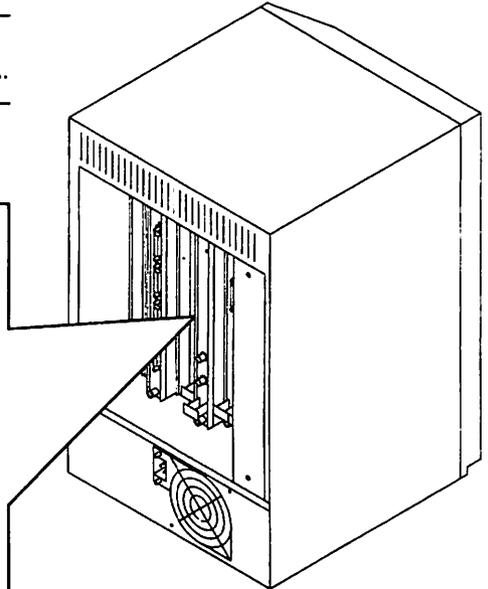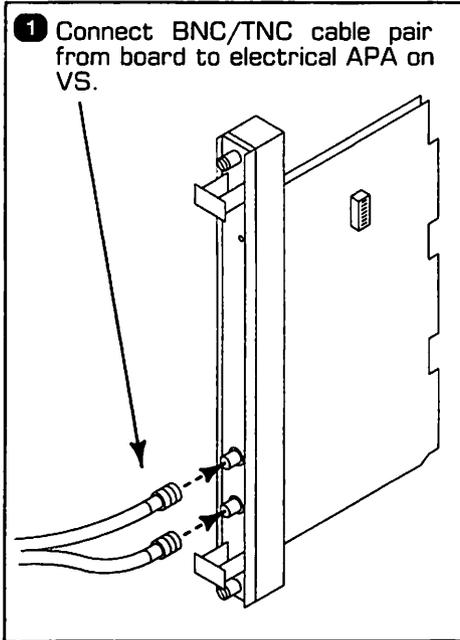
1 Connect BNC/TNC cable pair from board to electrical APA on VS.

9.5.3   2228B TC Controller Board Connections

NOTE

Use cable supplied with modem.

---

❶ Connect interface cable from board to modem.
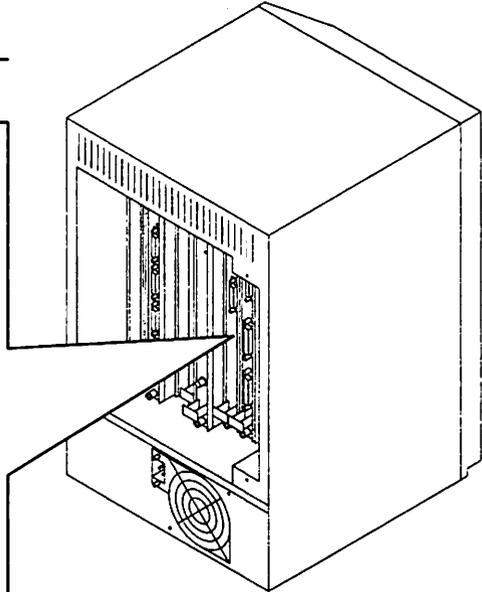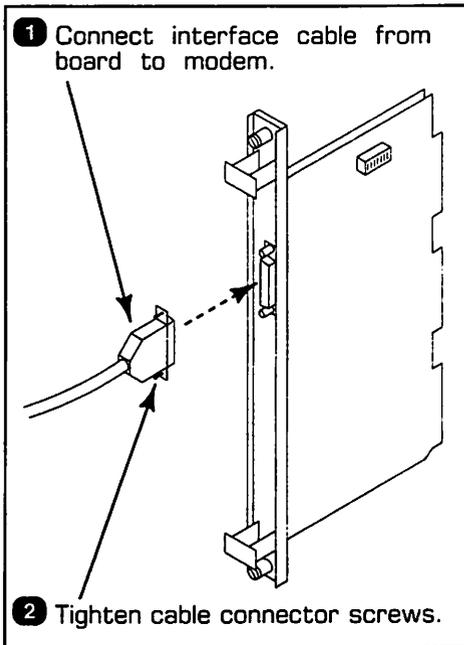
❷ Tighten cable connector screws.

9.5.4   22C32 Triple Controller Board Connections

NOTE

Use cables supplied with workstation, system disk drive, and/or printer.

❶ Connect appropriate interface cable from board to workstation, system disk drive, and/or printer.

TO W/S

TO DISK DRIVE

TO PRINTER
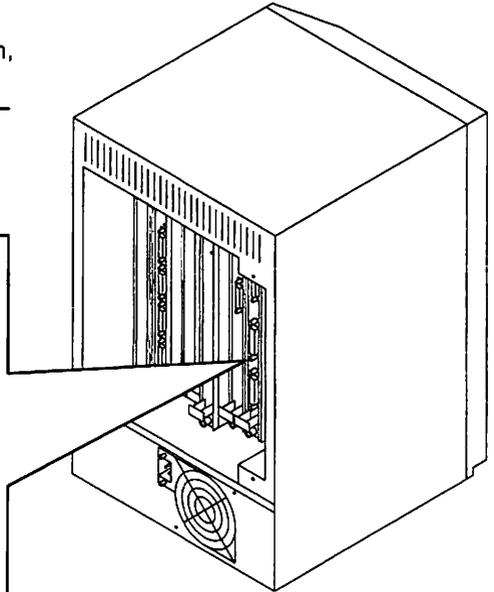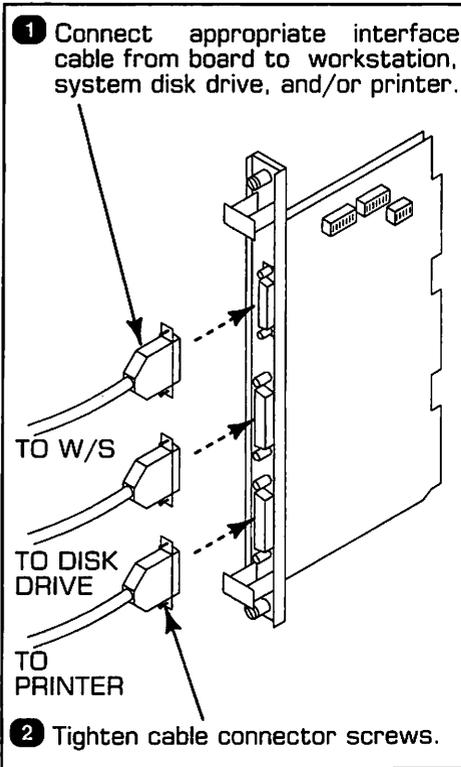
❷ Tighten cable connector screws.

9.5.5 Optional 2275MUX Board Connections

NOTE

Use cable(s) supplied with 22C80 interface board(s) and/or system disk drive.
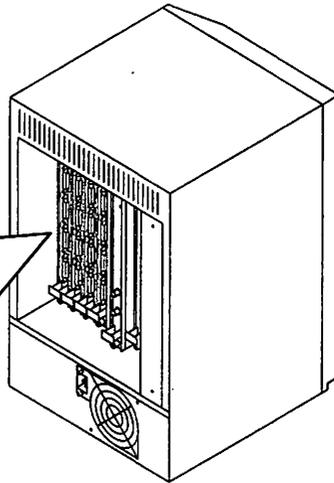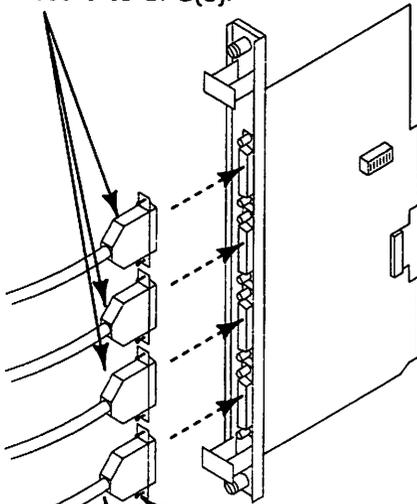
❶ Connect interface cable(s) from board to CPU(s).

❷ Connect interface cable from board to system disk drive.

❸ Tighten cable connector screws.

9.5.6   Optional 2275MUXE (Expansion) Board Connections

NOTE

Use cable(s) supplied with 22C80 interface board(s).

❶ Connect interface cable(s) from 2275MUXE board(s) and 22C80 interface board(s).

❷ Tighten cable connector screws.

① Connect AC power cord to CS.

② Secure power cord screws

③ Connect AC power cord plug to appropriate wall outlet.
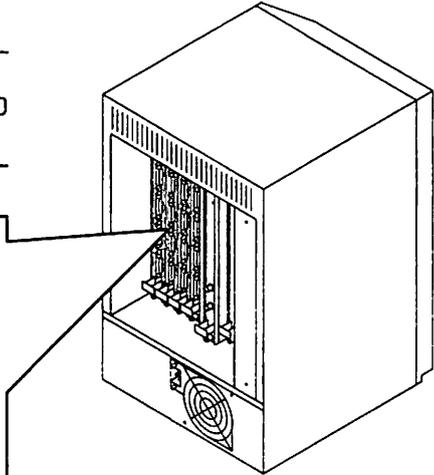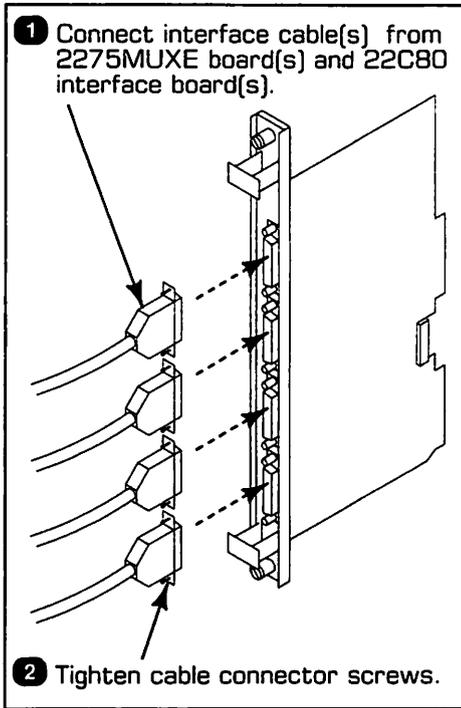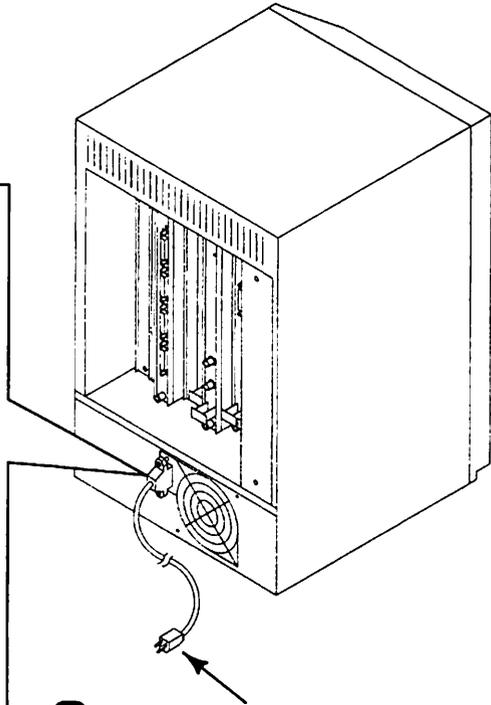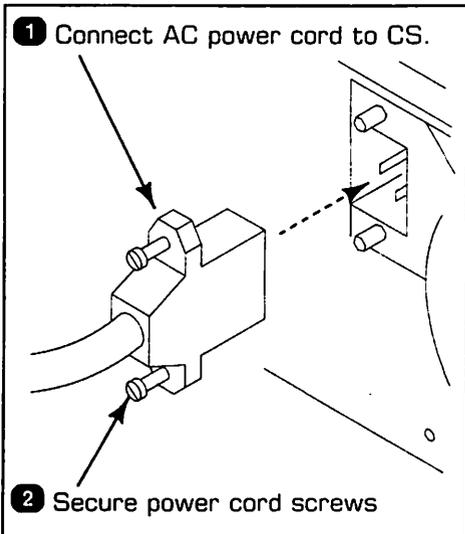
④ Power-up the CS (➡ 4.1).

⑤ Perform DC Voltage Check procedure (➡ 6.3).

9.7.1 System Verification

① Once power has been applied, the terminal connected as System Terminal 1 should display the following screen;

> **MOUNT SYSTEM PLATTER**
> **PRESS RESET**

② Place the System Platter Disk into the system drive and press the RESET key on the keyboard. (Press RESET if the terminal is a 2236DE, and SHIFT RESET if the terminal is a 2236DW.)

③ The following screen should now be displayed;

> **KEY SF'?**

④ Depress the special function key which corresponds to the drive you wish to IPL from. Disk addresses start with SF'00 and increment thereafter. For example; SF'00 accesses a disk address of 310, SF'01 an address of B10, SF'02 an address of 320, SF'03 an address of B20, etc.

⑤ The screen should display;

> ****SYSTEM 2200****
>
> Select item with   **MEMORY XK**
> **SPACE & BACKSPACE**
>
> Key RUN to execute,   **Terminal X**
> CLEAR or PREV SCRN
> for previous screen
>
>   ☐ **MVP BASIC-2**
>   _ **Diagnostics**

⑥ Space down to Diagnostic and key RUN. The screen will appear as follows;

> ****CUSTOMER**
> **DIAGNOSTIC MENU****
> Select item with   **MEMORY XK**
> **SPACE & BACKSPACE**
>
> Key RUN to execute,   **Terminal X**
> CLEAR or PREV SCRN
> for previous screen
>
>   ■ **CPU Instructions**
>   _ **Control Memory**
>   _ **Data Memory**
>   _ **CPU Registers**
>
>   _ **All of the Above**

⑦ Space down to "All of the Above" & key RUN. The diagnostics will begin immediately. As each set of tests are completed, the Chain Mode Pass will increment. These tests will run continuously until RESET is pressed to terminate the diagnostics.

NOTE

Refer to Section 6.4 for interpretations of all CS CPU Diagnostics mentioned here.

⑧ When a sufficient number of successful test passes have occured (5 to 10 passes), press RESET.

⑨ The system software must now be configured to support the attached peripherals.

9.7.2   Partition Generation (Sheet 1 of 2)

1 After all required system diagnostics have successfully completed, the partitions must be generated. Apply power to the system or press RESET. The screen will appear as follows;

> **MOUNT SYSTEM PLATTER**
> **PRESS RESET**

2 Mount the system disk and press RESET. The screen appears;

> **KEY SF'?**

3 Depress the special function key which corresponds to the drive containing the operating system. Disk addresses start with SF'00 and increment thereafter. For example; SF'00 accesses a disk address of 310, SF'01 an address of B10, SF'02 an address of 320, SF'03 an address of B20, etc.

NOTE

If the wrong SF key was depressed (there was no system disk at the device specified), the following screen will appear;

> **•••SYSTEM ERROR (DISK 00XX)•••**
> **PRESS RESET**

If this error occurs, press RESET, then the correct SF key.

---

4 The screen will now appear;

> ••••**SYSTEM 2200**••••
>
> **Select item with   MEMORY XK**
> **SPACE & BACKSPACE   Terminal X**
> **Key RUN to execute,**
> **CLEAR or PREV SCRN**
> **for previous screen**
>
>   ■ **MVP BASIC-2**
>   – **Diagnostics**

➡NEXT

9.7.2   Partition Generation (Sheet 2 of 2)

5 Select MVP BASIC-2 & key RUN.
The following screens will now
appear;

LOADING: MVP BASIC-2 RELEASE X.X

LIST OF STORED CONFIGURATIONS	(# PARTITIONS)	LIST OF OPTIONS
1. current	(X)	SF'00 - CLEAR PARTITIONS
2. ...		SF'01 - CLEAR DEVICE TABLE
		SF'02 - DIVIDE MEM. EVENLY
		SF'04 - EDIT PARTITIONS
		SF'05 - EDIT DEVICE TABLE
		SF'06 - EDIT $MSG
		SF'08 - LOAD CONFIGURATION
		SF'09 - SAVE CONFIGURATION
		SF'10 - DELETE CONFIGURATION
		SF'15 - EXECUTE
		FN - HELP

CONFIGURATION "CURRENT" LOADED.
NAME OF CONFIGURATION TO LOAD? _____

6 Enter the configuration parameters into the Operating System. If partition-generation modules have been previously defined, a list of those module names will appear in the @GENPART menu screen. Select and load one of these modules by typing in the name of the module and pressing RETURN, and SF'15. If desired, a new partition module can be created by depressing the appropriate Special Function keys to initiate partition generation.

● END

9.7.3 @GENPART SF Key Options (Sheet 1 of 2)

SF'00 - Clear Partitions:

Clears partition configuration parameters currently in memory, allowing the user to specify the total number of terminals and partitions in each bank, then automatically advances to SF'04 (Edit Partitions). Any number of partitions between 1 and 16 is allowable.

SF'01 - Clear Device Table:

Clears Master Device Table parameters currently stored in memory, resets the default peripheral addresses to 215 (printer), 310 (system disk), and 320 (secondary disk), allocates these devices to all users, then advances to SF'05 (Edit Device Table). Default device addresses can then be edited.

SF'02 - Divide Memory Evenly:

Divides remaining User Memory equally among the number of partitions specified with SF'04.

SF'04 - Edit Partitions:

Displays and allows editing of partition parameters such as size, terminal assignment, programmability, and name of bootstrap program. SF'04 DOES NOT allow addition or deletion of defined partitions in an existing configuration.

SF'05 - Edit Device Table:

Displays and allows editing of device addresses for all peripherals. All peripherals connected directly to I/O controllers must be specified in the Master Device Table.

SF'06 Edit SMSG:

Displays and allows editing of a user-defined broadcast message that will be displayed on each terminal's CRT whenever the READY message is displayed. This message appears on line 0 of the CRT, immediately above the READY message.

SF'08 - Load Configuration:

Loads a named configuration from the Configuration File, which is located on the system disk. To modify and/or execute any previosly defined configuration other than "current", this option must be used.

SF'09 - Save Configuration:

Used to save a system configuration in the Configuration File under a user-specified name (up to eight characters in length). If the user specifies a configuration name already used, @GENPART will verify that the user desires to replace the old configuration on disk file with the configuration currently in memory.

9.7.3 @GENPART SF Key Options (Sheet 2 of 2)

SF'10 - Delete Configuration:

Deletes a configuration from the Configuration File on the System Disk.

SF'15 - Execute Configuration:

Allows the operator to first review, & then to execute, a configuration. This configuration will automatically be saved in the Configuration File under the name "current" when the configuration is executed. Once a configuration has been executed, the system may be reconfigured again only after the Master Initialization procedure has been repeated.

FN - Help:

Displays @GENPART operating instructions.

In general, the order of executing these @GENPART options is as follows;

1 SF'08 - to load a configuration.

2 SF'00 - to modify this configuration by adding or deleting partitions.

3 SF'04 - to create the new partition parameters.

4 SF'05 - to create the Master Device Table.

5 SF'06 - to create the broadcast message.

6 SF'09 - to save the configuration with a name other than "current".

7 SF'15 - to execute the configuration.

NOTE
These steps will create a permanent system configuration.

●END

9.7.4 @GENPART Screen Loads (Sheet 1 of 3)

Load a Configuration (SF'08)

LIST OF STORED CONFIGURATION (#PARTITIONS)
    current   **(1)**

CONFIGURATION 'current' LOADED. NAME OF CONFIGURATION TO LOAD? _____

The last configuration executed (called 'current') is automatically loaded. To load any other configuration, enter its name, then press RETURN.

Clear Partitions (SF'00)

AVAILABLE USER MEMORY = xxK
REMAINING USER MEMORY = xxK
NO. OF TERMINALS?
NO. OF PARTITIONS?

The program responds with a display that requests the total number of terminals that are to be configured into the system and the number of partitions that will be created. Available User Memory is automatically calculated and displayed. Remaining memory is updated and displayed as memory is allocated to the partitions. When all information has been entered, and RETURN is pressed, the program automatically invokes SF'04 (Edit Partition) to allow the editing of partition parameters.

Edit Partitions (SF'04)

PARTITION SIZE (K)	TERMINAL	PROGRAMMABLE PROGRAM
1 _____	1	Y
2 _____	2	Y
3 _____	3	Y
4 _____	4	Y

EDIT WHICH PARTITION (DEFAULT = 1)?

This option displays parameters for all partitions and initiates a cycle of prompts for the altering of these parameters. The cycle recurs until another option is selected. The user is thus allowed to modify parameters for each partition. The display is updated each time an item is entered.

For example to enter parameters for partition #2, enter 2 then key RETURN. An asterisk appears beside the number of the partition whose parameters are being edited, and the following series of prompts will be displayed in succession at the bottom of the screen:

PARTITION SIZE (default = 2)?

9.7.4 @GENPART Screen Loads (Sheet 2 of 3)

Edit Partitions (SF'04) (cont.)

Any value greater than 1.25K and less than the amount of remaining User Memory is a valid response. Note that the default value is not a valid response unless all remaining user memory is to be divided evenly. After the amount of user memory allocated to this partition has been entered, the screen will appear;

| TERMINAL (default = 2)?

Enter the terminal number which will be assigned to this partition. The following screen will appear;

| ENABLE PROGRAMMING (Y or N)?

By default, programming is allowed for all partitions; however, to prevent inadvertant modification of certain programs, it may be desirable to disable the programming mode in some partitions. After responding to this prompt, the name of a program to be automatically loaded into this partition will now be requested. The screen appears as follows;

| NAME OF PROGRAM TO LOAD?

Enter the name of the program & key RETURN. When the configuration is executed, the program will be automatically loaded from the system disk into its' partition, and will then be run.

Other partitions which require modification may be serviced at this time following the same procedure. Once all partitions have been edited (if necessary), SF'05 is used to leave the "Edit Partition" cycle and invoke the "Edit Master Device Table" option. With this option selected, the screen will appear as follows;

	PARTI-		PARTI-
DEVICE	TION	DEVICE	TION
1.	/215	all	17.
2.	/310	all	18.
3.	/320	all	19.
.			.
.			.
.			.
16.			32.

| EDIT WHICH ENTRY (default = 1)?

Enter the device number of the item you wish to edit. An asterisk [*] will appear next to the device number selected. The screen appears as follows;

| DEVICE ADDRESS
| (default = /000,/000 to delete
| entry)?

Enter the device address, then RETURN. The screen now appears;

| ALLOCATE DEVICE TO WHICH
| PARTITION (default = all)?

9.7.4 @GENPART Screen Loads (Sheet 3 of 3)

Edit Partitions (SF'04) (cont.)

Enter the partition number to allocate the peripheral and its controller. These screens will continue, in order to allow the user to edit all entries in the Master Device Table. When the parameters for all peripheral/partition allocations have been specified, the user can select another Special Function option to exit the "Edit Device Table" mode.

Broadcast Message (SF'06)

When SF'06 is depressed, the following display appears at the bottom of the screen;

> **BROADCAST MESSAGE**

The user may now enter a broadcast message. While in the broadcast message mode, all S.F. keys revert to their system defined EDIT functions. The S.F. keys cannot be used for any @GENPART function until the entry of the broadcast message is complete.

Save Configuration (SF'09)

When SF'09 is depressed, the following display appears at the bottom of the screen;

> **CHECK CONFIGURATION TO SAVE.**
> **CONFIGURATION NAME?** _____

To save a configuration, ensure that the system diskette or hard disk is write-enabled, enter a unique name for the configuration, and key RETURN. The configuration currently in memory will automatically be saved under the name 'current'. However, each time a new configuration is executed, the new parameters replace the old parameters in the 'current' file.

Execute Configuration (SF'15)

Once all parameters of a configuration have been defined, the system configuration can be executed. When SF'15 is depressed, the configuration table will appear at the bottom of the screen, along with a prompt requesting the operator to verify the configuration parameters to be executed.

> **CHECK CONFIGURATION OK TO**
> **EXECUTE (Y or N)?**

If Y (RETURN) is chosen, the configuration will be executed. If N (RETURN) is entered, the system returns to the beginning of the "Edit Partition" cycle. Once executed, a configuration can only be changed by first Master Initializing the system, and then, by specifying the new parameters.

Delete a Configuration (SF'10)

When this is depressed, the following prompt will request which configuration to delete;

> **DELETE WHICH CONFIGURATION?**

Enter the name of the configuration to be deleted, then RETURN. The configuration will be deleted from the system disk.

●END

9.7.5   Evenly-Divided Partition Generation

To generate evenly-divided partitions, first load the BASIC-2 operating system by keying in the appropriate SF' key on System Terminal 1. Next, key SF'00 to initialize all terminals and clear the partitions.

The prompt "NO. OF TERMINALS?" refers to the number in each bank of user memory. Answer this prompt with the number of terminals attached, then answer the "NO. OF PARTITIONS?" with the same number, then key EXECUTE.

Now key SF'02 to divide memory evenly in each bank. Available memory will now be apportioned equally among the number of terminals entered earlier. Finally, key SF'15 to execute the configuration.

A prompt will appear "CHECK CONFIG-URATION. OK TO EXECUTE (Y or N)?". Enter Y and key EXECUTE if the configuration is correct. All terminals should now display "READY (BASIC-2)". Each terminal can now be used as an independant processor.

9.7.6   Customer Partition Generation

The user may write his or her own
partition generation utility as desired.
Directions for this are given in the
BASIC-2 Language Reference Manual.

9.7.7   System Turnover to Customer

When all diagnostics required for system installation have been successfully completed, and the software has been correctly completed, the system can be turned over to the customer as follows:

● Demonstrate to the customer or to the responsible computer operator the disk initialization procedure.

● Perform the Daily Power-Up procedure (➡ 4.1), & explain each step to the applicable customer personnel.

● Perform the Daily Power-Down procedure (➡ 4.2), & explain each step to the applicable customer personnel.

● Allow the customer to test the system using his programs. If the customer is satisfied with the operation of the system, officially turn the system over to the customer. This should be a verbal notification given by the CE performing the installation.

9.8.1 Installing 2275MUX Board Without 2275MUXE (Expansion) Board

NOTE

Use the following procedure to install and connect a single 2275MUX Board without any additional 2275MUXE Boards.

➡ 9.8.2 if one or more 2275MUXE Boards are being installed along with the 2275MUX Board.

❶ Power-down CS and disconnect AC power cord from outlet (➡ 4.2).

❷ Set switches on 2275MUX Board (➡ 9.4.5).

❸ Install 2275MUX Board into CS card cage.

❹ Connect interface cable(s) from board to CPU(s).

❺ Connect interface cable from board to system disk drive.
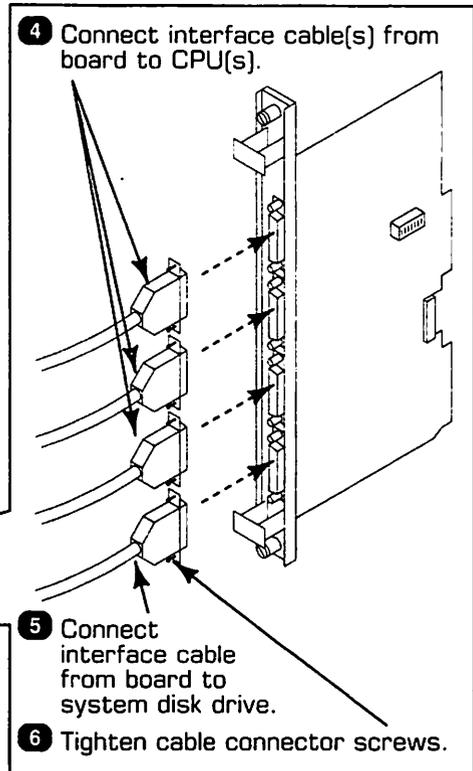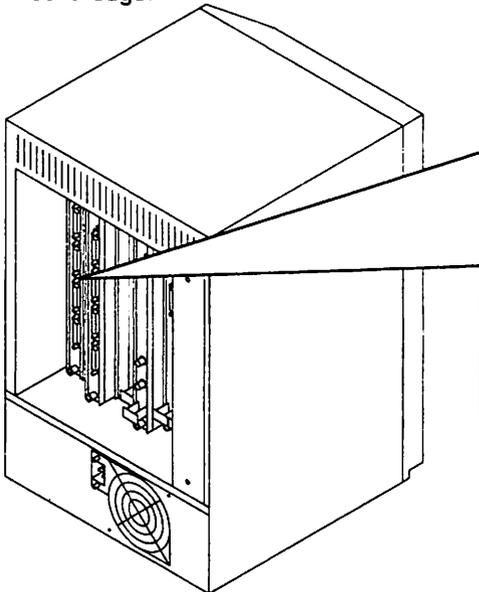
❻ Tighten cable connector screws.

9.8.2 Installing 2275MUX Board With 2275MUXE (Expansion) Board

1 Power-down CS & disconnect AC power cord from outlet (➡ 4.2).

2 Set switches on 2275MUX Board (➡ 9.4.5).

3 Set switches on 2275MUXE Board(s) (➡ 9.4.6).

4 Insert one end of ribbon cable (220-3588) to J5 on 2275MUX Board.

5 Insert J5 of the 2275MUXE Board into the next adjacent connector on the ribbon cable.

6 Repeat this step for any remaining 2275MUXE Boards.

7 Carefully install the 2275MUX Board and all 2275MUXE Boards into the CS card cage.
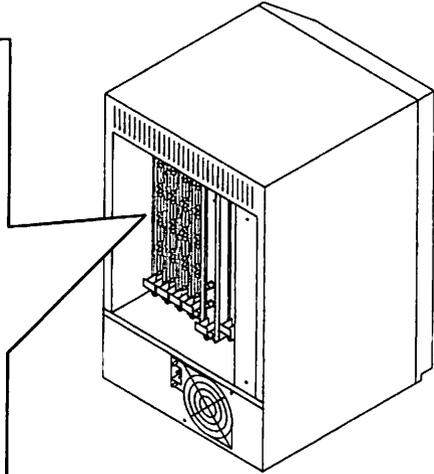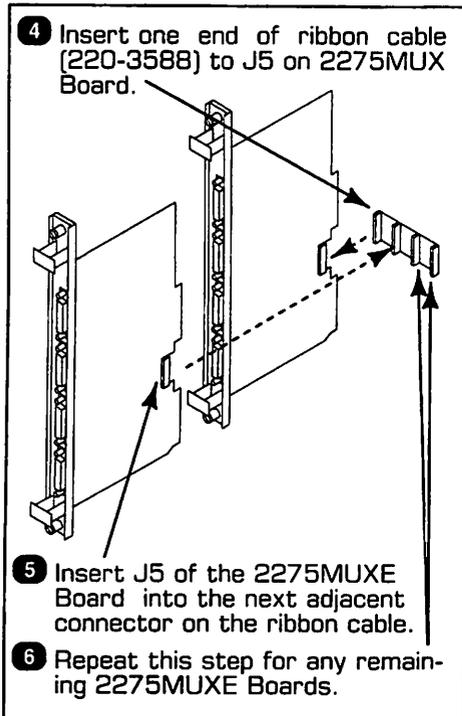
NOTE

Make sure the ribbon cable remains connected to all boards and does not get pinched against the motherboard.

8 Connect 2275MUX cables (➡ 9.5.5), and 2275MUXE cables (➡ 9.5.6).

9.8.3 Existing CS CPU/Memory PCB Upgrades

Existing 128KB or 512KB CPU PCB
users have the option of direct swap-
out replacement of current 128KB or
512KB CPU PCBs for the Enhanced
CPU PCBs, by ordering Upgrade kits
as follows:

Kit Name	Kit P/N	Kit Description	Enhanced CPU PCB P/N
UJ 5057	289-0969	128KB PCB to 512KB PCB	210-8937-B
UJ 5065	289-0968	128KB PCB to 1MB PCB	210-8937-C
UJ 5066	289-0967	128KB PCB to 2MB PCB	210-8937-D
UJ 5067	289-0966	128KB PCB to 4MB PCB	210-8937-E
UJ 5068	289-0965	128KB PCB to 8MB PCB	210-8937-F
UJ 5069	289-0964	512KB PCB to 1MB PCB	210-8937-C
UJ 5070	289-0963	512KB PCB to 2MB PCB	210-8937-D
UJ 5071	289-0962	512KB PCB to 4MB PCB	210-8937-E
UJ 5072	289-0961	512KB PCB to 8MB PCB	210-8937-F

CPU/Memory PCB Replacement Instructions:

1 Power-down system (➡4.2).

2 Remove existing 128KB or 512KB CPU PCB (➡7.2.1).

3 Install Enhanced CPU PCB replacement using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

● END

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 1 of 21)

NOTE

When the accessed memory exceeds 512KB, Operating System Version 3. 1 minimum is required.

NOTE

The Micro Diagnostic for Enhanced Memory Test is incorporated in the Operating System Release 3.1.

CS Models (Enhanced Memory):

The CS is available in the following models:

Model	CPU Memory	Control Memory
CS-2	128KB	32KB
CS-5	512KB	32KB
CS-10	1MB	32KB
CS-20	2MB	32KB
CS-40	4MB	32KB
CS-80	8MB	32KB

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 2 of 21)

CS CPU/Memory PCB Upgrade Kits:

Model Number	Description
UJ-5057	128KB to 512KB Memory Upgrade
UJ-5059	1MB to 2MB Memory Upgrade
UJ-5060	1MB to 4MB Memory Upgrade
UJ-5061	1MB to 8MB Memory Upgrade
UJ-5062	2MB to 4MB Memory Upgrade
UJ-5063	2MB to 8MB Memory Upgrade
UJ-5064	4MB to 8MB Memory Upgrade
UJ-5065	128KB to 1MB Memory Upgrade
UJ-5066	128KB to 2MB Memory Upgrade
UJ-5067	128KB to 4MB Memory Upgrade
UJ-5068	128KB to 8MB Memory Upgrade
UJ-5069	512KB to 1MB Memory Upgrade
UJ-5070	512KB to 2MB Memory Upgrade
UJ-5071	512KB to 4MB Memory Upgrade
UJ-5072	511KB to 8MB Memory Upgrade

CS CPU/Memory PCB Upgrade Kit Contents:

Each Upgrade Kit includes the following items:

- PAL chip specifically tailored to desired Upgrade Memory size

- Necessary quantity of additional SIMMs Memory Modules to accomplish the upgrade

- Operating System installed on diskette only

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 3 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Presently installed CPU/Memory PCBs may be upgraded to Enhanced CPU/Memory by ordering upgrade kits as follows:

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
128KB	512KB	UJ5057	289-0969	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-B using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 4 of 21)

Enhanced CPU/Memory PCB Upgrade Installation Instructions (Cont.):

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
128KB	1MB	UJ5065	289-0968	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following.

1 Power-down system (➡4.2).

2 Remove presently installed CPU/Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-C using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 5 of 21)

Enhanced CPU/Memory PCB Upgrade Installation Instructions (Cont.):

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
128KB	2MB	UJ5066	289-0967	Kit includes new Enhanced CPU PCB.

To accomplish upgrade. perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-D using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0. Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 6 of 21)

Enhanced CPU/Memory PCB Upgrade Installation Instructions (Cont.):

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
128KB	4MB	UJ5067	289-0966	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-E using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 7 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
128KB	8MB	UJ5068	289-0965	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-F using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 8 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
512KB	1MB	UJ5069	289-0964	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Install new Enhanced CPU/Memory PCB P/N 210-8937-C using reverse steps (➡7.2.1).

4 Power-up system (➡4.1).

5 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 9 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
512KB	2MB	UJ5070	289-0963	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

❶ Power-down system (➡4.2).

❷ Remove presently installed CPU/Memory PCB from system (➡7.2.1).

❸ Install new Enhanced CPU/Memory PCB P/N 210-8937-D using reverse steps (➡7.2.1).

❹ Power-up system (➡4.1).

❺ Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 10 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
512KB	4MB	UJ5071	289-0962	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

❶Power-down system (➡4.2).

❷Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

❸Install new Enhanced CPU/Memory PCB P/N 210-8937-E using reverse steps (➡7.2.1).

❹Power-up system (➡4.1).

❺Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 11 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
512KB	8MB	UJ5072	289-0961	Kit includes new Enhanced CPU PCB.

To accomplish upgrade, perform following:

① Power-down system (➡4.2).

② Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

③ Install new Enhanced CPU/Memory PCB P/N 210-8937-F using reverse steps (➡7.2.1).

④ Power-up system (➡4.1).

⑤ Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 12 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
1MB	2MB	UJ5059	289-0960	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3486) and two (2) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade. perform following:

❶ Power-down system (➡4.2).

❷ Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

❸ Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

❹ Remove the four (4) 256KB SIMMs Modules (➡9.8.4).

❺ Insert two (2) 1MB SIMMs Modules from the kit into the first two (2) empty SIMMs sockets starting at the bottom of the SIMMs connectors (➡9.8.4).

❻ Position jumper J2 correctly to reflect the 1MB SIMMs Module installation (➡9.8.4).

❼ Install the CPU/Memory PCB using reverse steps (➡7.2.1).

❽ Power-up system (➡4.1).

❾ Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).
➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 13 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
1MB	4MB	UJ5060	289-0959	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3487) and four (4) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

4 Remove the four (4) 256KB SIMMs Modules (➡9.8.4).

5 Insert four (4) 1MB SIMMs Modules from the kit into the first four (4) empty SIMMs sockets starting at the bottom of the SIMMs connectors (➡9.8.4).

6 Position jumper J2 correctly to reflect the 1MB SIMMs Module installation (➡9.8.4).

7 Install the CPU/Memory PCB using reverse steps (➡7.2.1).

8 Power-up system (➡4.1).

9 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 14 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
1MB	8MB	UJ5061	289-0958	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3488) and eight (8) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade, perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

4 Remove the four (4) 256KB SIMMs Modules (➡9.8.4).

5 Insert eight (8) 1MB SIMMs Modules from the kit into the eight (8) empty SIMMs sockets at the bottom of the SIMMs PCB connectors (➡9.8.4).

6 Position jumper J2 correctly to reflect the 1MB SIMMs Module installation (➡9.8.4).

7 Install the CPU/Memory PCB using reverse steps (➡7.2.1).

8 Power-up system (➡4.1).

9 Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 15 of 21)

Enhanced CPU/Memory PCB Upgrade Installation Instructions (Cont.):

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
2MB	4MB	UJ5062	289-0957	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3487) and two (2) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade, perform following:

❶ Power-down system (➡4.2).

❷ Remove presently installed CPU/Memory PCB from system (➡7.2.1).

❸ Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

❹ Insert the two (2) additional 1MB x 9 SIMMs Modules from the kit into the first two (2) empty SIMMs sockets at the bottom of the SIMMs connectors (➡9.8.4).

❺ Install the CPU/Memory PCB using reverse steps (➡7.2.1).

❻ Power-up system (➡4.1).

❼ Run Diagnostic Package P/N 195-2956-0, Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 16 of 21)

**Enhanced CPU/Memory PCB
Upgrade Installation Instructions
(Cont.):**

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
2MB	8MB	UJ5063	289-0956	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3488) and six (6) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade. perform following:

1 Power-down system (➡4.2).

2 Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

3 Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

4 Insert the six (6) additional 1MB x 9 SIMMs Modules from the kit into the first six (6) empty SIMMs sockets at the bottom of the SIMMs connectors (➡9.8.4).

5 Install the CPU/Memory PCB using reverse steps (➡7.2.1).

6 Power-up system (➡4.1).

7 Run Diagnostic Package P/N 195-2956-0. Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 17 of 21)

Enhanced CPU/Memory PCB Upgrade Installation Instructions (Cont.):

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
4MB	8MB	UJ5064	289-0955	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3488) and four (4) 1MB x 9 SIMMs Modules (P/N 377-4513).

To accomplish upgrade, perform following:

❶ Power-down system (➡4.2).

❷ Remove presently installed CPU/ Memory PCB from system (➡7.2.1).

❸ Replace the PAL chip at PCB location L2 with the PAL chip supplied in kit (➡9.8.4).

❹ Insert the four (4) additional 1MB x 9 SIMMs Modules from the kit into the first four (4) empty SIMMs sockets at the bottom of the SIMMs connectors (➡9.8.4).

❺ Install the CPU/Memory PCB using reverse steps (➡7.2.1).

❻ Power-up system (➡4.1).

❼ Run Diagnostic Package P/N 195-2956-0. Memory Diagnostic Revision 179E to verify system operation (supports memory up to 8MB).

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 18 of 21)

Memory
PAL L2

SIMMs Data Memory.
8 Modules Total.
Either 256KB or 1MB
each module.

J2

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 19 of 21)

SIMMs Module Removal:

1 Locate SIMMs Memory section of CPU board (➡9.8.4)
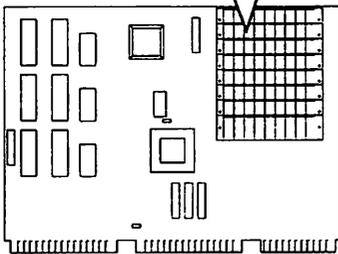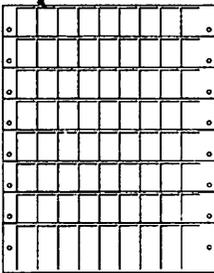
2 Remove SIMMs Module by spreading both locking connector posts.
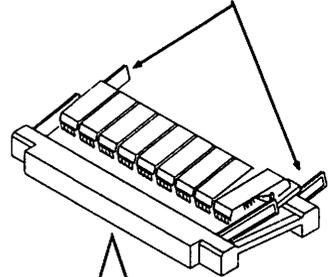
3 Grasp both SIMMs Module corners and pull SIMMs Module forward.
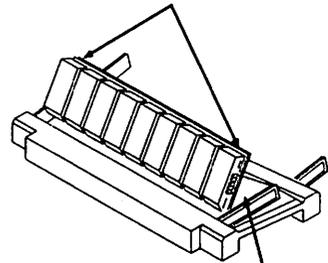
4 Lift SIMMs Module straight up and out of SIMM connector.

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 20 of 21)

SIMMs Module Insertion:

1 Locate SIMMs Memory section of CPU Board (➡9.8.4).
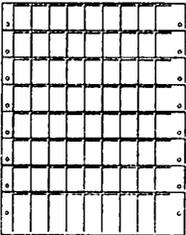
2 Insert SIMMs Module into SIMMs connector at 30^0 angle.
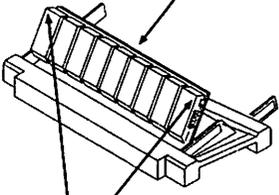
3 Place thumbs on both SIMMs Module corners.

4 Push SIMMs Module down toward board until locking posts snap into place.

➡NEXT

9.8.4 Enhanced CS CPU/Memory PCB Upgrades (Sheet 21 of 21)

SIMMs Memory Selection Jumper (J2):

- If 256KB SIMM size (memory size of 1MB or less) is used:

  ① Mount jumper on right side (shorting pins ② and ③ together).

- If 1MB SIMM size is used:

  ① Mount jumper on left side (shorting pins ① and ② together).

CPU Clock Jumper (J1):

Mount J2 Memory selection jumper as follows:

② J1 jumper must be connected for proper operation of CPU and CPU Clock functions.

● END

SECTION 10 CONTENTS

SECTION 10

FUNCTIONAL DESCRIPTION

Page

10.1 FUNCTIONAL DESCRIPTION
Introduction

Overall operation of the CS-2, -5, -10, -20, -40 and -80 is controlled by the CPU/Memory PCB (P/N 210-8034-1, 210-8034-2 or 210-8937-A thru F). This new Enhanced CPU/Memory PCB increases the maximum system memory to 8MB. This increased memory allows the user to allocate up to 1MB for user partitions. Memory not allocated to user partitions will be reserved for RAM-DISK. This section provides a brief description of this CPU.

● END

The CS CPU/Memory board contains the Micro 2200 chip, a 121-pin gate-array which comprises the entire CPU. The chip requires +5 volts at VDD1-2 (pins B7 & M7) and ground at VSS1-2 (pins G2 and G12). A 5-MHz square wave at pin F1 provides system timing, regulated by the crystal clock.

XTAL CLOCK

VLSI MICRO 2200 CHIP
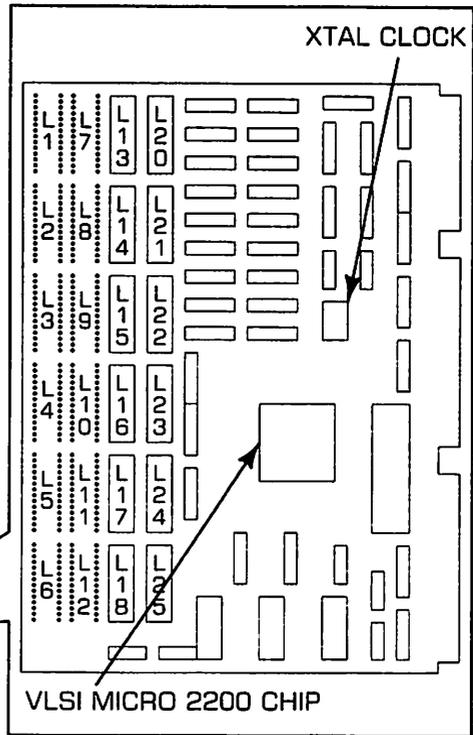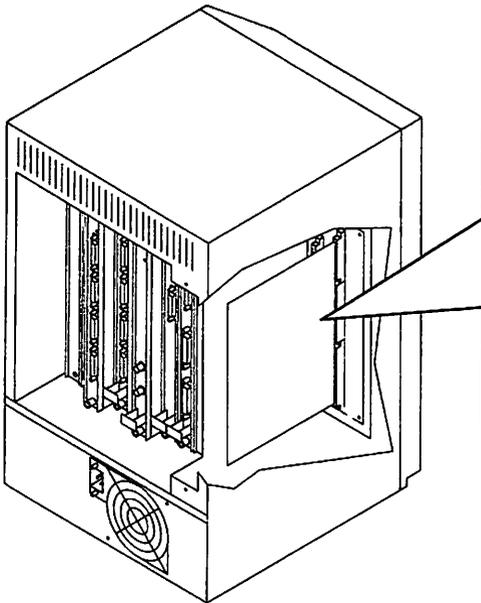
10.2.1   Control Memory

The CPU/Memory Board contains 32K of Control Memory. This is accomplished by loading 12 memory chips in board locations L13 through L18 and L20 through L25 (➡ figure below).

Locations L1 through L12 of the CPU/ Memory board are not loaded with memory chips. These locations are for possible future expansion.

The Control Memory is made up of 8K x 8 Static RAM configured in groups of three so that each group forms 8K of 24 bit words (one bank). Four of these groups (banks) produce 32K of control memory.

CONTROL MEMORY (32K)
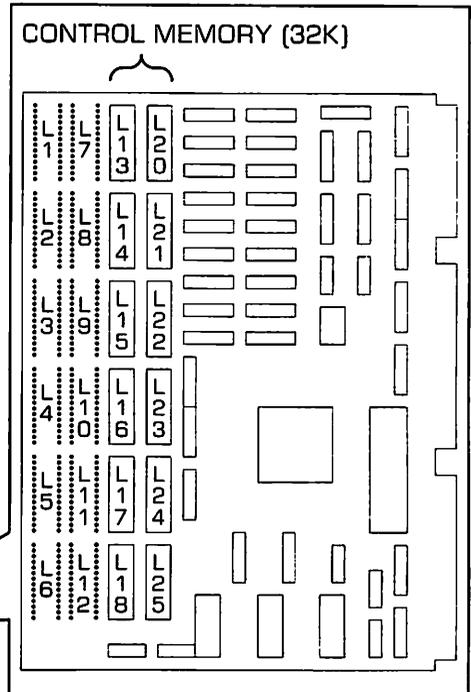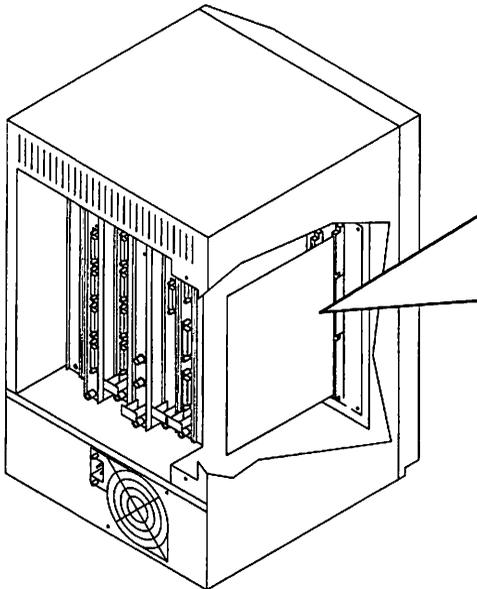
10.2.2 Bootstrap Proms

Three 2K x 8 proms, configured to form 24 bit words, comprise the boot-strap prom. If the address decoded on the system bus is between 8000 and 83FF, the bootstrap proms are enabled and chip select for the control memory store is inhibited.

BOOTSTRAP PROMS
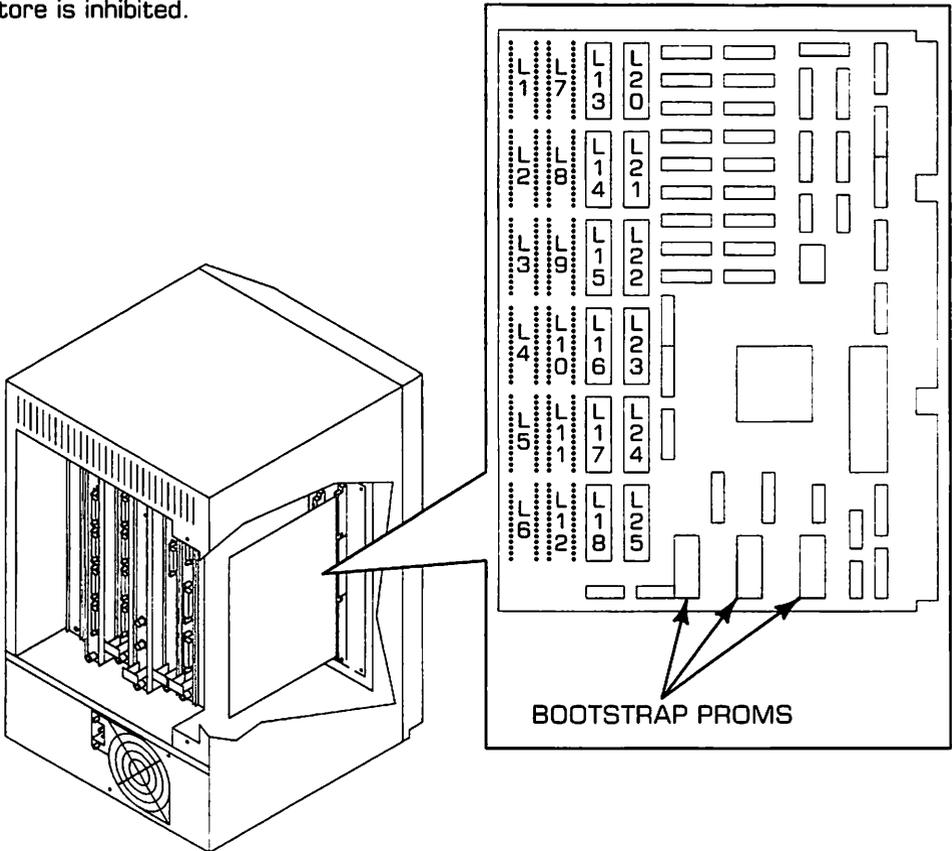
10.2.3 128K Data Memory (CS-1)

With a 128K Data Memory configuration there are two banks, with 9 chips in each bank, for a total of 18 chips. Each chip contains 64K x 1 bit which produces 64K x 9 bits (8 bits data plus 1 bit parity) in each bank. Together the two banks produce 128K 8 bit bytes plus parity. Operation of the data memory is controlled by the Data Memory Controller chip.
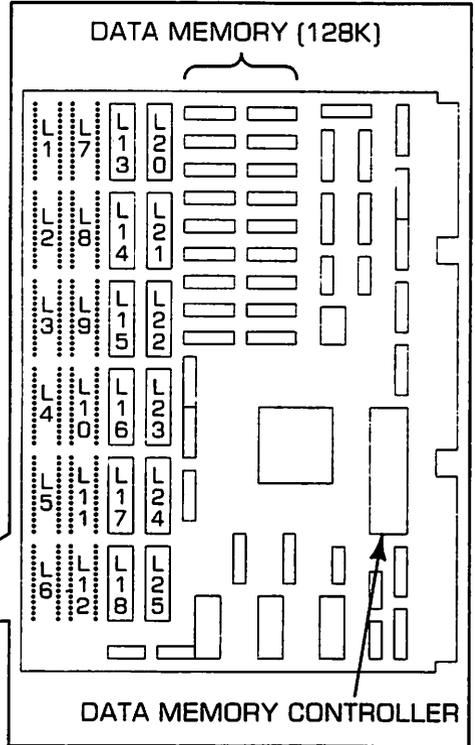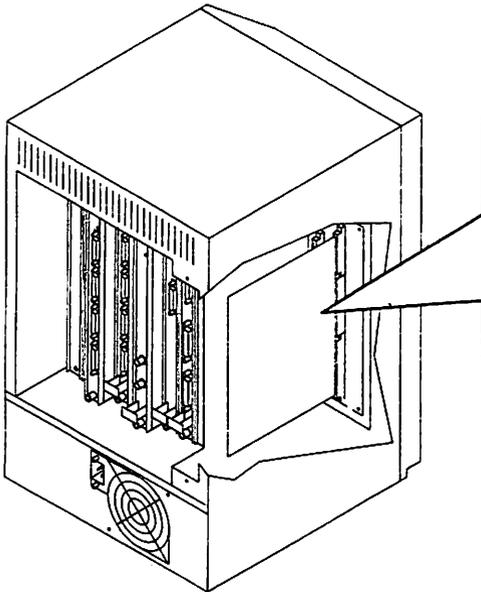
DATA MEMORY (128K)

DATA MEMORY CONTROLLER

10.2.3A 128KB Data Memory (CS-2, Original CPU PCB)

With a 128K Data Memory configuration there are two banks, with 9 chips in each bank, for a total of 18 chips. Each chip contains 64K x 1 bit which produces 64K x 9 bits (8 data bits plus 1 parity bit) in each bank. Together the two banks produce 128K 8 bit bytes plus parity. Operation of the data memory is controlled by the Data Memory Controller chip.

DATA MEMORY (128K)

DATA MEMORY CONTROLLER

● END
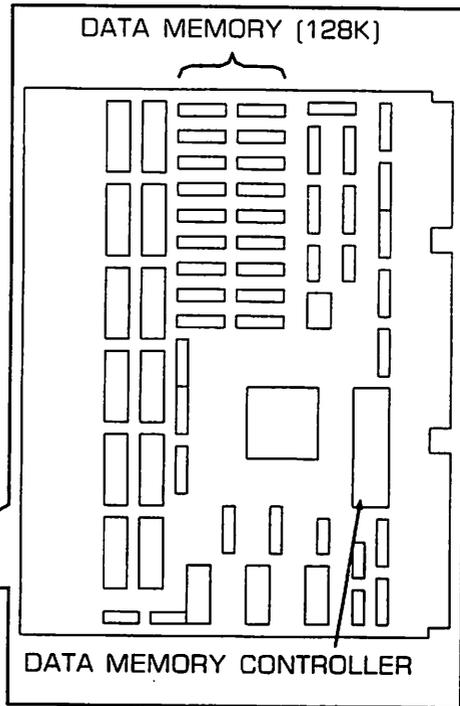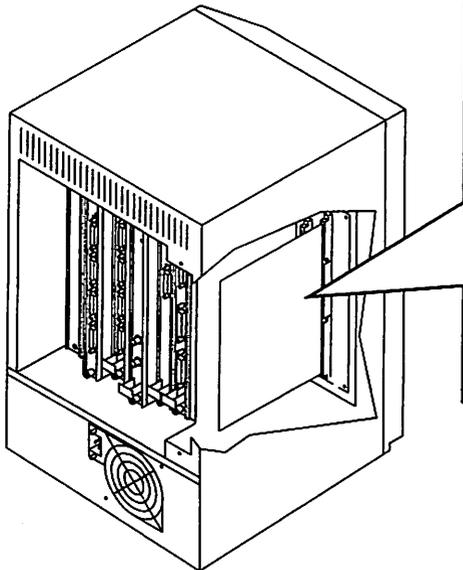
10.2.3B 128KB Data Memory (CS-2, Enhanced CPU PCB)

With a 128K Data Memory configuration there are two 256K SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 256K x 1 bit which produces 256K x 9 bits (8 data bits plus 1 parity bit) on each module. Together the two SIMMs modules produce 128K 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

BUT ONLY 128K IS ADDRESSABLE BECAUSE OF THE PAL CHIP L2.

MEMORY PAL (377·3483)
L2

SIMMs DATA MEMORY
2 MODULES TOTAL 128KB.
2 256K SIMMS IN TOP 2 LOC, L1 & L9

● END

10.2.4 512K Data Memory (CS-2)

With a 512K memory configuration, there are 2 banks, with 9 chips in each bank, for a total of 18 chips. Each chip contains 256K x 1 bit which produces 256K x 9 bits (8 bits data plus 1 bit parity) in each bank. Together the two banks produce 512K 8 bit bytes plus parity. Operation of the data memory is controlled by the Data Memory Controller chip.

DATA MEMORY (512K)

DATA MEMORY CONTROLLER

10.2.4A 512KB Data Memory (CS-5, Original CPU PCB)

With a 512K Data Memory configuration there are two banks, with 9 chips in each bank, for a total of 18 chips. Each chip contains 256K x 1 bit which produces 256K x 9 bits (8 data bits plus 1 parity bit) in each bank. Together the two banks produce 512K 8 bit bytes plus parity. Opertion of the data memory is controlled by the Data Memory Controller chip.

DATA MEMORY (512K)

DATA MEMORY CONTROLLER

● END
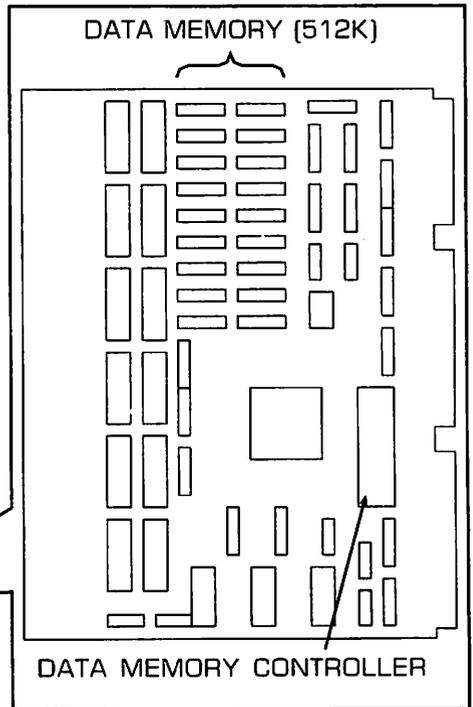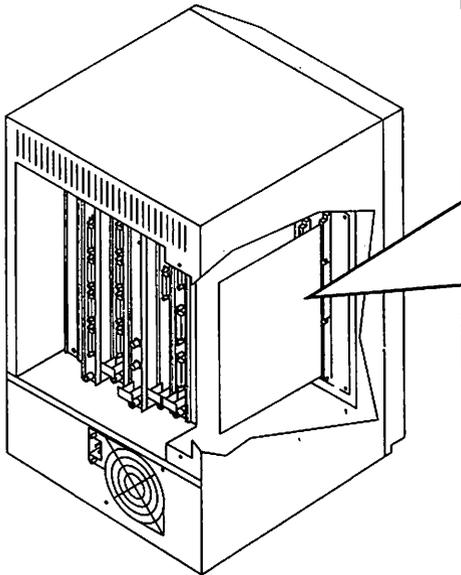
10.2.4B 512KB Data Memory (CS-5, Enhanced CPU PCB)

With a 512K Data Memory configuration there are two 256K SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 256K x 1 bit which produces 256K x 9 bits (8 data bits plus 1 parity bit) on each module. Together the two SIMMs modules produce 512K 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

MEMORY PAL(377-3484)
L2

SIMMs DATA MEMORY
2 MODULES TOTAL 512KB.
256K SIMMS LOADED IN TOP 2 LOC, L1 - L9

256K SIMMS - 377.4508

● END
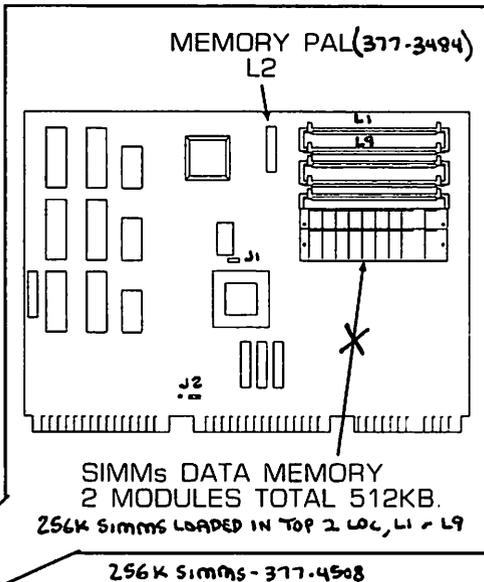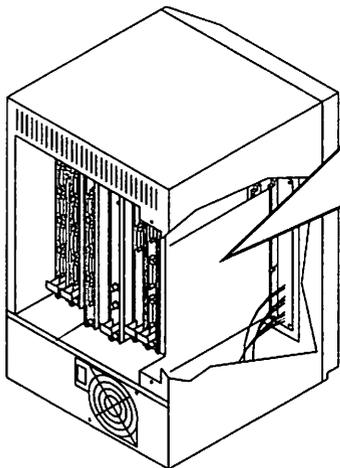
10.2.4C 1MB Data Memory CPU PCB (CS-10, Enhanced CPU)

With a 1MB Data Memory configuration there are four 256K SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 256K x 1 bit which produces 256K x 9 bits (8 data bits plus 1 parity bit) on each module. Together the four SIMMs modules produce 1MB 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

MEMORY PAL (377·3485)
L2

SIMMs DATA MEMORY
4 MODULES TOTAL 1MB
256K SIMMS LOADED IN TOP 4 SLOTS, L1, L9, L10, + L13

256K SIMMS - 377-4508

● END
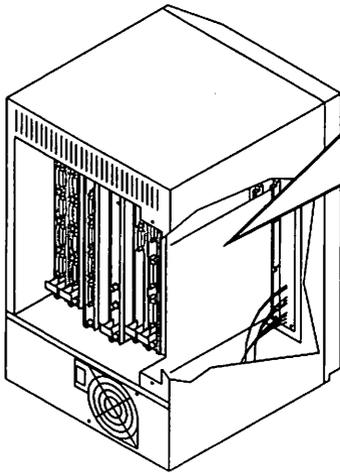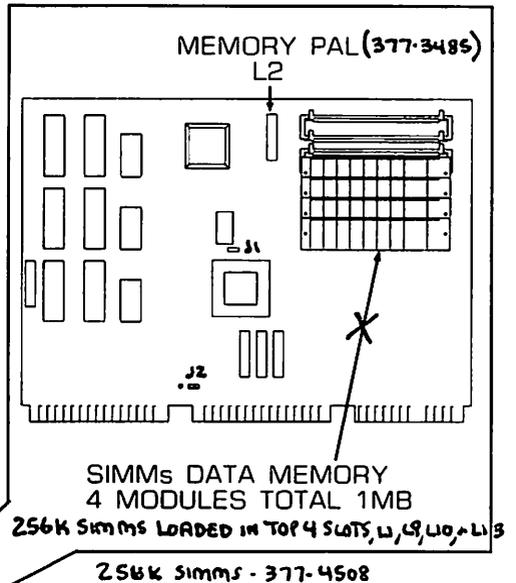
10.2.4D 2MB Data Memory CPU PCB (CS-20, Enhanced CPU)

With a 2MB Data Memory configuration there are two 1MB SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 1MB x 1 bit which produces 1MB x 9 bits (8 data bits plus 1 parity bit) on each module. Together the two SIMMs modules produce 2MB 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

MEMORY PAL (377-3486)
L2

SIMMs DATA MEMORY
2 MODULES TOTAL 2MB.
1 MB SIMMS LOADED IN L1 + L9
1 MB SIMMS - 377-4513

● END
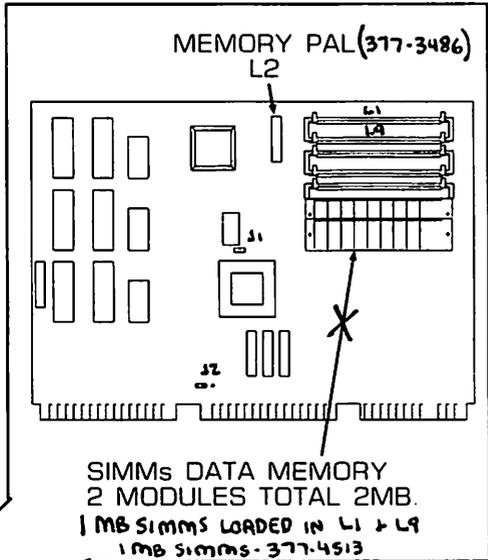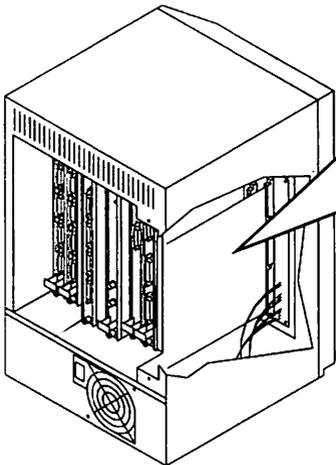
10.2.4E 4MB Data Memory CPU PCB (CS-40, Enhanced CPU)

With a 4MB Data Memory configuration there are four 1MB SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 1MB x 1 bit which produces 1MB x 9 bits (8 data bits plus 1 parity bit) on each module. Together the four SIMMs modules produce 4MB 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

MEMORY PAL(377-3487)
L2

SIMMs DATA MEMORY
4 MODULES TOTAL 4MB.
1 MB SIMMS LOADED IN TOP 4 SLOTS, L4, L9, L10, & L3

1 MB SIMMS 377-4513

● END
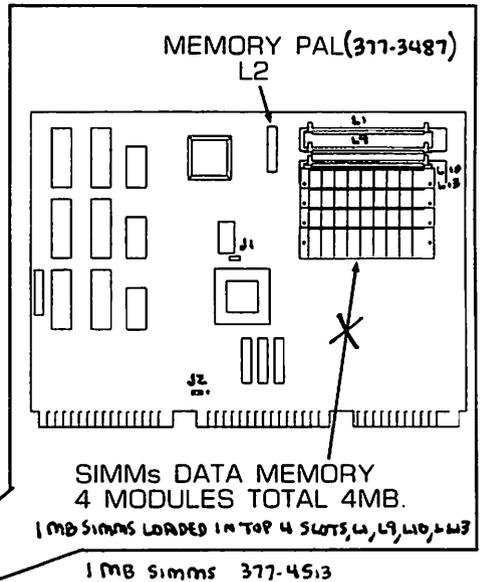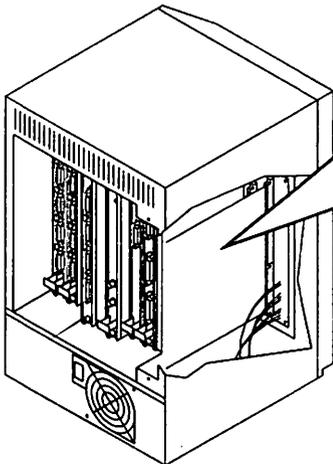
10.2.4F 8MB Data Memory CPU PCB (CS-80, Enhanced CPU)

With a 8MB Data Memory configuration there are eight 1MB SIMMs Modules, with 9 SIMMs chips on each module. Each SIMMs chip contains 1MB x 1 bit which produces 1MB x 9 bits (8 data bits plus 1 parity bit) on each module. Together the eight SIMMs modules produce 8MB 8 bit bytes plus parity. Data Memory addressing is accomplished by the PAL chip at CPU board location L2.

MEMORY PAL(377-3488)
L2

SIMMs DATA MEMORY
8 MODULES TOTAL 8MB.
1MB Simms 377-4513

• END
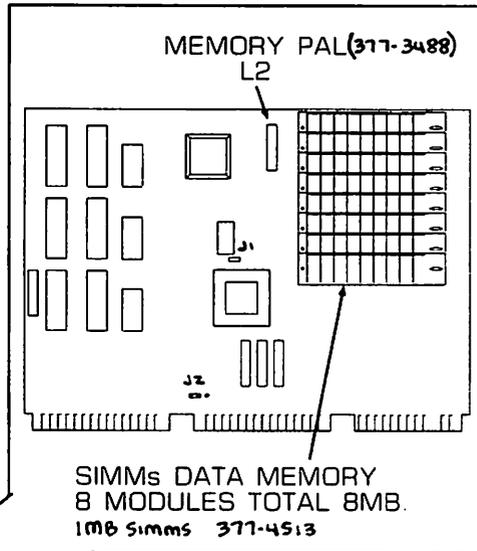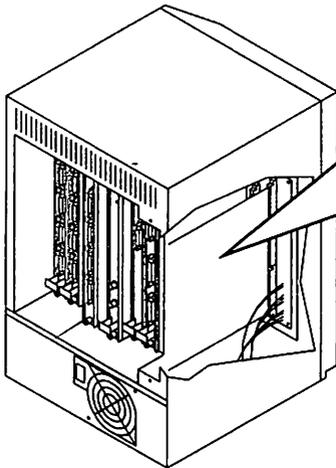
10.2.5 Memory Partitioning

When using the 512KB Memory, the maximum memory partition size is 28KB if all 16 partitions are used. When Main Memory is increased to 1MB, the maximum memory partition size will increase to 56KB.

● END

10.2.6   Generating Partitions (Sheet 1 of 2)

The number of partitions to be created and the amount of data memory to be allocated to each partition are specified by the user in a process called "partition generation". This process involves specifying certain attributes for each partition and supplying the addresses of peripheral devices connected to the system (➡ 9.7.1 through 9.7.6).

Once the Operating System has been loaded into Control Memory, a special utility program called @GENPART is loaded and executed at workstation no. 1 (➡ 9.7.3 & 9.7.4). This program, through a series of display prompts, guides the system operator through the necessary steps for "partition generation".

With partition generation implemented, the system handles each partition as it would the entire data memory space of a single-user system, with space allocated for housekeeping, user program, work areas, and data tables.

FIXED BOUNDARIES

LOWEST PARTITION ADDRESS
("BEGINNING" OF PARTITION)

ONE PARTITION

PARTITION HOUSEKEEPING AREA (947 BYTES, FIXED)
USER PROGRAM TEXT AREA (EXPANDS DOWNWARD)
WORK BUFFER AREA - 192 BYTES, MIN. (64 BYTES: FOR IMMEDIATE-MODE LINES) (128 BYTES: GENERAL WORK SPACE) (ENTIRE BUFFER FLOATS DOWNWARD AS PROGRAM EXPANDS
FREE SPACE (COMPRESSIBLE TO ZERO SPACE)
VALUE STACK (FLOATS UPWARD AS USER DATA IS ADDED TO VARIABLE TABLE. ALSO STARTING WITH ZERO SPACE, THE VS EXPANDS UPWARD DURING OPERATIONS.)
USER VARIABLES (DATA) TABLE (EXPANDS UPWARD)

HIGHEST PARTITION ADDRESS
("END" OF PARTITION)

FIXED BOUNDARY

FLOATING BOUNDARY

➡NEXT

10.2.6 Generating Partitions (Sheet 2 of 2)

The CS Operating System will support a maximum of 16 partitions and sixteen system users. All sixteen partitions may be allocated to a single user, or multiple-partition configurations may be created. Partition sizes are specified in 256 byte increments. The minimum size that may be specified for a partition is 1.25K (1280 bytes), with some portion of each partition accessable to all users (➡ 10.2.7). The guideline for maximum size, is that each partition must be defined wholly within the confines of one memory bank; no user partition is allowed to extend from one bank to another. The CS-1 system contains two 64K banks of user data memory (128K total), while the CS-2 system has eight 64K banks of user data memory (512K total).

● END

10.2.7 "Global Partitions"

Although partitions function independently, there are situations in which it is highly expedient for two or more partitions to cooperate with one another, to share common information, common programs. This sharing eliminates needless duplication of applications software and data, thus allowing more efficient use of available data memory space.

Partitions can therefore be "global"; that is, each partition designated as such, contains programs and/or data which become conditionally shareable. A foreground or background program that is running in a partition in one bank can access any global partition residing in that same bank. Additionally, a user terminal that is attached to a partition in that same bank can access those global routines and/or data.

Another form of "Global Partition" is an area in memory which contains programs and/or data which must be accessable to all system users. This area is restricted to the first 5K block of data memory and is called a "Universal Global Partition".

10.2.8   Switching Power Supply

The SPS255 Switching Power Supply is capable of outputting four supply voltages +5, -5, +12, and -12 volts dc. The power supply input circuit converts the ac line voltage (either 115 or 230 vac) into rectified and filtered high voltage dc. The high voltage dc is chopped at a frequency of 25 KHz by a pulse width modulator presenting high voltage pulsating dc to a multiple output transformer. This transformer steps down the high voltage pulsating dc.

All output voltages are full-wave rectified through their associated diode rectifier circuits. The power-on reset signal (WOLFTRAP) is an output of a comparator circuit that forward-biases an NPN transistor once the output voltages are stabilized.

Two voltages are adjustable; +5 & +12 volts. The voltage adjustment pots are accessible from the outside of the power supply enclosure (➡ 8.2 for adjustment procedures and voltage measurement locations).

WARNING

Do not open the switching power supply under any circumstance. Extremely dangerous voltage and current levels (in excess of 300 volts DC and unlimited current) are present within the power supply.

Do not attempt to repair the switching power supply; it is field replaceable only.

After powering the unit down and disconnecting the AC power connector from the power source receptacle, allow one minute before removing the power supply to provide adequate time for any residual voltage to drain through the bleeder resistors.

10.2.9   CPU/ Memory, and I/O Interface

As previously mentioned, the CPU functions are handled by a single VLSI chip (L55) on the CPU/Memory Board. Control Ram is accessed through Control Memory Access Lines CA0-15 & bi-directional data is passed through Buffered Control Memory Data Lines BCD0-23 (➡ 10.2.10). Two rows of data ram are accessed through Dynamic Ram Control & Data Address Lines DA0-18. Data is then transferred through memory data lines DD0-17, with DD9-17 being used as input for 16-bit read operations (18 if parity bits are included)only. Data lines DD0-8 are bi-directional and are used for both read and write operations.

I/O devices are accessed through an 8-bit address bus AB1-AB8 and data is passed through an 8-bit output data bus OB1-OB8. A 9-bit input bus, IB1-IB9, from the I/O devices to the CPU completes the interface. Overall control of the address bus, output bus, and input bus is accomplished by the CPU pulses OBS, IBS, ABS and CBS.

10.2 CPU Functional Theory

10.2.10 CPU/Memory Board Block Diagram
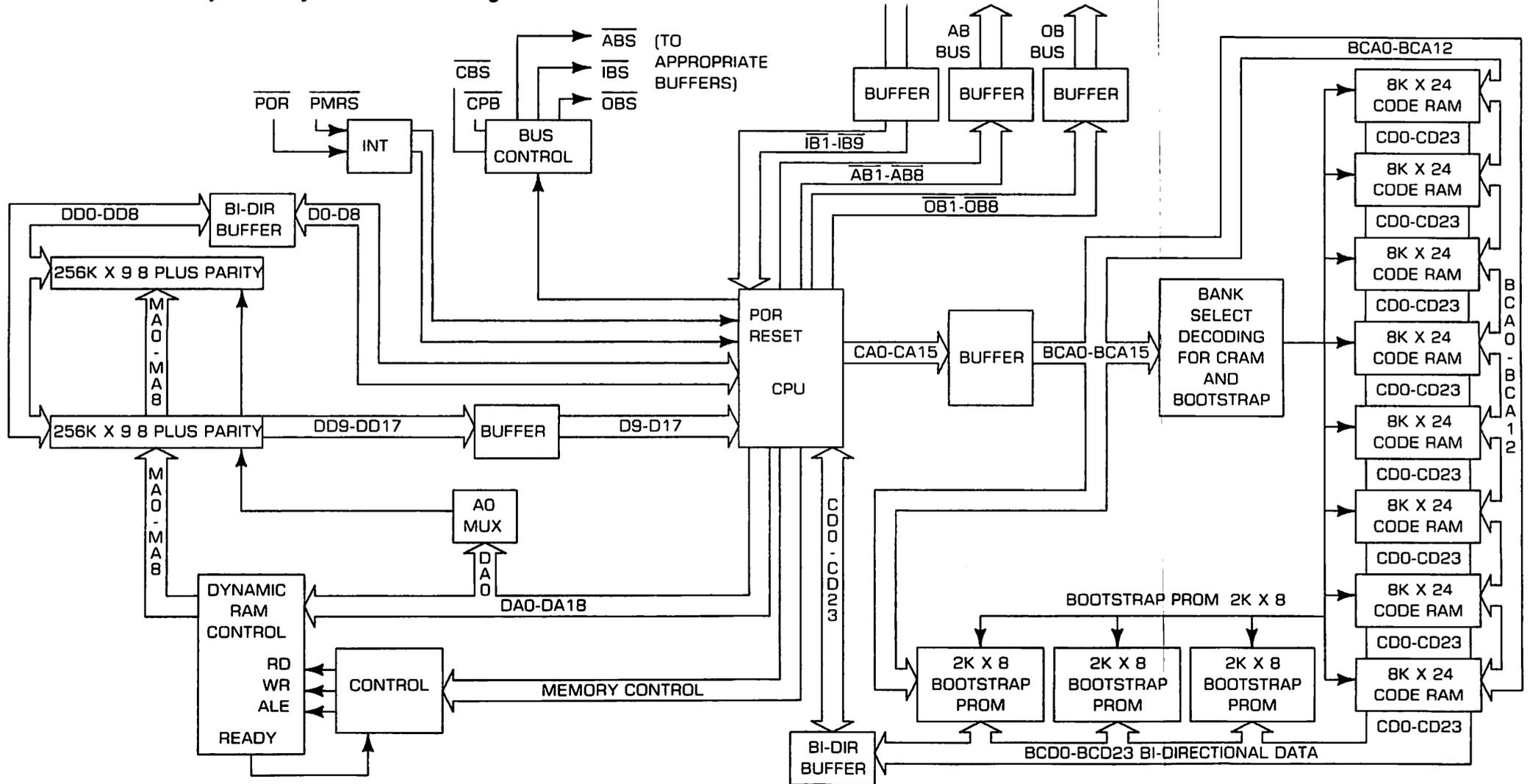
10.2 FUNCTIONAL DESCRIPTION
CPU Functional Theory

10.2.10A Enhanced CPU/Memory Board Block Diagram

The Enhanced CPU/Memory Board Block Diagram is not included in this edition of the Wang Computer System Manual. This information will be provided in a subsequent edition.

Programmable Array Logic (PAL):

Data Memory Addressing is accomplished on the Enhanced CPU Board via PAL circuitry at CPU Board location L2. PAL logic chips are programmable 20 pin DIP packaged AND array that provides inputs to a fixed OR array. Based on proven fuseable-link technology, PALs solve three problem areas which are:

• Decreasing board space due to increasing board density

• Inventory reduction due to less need for logic chips

• PALs accept fast internal design changes limited to fuseable links

Programmable Array Logic (PAL) chips greatly enhance 32 bit design, performance and unique operation of 16 bit processors.

● END

SECTION 11 CONTENTS

**SECTION 11
SPECIFICATIONS**

Physical Dimensions:

Width: 15 in. (38 cm)
Depth: 15¾ in. (40 cm)
Height: 23½ in. (59.7 cm)

Weight:

63 lbs. (28.6 kg)

Power and Environmental Requirements:

Input Circuit: Dedicated 20A circuit
Voltage: 115/230 VAC± 10%
Frequency: 50/60 Hz
Running Current: 2.0 amps @ 115 vac
             1.0 amps @ 230 vac
AC Power Cable: NEMA 5-15IG, 6 Feet

Operating Environment:

Ambient Temp.: 60 to 80 degrees F
            (15 to 28 degrees C)
Heat Loss: 581 BTU/Hr
            (146.4 KG Cal/Hr)

Government & Industry Standards & Approvals:

Domestic: UL Standard 114
        FCC Class A

Int'l: CSA Standard C22.2 #154
        IEC 435
        VDE Standard for Germany

Service Space Requirements:

30 inches (rear)

Special Requirements:

None

**SECTION 12
ILLUSTRATED PARTS**
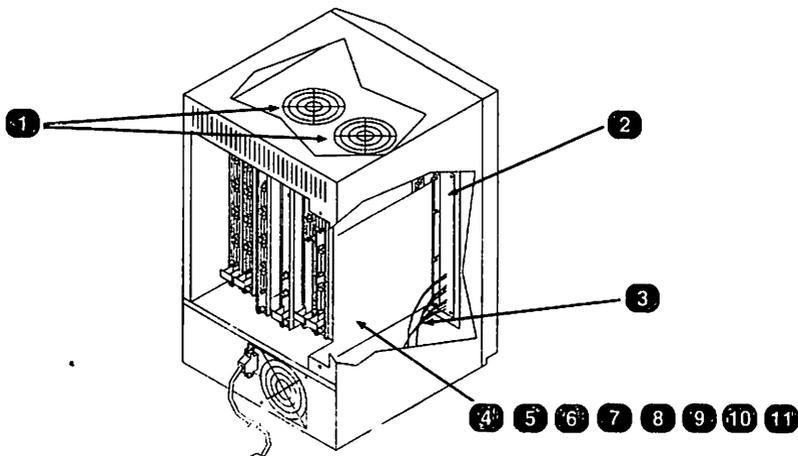
Item	Part Number	Description
1	270-3403	+12V DC Fan
2	210-8176	Motherboard
3	220-2606	DC Cable Harness Assembly
4	210-8034-1	128KB CPU Board (Original CPU)
5	210-8034-2	512KB CPU Board (Original CPU)
6	210-8937-A	128KB CPU Board (Enhanced CPU Model)
7	210-8937-B	512KB CPU Board (Enhanced CPU Model)
8	210-8937-C	1MB CPU Board (Enhanced CPU Model)
9	210-8937-D	2MB CPU Board (Enhanced CPU Model)
10	210-8937-E	4MB CPU Board (Enhanced CPU Model)
11	210-8937-F	8MB CPU Board (Enhanced CPU Model)
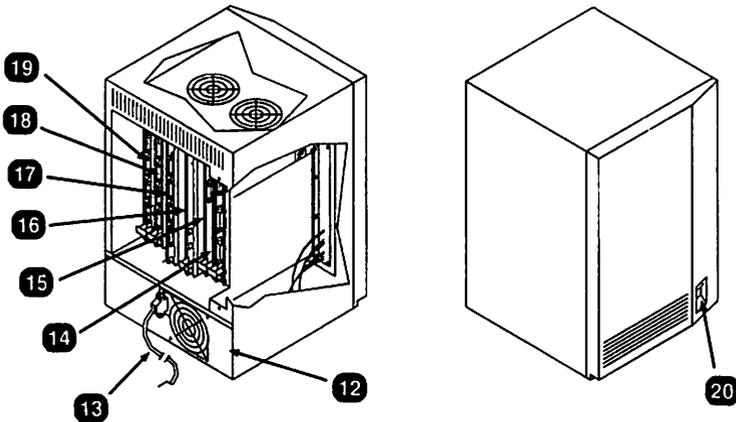
Item	Part Number	Description
12	270-0986	Power Supply
13	220-2569	AC Power Cable (6 Ft. NEMA 5-151G)
14	212-3012	22C32 Triple Controller Board
15	177-2228-B	2228B TC Controller Board
16	210-8576	2258 Local Communication Option Board
17	212-3032	2236MXE 4-Port Controller Board
18	210-8824	2275 MUX Board
19	210-8825	2275 MUXE Board
20	325-0096	AC Power Switch
21	220-3588	MUX/MUXE Interconnecting Ribbon Cable (Not Shown)
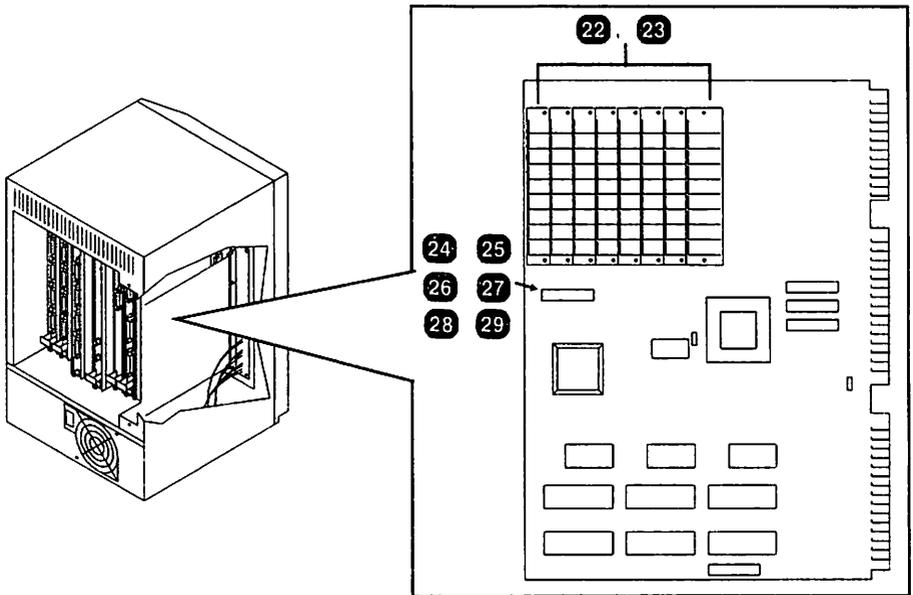
Item	Part Number	Description
22	377-4508	256KB SIMMs CPU Memory Module
23	377-4513	1MB SIMMs CPU Memory Module
24	377-3483	Memory PAL (L2) (128KB CPU Memory Board)
25	377-3484	Memory PAL (L2) (512KB CPU Memory Board)
26	377-3485	Memory PAL (L2) (1MB CPU Memory Board)
27	377-3486	Memory PAL (L2) (2MB CPU Memory Board)
28	377-3487	Memory PAL (L2) (4MB CPU Memory Board)
29	377-3488	Memory PAL (L2) (8MB CPU Memory Board)

● END

APPENDIX A CONTENTS

APPENDIX A
CS-D/CS-N
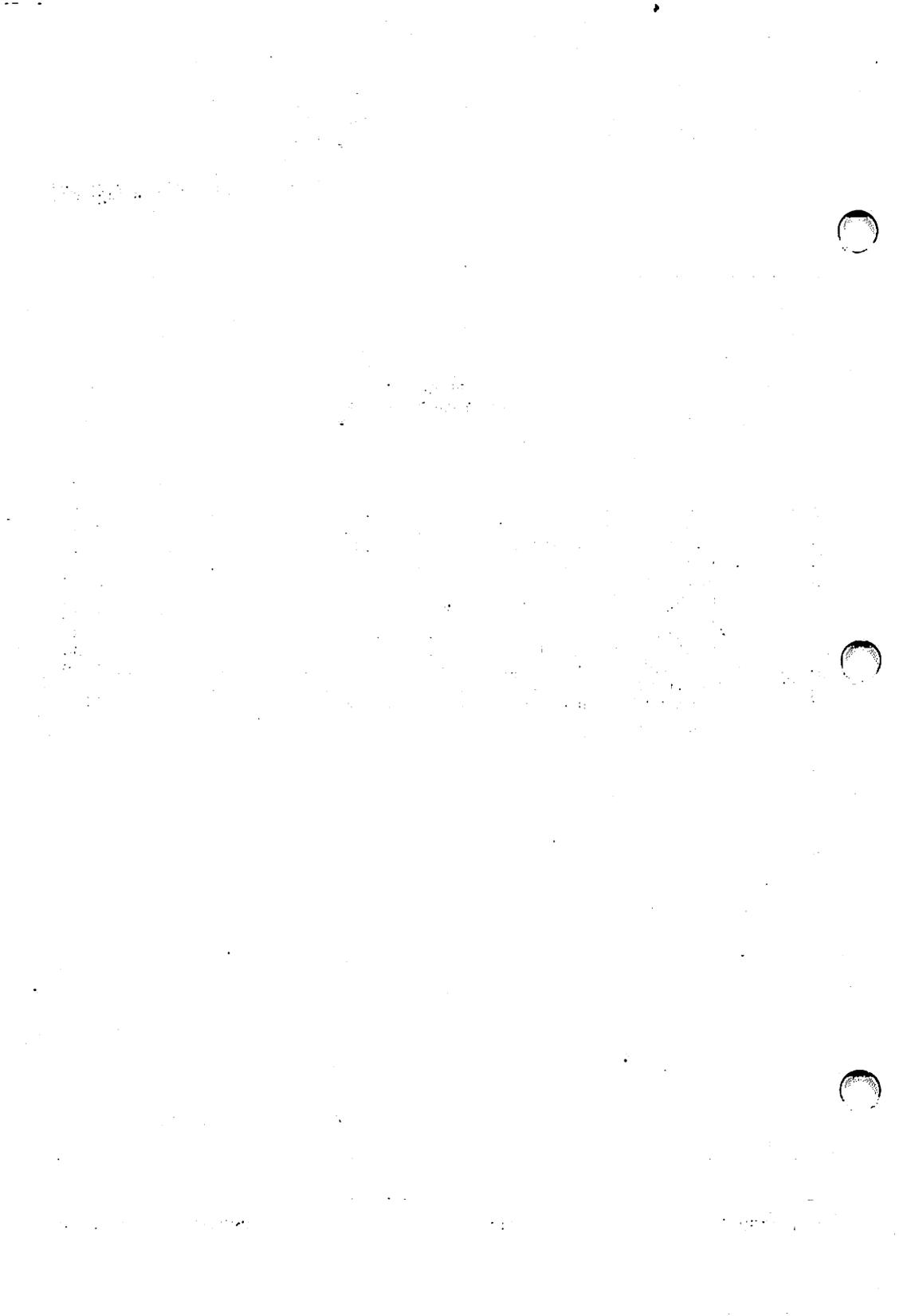
A.1.1 Scope and Purpose

The scope and purpose of this Illustrated
Manual [IM] Appendix is to provide the Wang
Customer Engineer with the information necessary
to install, troubleshoot, and repair the Wang CS-D
and CS-N in the field. Familiarity with the Wang
2200 product line is recommended for effective use
of this IM.

The Wang Computer System [CS-D, CS-N] is an
interactive, multi-user, multi-task, disk-based
computer system utilizing VLSI [Very Large Scale
Integration] technology. The CS supports up to 16
terminals and 16 jobs [partitions] concurrently,
as well as a wide range of peripheral devices,
such as printers, plotters, disk drives, tape
drives, and TC devices. Disk drive sharing for up
to 15 additional CPUs is also available as an
option.

By utilizing VLSI, the CS processor design is
incorporated into a single chip. This allows the
CPU, control memory, and user memory to reside on
a single PC board.

The CS-D, CS-N Computer Systems replace the
current CS Computer System CPUs. Users may
utilize the new CS-D, CS-N Computer Systems in the
following categories:

• Users needing greater than 140MB of storage,
  or more than a single Fixed Winchester Disk
  Drive, should order a CS-N with a DS cabinet.

• Internal storage is limited to a single Floppy
  Disk Drive, Streaming Cartridge Tape Drive,
  and a Fixed Winchester Disk Drive.

• Users desiring a multiple CPU solution should
  order the CS-D as the main CPU, and CS-Ns
  without built-in Disk Processing Unit (DPU),
  or existing CS CPUs for multiplexing the
  Internal Winchester Disk Drive.

A.1.1   Scope and Purpose

The CS-D, CS-N Computer Systems incorporate the following improvements:

- Modified CS cabinet

- New Motherboard

- Internal Winchester Disk Drives

- Disk Processing Unit (DPU) Board with Cache Memory, 2200 Interface, and Printer Port

- 360KB or 1.2MB Floppy Disk Drives used for data storage backup

- Streaming Cartridge Tape Drive used for data storage backup

- Single, Internal, Fixed Half-Height, or Fixed Full-Height (20MB, 32MB, 64MB or 140MB) Winchester Disk Drives

- Complete I/O connector compatibility and support for all previous controllers used on CS equipment

- 100% software compatible with CS-2 through CS-80 equipment

- CS-D available with Internal Disk/Tape Drives, and DPU Board, or without DPU Board as model CS-N

The CS-D and CS-N are available in the following models:

MODEL	CPU MEMORY	CONTROL MEMORY
CS-2D, -2N	128KB	32KB
CS-5D, -5N	512KB	32KB
CS-10D, -10N	1MB	32KB
CS-20D, -20N	2MB	32KB
CS-40D, -40N	4MB	32KB
CS-80D, -80N	8MB	32KB

● END

A.2.1 Major Parts

A.2.1.1 CS-D Components
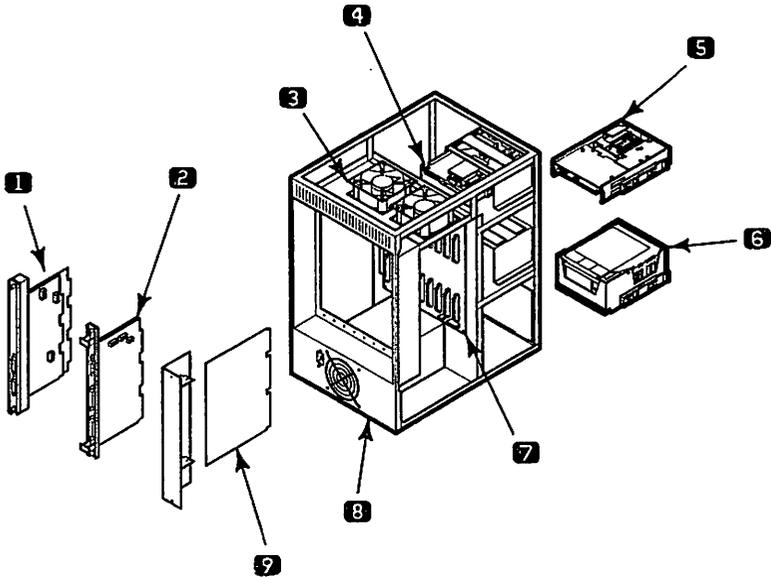
ITEM	COMPONENT

1] Disk Processing Unit (DPU) PCA with Printer Port
2] I/O Controller PCAs
3] Fans
4] Floppy Disk Drive
5] Streaming Cartridge Tape Drive
6] Winchester Disk Drive (20MB, 32MB, 64MB, or 140MB)
7] Motherboard
8] SPS-255 Power Supply
9] CPU/Memory PCA

● END

A.2.1 Major Parts

A.2.1.2 CS-N Components
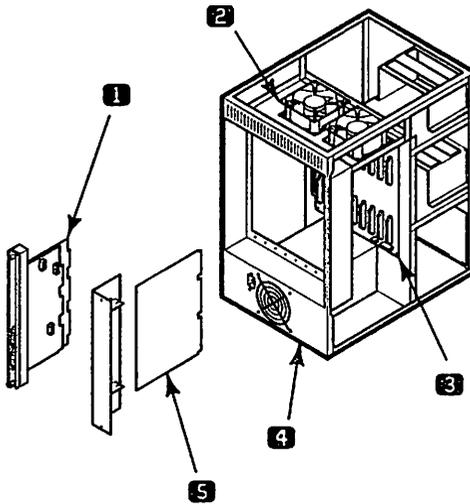
ITEM	COMPONENT
1]	I/O Controller PCAs
2]	Fans
3]	Motherboard
4]	SPS-255 Power Supply
5]	CPU/Memory PCA

● END

A.3.1 Operator Controls

A.3.1.1 Power-On Control
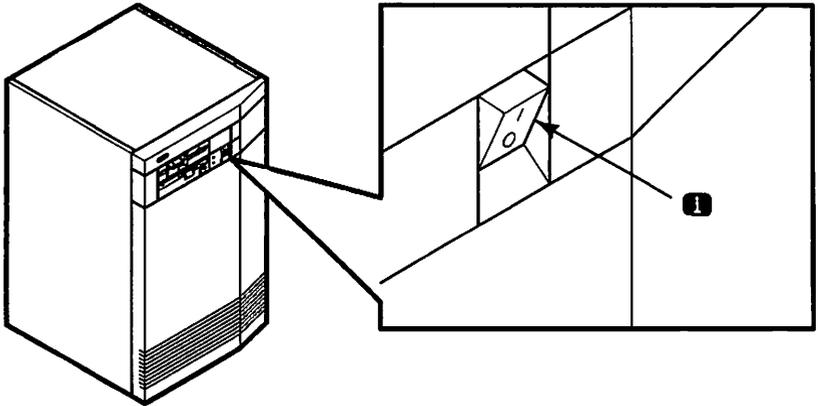
ITEM	NAME	TYPE AND FUNCTION
1]	Power On-Off Switch	Rocker-type switch: "1" switch position applies AC power to CS-D, CS-N, initiates B.I.T. Power-Up Diagnostics, and Initial Program Load (IPL) [providing diagnostics pass]. "O" switch position removes AC power from CS.

● END

A.3.2 Service Controls

A.3.2.1 Disk Processing Unit (DPU) Mother Board Controls
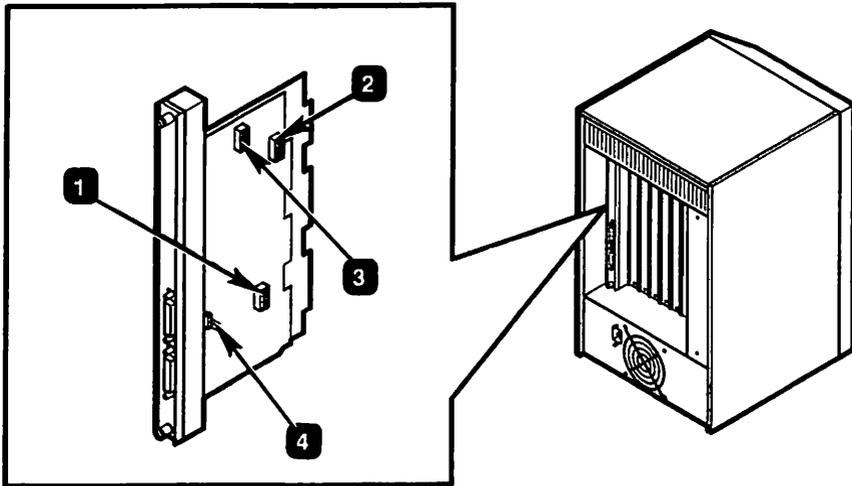
ITEM	NAME	TYPE AND FUNCTION
1]	Drive Type Switch SW3	Slide type, 8-bit switch bank; SW3, selects drive memory/drive type interfaced to the CS-D.
2]	Printer Address Switch SW2	Slide type, 8-bit switch bank; SW2, selects address of printer interfaced to the CS-D.
3]	Disk Address Switch SW1	Slide type, 8-bit switch bank; SW1, selects address of disk drive interfaced to the CS-D.
4]	MUX/BUS Jumper J3A	Two [2] position; J3A, selects either MUX or BUS position for multiplexing the internal disk drive.

SEE PG A38, A39 FOR SW SETTINGS

A.3.2 Service Controls

A.3.2.2 Disk Processing Unit (DPU) Daughter Board Controls
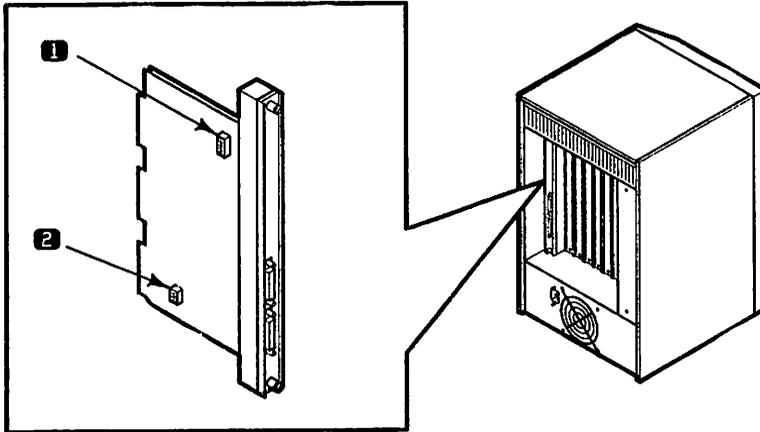
ITEM	NAME	TYPE AND FUNCTION
1]	Factory Use Only Switch SW4	Slide type, 8-bit switch bank; SW4, selects factory test positions of the CS-D.
2]	Floppy Drive Memory Type/ Tape Drive Switch SW5	Slide type, 4-bit switch bank; SW5, selects Floppy Drive Type (360KB or 1.2MB), or Tape Drive use.

● END

A.3.3 Service Indicators

A.3.3.1 Motherboard Test Point Indicators
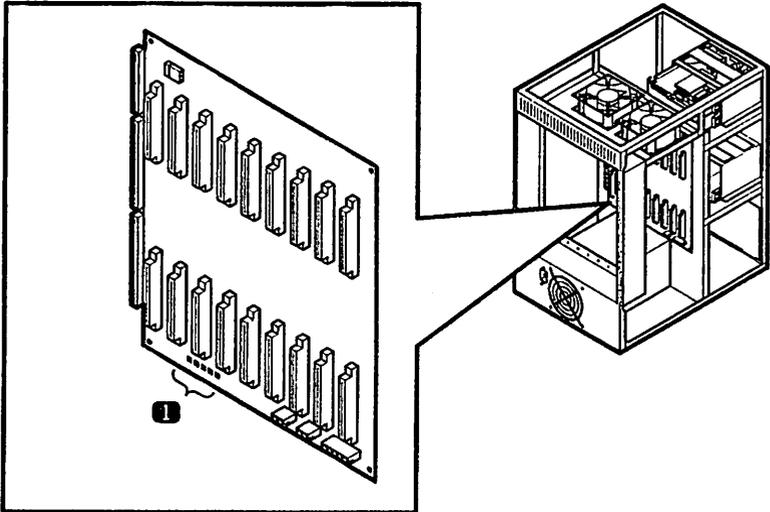
ITEM	NAME	FUNCTION
1]	TP1 thru TP5	Provide test points for Power Supply voltages distributed to Motherboard connectors.

● END

A.3.3 Service Indicators

A.3.3.2 Front Panel Indicators
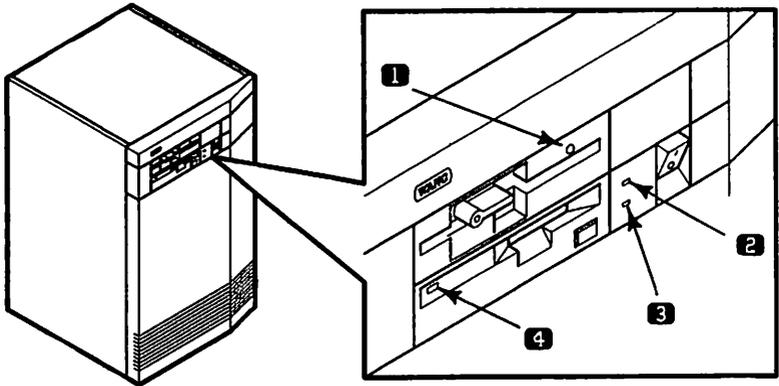
ITEM	NAME	FUNCTION
1]	LED1	Floppy Disk LED; Amber, indicates CS-D Floppy Disk activity, and DPU BIT Test Pass/Fail at Power-Up.
2]	LED2	AC Power-On LED; Green, indicates CS-D, CS-N Power-Up condition.
3]	LED3	Winchester LED; Amber, indicates CS-D Winchester Disk activity.
4]	LED4	Streaming Tape Drive LED; Red, indicates CS-D Streaming Tape Drive activity.

● END

A.4.1 Power-Up Procedure

⁻ 4.1 for information on CS-D, CS-N Power-Up
Procedure.

● END

A.4.2 Power—Down Procedure

→ 4.2 for information on CS—D, CS—N Power—Down
Procedure.

● END

A.5.1 Visual Inspection

The Wang CS-D, CS-N Computer Systems do not
require scheduled Preventive Maintenance.
Visually inspect both cooling fans for operation
and I/O cable for integrity during site visits.

● END

A.6.1 Tools and Equipment

No special tools or test equipment are required to repair the CS-D or the CS-N.

Microcode Diagnostics and Peripheral Device Diagnostics are available for the CS-D and CS-N through Diagnostic Package P/N 195-2956-0.

● END

```
                    ┌──────────┐
                    │  Start   │
                    └────┬─────┘
                         │
   ┌──────────────┐   ╱────────╲   NO  ╱────────╲   YES
   │ Power-up the │  ╱  Power    ╲────►╱  Wall    ╲────►┌───┐
   │ CS (➡4.1).   │─►╲ supply fan ╱    ╲ AC outlet ╱    │ A │
   └──────────────┘  ╲   on?     ╱     ╲  OK?     ╱     └───┘
                      ╲────────╱   │    ╲────────╱        3
                           │      YES        │ NO
                           │                 ▼
                           │        ┌──────────────────┐
                           │        │ Repair as required.│
                           │        └──────────────────┘
                           ▼
   ╱────────╲   NO   ╱────────╲   NO   ┌───┐
  ╱  Both    ╲─────►╱  Either  ╲─────►│ E │
  ╲ cabinet  ╱      ╲ fan on    ╱     └───┘
  ╲ fans on? ╱      ╲   ?      ╱        4
   ╲────────╱        ╲────────╱
       │ YES              │ YES
       ▼                  ▼
 ┌──────────────┐  ┌──────────────────┐
 │Wait 30 secs. │  │ Replace defective│
 └──────┬───────┘  │ fan ( ➡7.2.5).   │
        │          └──────────────────┘
        ▼
  ╱────────╲   NO   ┌──────────────┐          ╱────────╲   NO
 ╱  Floppy  ╲─────►│ Replace DPU  │───►     ╱ System    ╲────►┌───┐
 ╲ light    ╱      │ ( ➡A.7.2.4). │        ╱ Terminal 1  ╲    │ C │
 ╲ turns    ╱      └──────────────┘        ╲ displays     ╱   └───┘
 ╲ off?    ╱                               ╲ "KEY SF" ?  ╱      2
  ╲──────╱                                  ╲────────╱
     │ YES                                       │ YES
     ▼                                           │
 ╱──────────╲                               ╱────────╲   NO
╱  System    ╲   ┌──────────────┐          ╱ System    ╲────►┌───┐
╲ Terminal 1  ╲  │ Press RESET  │         ╱ Terminal 1  ╲    │ D │
╲ displays     ╱─►│ key on System│──►     ╲ displays     ╱   └───┘
╲ "MOUNT       ╱  │ Terminal 1.  │        ╲ "2200 SYSTEM ╱      2
╲ SYSTEM       ╱  └──────────────┘        ╲ MENU" ?     ╱
╲ PLATTER  YES               │             ╲────────╱
╲ PRESS                      ▼                  │ YES
╲ RESET" ?   ┌──────────────────────┐          ▼
 ╲────────╱  │ At System Terminal 1,│  ┌──────────────────┐
     │ NO    │ press SF key for disk│  │ Load the operating│
     ▼       │ address that contains│  │ system or load &  │
   ┌───┐     │ operating system:    │  │ run diagnostics.  │
   │ B │     └──────────────────────┘  └──────────────────┘
   └───┘
     2
```

➡NEXT

A.6.2 Troubleshooting Flowchart [Sheet 2 of 5]


```
        ┌──┐
        │ B│
        └──┘
         1
```

Does System Terminal 1 display any part of the message?
— NO → **Does System Terminal 1 pass power up diagnostics?**
— YES →

Check:
1. CS DC voltages (➡ 6.3).
2. CPU/Memory Bd. (➡ 7.2.1).
3. Workstation Controller Board (➡ 7.2.2).
4. Workstation I/O Cable.

YES → **Replace the CPU/memory bd. (➡ 7.2.1) and retry.**

NO → **Troubleshoot System Terminal 1.**

```
┌──┐
│ C│
└──┘
 1
```

→ **System error appears?**
— NO →

Check:
1. Defective RESET key (kybd., wkstn.)
2. Defective wkstn. controller.
3. Defective I/O cable.
4. Defective CPU/memory bd. (➡ 7.2.1).

YES → **Troubleshoot according to error listing (➡ 6.8).**

```
┌──┐
│ D│
└──┘
 1
```

"KEY SF" repeats?
— NO → **I/O error message?**
— NO → **Verify software O/S disk/floppy.**

YES → **- Verify SF key**
- Check DPU disk address switch #SW3 setting (➡ A.3.2.1).

YES → **Troubleshoot system drive**

➡NEXT

A.6.2 Troubleshooting Flowchart [Sheet 3 of 5]

```
        E
     1  ▼
   ┌─────────────┐  YES  ┌──────────────────┐
  ◇ Is +12V      ◇ ────→ │ Replace fan(s)   │
   ◇ at fan      ◇       │ (➡ 7.2.5).       │
   ◇ connector?  ◇       └──────────────────┘
        │ NO
        ▼
 ┌──────────────────┐   ┌──────────────┐ YES ┌──────────────────────┐
 │ Check voltage at │   ◇ +12V         ◇ ──→ │ Troubleshoot cable.  │
 │ P/J2 black and   │ ─→◇ between blue  ◇     │ Repair/replace cable.│
 │ blue wires for   │   ◇ and black     ◇     └──────────────────────┘
 │ +12V.            │   ◇ wires of P/J2?◇
 └──────────────────┘        │ NO
                             ▼
                        ◇ DC       ◇ NO  ┌──────────────────────┐
                        ◇ voltages  ◇ ──→ │ Replace power supply │
                        ◇ OK?       ◇     │ (➡ A.7.2.10).        │
                             │ YES        └──────────────────────┘
                             ▼
                             F  5
```

➡NEXT

A.6.2 Troubleshooting Flowchart [Sheet 5 of 5]

Motherboard Voltage Test Points
TP1 = Ground
TP2 = -5V
TP3 = +5V
TP4 = +12V
TP5 = -12V

➡NEXT

A.6.3   CS-D Disk Controller Diagnostic Error Codes

→ 6.8.15 for information on CS-D Disk
Controller 190X Error Codes.

● END

A.7.1 Tools and Test Equipment

    No special tools or test equipment are
required to repair the CS-D or the CS-N.

● END

A.7.2 Removal Procedures

A.7.2.1 Top Cover Removal

NOTE

This procedure applies to CS-D and CS-N.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove two (2) Phillips-Head screws at top rear of CS-D System chassis.

3 Slide Top Cover towards rear of cabinet, and lift away from CS-D cabinet.

● END
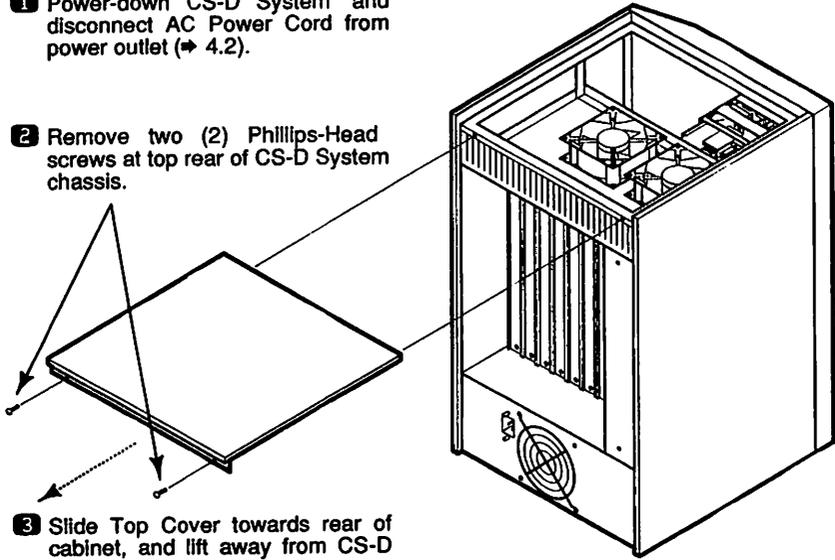
A.7.2   Removal Procedures

A.7.2.2   Front Panel Removal

NOTE

This procedure applies to CS-D and CS-N.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

4 Slide Front Cover upwards, and lift away from CS-D cabinet.

3 Loosen two (2) Phillips-Head screws found inside top front of chassis (below top cover).

● END
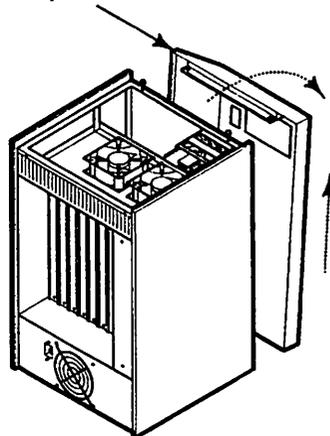
A.7.2   Removal Procedures

A.7.2.3   Side Panel Removal

NOTE

This procedure applies to CS-D and CS-N.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Grasping the top of the Side Panel, pull Side Panel upwards, and lift away from CS-D cabinet.
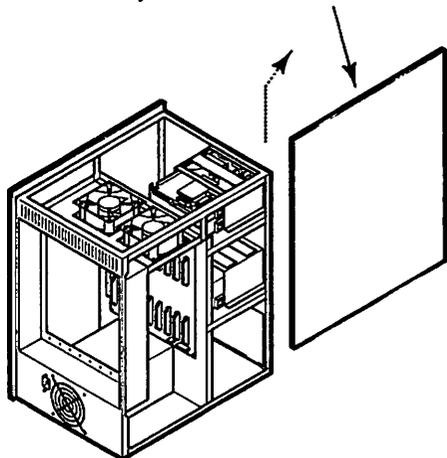
4 Repeat step 3 for the remaining Side Panel.

● END

A.7.2   Removal Procedures

A.7.2.4   Disk Processing Unit (DPU) Removal

NOTES

This procedure applies only to 'CS-D.

Take special precautions against DPU component damage when removing or replacing the DPU assembly.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Position CS-D cabinet for removal of second Blank PCA Panel, or an I/O Controller next to Disk Processing Unit (DPU) PCA, at extreme left of rear of CS-D cabinet.

3 Loosen two (2) slotted screws holding DPU PCA in place.

4 Carefully remove DPU assembly by grasping assembly at top and bottom, and sliding assembly out from rear of CS-D Cabinet.

● END
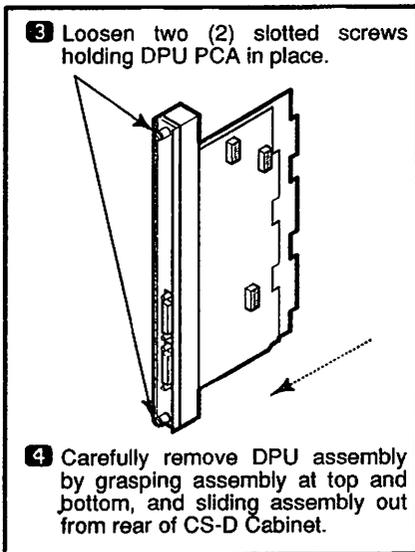
A.7.2 Removal Procedures

A.7.2.5 CPU Board Removal

NOTE

This procedure applies to CS-D and CS-N.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove two (2) slotted screws holding large PCA Panel Cover in place.
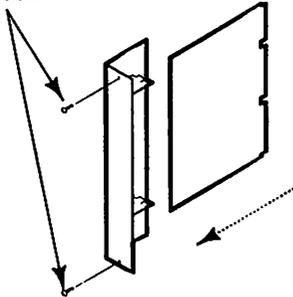
3 Carefully remove CPU PCA by grasping CPU PCA, being careful of CPU component damage, and pulling PCA out of its Motherboard connector and away from CS-D Cabinet.

● END
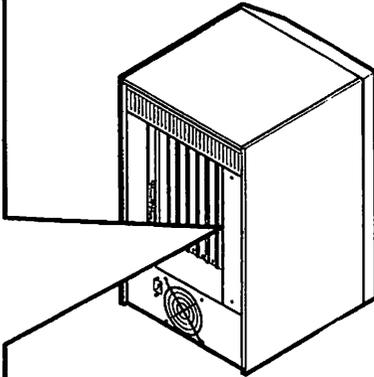
A.7.2   Removal Procedures

A.7.2.6   Winchester Disk Drive Removal

NOTE

This procedure applies only to CS-D.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Push plastic slide-lock mechanisms found on both sides of Winchester Disk Drive together and carefully slide drive half way out of CS-D Cabinet.

6 Disconnect A and B cables connected to rear of Winchester Disk Drive.

7 Disconnect DC Power cable connected to rear of Winchester Disk Drive.

8 Remove Winchester Disk Drive by sliding drive out of CS-D cabinet.

● END
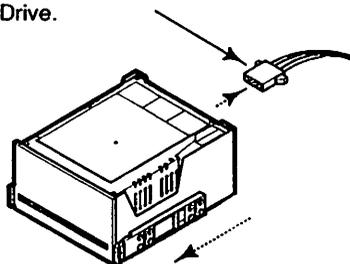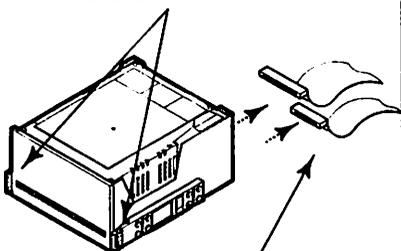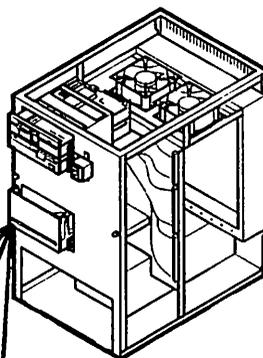
A.7.2   Removal Procedures

A.7.2.7   Floppy Disk Drive Removal

NOTE

This procedure applies only to CS-D.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).
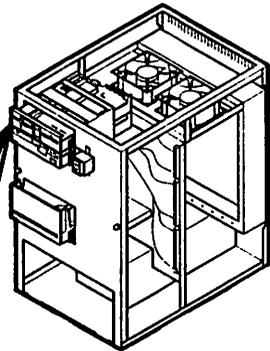
5 Push plastic slide-lock mechanisms found on both sides of Floppy Disk Drive together and carefully slide drive half way out of CS-D Cabinet.
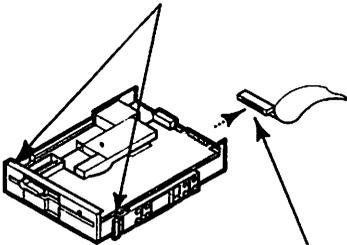
6 Disconnect I/O cable connected to rear of Floppy Disk Drive.

7 Disconnect DC Power cable connected to rear of Floppy Disk Drive.
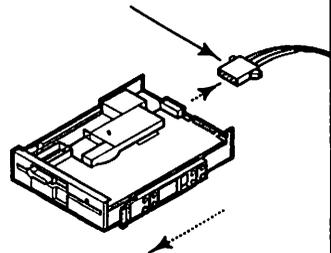
8 Remove Floppy Disk Drive by sliding drive out of CS-D cabinet.

● END

A.7.2   Removal Procedures

A.7.2.8   Streaming Cartridge Tape Drive Removal

NOTE

This procedure applies only to CS-D.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).
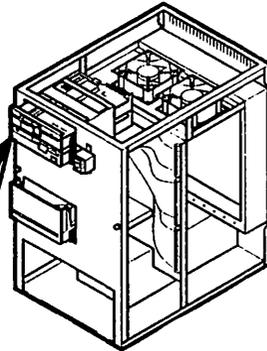
5 Push plastic slide-lock mechanisms found on both sides of Streaming Tape Drive together and carefully slide drive half way out of CS-D Cabinet.
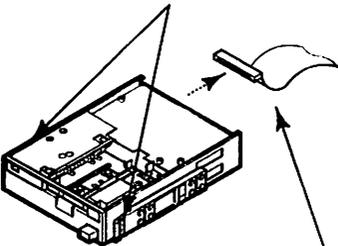
6 Disconnect I/O cable connected to rear of Streaming Tape Drive.

7 Disconnect DC Power cable connected to rear of Streaming Tape Drive.
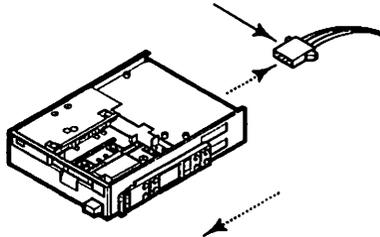
8 Remove Streaming Tape Drive by sliding drive out of CS-D cabinet.

● END

A.7.2 Removal Procedures

A.7.2.9 Motherboard Removal

NOTE

This procedure applies to CS-D and CS-N.

---

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Remove all CS-D PCAs and blank-out panels from rear of CS-D Cabinet (➡ 7.2.2).

7 Unplug connector J25 from top left corner of Motherboard.

8 Remove fourteen (14) Phillips-Head Screws fastening Motherboard to CS-D Chassis.
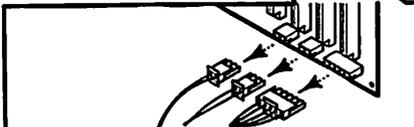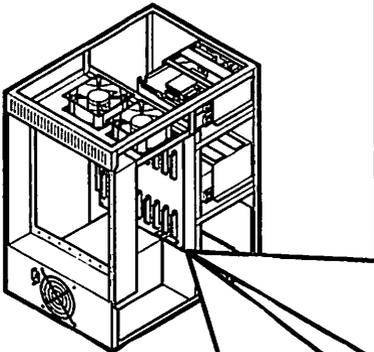
6 Remove DC Power harness plugged into connectors J22, J23, and J24 mounted on lower right corner of Motherboard.

◆ END

A.7.2 Removal Procedures

A.7.2.10 Power Supply (SPS-255) Removal

NOTE

This procedure applies to CS-D and CS-N.

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Remove two (2) Phillips-Head Screws attaching SPS-255 Power Supply to outside rear of CS-D Cabinet at power supply cooling fan grille.
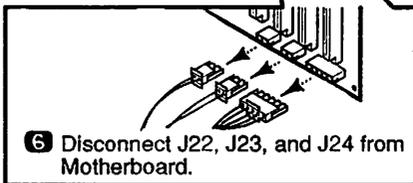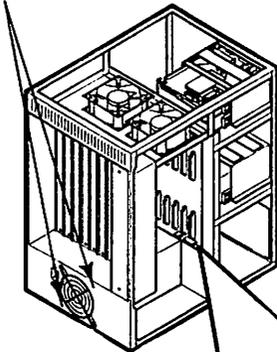
6 Disconnect J22, J23, and J24 from Motherboard.

7 Remove remaining two (2) Phillips-Head Screws attaching SPS-255 Power Supply to CS-D Chassis floor plate.
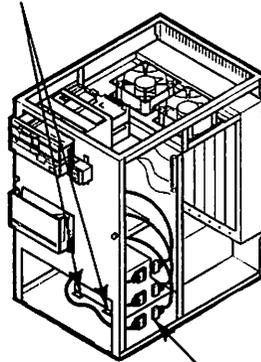
8 Disconnect connection P/J-1, P/J-2, and P/J-3.
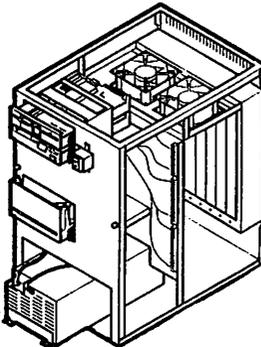
9 Remove SPS-255 Power Supply from front of CS-D Cabinet.

● END

A.8.1 Tools and Test Equipment

No special tools or test equipment are required to perform adjustments on the CS-D or CS-N.

● END

WARNING

DO NOT OPEN THE SWITCHING PO-
WER SUPPLY UNDER ANY CIRCUM-
STANCES. EXTREMELY DANGEROUS
VOLTAGE (IN EXCESS OF 300 VOLTS
DC) AND UNLIMITED CURRENT ARE
PRESENT WITHIN THE POWER SUP-
PLY. DO NOT ATTEMPT TO REPAIR
THE POWER SUPPLY; IT IS FIELD
REPLACEABLE ONLY.

Tools and test equipment required:

- Fluke DVM (or equivalent).
- Small flat-blade plastic screwdriver.

1 Power-down CS-D System and
disconnect AC Power Cord from
power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove two Side Covers (➡ A.7.2.3).
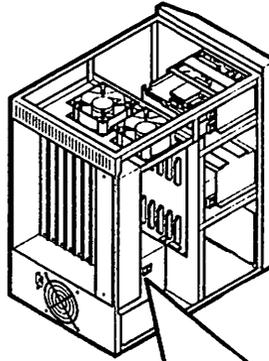
4 Set AC Voltage Select Switch on
SPS-255 Power Supply to correct
voltage available on site.

➡NEXT

5 Reconnect AC Power Cord to wall outlet.

6 Power-up CS-D (➡ 4.1).
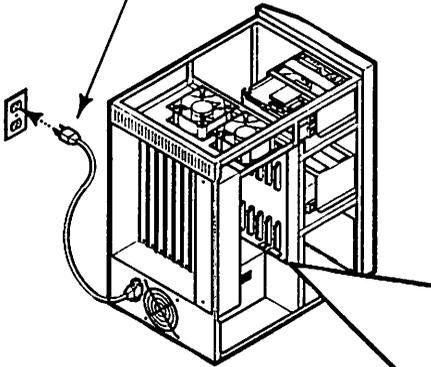
7 Connect common lead of DVM to TP1 (ground) on Motherboard.
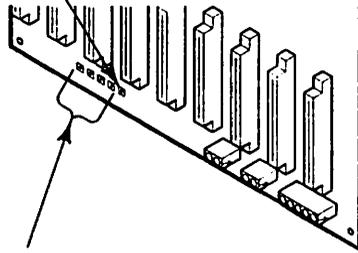
8 Connect DVM to TP2 thru TP5 on Motherboard to verify DC Voltage limits as follows:

Test Voltage		Limits (VDC)
TP1	Ground	
TP2	-5V (fixed)	-4.95V to -5.05V
TP3	+5V (adj)	+4.95V to +5.05V
TP4	+12V (adj)	+11.95V to +12.05V
TP5	-12V (fixed)	-11.95V to -12.05V

● END

A.9.1 Installation Site Check

Proper equipment location and site preparation are important for reliable operation of the Wang CS-D. Actual installation should not begin until all site requirements detailed in the Customer Site Planning Guide have been met.

Installation Site Check

A minimum clearance of 12 inches should be provided at the rear of the CS-D to ensure proper airflow through the fan vents.

Ideally, the area should be easily accessible, relatively dust free, and both temperature and humidity controlled.

AC Power Line Requirements

An adequate AC Power Line that is regulated and noise-free to minimize electromagnetic interference should be dedicated to the CS-D.

The CS-D requires approximately two (2) amperes of current at 115VAC [1 ampere at 230VAC] during operation.

● END

A.9.2 Tools and Equipment

No special tools or test equipment are
required for Unpacking and Setup of the CS-D or
CS-N.

● END

A.9.3 Unpacking Procedure

A.9.3.1 CS-D Unpacking Procedure

→ 9.3 for information on CS-D, CS-N System
Unpacking Procedure.

● END

A.9.3   Unpacking Procedure

A.9.3.2   CS-D Floppy/Streaming Tape/Winchester
          Drive Unpacking Procedure

   ⌐ 9.4, 9.5, and 9.6 of Data Storage Cabinet
manual, 741-1806, for information on CS-D Floppy
Disk Drive, Streaming Tape Drive, and Winchester
Disk Drive Unpacking Procedure.

● END

A.9.4 Switch Settings

A.9.4.1 Disk Processing Unit (DPU) Motherboard
Switch Settings Diagram

SW1
Disk Address

MSB
8 7 6 5 4 3 2 1
LSB

ON

310   320   330

SW2
Printer Address

MSB
8 7 6 5 4 3 2 1
LSB

ON

215   216

SW3
Drive Type

MSB
8 7 6 5 4 3 2 1
LSB

ON

No Drive Present | 10 Mb Removeable Cartridge Winchester | 10 Mb Winchester | 20 Mb Winchester | 32 Mb Winchester | 64 Mb Winchester | 140 Mb Maxtor 14 x 10 Mb | 32 Mb Micropolis Winchester | 112 Mb Maxtor 7 x 16 Mb

▤ = SWITCH POSITION
o = OPEN CONTACTS
x = CLOSED CONTACTS
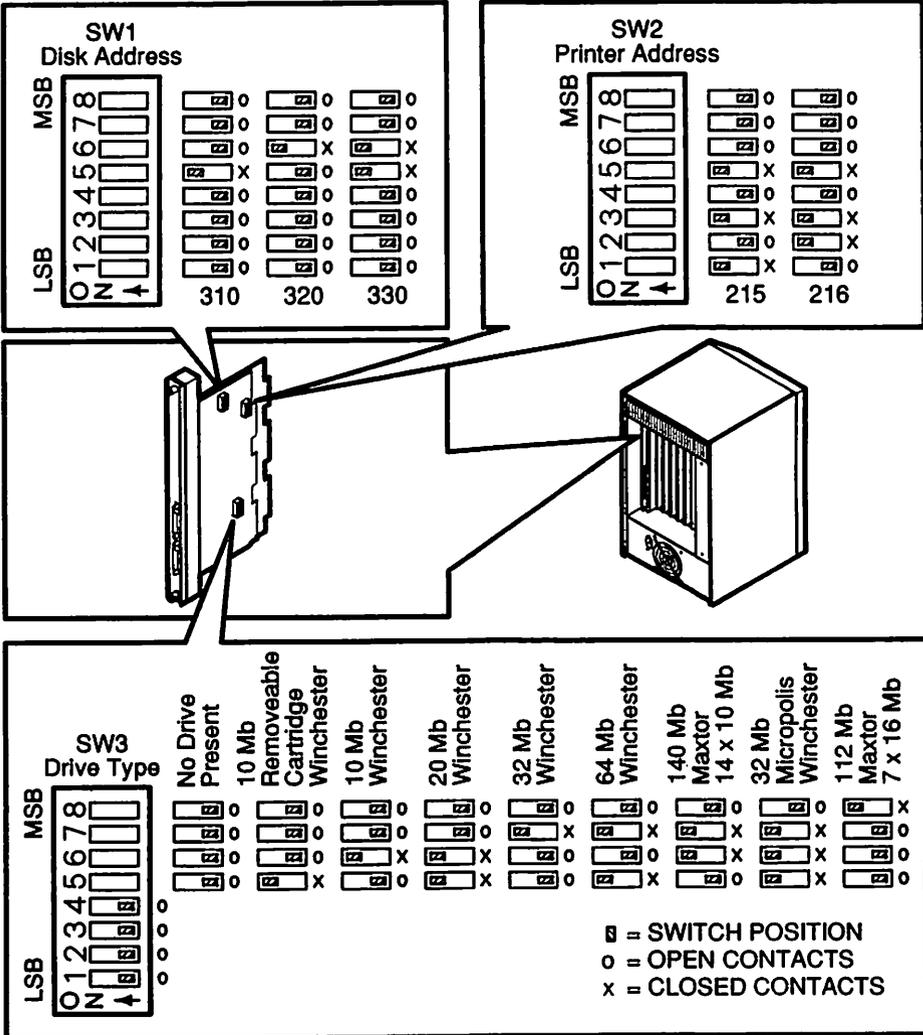
A.9.4 Switch Settings

A.9.4.2 Disk Processing Unit (DPU) Daughterboard
         Switch Settings Diagram

SW4

(All Set OFF
Factory Use Only)

B = SWITCH POSITION
O = OPEN CONTACTS
X = CLOSED CONTACTS

SW5

320Kb   o   x 1.2Mb
No   o   x Tape
Tape   o
                o
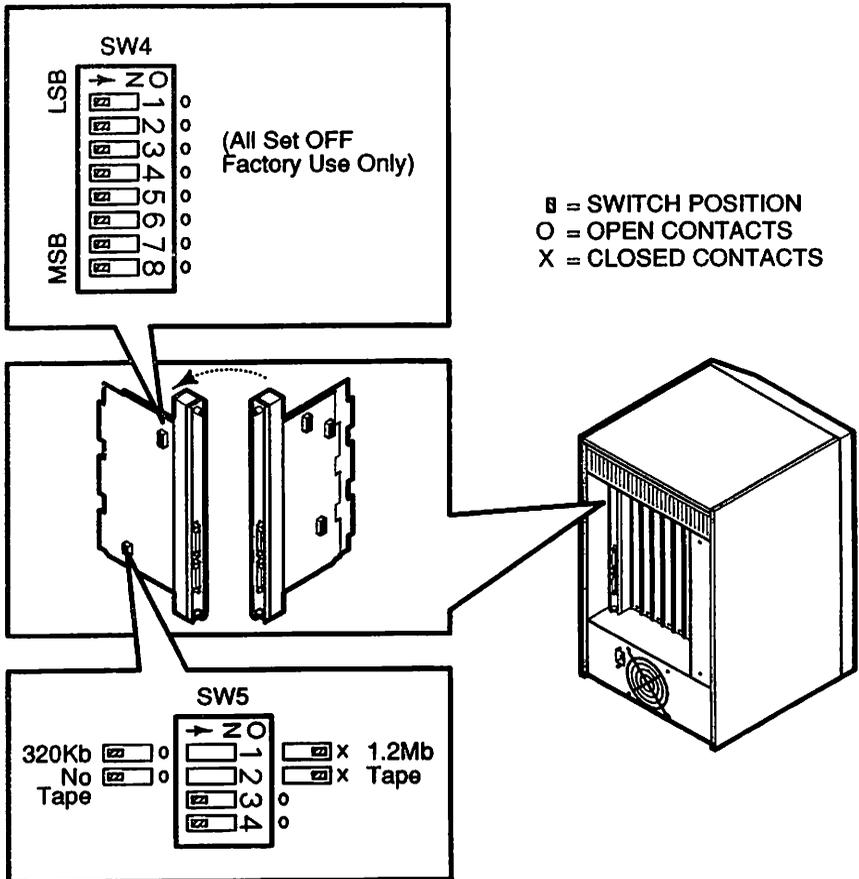
A.9.5   Cable Connections

**A.9.5.1   Disk Processing Unit (DPU) PCA/Winchester
Disk/Floppy Tape/Streaming Tape Drive
Cabling Diagram**
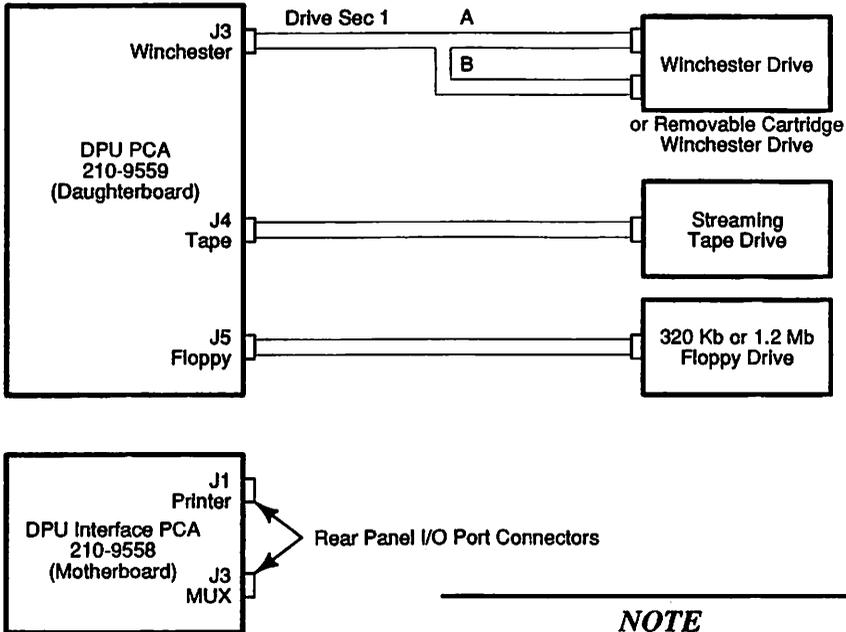
NOTE

Terminating Resistors of Winchester Drive
Must Not Be Removed.

● END

A.9.6 Disk/Tape Drive Installation

A.9.6.1 Magnetic Device Mounting Preparation

Each magnetic device is shipped with an installation kit containing (in addition to items pertaining to the specific device):

- Two (2) Drive Mounting Brackets
- Four (4) Phillips-Head Screws - 6-32 x 1/4"
- Two (2) Grounding Clips

The mounting brackets must be attached to the given drive to enable installation of the drive into the selected cabinet locations in the following manner:

1 Line up holes in mounting bracket and grounding clip and fasten bracket with screw onto drive. (Use hole in mounting bracket which best fits location of screw receptacle.) Curved end of grounding clip must protrude through bracket aperture.
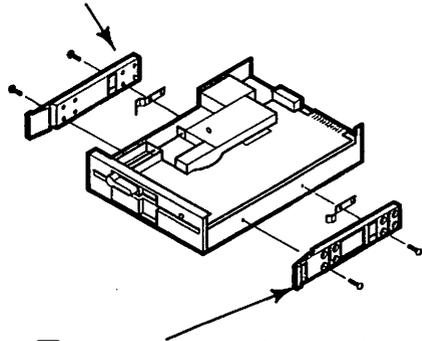
2 Repeat procedure for opposite side of drive.

● END

A.9.6 Disk/Tape Drive Installation

A.9.6.2 Installing Winchester Disk Drive

Each Winchester Disk Drive is shipped with an installation kit containing the following items:

- Two (2) Drive Mounting Brackets
- Four (4) Phillips-Head Screws - 6-32 x 1/4"
- Two (2) Grounding Clips

Installation of Winchester Disk Drive should be accomplished using the following instructions:

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Attach mounting brackets and grounding clips to Winchester Disk Drive (➡ A.9.6.1).

6 Install Winchester Disk Drive half way into slot 3 to point at which mounting brackets engage latch.

7 Install A and B signal cables and DC Power cable on rear of Winchester Disk Drive.
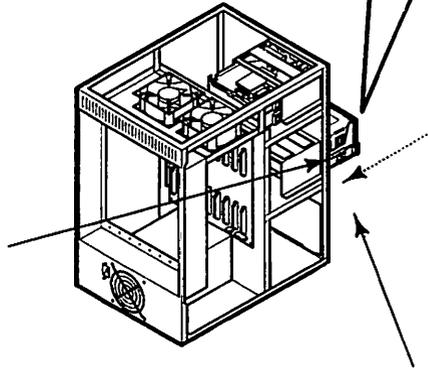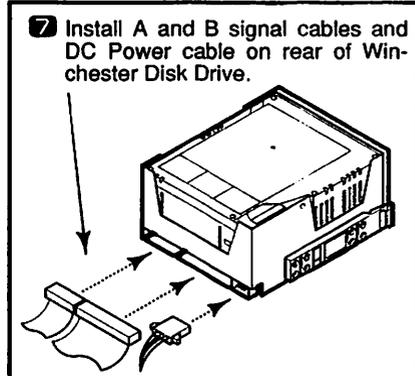
8 Push Winchester Disk Drive into cabinet and mounting brackets will lock into position.

● END

A.9.6 Disk/Tape Drive Installation

A.9.6.3 Installing Streaming Cartridge Tape Drive (Sheet 1 of 2)

Each Streaming Tape Drive is shipped with an installation kit containing the following items:

- Two (2) Drive Mounting Brackets
- Four (4) Phillips-Head Screws -
  6-32 x 1/4"
- Two (2) Grounding Clips

Installation of Streaming Tape Drive should be accomplished using the following instructions:

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Attach mounting brackets and grounding clips to Streaming Tape Drive (➡ A.9.6.1).

6 Install Streaming Tape Drive half way into slot 2 to point at which mounting brackets engage latch.

7 Install signal cable and DC Power cable on rear of Streaming Tape Drive.
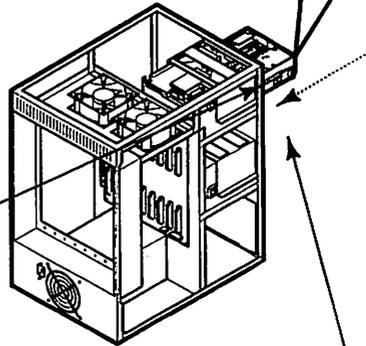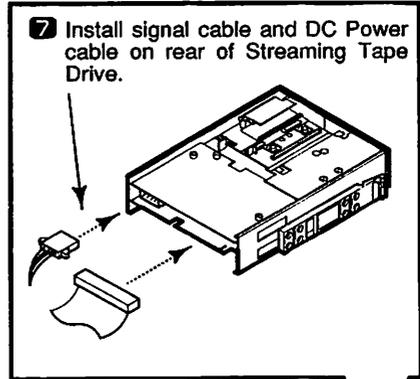
8 Push Streaming Tape Drive into cabinet and mounting brackets will lock into position.

A.9.6 Disk/Tape Drive Installation

A.9.6.3 Installing Streaming Cartridge Tape Drive (Sheet 2 of 2)

NOTE

Cartridge Installation:

Cartridge provides a two position tab
for selection of write/enable
(unprotected) or write/disable
(protected) functions. To install
cartridge insert tab end of cartridge
into Streaming Cartridge Tape Drive. A
notch on top of cartridge ensures proper
installation.

Write/Disable	Write/Enable
(Protected)	(Unprotected)

● END
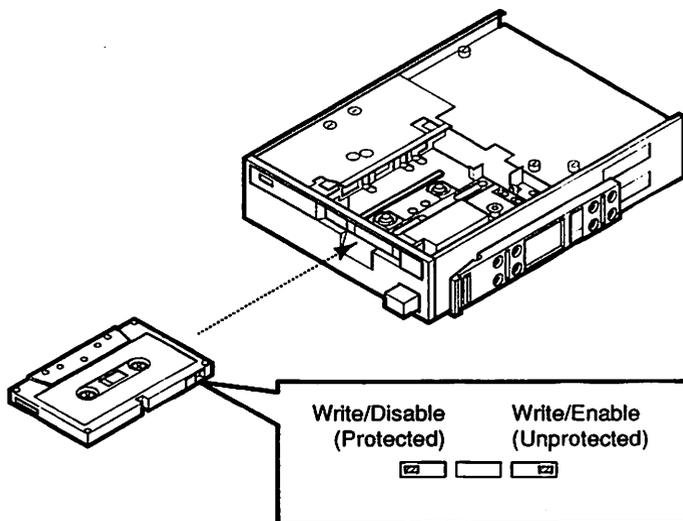
A.9.6 Disk/Tape Drive Installation

A.9.6.4 Installing Floppy Disk Drive

Each Floppy Disk Drive is shipped with an installation kit containing the following items:

- Two (2) Drive Mounting Brackets
- Four (4) Phillips-Head Screws -
  6-32 x 1/4"
- Two (2) Grounding Clips

Installation of Floppy Disk Drive should be accomplished using the following instructions:

1 Power-down CS-D System and disconnect AC Power Cord from power outlet (➡ 4.2).

2 Remove Top Cover (➡ A.7.2.1).

3 Remove Front Panel Cover (➡ A.7.2.2).

4 Remove both left and right Side Covers (➡ A.7.2.3).

5 Attach mounting brackets and grounding clips to Floppy Disk Drive (➡ A.9.6.1).

6 Install Floppy Disk Drive half way into slot 1 to point at which mounting brackets engage latch.

7 Install signal cable and DC Power cable on rear of Floppy Disk Drive.
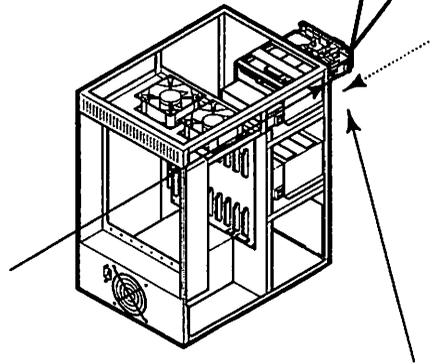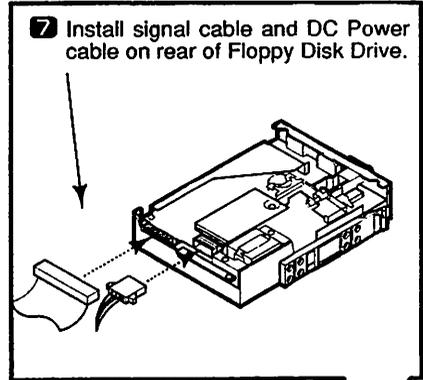
8 Push Floppy Disk Drive into cabinet and mounting brackets will lock into position.

● END

A.9.7   Initial Power-Up and Voltage Check

    → 4.1, A.8.2 for information on CS-D, CS-N
Initial Power-Up and Voltage Check.

● END

A.9.8   Software Installation

A.9.8.1   Winchester Drive Software Installation

⊸ 9.7 for information on CS-D Winchester Drive
Software Installation.

● END

A.9.9   Installing Options

A.9.9.1   CS-N to CS-D Upgrade

Upgrade From	Upgrade To	Upgrade Kit Number	Part Number	Upgrade Comments
CS-N	CS-D	UJ6047	205-6047	Kit includes one (1) DPU PCA [P/N 212-7113].

NOTE

Disk Drives must be ordered separately from Upgrade Kit.

● END

A.10.1 Disk Processing Unit (DPU) Board Functional Theory

The Disk Processing Unit (DPU) Controller Assembly (two [2] PCA's): located in the CS-D cabinet, consists of a Motherboard and Daughterboard with Z80 controlled logic. This logic is capable of supporting a total of three magnetic devices such as:

- ST-506 Winchester Disk Drives
- 1.2MB Floppy Drive
- Streaming Tape Drive (STD)

The Disk Processing Unit (DPU) Controller PCA can be accessed, via the MUX cable, by any 2200 CPU, including the CS, the CS-D, and the CS-N.

The Disk Processing Unit (DPU) Controller consists of the following:

- 4MHZ Z80 Microprocessor
- 32KB EPROM
- Four-channel DMA Controller chip
- Two four-channel CTC chips
- 16KB of System RAM with Parity
- 16 banks of 16KB Cache RAM with Parity
- Model 765 Floppy Disk Controller with Integral Data Separator
- Western Digital 2010B Winchester Disk Controller
- Western Digital 10C020B Data Separator
- QIC-02 Interface Logic PCA for control of Streaming Tape Drive
- 2200 BUS Interface Logic
- 2275 MUX Interface Logic

A.10.1   Disk Processing Unit (DPU) Board Functional Theory

Memory Control

    The Disk Controller PCA memory consists of
32KB of EPROM, 16KB of System RAM, and 256KB of
Cache RAM. Cache RAM is organized in 16 banks,
with only one of the 16 banks occupying the top
16K slot of the Z80 Memory Address space. Bank
selection is done with MEMBKSEL (OUT 70) in
conjunction with D0 - D3.

Memory Allocation Map
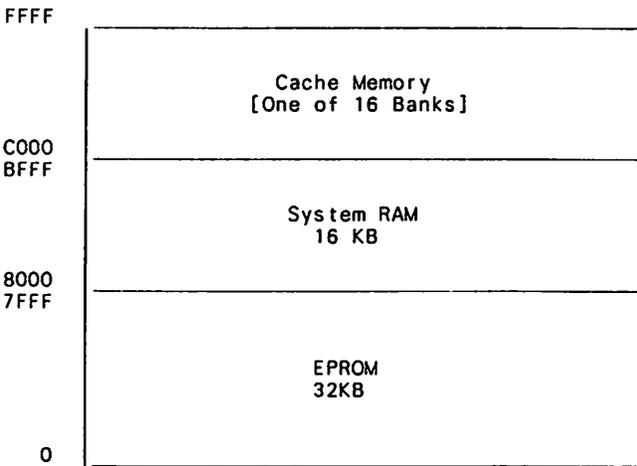
```
FFFF  _____
     |                                                |
     |                 Cache Memory                   |
     |               [One of 16 Banks]                |
C000 |_____|
BFFF |                                                |
     |                                                |
     |                  System RAM                    |
     |                   16 KB                        |
8000 |_____|
7FFF |                                                |
     |                                                |
     |                   EPROM                        |
     |                   32KB                          |
   0 |_____|
```

A.10.1 Disk Processing Unit (DPU) Board Functional Theory

The Disk Controller provides hardware logic making it possible to interface with any Streaming Cartridge Tape Drive (SCTD). I/O commands are used for both reading SCTD status and for sending control command to the SCTD. Data transfers to and from the SCTD are done via DMA. The SCTD records data in 512 Byte blocks while data in the 2200 is organized in 256 Byte blocks. This necessitates having two separate 256 Byte DMA transfers to meet the 512 Byte block SCTD requirement of controlling BUS direction. The Disk Controller generates and sends to the SCTD an odd parity bit during both data and control transmission. The SCTD reciprocates with its own odd parity bit during its transmission cycle to the Disk Controller. The Z80 is interrupted if the Disk Controller parity checker detects a parity error during incoming data or during a status from the SCTD. All Z80 interrupts, except NMI, are routed to the Z80 via the two CTC chips. The SCTD generates an exception when it receives wrong parity from the Disk Controller.

2200 to Disk Controller Interface

The Disk Controller accepts data from the 2200 either by using Z80 I/O command or by using DMA channel 1. Data flow is controlled by the Disk Controller generated Ready/Busy (R/B) line. This Ready/Busy line is set to the '0' level when the Disk Controller is ready to receive data from the 2200. The Output Strobe (OBS) signals the Disk Controller that a byte of data (OB1–OB8) has been placed on the 2200 output bus.

Disk Controller to 2200 Interface

The Disk Controller transfers data to the 2200 either by using Z80 I/O commands or DMA channel 2.

● END

A.11.1 Hardware

CS-D, CS-N CABINET DIMENSIONS:

Height: 23 7/8 Inches (60.6 Cm.)
Width: 15.0 Inches (38.1 Cm.)
Length: 15 3/4 Inches (40.0 Cm.)

OPERATING ENVIRONMENT:

Temperature Range:
    Storage: 0° to 120°F. (-17° to 50°C.) [packaged]
    Operating: 60° to 90°F. (17° to 32°C.)

Humidity Range:
    Storage: 10% to 90% [packaged]
    Operating: 20% to 80%
    Maximum Wet Bulb Temperature: 75°F. (24.4°C.)

Service Space Requirements:
    Front: 30 Inches (76.2 Cm.)
    Rear: 36 Inches (91.4 Cm.)
    Top: 20 Inches (50.8 Cm.)

Voltage Range:
    115 Vac., 60 Hz., +12 Volts, -12 Volts; +0.5 Hz., -0.5 Hz.
    230 Vac., 50 Hz., +24 Volts, -24 Volts; +0.5 Hz., -0.5 Hz.

Input Current:
    2.0 Amps. @ 115 Vac 60 Hz.
    1.0 Amp. @ 230 Vac 50 Hz.

Input Power:
    170 Watts, 230 Volt/Amps.

Power Factor:
    0.74 lagging

Heat Loss:
    581 BTU/Hr. (146.4 Kilogram Calories/Hour)

Leakage Current:
    0.2 Amps. @ 115 Vac. 60 Hz.
    0.2 Amps. @ 230 Vac. 50 Hz.

Power Cord Data:
    Plug Type: NEMA 5-15, 120 Vac.
    Cord Length: 6 Feet (1.83 Meters)

● END

A.11.2 Software

The recommended O/S for the CS-D or CS-N is release 3.4.

The minimum O/S required for CPU RAM Disk, address 340, is release 3.0.

ILLUSTRATED PARTS

A.12.1 System Components (Sheet 1 of 6)
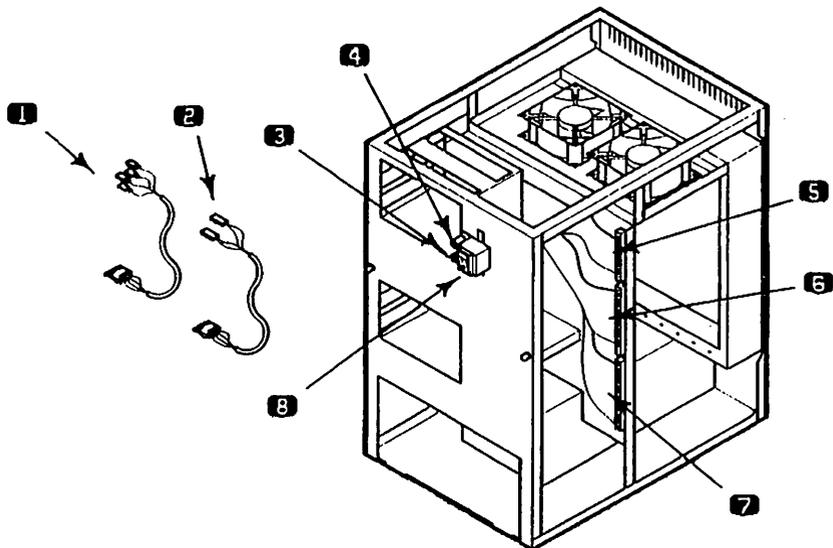
741-1769/A.12.1-1

Item	Part Number	Description
1	220-2057	Ac Power Harness
2	220-2849	Indicator Cable
3	370-0027	Winchester Activity LED
4	370-0051	Power-On (Green) LED
5	220-3707	Streaming Cartridge Tape Drive Signal Cable
6	220-3708	Floppy Disk Drive Signal Cable
7	220-3709	Winchester Disk Drive Control Cable
8	325-0105 325-0096	Ac Power-On/Off Switch (CS-D, CS-N) Ac Power-On/Off Switch (CS Only)

ILLUSTRATED PARTS

A.12.1 System Components (Sheet 2 of 6)
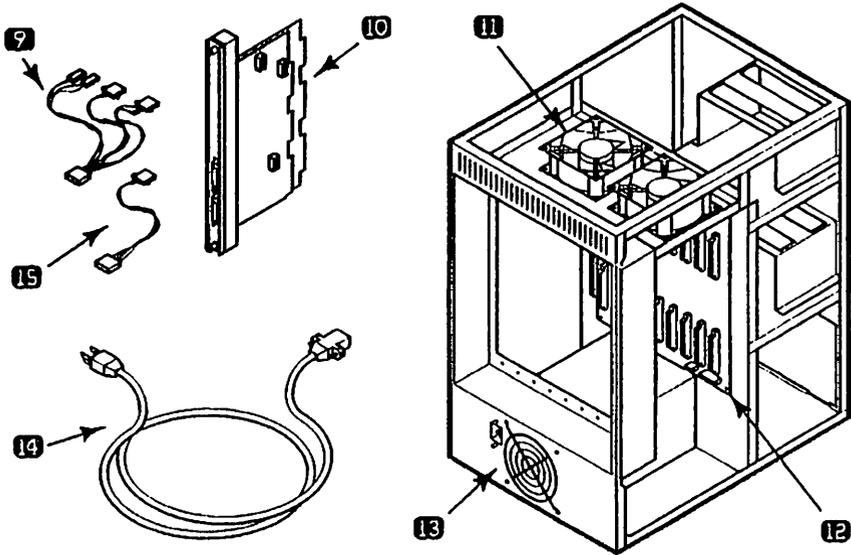
741-1769/A.12.1-2

Item	Part Number	Description
9	220-2851	Dc Power Harness
10	212-7113	Disk Processing Unit (DPU) PCA
11	270-3483	Fan (+12Vdc)
12	210-9560	CS-D, CS-N Motherboard
13	270-0890-1	SPS-255 Dc Power Supply (CS-D, CS-N Version)
	270-0986	SPS-255 Dc Power Supply (CS Version)
14	220-2569	Ac Power Cable
15	220-2850	Dc Power Harness

ILLUSTRATED PARTS

741-1769/A.12.1-3
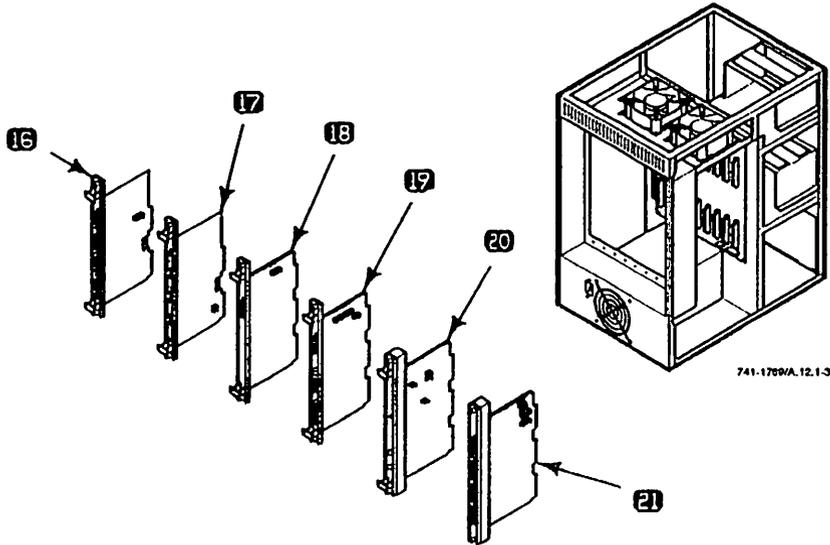
Item	Part Number	Description
16	210-8824	2275 MUX Board
17	210-8825	2275 MUXE Board
18	177-2228-B	2228B TC Controller Board
19	212-3012	22C32 Triple Controller Board
20	210-8576	2258 Local Communications Option Board
21	212-3032	2236MXE 4-Port Controller Board
	212-7113	Disk Processing Unit (DPU) PCA (See Item 10)
	210-8937-x	CPU Board (See Item 24)

ILLUSTRATED PARTS
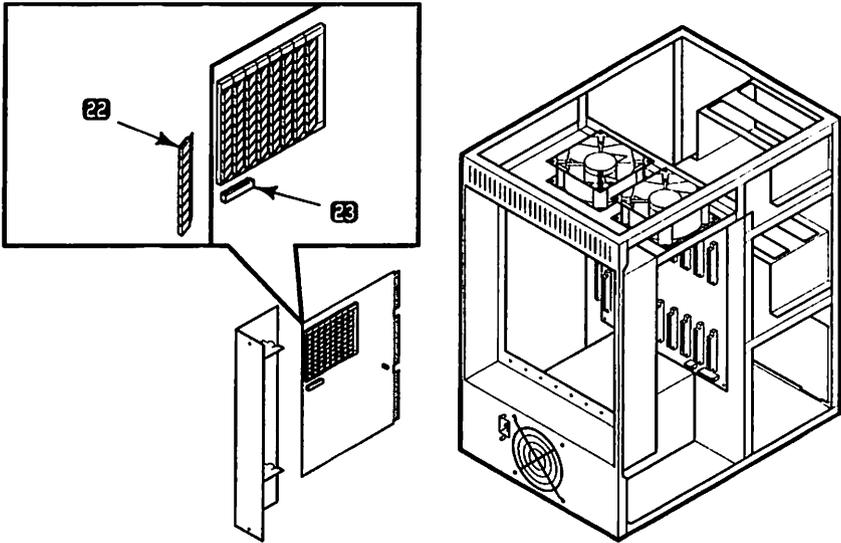
ITEM	PART NUMBER	DESCRIPTION
22)	377-4508	256KB SIMMs CPU Memory Module
	377-4513	1MB SIMMs CPU Memory Module
23)	377-3483	Memory PAL (L2) [128KB CPU Memory Board]
	377-3484	Memory PAL (L2) [512KB CPU Memory Board]
	377-3485	Memory PAL (L2) [1MB CPU Memory Board]
	377-3486	Memory PAL (L2) [2MB CPU Memory Board]
	377-3487	Memory PAL (L2) [4MB CPU Memory Board]
	377-3488	Memory PAL (L2) [8MB CPU Memory Board]

➡NEXT

A.12.1 System Components (Sheet 5 of 6)
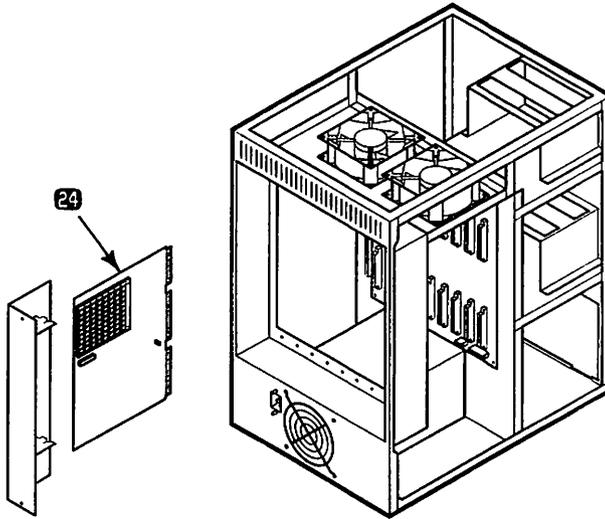
ITEM	PART NUMBER	DESCRIPTION
24)	210-8937-A	CS-2D, CS-2N 128KB Enhanced CPU/Memory Board
	210-8937-B	CS-5D, CS-5N 512KB Enhanced CPU/Memory Board
	210-8937-C	CS-10D, CS-10N 1MB Enhanced CPU/Memory Board
	210-8937-D	CS-20D, CS-20N 2MB Enhanced CPU/Memory Board
	210-8937-E	CS-40D, CS-40N 4MB Enhanced CPU/Memory Board
	210-8937-F	CS-80D, CS-80N 8MB Enhanced CPU/Memory Board
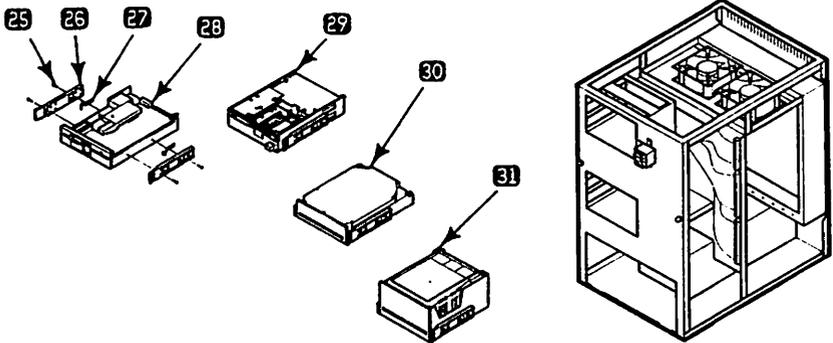
ITEM	PART NUMBER	DESCRIPTION
25)	650-3080	Phillips-Head Screws
26)	449-1213	Magnetic Components Drive Mounting Brackets
27)	465-1864	Grounding Clips
28)	278-4033	5 1/4" Half-Height Internal 360KB Floppy Diskette Drive
	278-4055	5 1/4" Half-Height Internal 1.2MB Floppy Diskette Drive
29)	725-1481	5 1/4" Half-Height Internal Streaming Cartridge Tape Drive
30)	278-4062	20MB Half-Height Internal Winchester Drive
31)	278-4069	32MB Full-Height Internal Winchester Drive
	278-4054	64MB Full-Height Internal Winchester Drive
	725-0271	140MB Full-Height Internal Winchester Drive

● END

APPENDIX B

CS/386-D, -N

B.1.1   Scope and Purpose

The scope and purpose of this Appendix is to provide the information necessary to install, troubleshoot, and repair the Wang CS/386-D and CS/386-N (386 CPU) in the field. Familiarity with the Wang CS product line is recommended for effective use of this document.

Based on the Intel 386 Micro-processor, the 32-bit multi-user CS/386 delivers twice the power of earlier CS models. The CS/386 utilizes the CS-D/-N chassis and replaces CS-10D, -10N thru CS-80D, -80N models. A CPU PCA Upgrade version is also offered to existing VLSI CPU users. The CS/386 provides the following performance benefits:

- Improved performance of 200% to 300% for CPU intensive operations.

- Provides an upgrade path for existing VLSI CPU users.

- Provides improved product performance with larger partition size, an increased number of partitions, improved system filing, and improved I/O performance.

The CS/386 CPU consists of the following features:

- CS-D/N Chassis

- New CPU PCA

- New BASIC 2/386 Operating System (Revision 1.0)

- Plug-compatible with all existing CS series I/O Controllers

- Runs all current software supported on the VLSI CPU

- 16 MHZ 80386 Microprocessor

- Less than One (1) Wait State (Column Static Memory)

- 1MB to 8MB of RAM

- Unlimited Partition size

- 2200 I/O Bus Interface

- High-speed I/O Channel

  Real-time Clock with Battery back-up

- Optional 80387 Co-Processor

- Timer

B.2.1   Major Parts

B.2.1.1   CS/386–D, –N Components
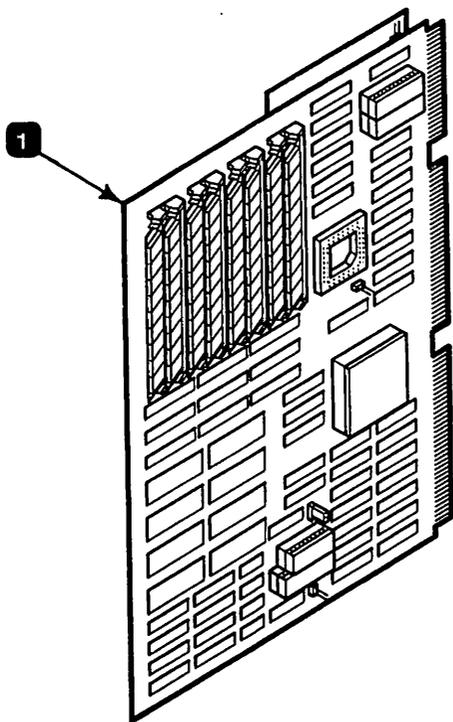
Item	Component
1]	CS/386–D, –N CPU/Memory PCA

B.3.1 Service Controls

B.3.1.1   Central Processing Unit (CPU) Board Controls
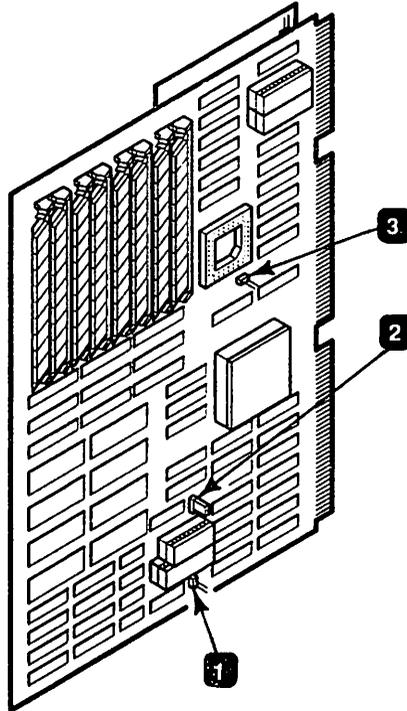
Item	Name	Type and Function
1)	Jumper, J4	PC Board Jumper; select only for PC Board Repair.
2)	Jumper, J5	PC Board Jumper; indicates DRAM SIMM Memory type used (256KB or 1MB).
3)	Jumper, J7	PC Board Jumper; select only for PC Board Repair.

B.3.2   Service Indicators

B.3.2.1   Central Processing Unit (CPU) Board Indicators
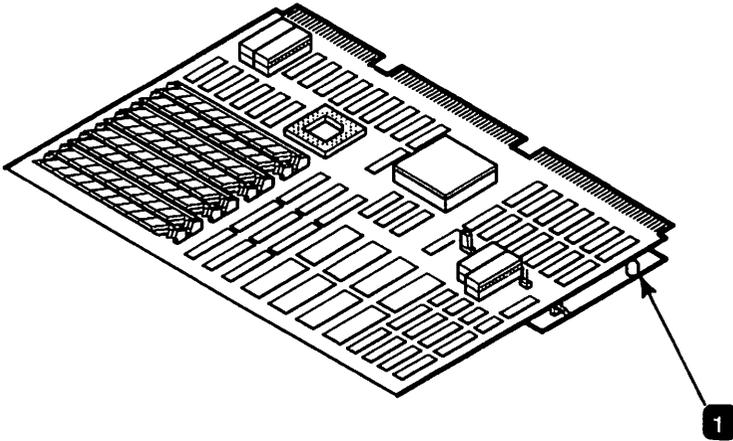
Item	Name	Function
1]	LED1	Power-ON/BIT Test LED; Amber, Indicates BIT Test Pass/Fail at Power-ON.

B.4.1 Diagnostic Error Messages

B.4.1.1   CS/386-D, CS/386-N CPU BIT Diagnostic Tests (Sheet 1 of 4)

The minimum configuration for proper operation of the BIT Diagnostic is a CS-D or CS-N cabinet with a Triple Controller (MXE), a Terminal, and a 386 CPU PCA with 32K PROMs containing the latest version of firmware and diagnostic BIT (located at L23 and L33).

The BIT tests the following hardware on the CS/386 CPU PCA: 80386 CPU, RTC, 32K PROM, 256K SRAM and up to 8MB of installed DRAM. User messages are received via the CPU PCA LED or the 2200 Terminal. The BIT automatically runs when the CS/386-D, CS/386-N is Powered-ON.

#	Test Name	Hardware Tested
1]	SRAM Data Bus Test	Data lines of Static RAM
2]	SRAM Parity Generator/Check Test	SRAM Parity Error Circuitry
3]	SRAM Byte Decode Address Line Test	SRAM Byte Decode Address lines
4]	SRAM Address Line Test	Address Bus of SRAM
5]	SRAM Data Fast Exchange Test	All SRAM Cells Dynamic Data Test Faults
6]	DRAM Data Bus Test	Data lines of DRAM
7]	DRAM Parity Generator/Check Test	DRAM Parity Error Circuitry
8]	DRAM Byte Decode Address Line Test	DRAM Byte Decode Address lines
9]	DRAM Address Line Test	Address Bus of DRAM
A]	DRAM Data Fast Exchange Test	All SRAM Cells Dynamic Data/ Address Faults

B.4.1   Diagnostic Error Messages

B.4.1.1   CS/386-D, CS/386-N CPU BIT Diagnostic Tests (Sheet 2 of 4)

CPU BIT Operation

Prior to a normal Power-ON of the
CS/386-D or CS/386-N System,
perform the following:

1. Remove the CS/386-D or
CS/386-N Chassis Side Panel
to view the following test
results found at the CPU PCA
LED [->A.7.2.3].

Following a normal Power-ON, the
Diagnostic LED is illuminated-ON,
and then is illuminated-OFF if the
BIT Diagnostic Test is complete.
If the LED remains illuminated-ON,
the indication is that the SRAM
did not pass the BIT Test.
Additional Troubleshooting
Diagnostic Tests can be run as
follows:

2 WARM-UP START: Select CPU
Diagnostics entry and BIT
will restart from Test 5 thru
to Test A [->B.4.1.1].

2200 (CPU BIT) Terminal Display

When the 2200 Terminal displays:

    Copyright, Wang Laboratories, Inc., 1989 Rev.5950
    SRAM 256KB

    This indicates that the SRAM
has passed BIT and the 80386 is in
a protect mode.

END

B.4.1 Diagnostic Error Messages

B.4.1.1   CS/386–D, CS/386–N CPU BIT Diagnostic Tests (Sheet 3 of 4)

2200 (CPU BIT) Terminal Display

When the 2200 Terminal continu-
ously displays:

          Copyright, Wang Laboratories, Inc., 1989 Rev.5950
          SRAM 256KB
          DRAM 8192KB

     This indicates that the DRAM
has passed BIT and the DRAM size
is 8MB. The memory size shown is
the BIT detected size. If the
size indicated is less than the
physically configured size, the
DRAM is faulty. After the above
display is shown, the BIT passes
the control to Boot Loader
firmware.

When the 2200 Terminal displays:

          Copyright, Wang Laboratories, Inc., 1989 Rev.5950
          SRAM 256KB

     Test 6 has failed, and DRAM
Data Bus is open or shorted.

When the 2200 Terminal displays:

          Copyright, Wang Laboratories, Inc., 1989 Rev.5950
          SRAM 256KB
          D

     Test 7 has failed, and DRAM
has Parity Error.

B.4.1 Diagnostic Error Messages

B.4.1.1 CS/386-D, CS/386-N CPU BIT Diagnostic Tests (Sheet 4 of 4)

2200 (CPU BIT) Terminal Display

When the 2200 Terminal displays:

```
Copyright. Wang Laboratories. Inc., 1989  Rev.5950
SRAM 256KB
DR
```

Test 8 has failed, and DRAM
Byte Decode Address lines has an
error.

When the 2200 Terminal displays:

```
Copyright. Wang Laboratories. Inc., 1989  Rev.5950
SRAM 256KB
DRA
```

Test 9 has failed, and DRAM
Address Bus is either open or
shorted.

When the 2200 Terminal displays:

```
Copyright. Wang Laboratories. Inc., 1989  Rev.5950
SRAM 256KB
DRAM    0KB
```

Test A has failed, and the
first 128KB DRAM has a read/write
error.

When the 2200 Terminal displays:

```
Copyright. Wang Laboratories. Inc., 1989  Rev.5950
SRAM 256KB
DRAM 128KB
```

Test A has failed, and the
DRAM between 128KB and 256KB has a
read/write error.

B.5.1 Removal Procedure

B.5.1.1   CS–D, CS–N CPU PCA Removal

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                  NOTE

This procedure applies to CS–D and
CS–N Systems.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Removal of the CS–D and CS–N CPU
PCA is accomplished (for upgrade
purposes) as follows:

1 Power–OFF the CS–D or CS–N
   System [–>4.2].

2 Remove Side Panels
   [–>A.7.2.3].

3 Remove CPU PCA [–>A.7.2.5].

END

B.6.1 Unpacking Procedure

B.6.1.1 CS/386-D, CS/386-N CPU PCA Unpacking Procedure

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
CAUTION

The CS/386-D and CS/386-N CPU PCAs are of unique construction (Mother-board, Daughterboard) and must be handled carefully to eliminate component damage on both PCAs.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Unpacking CS-386 CPU PCA

Unpack the CPU PCA as follows:

1 Open packing carton and remove CPU PCA.
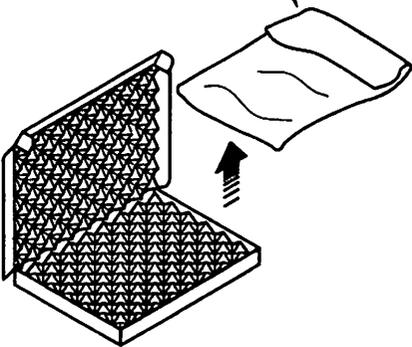
2 Carefully remove CPU PCA from anti-static bag.
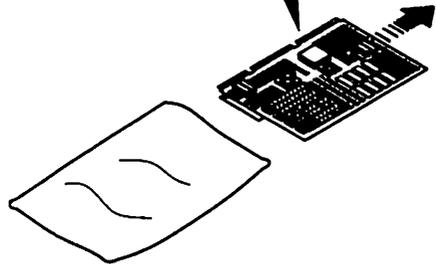
Claims Information

1 Inspect CPU PCA for damage. Report damage to your manager.

END

B.6.1   System Software

B.6.1.1   Minimum Required Operating System

Proper operation of the
CS/386-D,-N requires that the
BASIC 2/386 Operating System,
minimum Revision 1.0 (available on
diskette) be installed.

Microcode Diagnostics and
Peripheral Device Diagnostics for
the CS/386-D, -N are in Diagnostic
Package P/N 195-2956-0.

B.6.2   Lithium Battery Installation

B.6.2.1   Safety Procedure

~~~~~~
                WARNING

Lithium batteries can be a fire,
explosion, or severe burn hazard.
Do not recharge, heat above 212°F,
disassemble, solder directly to
the cell, incinerate, or expose
contents to water.
~~~~~~

B.6.2   Lithium Battery Installation

B.6.2.2   Installation Procedure

Install the Lithium Battery as
follows:

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                NOTE

Proper operation of the CS/386 CPU
Clock is dependent on the correct
battery polarity connection.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

1 Attach female connector of
Lithium Battery to male
connector mounted on side of
Daughterboard.

2 Remove wax paper covering
battery adhesive pad and
press battery firmly to
nearby chassis frame.

END
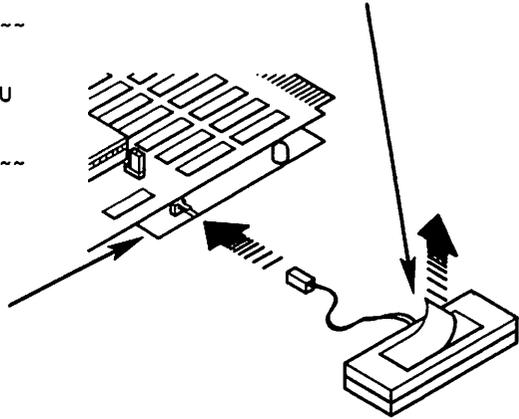
B.6.3   CS-D, CS/386-D Upgrades

B.6.3.1   Chassis Cabling Diagram

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
NOTE

When Multiplexing internal Disk
Drives of a CS-D or CS/386-D, a
maximum of 16 CPUs can be connected
(15 CPUs plus the Host CPU).
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
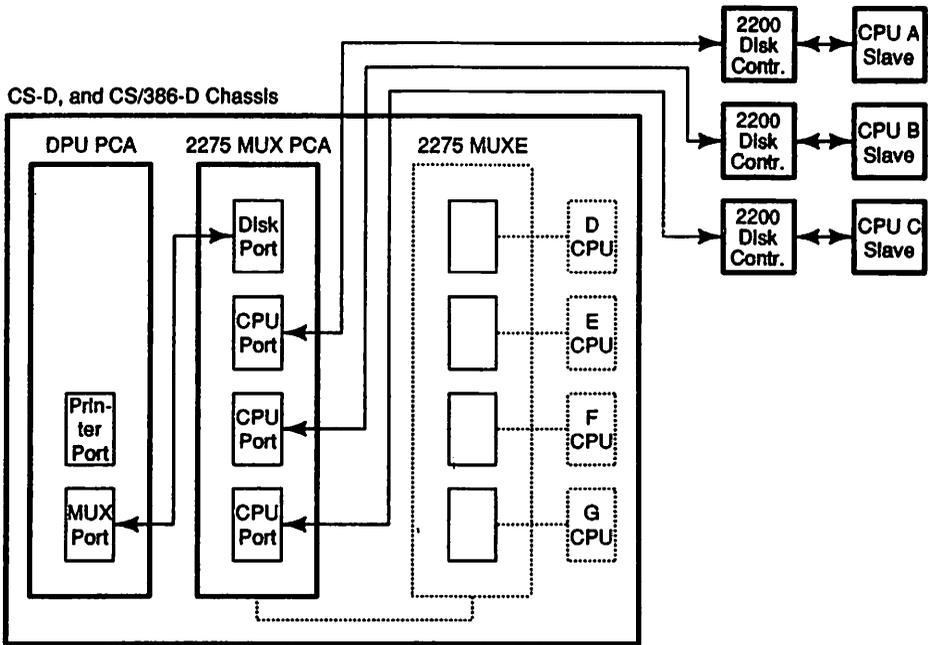
B.6.3   CS-D, CS/386-D Upgrades

B.6.3.2   DPU PCA (J3A) Jumper Settings

Set DPU PCA MUX/BUS Jumper (J3A)
as follows:

1   If system is multiplexing
the internal disk drive,
set jumper shorting pins 1
and 2 (MUX position).

J3A   3
      2
      1

2   If system is used as a
stand-alone CPU, set jumper
shorting pins 2 and 3 (BUS
position).

J3A   3
      2
      1

END

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.3   Multiplexing CS-D, CS/386-D Internal Disk Drives
(Sheet 1 of 3)

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
NOTE

• Set the Disk Address on the
2275 MUX PCA (not on the DPU
PCA).

• The 2275 MUX and 2275 MUXE PCAs
must be installed in adjacent
I/O slots.

• A maximum of 16 CPUs can be
connected (15 CPUs plus the
Host CPU).

• Three (maximum) additional MUXE
PCAs can be added for
additional CPUs.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Multiplexing Procedure

2 Install 2275 MUX PCA in I/O
slot adjacent to DPU PCA
[->9.8.2].

1 Set Disk Address (SW1) on
2275 MUX PCA.

```
 1 2 3 4 5 6 7 8
┌─────────────────┐
│ ⊓⊓⊓⊓⊓⊓⊓⊓ │
└─────────────────┘

              o o o o X o o o
Address      ⬚⬚⬚⬚⬚⬚⬚⬚
310

              o o o o X o o
Address      ⬚⬚⬚⬚⬚⬚⬚⬚
320

              o o o o X X o o
Address      ⬚⬚⬚⬚⬚⬚⬚⬚
330
```

8 = Switch Position
o = Open
x = Closed

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.3   Multiplexing CS-D, CS/386-D Internal Disk Drives
(Sheet 2 of 3)

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
NOTE

When using additional boards, no
two addresses can have the same
setting.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

4   Install any 2275 MUXE PCAs in
slots adjacent to 2275 MUX
PCA [->9.8.2].

5   Install cable from MUX Port
of DPU PCA to Disk Port of
2275 MUX PCA [->9.5.5, 9.8.1,
A.9.5.1].

3   Set 2275 MUXE Address
Switch #1 for proper MUXE
Address.

Addresses

	1	2	3
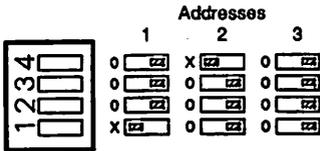
CB = Switch Position
0 = Open
X = Closed

->NEXT

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.3   Multiplexing CS-D, CS/386-D Internal Disk Drives
(Sheet 3 of 3)

Multiplexing Procedure

6   Set Disk Address (SW1) on
22C80 Disk Controller
[->9.4.4].

7   Install 22C80 Disk Controller
in Slave System [->9.8.2].

8   Install cable from 22C80 Disk
Controller to CPU Port on
2275 MUX or 2275 MUXE PCA
[->9.5.5, 9.8.1, A.9.5.1].

9   Verify that Slave CPU can
access Disk Drive in CS-D or
CS/386-D System.

END

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.4   CPU PCA SIMMs Memory (J5) Jumper Settings

Set SIMMs Memory Jumper (J5) as
follows:

1   If 256KB SIMM size (SIMMs
Memory values up to and
including 2MB) is used,
mount jumper shorting pins
1 and 2.

J5   3
     2
     1

2   If 1MB SIMM size (SIMMs
Memory values over 4MB) is
used, mount jumper shorting
pins 2 and 3.

J5   3
     2
     1

END
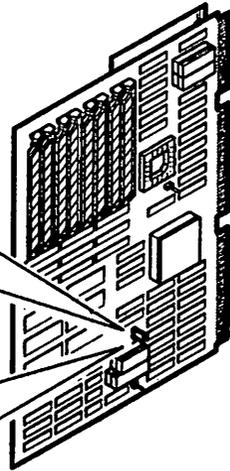
B.6.3   CS-D, CS/386-D Upgrades

B.6.3.5   Existing VLSI CPU PCA Memory Upgrades

Existing users can replace a VLSI
CPU PCA with the CS/386 CPU PCA by
ordering an Upgrade Kit:

Kit Name	Kit P/N	Kit Description	386 CPU PCA Memory
UJ-6048	205-6048	VLSI CPU PCA to 1MB 386 CPU PCA	1MB
UJ-6049	205-6049	VLSI CPU PCA to 2MB 386 CPU PCA	2MB
UJ-6050	205-6050	VLSI CPU PCA to 4MB 386 CPU PCA	4MB
UJ-6051	205-6051	VLSI CPU PCA to 8MB 386 CPU PCA	8MB

CPU/Memory PCA Replacement Instructions

1 Power-OFF system [->4.2].

2 Remove VLSI CPU PCA [->7.2.1].

3 Install 386 CPU PCA using
reverse steps [->7.2.1].

4 Power-ON system [->4.1].

5 Install new (Basic 2/386
Operating System, minimum
Revision 1.0), available on
diskette.

6 Run Diagnostic to verify
system CPU operation.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
NOTE

The Micro Diagnostic for the 386
CPU/Memory PCA is incorporated in
the Basic 2/386 Operating System,
Revision 1.0.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

END

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.6   386 CPU PCA Memory Upgrade Procedures (Sheet 1 of 8)

386 CPU/Memory PCA Upgrade Kits

Kit Name	Kit Description
UJ-6052	1MB to 2MB 386 CPU PCA Memory Upgrade
UJ-6053	1MB to 4MB 386 CPU PCA Memory Upgrade
UJ-6054	1MB to 8MB 386 CPU PCA Memory Upgrade
UJ-6055	2MB to 4MB 386 CPU PCA Memory Upgrade
UJ-6056	2MB to 8MB 386 CPU PCA Memory Upgrade
UJ-6057	4MB to 8MB 386 CPU PCA Memory Upgrade

386 CPU/Memory PCA Upgrade Contents:

Each Upgrade Kit includes, in addition to the CS/386 CPU, the following items:

- PAL chip specifically tailored to desired upgrade memory size

- Necessary quantity of DRAM SIMMs Memory Modules to accomplish the upgrade

- Operating System (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.6   386 CPU PCA Memory Upgrade Procedures (Sheet 2 of 8)

Presently installed CPU/Memory
PCAs can be upgraded to 386
CPU/Memory PCAs by ordering the
following upgrade kits:

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
1MB	2MB	UJ-6052	205-6052	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3777) and four (4) 256KB DRAM SIMMs Modules (P/N 377-4516).

Accomplish the upgrade as follows:

1 Power-OFF system [->4.2].

2 Remove CPU/Memory PCA from system [->7.2.1].

3 Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4 Insert four (4) 256KB DRAM SIMMs Modules using reverse steps [->9.8.4].

5 Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

6 Power-ON system [->4.1].

7 Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

8 Run Diagnostic to verify operation of 386 CPU PCA and system operation.

->NEXT

B.6.3 CS-D, CS/386-D Upgrades

B.6.3.6 386 CPU PCA Memory Upgrade Procedures (Sheet 3 of 8)

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
1MB	4MB	UJ-6053	205-6053	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3778) and four (4) 1MB DRAM SIMMs Modules (P/N 377-4518).

Accomplish the upgrade as follows:

1 Power-OFF system [->4.2].

2 Remove CPU/Memory PCA from system [->7.2.1].

3 Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4 Remove four (4) 256KB SIMMs Modules [->9.8.4].

5 Insert four (4) 1MB DRAM SIMMs Modules using reverse steps [->9.8.4].

6 Position jumper J5 correctly to reflect 1MB DRAM SIMMs Module installation [->B.6.5.4].

7 Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

8 Power-ON system [->4.1].

9 Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

10 Run Diagnostic to verify operation of 386 CPU PCA and system operation.

-->NEXT

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.6   386 CPU PCA Memory Upgrade Procedures (Sheet 4 of 8)

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
1MB	8MB	UJ-6054	205-6054	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3779) and eight (8) 1MB DRAM SIMMs Modules (P/N 377-4518).

Accomplish the upgrade as follows:

1 Power-OFF system [->4.2].

2 Remove CPU/Memory PCA from system [->7.2.1].

3 Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4 Remove four (4) 256KB SIMMs Modules [->9.8.4].

5 Insert eight (8) 1MB DRAM SIMMs Modules using reverse steps [->9.8.4].

6 Position jumper J5 correctly to reflect 1MB DRAM SIMMs Module installation [->B.6.5.4].

7 Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

8 Power-ON system [->4.1].

9 Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

10 Run Diagnostic to verify operation of 386 CPU PCA and system operation.

B.6.3   CS-D, CS/386-D Upgrades

B.6.3.6   386 CPU PCA Memory Upgrade Procedures (Sheet 5 of 8)

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
2MB	4MB	UJ-6055	205-6055	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3778) and four (4) 1MB DRAM SIMMs Modules (P/N 377-4518).

Accomplish the upgrade as follows:

1 Power-OFF system [->4.2].

2 Remove CPU/Memory PCA from system [->7.2.1].

3 Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4 Remove eight (8) 256KB SIMMs Modules [->9.8.4].

5 Insert four (4) 1MB DRAM SIMMs Modules using reverse steps [->9.8.4].

6 Position jumper J5 correctly to reflect 1MB DRAM SIMMs Module installation [->B.6.5.4].

7 Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

8 Power-ON system [->4.1].

9 Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

10 Run Diagnostic to verify operation of 386 CPU PCA and system operation.

-> NEXT

B.6.3 CS-D, CS/386-D Upgrades

B.6.3.6   386 CPU PCA Memory Upgrade Procedures (Sheet 6 of 8)

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
2MB	8MB	UJ-6056	205-6056	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3779) and eight (8) 1MB DRAM SIMMs Modules (P/N 377-4518).

Accomplish the upgrade as follows:

1   Power-OFF system [->4.2].

2   Remove CPU/Memory PCA from system [->7.2.1].

3   Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4   Remove eight (8) 256KB SIMMs Modules [->9.8.4].

5   Insert eight (8) 1MB DRAM SIMMs Modules using reverse steps [->9.8.4].

6   Position jumper J5 correctly to reflect 1MB DRAM SIMMs Module installation [->B.6.5.4].

7   Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

8   Power-ON system [->4.1].

9   Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

10   Run Diagnostic to verify operation of 386 CPU PCA and system operation.

-->NEXT

B.6.3 CS-D, CS/386-D Upgrades

B.6.3.6 386 CPU PCA Memory Upgrade Procedures (Sheet 7 of 8)

Upgrade From	Upgrade To	Kit Number	Upgrade Part Number	Upgrade Comments
4MB	8MB	UJ-6057	205-6057	Kit includes one (1) new PAL chip for memory addressing (P/N 377-3779) and four (4) 1MB DRAM SIMMs Modules (P/N 377-4518).

Accomplish the upgrade as follows:

1 Power-OFF system [->4.2].

2 Remove CPU/Memory PCA from system [->7.2.1].

3 Replace PAL chip at PCA location L62 with PAL chip supplied in kit [->B.6.5.6].

4 Insert four (4) 1MB DRAM SIMMs Modules using reverse steps [->9.8.4].

5 Install upgraded CPU/Memory PCA using reverse steps [->7.2.1].

6 Power-ON system [->4.1].

7 Install new (Basic 2/386 Operating System, minimum Revision 1.0), available on diskette.

8 Run Diagnostic to verify operation of 386 CPU PCA and system operation.

END

B.6.3 CS-D, CS/386-D Upgrades

B.6.3.6 386 CPU PCA Memory Upgrade Procedures (Sheet 8 of 8)

386 CPU PCA
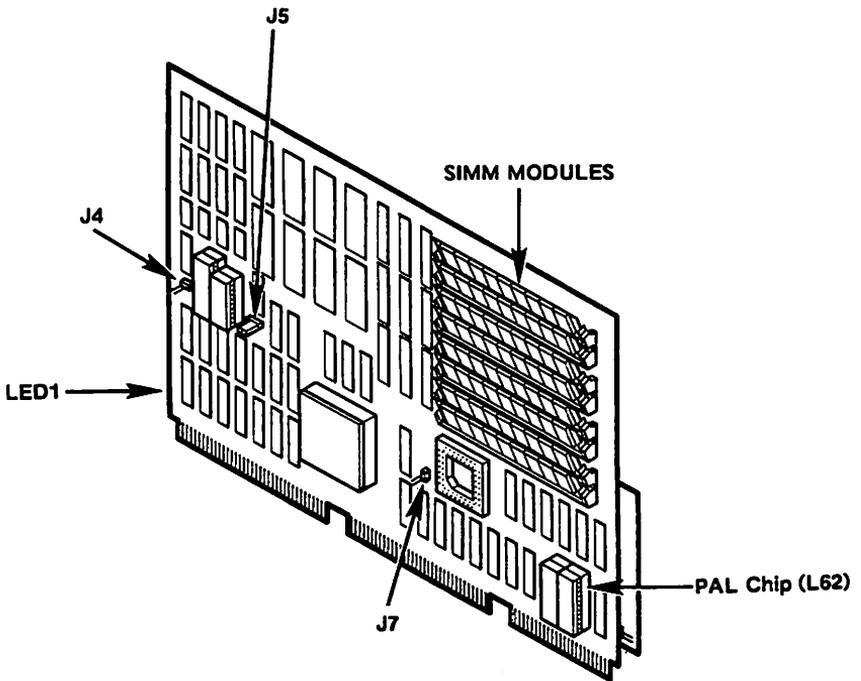
B.7.1   Introduction

The CS/386-D, -N Computer System
is a high performance CPU with
expanded memory. The following
lists major features of the
CS/386-D, -N Computer System.

- 32 BIT CPU PCA designed to
  utilize the INTEL 80386-16
  Microprocessor.

- Choice of 1MB, 2MB, 4MB or 8MB
  of SIMM DRAM CPU Memory.

- CS/386 CPU PCA replaces VLSI
  CPU PCA (uses the same slot).

- Includes a Daughter Board
  attached to the CS/386 CPU PCA
  which simulates Wang 2200
  series CPU I/O Timing and
  Programming•Note.

- SRAM Controller Timing and SRAM
  Memory

- DRAM Controller Timing and DRAM
  Memory

- DRAM Refresh Counter

- Bootstrap EPROM

B.7.2   System Description

CPU PCA

The CPU PCA utilizes an INTEL
80386-16, 32-BIT high performance
Microprocessor chip as the main
processing device. This chip is
packaged in ceramic, and contains
132 (input/output) pins for
different buses and signals needed
for correct CS-386/D, -N operation.

CPU PCA MEMORY

The CPU PCA memory is organized in
banks of 36 bits (32 bits of Data
and 4 bits of Parity). This
design utilizes eight (8) 32KB
SRAM chips or four (4) 64KB SRAM
chips for the 256KB system
memory. The 1MB CPU Memory is
comprised of four (4) 256K X 9 Bit
SIMM Modules, the 2MB CPU Memory
is comprised of eight (8) 256K X 9
Bit SIMM Modules, the 4MB CPU
Memory is comprised of four (4) 1
MEG X 9 Bit SIMM Modules, and the
8MB CPU Memory is comprised of
eight (8) 1 MEG X 9 Bit SIMM
Modules.

All memory operates under the
INTEL 80386 Pipelined Address
except EPROM Bootstrap Memory.
Therefore, the CPU Address line
always stores L39 and L75 until
the next Read/Write signal is
accepted.

B.7.2 System Description

CPU PCA BLOCK DIAGRAM

80386-16 CPU

I/O EPROM Decoder

DRAM PAL Decoder

Address Latch

SRAM PAL Decoder

16 Bit Data Buffer

32 Bit Data Buffer

2=1 MUX

CS0

CS1

CSX

LA2 | 16 LA2 | 16 LA2 | 17

BA0

	SRAM	
32K X 8	32K X 8	64K X 1
32K X 8	32K X 8	64K X 1
32K X 8	32K X 8	64K X 1
32K X 8	32K X 8	64K X 1

7
8
15
16
23
26
31

A4S1

RAS09

Max. | 9 Max | 9

#4	DRAM SIMM #0	CAS0
		BD0-7
		BD8-15
#5	#1	CAS1
		BD16-23
#6	#2	CAS2
		CAS3
#7	#3	BD24-31

EPROM (Odd)

EPROM (Even)

CPU Status & CTRL Signal

Address Bus

Out Bus

IB Bus

Real Time Clock

CPB | ABS | CBS | OBS | IBS | HALT | IDCLK | R-B

B.7.2   System Description

MEMORY ALLOCATION MAP

SRAM	00000000	
	0003FFFF	
DRAM	00040000	
	0083FFFF	
RESERVED	00840000	
	FFF7FFFF	
TIMSET	FFFF8000	
CPUST	FFFF8002	
CPUFLG	FFFF8004	
CPURDY	FFFF8006	
RTCLOCK	FFFF8008	
RTCLOCK	FFFF800A	
IBGET	FFFF800C	
IOB	FFFF800E	
RESERVED	FFFF8010	
ABS	FFFF8012	
OBS	FFFF8014	
RESERVED	FFFF8016	
CBS	FFFF8018	
RESERVED	FFFF801A	
	FFFF801F	
NOT USED	FFFF8020	
	FFFFBFFF	
EPROM	FFFFC000	
	FFFFFFFF	
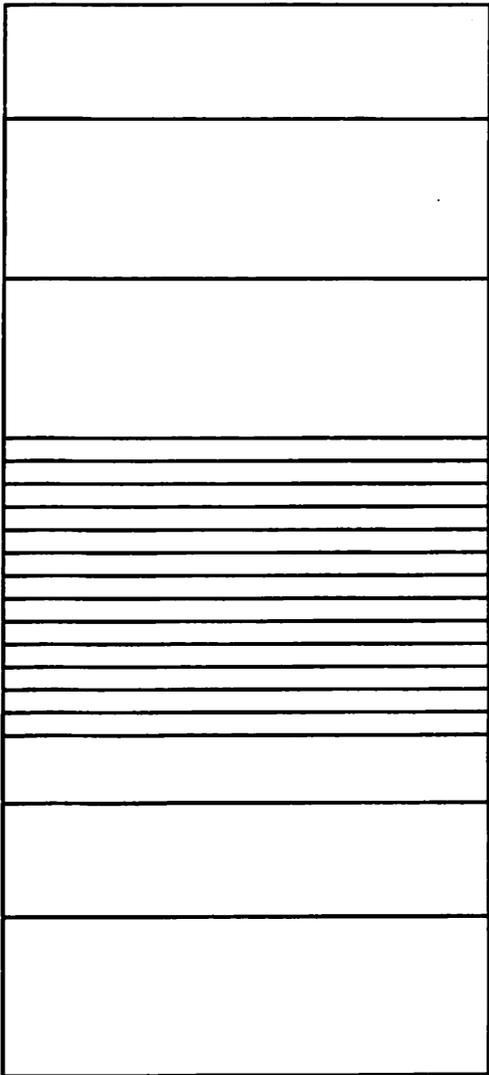
B.7.2   System Description

SRAM MEMORY ACCESS ARBITRATION AND CYCLE CONTROL

The allocation of SRAM Memory Access Arbitration and Cycle Control area of memory is from 00000000 to 0003FFFF. This memory area stores organized 256KB memory as 36 bit data consisting of 32 bits of data (eight [8] 32KB SRAM chips) and four [4] Bits of Parity (four [4] 64KB of SRAM chips).

SRAM MEMORY ACCESS ARBITRATION

The PAL chip (L40) checks all Addresses transmitted from the 80386 CPU and then changes the decoded output to an active state. When the signal named "STAT0 and STAT1" (any output of PAL chip L40) is changed, this indicates that the SRAM memory is activated from an idle mode. When the 80386 Microprocessor chip is performing a write cycle to SRAM Memory, this PAL decodes one or more of the WE0/, WE1/, WE2/, or WE3/ signals. During these transactions, "STAT0 or STAT1" is transmitted to PAL chip (L44) as a timing reference to the Decoded Output SRAM Control Signal such as OE (Output/Enable), CS (Chip Selected) and 80386 Control Signal such as NAS/ (Pipeline Address for SRAM), RDYS/ (SRAM ready, read or write for 80386).

B.7.2   System Description

SRAM MEMORY BLOCK DIAGRAM

                   COMPANY CONFIDENTIAL
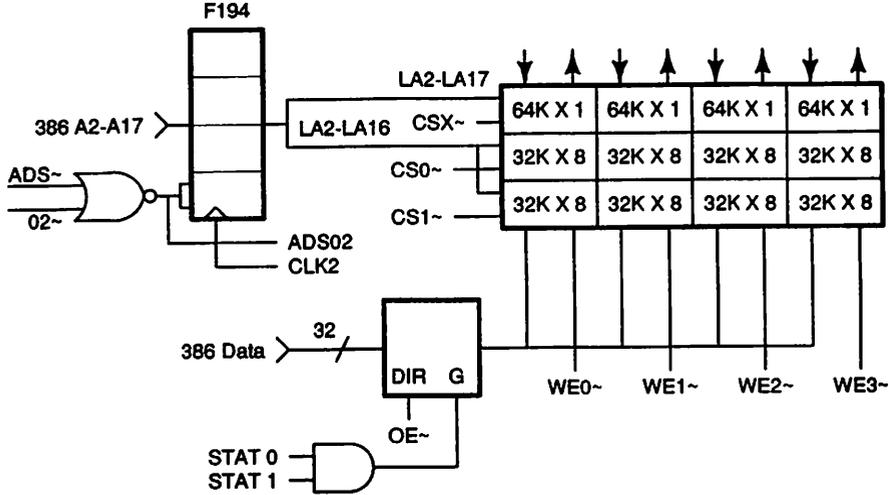
B.7.2   System Description

DRAM MEMORY

DRAM memory is allocated from 00040000 to 0083FFFF. This memory area stores organized 1MB Memory up to 8MB Memory as 36 Bit wide data length consisting of four (4) 256K X 9 Bit SIMM or 1 Meg X 9 Bit SIMM Memory. Page mode operation, available with most DRAMs, operates because the access to the internal DRAM array makes available a large number of memory bytes (512 Bytes in a 256K SIMM or 1024 Bytes in a 1 Meg SIMM) that are selected by using the column address. If four (4) SIMMs are used to implement a bank, a page consists of 512 X 4 = 2KB or 1024 X 4 = 4KB of memory. The page mode has a faster access time than the normal access time, permitting more relaxed timing in order to achieve the same zero wait-state "hit" access.

DRAM MEMORY ACCESS ARBITRATION

Referring to the System Block Diagram, the PAL (L62) checks the addresses coming from the 80386 CPU and then drives the decoded output to an active state. When the signals named STATD0, STATD1 and STATD2 (any output of L62-18, 19, and 20) change state, this indicates that the DRAM Memory is activated from the idle mode or enter refresh DRAM cycle. At the same time the RASE0, RASE1, R5 and ROE may be activated according to STATD0, STATD1, or STATD2.

The STATD0, STATD1 or STATD2 signals are sent to PAL (L63) which are then sent along with BE0, BE1, BE2, BE3, Write/Read to a decoded output CAS*/DWE* for DRAM SIMM as a control signal.

B.7.2   System Description

DRAM MEMORY BLOCK DIAGRAM
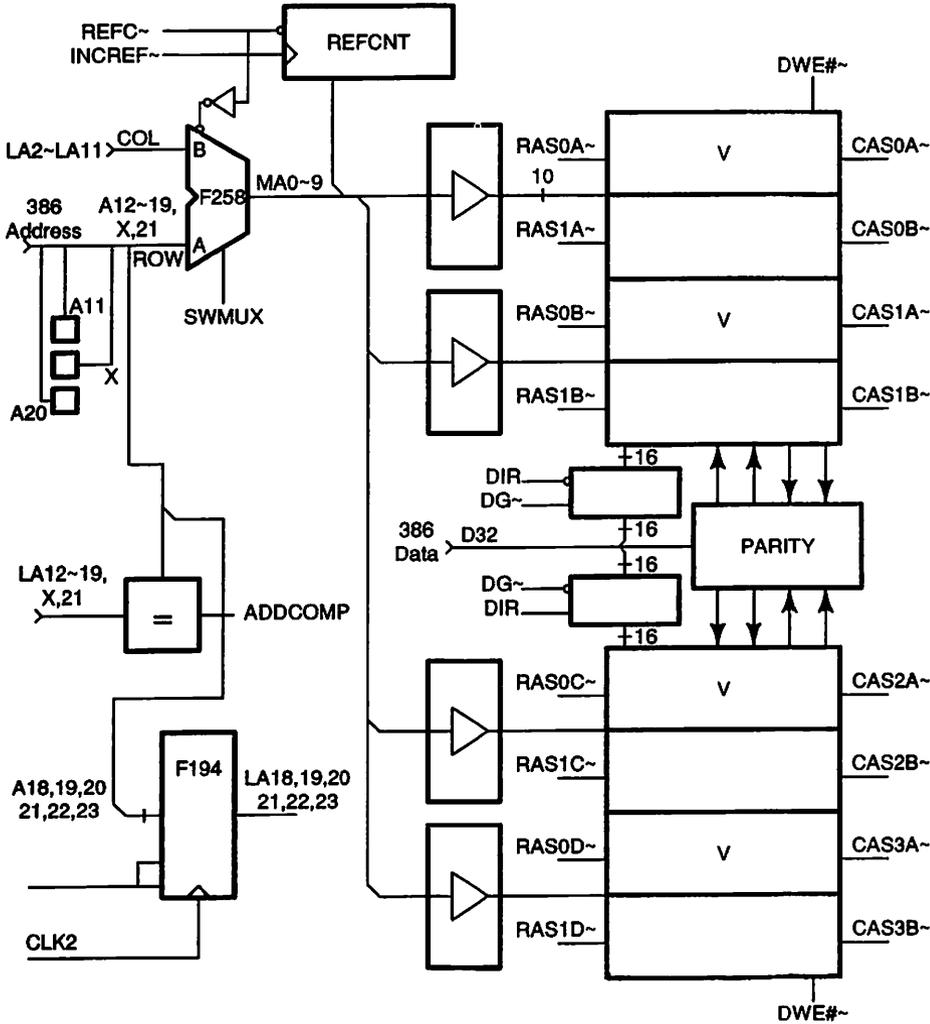
B.7.2   System Description

RAS/CAS ADDRESS

During the memory cycle, the address line coming from the 80386 is sent to the A Port input pin of the tristate multiplex PALs (L34, L35 and L36) as RAS Addresses, and the B Port pin connected to the Address Latch circuit is sent as CAS Addresses. These multiplexed outputs pass through four (4) ten (10) Bit Address Buffers (L1, L19, L32 and L33), then are sent to DRAM SIMM Memory as Memory Addresses.

REFRESH CYCLE

Referring again to the System Block Diagram, the divide counter creates the MSB (most significant bit) Pulse as a Refresh Request signal. PAL (L7) uses this signal to check the state status coming from the 80386 CPU PCA, and then drives the decoded output as Refresh Cycle Counter output (REFA4, REFA5, REFA6, REFA7 and REFA8 and REFC/).

CLOCK GENERATOR/RESET

The Clock Generator is a 32 Mhz Oscillator designed to drive the 80386 CPU chip. The 32 Mhz Clock functions as a divide by two circuit to define Phase 1 or Phase 2 periods of the Processor Clock. This output along with additional logic creates a System RESET signal.

B.7.2   System Description

PARITY CHECK

The 80386 CPU has a Non-Maskable Interrupt (NMI) that functions on the occasion of an on-board parity error. Four (4) Parity Generators (L70, L71, L72 and L73) and additional logic (L18, L67) exist that create and latch parity error (L17 for DRAM, L16 for SRAM) when parity error occurs.

MISCELLANEOUS LOGIC

The page mode of DRAM's faster performance function is utilized to create a 'No Wait' cycle if a 'Hit RASE Address' is generated. PAL chips (L37, L38) are used to compare RASE Address and generate a Hit Signal 'ADDCOMP/'. The 128 Divide Counter (L46, L64) is used to 'turn-on' DRAM RASE Precharge during this period.

BOOTSTRAP EPROM

There are 16KB of EPROM resident on the 80386 CPU PCA. The Boot ROM handles the following: Power-ON diagnostics, system functions present, system status (functional/non-functional), and loading in the software loader from external storage. The EPROM can be addressed from OFFFFC000 to OFFFFFFFF, and the Power-ON Enter Point can be addressed at OFFFFFFF0.

I/O INTERFACE AND REAL-TIME CLOCK

Referring to the System Block Diagram, PAL (L31) generates 16 Bits of P0386 signals such as: BS₁6/ (originates from a 16 Bit wide device or memory), EPIORDY/ (EPROM or I/O Ready Signal), EPROM/ (EPROM selected), IODEV (I/O selected), and I/O Status Bit (STE0, STE1, STE2).

B.7.2 System Description

PARITY GENERATOR
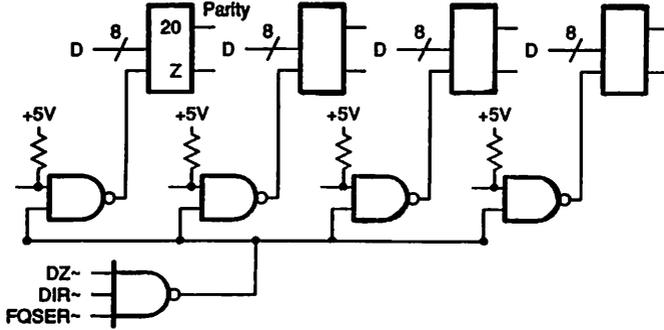
PARITY ERROR LATCH FOR DRAM
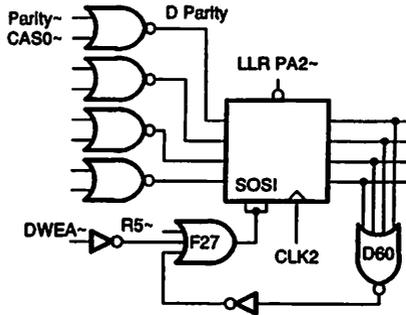
PARITY ERROR LATCH FOR SRAM
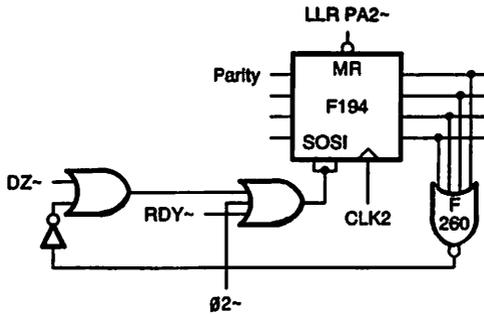
B.7.2   System Description

DRAM ROW ADDRESS COMPARE
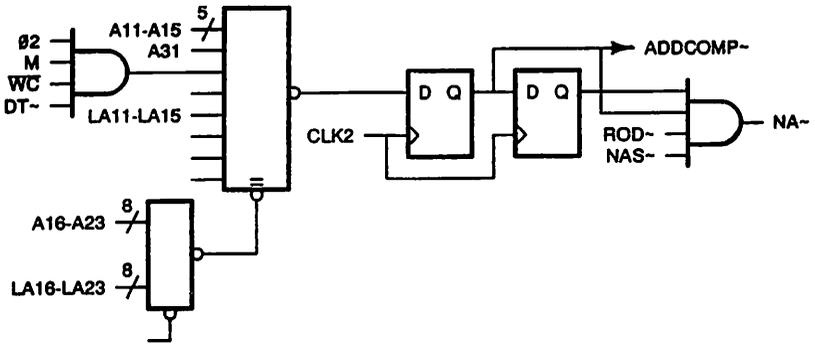
DRAM REFERENCE COUNTER
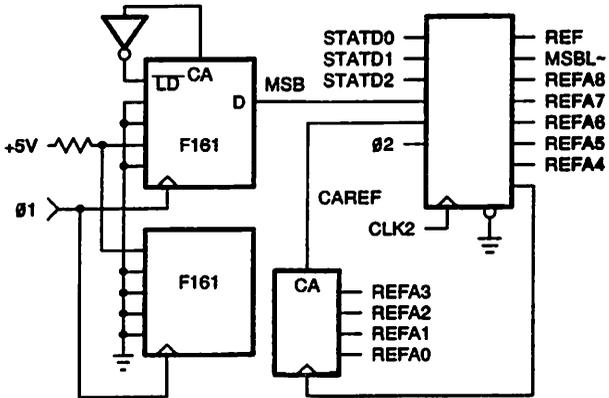
B.8.1   Hardware

CS/386-D, -B CABINET DIMENSIONS:

Height: 23.87 Inches (60.6 Cm.)
Width: 15.0 Inches (38.1 Cm.)
Length: 15.75 Inches (40.0 Cm.)

OPERATING ENVIRONMENT:

Temperature Range:
Storage: 0° to 120°F. (packaged)
            (-17° to 50°C.)
Operating: 60° to 90°C.
            (17° to 32°C.)

Humidity Range:
Storage: 10% to 90% (packaged)
Operating: 20% to 80%
Maximum Wet Bulb Temperature:
            75°F. (24.4° C.)

Service Space Requirements:
Front: 30 Inches (76.2 Cm.)
Rear: 36 Inches (91.4 Cm.)
Top: 20 Inches (50.8 Cm.)

Voltage Range:
115 Vac., 60 Hz., +12/-12 Volts,
            +0.5/-0.5 Hz.
230 Vac., 50 Hz., +24/-24 Volts,
            +0.5/-0.5 Hz.

Input Current:
2.0 Amps. @ 115 Vac., 60 Hz.
1.0 Amp. @ 230 Vac., 50 Hz.

Input Power:
170 Watts, 230 Volt/Amps.

Power Factor: 0.74 lagging

Heat Loss:
581 BTU/Hr. (146.4 Kg. Cal./Hr.)

Leakage Current:
0.2 Amps. @ 115 Vac., 60 Hz.
0.2 Amps. @ 230 Vac., 50 Hz.

Power Cord Data:
Plug Type: NEMA 5-15, 120 Vac.
Cord Length: 6 Feet (1.83 Meters)

B.9.1 System Components
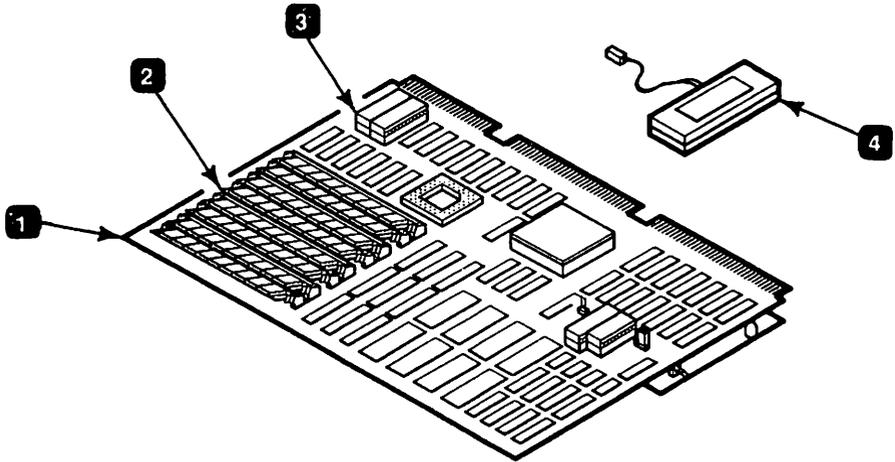
Item	Part Number	Description
1	212–7129–A	CS/386–D, CS/386–N 1MB CPU/Memory PCA
	212–7129–B	CS/386–D, CS/386–N 2MB CPU/Memory PCA
	212–7129–C	CS/386–D, CS/386–N 4MB CPU/Memory PCA
	212–7129–D	CS/386–D, CS/386–N 8MB CPU/Memory PCA
2	377–4516	256KB DRAM SIMM PCA
	377–4518	1MB DRAM SIMM PCA
3	377–3776	PAL Chip, 1MB Memory
	377–3777	PAL Chip, 2MB Memory
	377–3778	PAL Chip, 4MB Memory
	377–3779	PAL Chip, 8MB Memory
4	666–1016	Battery, Lithium (4.8 Vdc.)
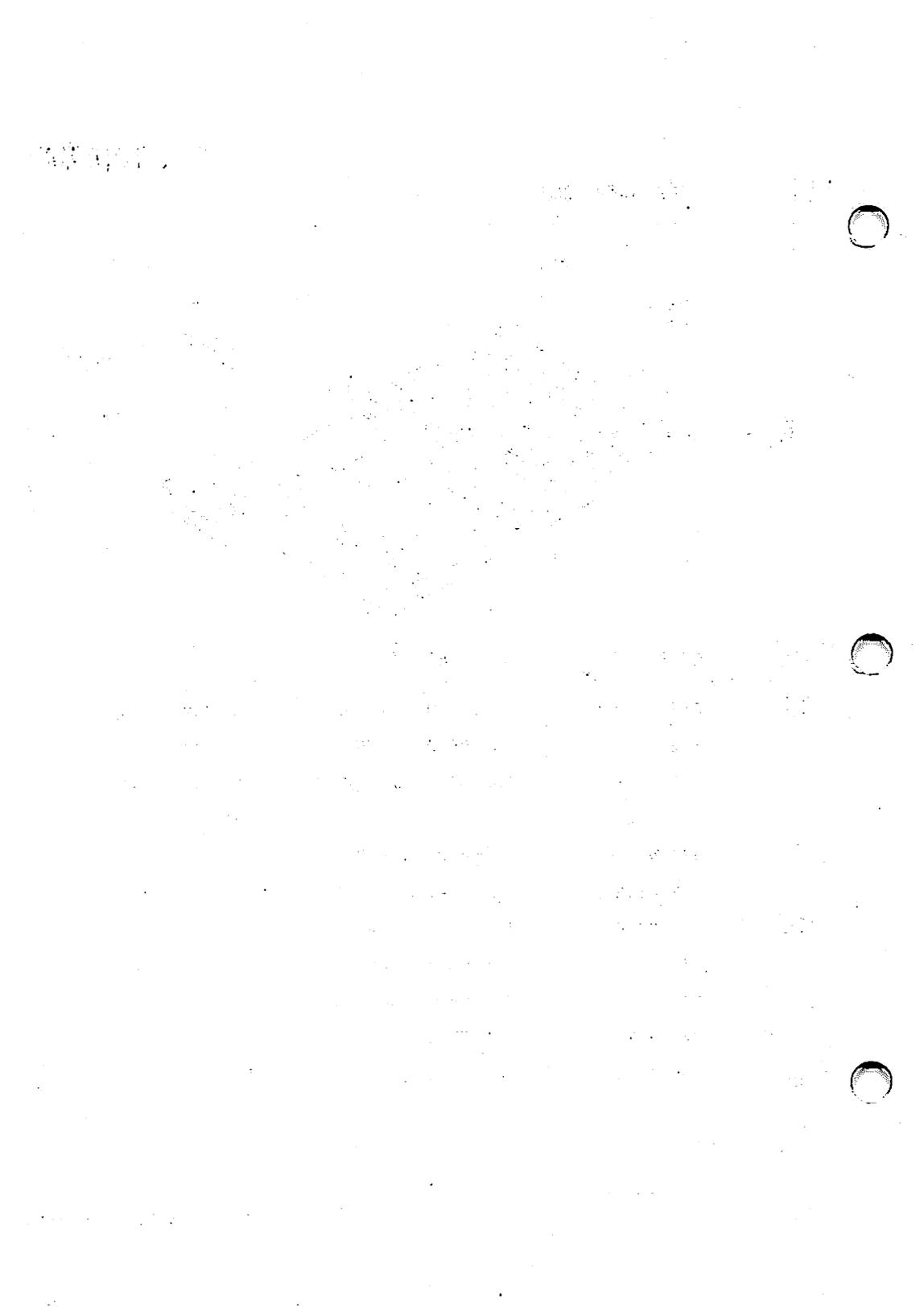
386 TURBO

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APPENDIX C
CONTENTS

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C.1 Introduction

C.1.1 Overview (Sheet 1 of 3)

The CS/386 Turbo is the latest edition to the 2200 family of processors. It consists of four new major components:

- Motherboard (two versions)

- 386 based, 33MHz CPU Board

- Two new high-speed controllers
    16-Port MXF Terminal Controller
    22C11-HS Printer/Disk Controller

The two controllers have 80286 processors that allow them to handle communications with the peripherals which in the past was handled by the CPU. This helps I/O performance by allowing the CPU to go on to other tasks until the controller completes its job and signals the CPU for attention.

The new motherboard contains a 3rd connector (140 pin) used by the CPU for all communications to the new controllers. This new communications path utilizes a 32 bit data bus as opposed to the 8 bit data bus used with older controllers. The High-Speed Printer/Disk controller includes a disk Mux port, J3, that is functionally equivalent to the 22C80 (210-7715), and can be used instead of the standard disk port.

The new hardware and new Turbo operating system provide the following enhancements over existing 2200s:

- Partitions supported increased from 16 to 64

- Terminals supported increased from 16 to 64 (**32 is the current recommended maximum for FCS**)

- Up to 32MB main memory, available in four memory sizes; 4MB, 8MB, 16MB, and 32MB

- Extended RAM disk capabilities, all non-partitioned memory, address 340

- CPU processing time twice as fast as the CS/386, up to five or six times faster than the VLSI and MVP/LVP CPUs

- New $MOVEl command to simplify converting programs from 'OLD' to 'NEW' format

- Disk I/O performance up to 25% faster dependent on the number of users

- Supports 3 byte addressing which will allow disk surfaces greater than the current 16M restriction. This will only be supported on the DS with the next PROM revision, R4, which should be available by the beginning of 1992 and on SCSI with a new High Speed SCSI Controller also due out in the beginning of 1992.

C.1 Introduction

C.1.1 Overview (Sheet 2 of 3)

The 386 Turbo boards and their descriptions are:

- **Motherboard - 210-9578 (CS-D/N) or 210-9583 (CS/Micro VP)**
  In addition to the standard I/O connectors, these two motherboards contain a 3rd 140 pin connector at the CPU slot and at each I/O slot. The new connectors are located along the center of the motherboard, offset and between the standard connectors (see C.3.4 for connector locations). Through this channel the CPU communicates with the new high-speed controllers via a 32-bit data bus and 32-bit address bus. The old controllers use an 8-bit data bus. Both motherboards are downward compatible to the CS/386 CPU board, but only the 210-9578 motherboard supports the VLSI CPU. The VLSI CPU board is not supported on the 210-9583 motherboard due to timing changes that result because of etch changes. These etch changes intermittently result in a failure to properly display the 'Mount System Platter, Press RESET' message on power up. If the power supply is given 10 seconds to bleed down after powering off, it will usually boot properly. Any I/O board can be placed in any slot. All slots have equal access.

- **CPU/Memory Board - 210-9576-A**
  The CPU board is a mother/daughter board arrangement with a 33 MHz 80386 CPU-based processor. It utilizes a new 32-bit address bus and a 32-bit data bus to communicate with the new high-speed controllers. The current 2200 8-bit bus is provided via the CPU daughterboard, part number 210-9577, thus supporting existing I/O controllers. All controllers currently supported on any of the multi-user 2200 CPUs should work with the 386 Turbo. Additionally, the 386 Turbo contains a Real Time Clock chip with built-in battery for time of day. The CPU/Memory board can be loaded in four memory configurations: 4MB, 8MB, 16MB, and 32MB. The memory resides on the motherboard, part number 210-9576. Memory consists of either 1MB or 4 MB SIMM devices. Refer to C.6.5 for memory ugrades and SIMM loading.

C.1 Introduction

C.1.1 Overview (Sheet 3 of 3)

- **MXF 16-Port Terminal Controller 212-9717**

  The MXF 16-Port Terminal Controller (2236MXF) is an 80286 processor-based intelligent controller providing support for up to 16 terminals. The MXF 80286 CPU allows the controller to handle communications with the terminals, allowing the CPU to perform other tasks. The MXF Terminal Controller communicates with the CPU over the 32-bit bus. This controller has four connectors located on the external rail, with two standard RS232 connectors, J1 and J2, supporting the first two terminals, and the remaining two 36-pin amphenol connectors, J3 and J4, supporting seven terminals each via two 7-port octopus cables. One octopus cable (part number 421-0181) is supplied with the controller. A second octopus cable must be ordered separately. A maximum of 4 MXF controllers, 64 ports, are supported per CPU.

- **High-Speed Printer/Disk Controller, 212-9718**

  The High-Speed Printer/Disk Controller (22C11-HS) is an 80286 processor-based intelligent controller providing support for disk drives and printer. The High-Speed Printer/Disk controller can be used with the DS, 2275, and Phoenix drives and all printers presently supported on the mutli-user 2200 systems. NOTE: To us with the Phoenix disk drive, different mircocode must be downloaded to the 22C11-HS on boot to accomodate timing differences with this device. To do this, contact the 2200 Product Support Group.

  This controller provides communications to the CPU over the 32-bit bus, four times the current disk controller bus size. It also controls the disk I/O functions which previously had to be performed by the CPU on older machines. This frees the CPU for other tasks and increases performance as the number of users are increased. Additionally, the middle connector on the controller is a disk mux port that is equivalent to a 22C80 and can be cabled to a CPU port on a 2275 Mux Master or a 2275 Mux Extender to access a Mux'ed disk unit. Either the standard disk port, J2, or the disk mux port, J3, can be used, but not both. The desired port is selected by SW1 on the 210-9581 peripheral controller board (see C.2.3).

C.1 Introduction

C.1.2 Configuration Requirements

The 386 Turbo card set can be installed in any 2200 CPU built for the single board VLSI or 386 CPU board, which includes the MicroVP, CS, CS-N, and CS-D. Configuration requirements and restrictions are basically the same for the 386 Turbo as the existing CS/386 CPU. The exception would be the number of terminals and partitions, which is now 64 **(32 terminals is the recommended maximum with the current hardware).** As with the existing Multi-user 2200 CPUs, a legal limit of three (3) disk controllers (addresses 310, 320, 330), three printer controllers (addresses 215, 216, 217), and a maximum of four (4) terminal controllers of any type (MXF, MXE, MXD, etc.) exists. All controller address switches must be set to legal addresses. Setting switches to all ON or all OFF is not a legal address for a disk or printer controller.

All MXF boards should be assigned first when setting the board's controller (switch) number (SW1 on the 210-9579 I/O Processor Board [see C.2.2]); therefore if two 16-Port MXF boards are installed and two 4-Port MXE boards are installed, the configuration would be:

> MXF Board #1 - Ports 1 thru 16
> MXF Board #2 - Ports 17 thru 32
> MXE Board #3 - Ports 33 thru 36
> MXE Board #4 - Ports 37 thru 40

NOTE

When setting the board number on an MXE, MXD, or Triple Controller (terminal, printer, disk), count each MXF as one board just as you would if it were an MXD or MXE.

Additional examples:

If the configuration consists of one 16-Port MXF board and three 4-Port MXE boards, the configuration would be:

> MXF Board #1 - Ports 1 thru 16
> MXE Board #2 - Ports 17 thru 20
> MXE Board #3 - Ports 21 thru 24
> MXE Board #4 - Ports 25 thru 28

If the configuration consists of three 16-Port MXF boards and one 4-Port MXE board, the configuration would be:

> MXF Board #1 - Ports 1 thru 16
> MXF Board #2 - Ports 17 thru 32
> MXF Board #3 - Ports 33 thru 48
> MXE Board #4 - Ports 49 thru 52

Only the DS, 2275, and Phoenix drives should be used with the 22C11-HS disk controller. Using the Phoenix drive with the 22C11-HS controller requires different microcode to be down loaded to the controller at boot time to accomodate timing differences. Contact the 2200 Product Support Group for assistance if this change is necessary. All other supported drives should only be used on the old bus.

C.1 Introduction

C.1.3 Hardware Compatibilty

The 386 Turbo card set can be installed in any CPU chassis built for a single board VSLI or 386 CPU. This includes the MicroVP, CS, CS-N, and CS-D. All I/O controllers and all peripherals currently supported by these CPUs should work with the 386 Turbo. However, only the DS, 2275, and Phoenix drives will be supported for direct use with the 22C11-HS disk controller. To use the Phoenix drive with the 22C11-HS controller, different microcode *must* be down loaded to the controller at boot time to accomodate timing differences. Contact the 2200 Product Support Group for assistance if this change is necessary. All other supported drives should only be used on the old bus.

Both versions of the motherboard for the Turbo will support the CS/386 CPU board. The VLSI CPU board will also work with these motherboards but will not be supported with the 210-9583 motherboard used with the CS and MicroVP chassis due to power up problems that can occur due to etch changes on this board. Only non-Turbo controllers will work when using these CPU boards. The Turbo CPU board must be installed to use the Turbo MXF and 22C11-HS Printer/Disk Controller.

Note: After upgrading a MicroVP or CS chassis to a Turbo there could be a problem securing some I/O controllers to the chassis because the screws may not be long enough. New one inch thumbscrews (1/4 inch longer) will be available under part number 650-9529.

MXF BoARD ALSO HAS A RESTRICTION. THE 2236D TERMINAL WILL NOT WORK PROPERLY WITH THIS BOARD.

C.1 Introduction

C.1.4 CS/386 Turbo Operating System

CS/386 Turbo operating system release 1.0 is based on the current CS/386 operating system and functions similarly. BASIC-2/Turbo O/S Release 1.0 part number by diskette is:

 1.2MB - 734-8446
 360KB - 731-8026, 8027, 8028

BASIC-2/Turbo enhancements include:

❏ Support for up to 64 terminals (32 terminals currently recommended for FCS).

❏ Support for up to 64 partitions.

❏ Most software compatible to the CS/386 will be 100% compatible to the 386 Turbo. The exception would be programs that reference a status byte in the O/S or the CPU ID number. Certain non-standard GIO commands may also be a problem. (See Software Compatibilty C.1.5)

❏ Supports 3 byte addressing by use of a new command 'SELECT 3 ON'. This eliminates the current 16M platter size restriction. This will be supported with the DS and will require an R4 PROM which should be available at the beginning of 1992. This will also be supported with SCSI drives when the new Turbo SCSI Controller becomes available, also in the beginning of 1992.

NOTE

3 byte addressing creates addressing changes which alter the sector headers and index for the platter. 3 byte addressing must be shut off when accessing disk created in the 2 byte format. 3 byte addressing should not be used without full knowledge of changes it requires. Failure of proper use could result in disk corruption.

❏ The $MOVE! command simplifies converting programs from the old 2200 format to the 386 format.

C.1 Introduction

C.1.5 Software Compatibility (Sheet 1 of 4)

The 386 Turbo Operating System is based on the CS/386 O/S and has the look and feel of its 2200 predecessors. Most programs now running on a 2200 '386' CPU should run without change, exceptions being programs that reference the CPU ID number, programs that reference a status byte in the O/S, or programs using non-standard GIO commands. Although no additional memory is required for the programs when upgrading from a 386, there is additional overhead used by the operating system. With programs that come close to using the entire partition, additional memory may be required. Like the 386, it is critical to have programs on disk in 'NEW' or '386' format for maximum disk I/O performance (see C.1.5, sheet 3 of 4). Although most programs running on non-386 2200 CPUs will run on the Turbo, there may be some changes needed to ensure proper operation and maximum performance. Most of these changes are the same ones required when upgrading from a non-386 to the CS/386 CPU.

The following is a list of software changes to be aware of when upgrading to the Turbo.

Operating System

Partition Size - When upgrading from a non-386 CPU, partition size must be increased by about 80%. This is because the 386 CPU uses a binary format and non-386 CPUs are in binary coded decimal (BCD). Some commands and variables require more space in the binary format. If an inadequate partition size is set, A01 and A02 errors will occur. Minimum supported partition size is 6K. Partitions can be increased to any size as long as available memory is not exceeded. As previously mentioned, in the first paragraph of this section, if a program currently running on a CS/386 CPU comes close to using the entire partition, additional partition size may be needed because of the additional overhead requirements of the Turbo.

Global Partitions - Any partition of any size may be global to any other partition. The concept of bank partitions does not exist.

Device Table - Within '@GENPART', only one entry may be made per disk controller address. There are only three supported disk controller addresses. These are /310, /320, /330. For each controller address (i.e. /310), make a single entry (/310) in the device table. Do not make an entry for any other address within that unit including the tape drive. Additional entries could result in I92 errors if RESET is keyed while accessing disk. With 386 CPUs, RESET

C.1.5 Software Compatibility (Sheet 2 of 4)

is a software function, not a hardware function as on older CPUs. When RESET is keyed on the 386 CPUs, the Device Table is checked and a RESET is sent to each device found. If there are multiple addresses for the same disk unit, the RESET will take an extended time slice which could result in an error for other users if actively using the disk.

Programming and Operational Problems/Concerns

Increasing Partition Size - Increasing partition size can create problems for some programs. Certain sort modules and possibly other programs may make calculations based on partition size. One such program is part of KFAM and the ISS Utilities. In program 'SORT.402A', line 4590 should be changed:

from

    4590 M1=INT(M*1024)-698

to

    4590 M1=INT(MIN(M,64)*1024)-698

These types of changes should be made by the customer's software vendor.

Programs/Software That Looks for CPU Type - Partition status line byte 9 is coded as 'T' for Turbo, 'W' for CS/386, 'M' for MVP/LVP/VLSI, and 'V' for VP. Certain versions of TOM software utilize this bit and would need to be changed. In the ISS Utilities, program 'ISS.000M' requires this change. In line 420 change the 'M' (or 'W' if CS/386) to 'T' as follows:

From

    420 A$=$PSTAT (#PART): IF STR(A$,9,1)="M"
    THEN S3=4 .... etc.

To

    420 A$=$PSTAT (#PART): IF STR(A$,9,1)="T"
    THEN S3=4 .... etc.

This problem may also occur when running Multi-Disk ('MULTIDSK') causing the message 'CPU SOFTWARE MUST BE UPGRADED TO RUN THIS PROGRAM'. On the latest version, 69C1, this message is on line 175. On the previous line, Line 170 in this case, which begins as:

    170 P$=$PSTAT(1): .... etc.

Append to the end of the line:

    :IF STR(P$,9,1)="T" THEN 180

Program FTU from the same magnetic media diagnostic disk also must be revised. With the latest version of FTU (Rev 8734) [corrected for the CS/386], line 120 needs to be changed or a message similiar to that shown for MULTIDSK above will be displayed. Line 120 begins as:

    120 B$=$PSTAT(1): IF STR(B$,9,1) ...etc.

After the first colon (:), insert:

    IF STR(B$,9,1)="T" THEN 125:

C.1 Introduction

C.1.5 Software Compatibility (Sheet 3 of 4)

Programming and Operational Problems/Concerns (Continued)

Partition Status Line Bytes 10 and 11
If the current 2200/VLSI software makes decisions using partition status line 10 and 11, a change is required to run on the TURBO or CS/386 CPU. Under the non-386 multi-user operating systems, byte 10 denotes memory bank and byte 11 denotes the amount of partiton memory. On the Turbo and CS/386, bytes 10 and 11 signify partition size. There are no banks.

Floating Point Mathematics - Floating point mathematics on the Turbo and CS/386 ensures accuracy to ten (10) digits as compared to 13 digit accuracy on earlier 2200 CPUs. This could cause the 9th through 13th numbers to the right of the decimal point to be slightly different after a calculation is performed between these machines. Programs dependant on 13 digit accuracy may need to be altered by the programmer.

GIO Commands - GIO Commands are handled differently on the Turbo than both the CS/386 and non-386 CPUs. Each GIO command had to be recoded individually. The standard GIOs have been recoded, but for programmers who developed there own GIO commands, a problem may exist. Any problems of this type should be escalated via a PTR to RDB 8760. In the PTR, provide the specific GIO with a detailed explanation of the GIO commands purpose.

With non-386 CPUs, GIO commands could speed up the processing because they directly address code in the O/S. With the Turbo and CS/386, this is not the case and usually a GIO will be slower than the basic command it replaces. Customers may want to consider replacing the GIOs with the applicable basic command where possible.

Header Record For a Program on Disk
The first byte of a header record for a program on disk must be 40, 50, 60 or 70. If the second digit is other than a 0, an error A01 may occur. Older 2200 systems do not care about this bit and it was used by some programmers to protect their software.

Programs in 'NEW' or '386' Format
For maximum disk performance, it is critical to have programs in 'NEW' or '386' format. The Turbo is coded in binary while non-386 2200's are in binary coded decimal, BCD. Programs coded in binary require more memory. When loading programs in the 'OLD' BCD format on the Turbo, it has to go through a conversion process which slows down disk I/O. If the program is in binary, 'NEW' or '386' format, this conversion process is eliminated. There are two BASIC2 commands to aid the user in performing this conversion. These are: 'SELECT NEW' and '$MOVE!'. Programs require more space when converted to 'NEW' format, both in memory and disk.

C.1 Introduction

C.1.5 Software Compatibility (Sheet 4 of 4)

Programming and Operational Problems/Concerns (Continued)

Programs in 'NEW' or '386' Format (Continued) - Additionally, any long program line of approximately 190 characters or more when converted to the 'NEW' format could exceed the 256 character/line limit, thus requiring the line to be split into two lines to enable the conversion. Noting that, if the 'SELECT NEW' command is executed, any program saved will be in the 'NEW' format. Programs in the NEW format can be identified by an apostrophe (') after the P for program when LISTing the disk (P'). The 'SELECT OLD' command allows you to change to 'OLD' or BCD format and is the default at boot time. The 'LIST SELECT' command can be used to identify if 'OLD' or 'NEW' format is currently selected. The '$MOVE!' command is used to move an entire address from 'OLD' to 'NEW' format. It provides the ability to identify each program that can not be MOVE'd, and the first line number in that program needing a line split. '$MOVE!' performs this while converting all other programs and moving all other files. Syntax for the $MOVE! command is shown below.

The data file **must have** already been opened before executing the $MOVE command or an error D80 will occur. The data file format is:

    8 bytes for program name
    6 bytes for line number
    2 bytes for error type

Non-386 CPUs can not read programs in the 'NEW' format. Data files are loaded as is with all CPU types and have no effect on performance. The conversion process should be done by either the system administrator or a programmer.

```
$MOVE (! &) T (file#,) (filename i) TO T (file#,) (filename o)
            disk,                   disk
Where
        I is move to new file program format
        & is move to old file program format
        filename i =  8 character program to be converted or
                      8 character data file name with program name in it
        filename o = 8 character data filename that will store program names that have failed
                      the $MOVE command
```

C.1 Introduction

C.1.6 Product/Performance Comparison (Sheet 1 of 3)

The following table lists the CPU speed/ performance for several standard Basic-2 operations with the times required for each computation on the three most current 2200 CPUs; The CS, CS/386, and CS/Turbo. The times listed represent average execution times and assume full 11-digit precision for each operation.

CS, CS/386, and CS/Turbo Performance

Module and Number of Repetitions	Seconds		
	CS	*CS/386*	*CS/Turbo*
Expressions/1,000	5.00	2.00	Less than 1.00
Array Elements/1,000	8.00	3.00	1.00
Array as a Parameter/500	25.00	10.00	5.00
Conditional Jumps/3,000	7.00	4.00	2.00
Integer Arithmetic/1,000	5.00	2.00	1.00
Trigonometric Functions/500	29.00	12.00	5.00
Subroutine Calls/2,000	7.00	3.00	1.00
Array References/2,000	4.00	2.00	1.00
Interger Arithmetic/3,000	6.00	3.00	2.00
Standard Functions/500	4.00	4.00	2.00
Total Seconds	**100.00**	**45.00**	**21.00**

C.1 Introduction

C.1.6 Product/Performance Comparison (Sheet 2 of 3)

The model comparison chart (below and on sheet 3 of 3) provides general product specifications for most of the 2200 Models shipped since 1972. Maximums are expressed in practical installable limits.

Model Comparison Chart

FEATURES	A/B/C WCS	T/S	PCS	VP	SVP	LVP	LVPC
Memory	4K-16K	8K-32K	8K-32K	16K-64K	16K-128K	16K-256K	32K-512K
I/O Slots	3/6/11	3/6/9	1	9	1	3	7
Users	1	1	1	1	1-3	8	16
Tasks	1	1	1	1	16	16	16
BASIC	Yes	Yes	Yes	No	No	No	No
BASIC2	No	No	No	Yes	Yes	Yes	Yes
Control Memory	PROM	PROM	PROM	32K	32K	32K	32K
Field Upgrade	No	No	No	To MVP	OptW	To LVPC	No
Internal Tape Storage	No	No	80K Some Versions	No	No	No	No
Internal Diskette Storage	No	No	11K Some Versions	No	1.2MB	1.2MB	1.2MB
Internal Disk Storage	No	No	No	No	2MB to 16MB	2MB to 16MB	2MB to 32MB
External Storage	2260 2270C	2260 2270	Some Versions	2260 2270 2280 2275 DS	No	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS
TC	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RAMDISK (CPU)	No	No	No	No	No	No	No

C.1 Introduction

C.1.6 Product/Performance Comparison (Sheet 3 of 3)

Model Comparison Chart (Continued)

FEATURES	MVP	MVPC	CS/ MICROVP①	CS-D/ CS-N①	386	Turbo
Memory	16K-256K	32K-512K	128K-8M	128K-8M	1M-8M	4M-32M
I/O Slots	9	7	9	9	9	9
Users	16	16	16	16	16	32⑤
Tasks	16	16	16	16	16	64
BASIC	No	No	No	No	No	No
BASIC2	Yes	Yes	Yes	Yes	Yes②	Yes③
Control Memory	32K	32K	32K	32K	256K	256K
Field Upgrade	No	No	386 or Turbo	386 or Turbo	Turbo	No
Internal Tape Storage	No	No	No	150M④	150M④	150M④
Internal Diskette Storage	No	No	No	1.2MB④	1.2MB④	1.2MB④
Internal Disk Storage	No	No	No	20MB to 140MB④	20MB to 140MB④	20MB to 140MB④
External Storage	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS	2260 2270A 2280 2275 DS SCSI
TC	Yes	Yes	Yes	Yes	Yes	Yes
RAMDISK (CPU)	No	No	Yes	Yes	Yes	Yes

①VLSI CPUs   ②Requires CS/386 OS   ③Requires CS/386 Turbo OS   ④CS-D Cabinet Only
⑤32 Recommended maximum with current hardware, 64 Users in future.

C.1 Introduction

C.1.7 Related Documentation

Part Number	Title
715-3949	BASIC-2 Utilities Reference Manual
715-4080F	Multiuser Basic-2 Language Reference Manual
715-2364A	CS-D/N, CS/386, and CS/Turbo User's Guide
741-1668	2200 Micro VP Computer System
715-3997	Basic-2/Turbo Operating System 1.0 Customer Software Release Notice

C.1.8 Specifications

Refer to section A.11.1 of this manual for specifications for the Turbo when used in a CS-D/N chassis.

Refer to section 11.1 of this manual for specifications for the Turbo when used in a CS chassis.

Refer to section 1.4 of the *2200 Micro VP Computer System* manual (741-1668) for specifications for the Turbo when used in the MicroVP chassis.

C.2 Settings

C.2.1 CPU Board 210-9576A

Daughter Board 210-9577

J4
Board Repair

J5
EPROM Select
L50 , L64

```
3  2  1
```
EPROM 27C256

EPROM 27C512

LED1

J6
Board Repair

J4
Board Repair

LED1

J3
Board Repair
(Removed on
newer boards)

SW1
Memory Size Select

J7
Board Repair

On

```
1 2 3 4
```

J8
Board Repair

o o o x
4MB - 4 1MB SIMMS (locations L3, L10, L18, L29) (210-9576-A)
8MB - 8 1MB SIMMS (All locations) (210-9576-B)

o o o o
16MB - 4 4MB SIMMS (locations L3, L10, L18, L29) (210-9576-C)
32MB - 8 4MB SIMMS (All locations) (210-9576-D)

[] = Switch Position
x = Contacts Closed
o = Contacts Open

C.2 Settings

C.2.2 MXF 16-Port Terminal Controller (212-9717)
(Sheet 1 of 3)
High-Speed I/O Processor 210-9579

P1
Crystal Enable

LED1

J5 (RS232)
Terminal 1

J4 (RS232)
Terminal 2

J3 (36-pin Amphenol)
Terminal 3 thru 9*

J2 (36-pin Amphenol)
Terminal 10 thru 16*

* requires Octopus Cable,
421-0181

SW1
On

1st MXF Terminals 1-16	2nd MXF Terminals 17-32
x	o
x	x
o	o
x	x

3rd MXF Terminals 33-48	4th MXF Terminals 49-64
x	o
o	o
o	o
x	x

⚏= Switch Position
x = Contacts Closed
o = Contacts Open
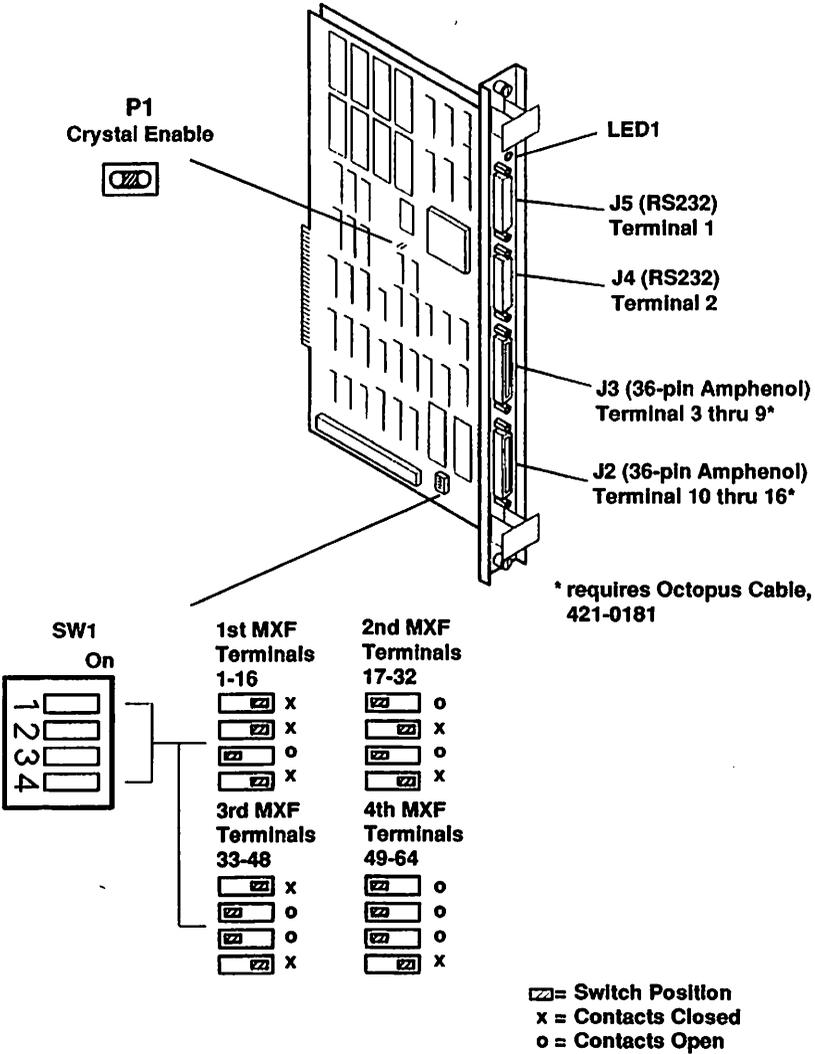
C.2 Settings

C.2.2 MXF 16-Port Terminal Controller (212-9717) (Sheet 2 of 3)

Terminal Controller Board 210-9580
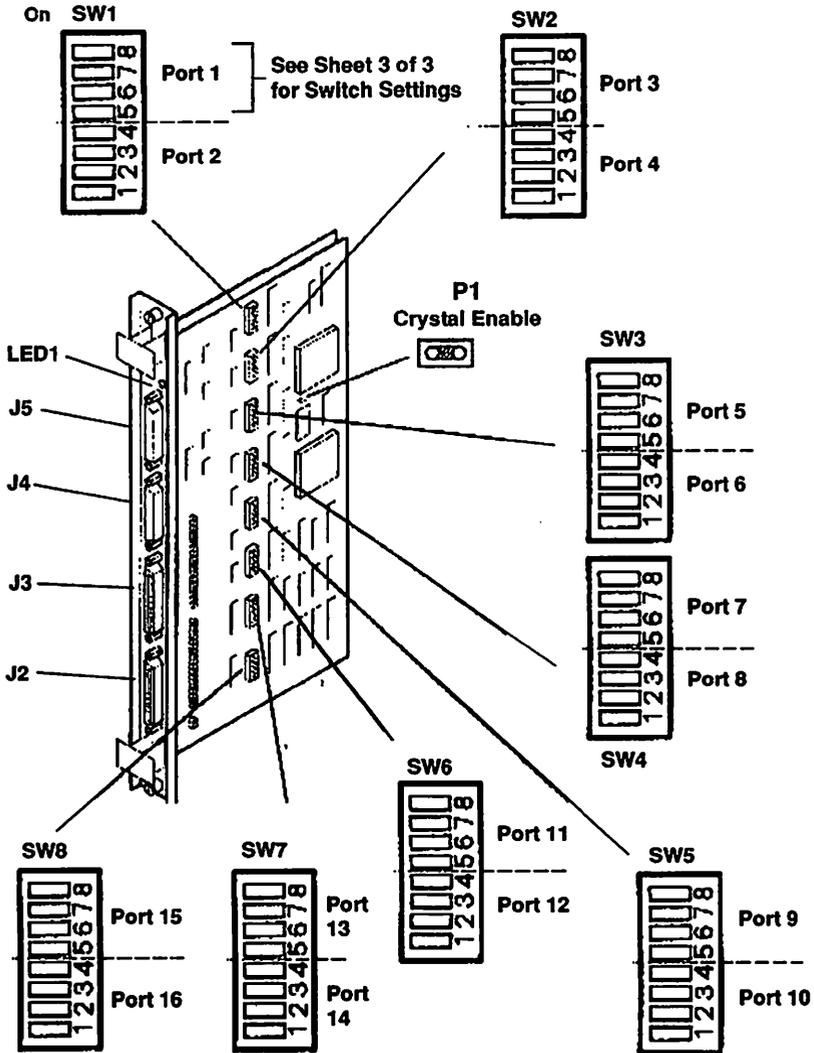
C.2 Settings

C.2.2 MXF 16-Port Terminal Controller (212-9717) (Sheet 3 of 3)

Terminal Controller Board 210-9580
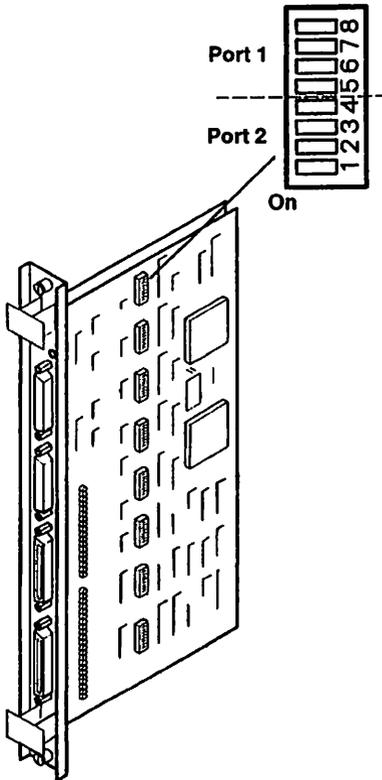
Baud Rate Switch Settings
Port 1 Settings Shown

Switches	38400	9600	2400	600
8 or 4	x	x	x	o
7 or 3	x	x	o	x
6 or 2	x	o	o	o
5 or 1	o	o	o	x

Switches	19200	4800	1200	300
8 or 4	x	x	o	o
7 or 3	x	o	x	x
6 or 2	o	x	x	o
5 or 1	x	o	o	o

Switches	7200	1800	200	150
8 or 4	x	o	o	o
7 or 3	o	x	o	o
6 or 2	x	x	x	x
5 or 1	x	x	x	o

Switches	134.4	110
8 or 4	o	o
7 or 3	o	o
6 or 2	o	o
5 or 1	x	o

Baud Rate Settings for Ports 3 through 16 are the same.

▨ = Switch Position
x = Contacts Closed
o = Contacts Open

NOTE

All unlisted baud rates will default to 19,200, with the exception of **DIAGNOSTIC RUN-IN MODE (all switches on all switch banks set to Open).** See C.5.4.

C.2 Settings

C.2.3 Printer/Disk Dual Controller (212-9718)
(Sheet 1 of 2)
High-Speed I/O Processor 210-9579

P1
Crystal Enable

LED1

J4
Printer Port

J3
Disk Mux Port
(Equivalent to 22C80,
210-7715)

J2
Disk Port

SW1
Disk/MUX
Address

On	Address 310		Address 320		Address 330	
1		o		x		o
2		x		o		o
3		x		x		x
4		x		x		x

▨= Switch Position
x = Contacts Closed
o = Contacts Open
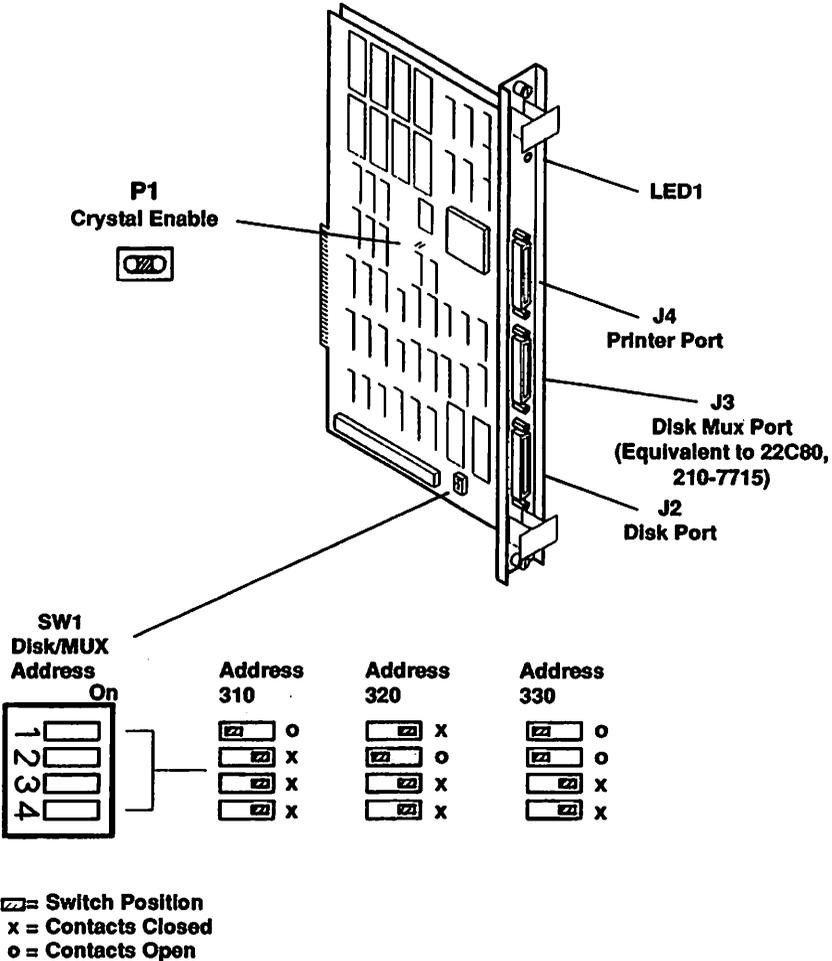
C.2 Settings

C.2.3 Printer/Disk Dual Controller (212-9718)
(Sheet 2 of 2)
Peripheral Controller 210-9581

SW1
Disk/MUX
Port Status
On

Disk Port J2 Active	Mux Port J3 Active
▨ o	▨ x
▧	▨ ɔ

SW 1 Not Used and
always set to Off (o)

LED1

J4
Printer Port

J3
Disk Mux Port
(Equivalent to 22C80,
210-7715)

J2
Disk Port

SW2
Printer Address
On

	Address 215	Address 216	Address 217
8	▨ o	▨ o	▨ o
7	▨ o	▨ o	▨ o
6	▨ o	▨ o	▨ o
5	▨ x	▨ x	▨ x
4	▨ o	▨ o	▨ o
3	▨ x	▨ x	▨ x
2	▨ o	▨ x	▨ x
1	▨ x	▨ o	▨ x

▨= Switch Position
x = Contacts Closed
o = Contacts Open
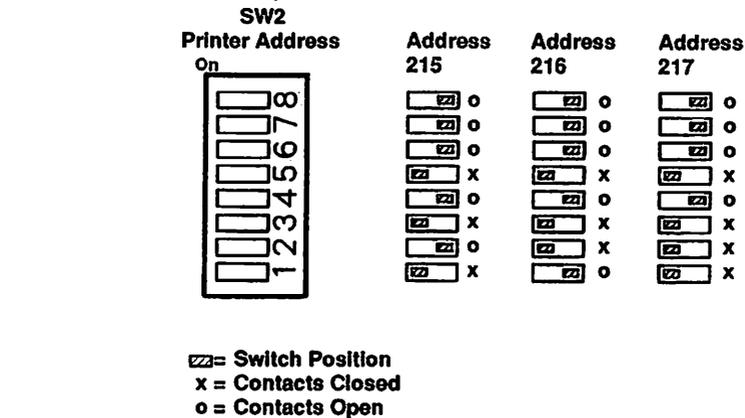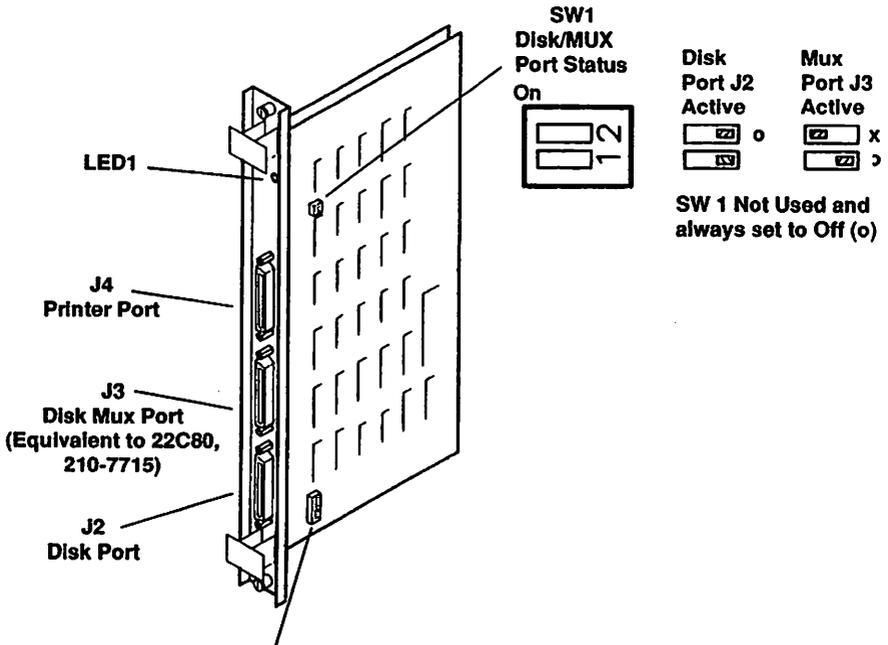
C.3 Controls and Indicators

C.3.1 CPU Board 210-9576A
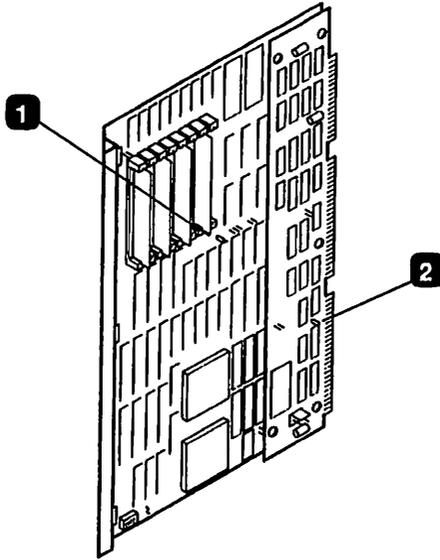
Item	Name	Description
1	Diagnostic LED	LED; yellow, lights during power-up and goes out (usually within one second) after the CPU board passes the built-in self-test. If LED remains on, a failure has occured and the CPU board must be replaced.
2	Diagnostic LED	LED; yellow, lights during power-up and goes out (usually within one second) after the daughter-board passes the built-in self-test. If LED remains on, a failure has occured and the CPU/Daughter board must be replaced.

C.3 Controls and Indicators

C.3.2 MXF 16-Port Terminal Controller (212-9717)

Item	Name	Description
1	Diagnostic LED LED 1	LED; Red, lights during power-up and goes out (normally within three to four seconds) after the board passes the built-in self-test. If LED remains on, a failure has occured and the board must be replaced. The LED also lights while running Customer Level Diagnostics (see C.5.3), except on the MXF supporting terminal 1.

C.3 Controls and Indicators

C.3.3 Printer/Disk Dual Controller (212-9718)

Item	Name	Description
1	Diagnostic LED LED 1	LED; Red, lights during power-up and goes out (normally within three to four seconds) after the board passes the built-in self-test. If LED remains on, a failure has occured and the board must be replaced. This LED also lights while running Customer Level Diagnostics. (See C.5.3)

C.3 Controls and Indicators

C.3.4 Motherboard 210-9578/9583

NOTE

Both motherboard versions are similar with the exception of the mounting holes and the CS-N/D version being a little longer. Also on the 210-9583, J34 has been removed and the voltage test points are located vertically between the two bottom connectors in the lower left hand corner. The CS-N/D version, 210-9578, comes with the mounting rails attached.

J34
Front Panel LEDs
(Removed on CS and
Micro VP Motherboard
210-9583)

210-9583 Motherboard Voltage Test Points

◎ TP4 -5V

◎ TP5 GND

◎ TP3 +5V

◎ TP1 -12V

◎ TP2 +12V

210-9578 Motherboard Voltage Test Points

◎	◎	◎	◎	◎
TP5 Gnd	TP4 -5V	TP3 +5V	TP2 +12V	TP1 -12V

J33   J32   J31
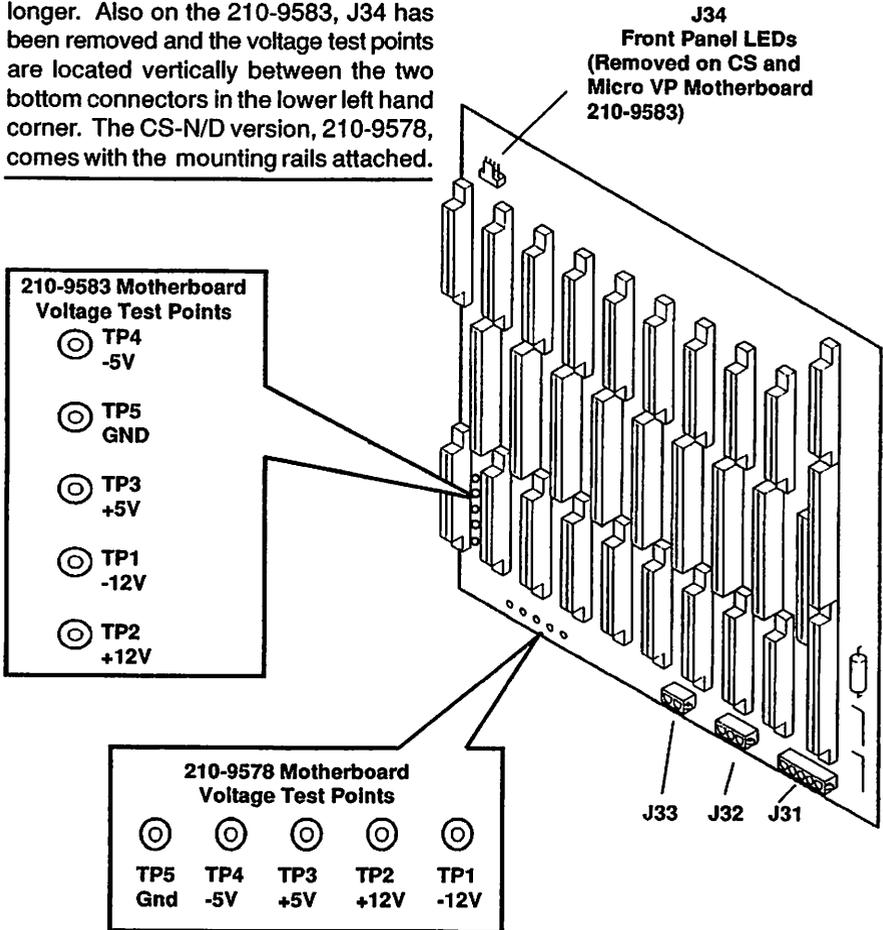
C.4 Preventive Maintenance

C.4.1 General

This section contains preventive maintenance and adjustment procedures for the Turbo. This section only provides information for the maintenance of the CPU. Maintenance for attached peripherals is documented in the appropriate product manuals.

Special Tools and Equipment

No special tools or equipment are required for maintaining the CS/386 Turbo CPU. A phillips screwdriver, a pot adjustment tool (non-metallic), and a digital voltmeter or equivalent with preferably straight pointed leads should be the only tools required. A light of some type may also be handy to see the voltage pots in the power supply.

Maintenance Procedures

To ensure proper operation, the Turbo should have periodic preventive maintenance consisting of inspection, cleaning, and adjustments. The following preventive maintenance procedures should be performed on an on-site as needed basis or whenever there is a CPU problem.

1. Check cooling fans for proper operation.

2. Clean the unit as outlined below.
   a. Remove covers from CPU.
   b. Remove I/O controllers and CPU/Memory board.
   c. Remove all dust from unit interior.
   d. Clean finger connections of each PCA.
   e. Reinstall all PCAs into system.
   f. Using a mild detergent and a soft cloth or sponge, clean the CPU cabinet. Do not use abrasive or corrosive materials.

3. Check the operating voltage levels and ripple as defined in section C.4.2.

4. Replace covers and run diagnostics as required to ensure proper operation of equipment.

741-1769-A   **C-25**   **COMPANY CONFIDENTIAL**

C.4 Preventive Maintenance

C.4.2 Voltage Check/Adjustment (Sheet 1 of 3)

1 With power off, remove I/O controllers or blank I/O panels to expose voltage test points.

J34
Front Panel LEDs
(Removed on CS and Micro
VP Motherboard 210-9583)

NOTE

For correct voltage readings, at least one board must be installed to supply a load on the power supply.

**210-9583 Motherboard
Voltage Test Points**

- ◎ TP4 -5V
- ◎ TP5 GND
- ◎ TP3 +5V
- ◎ TP1 -12V
- ◎ TP2 +12V

**210-9578 Motherboard
Voltage Test Points**

◎	◎	◎	◎	◎
TP5 Gnd	TP4 -5V	TP3 +5V	TP2 +12V	TP1 -12V

J33   J32   J31
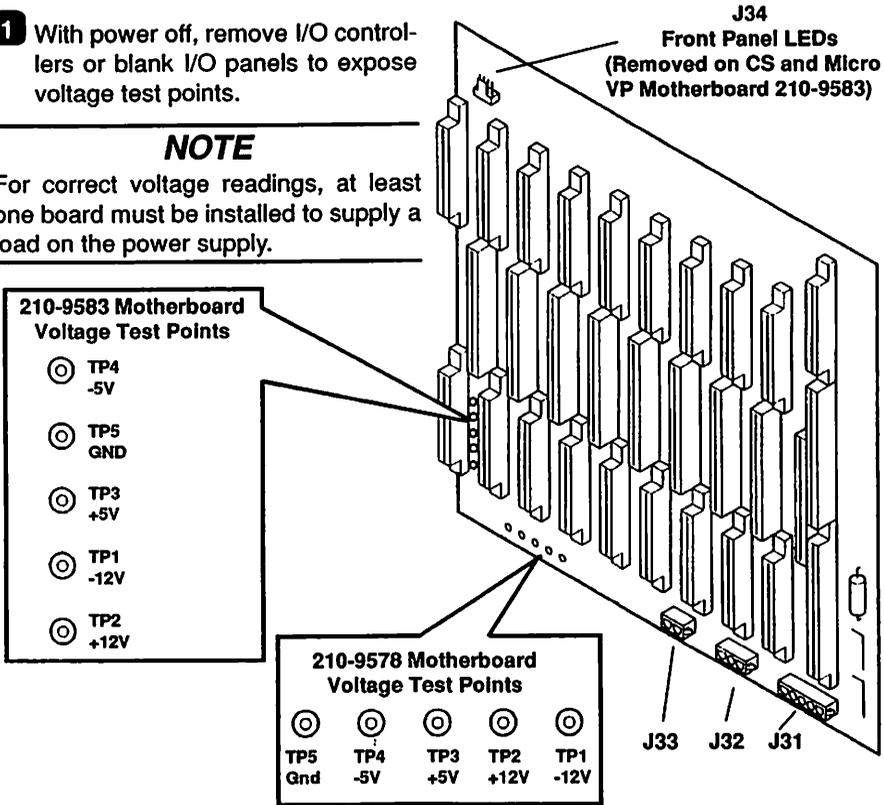
2 Be careful not to short out against any of the I/O boards. Using a voltmeter with straight pointed leads, measure each voltage.

Voltage	Limits	Ripple	Comments
+5Vdc	+4.95 to +5.05 Vdc	15mv p-p	Adjustable
-5Vdc	-4.95 to -5.05 Vdc	15mv p-p	Fixed
+12Vdc	+11.95 to +12.05 Vdc	15mv p-p	Adjustable
-12Vdc	-11.95 to -12.05 Vdc	15mv p-p	Fixed

C.4 Preventive Maintenance

C.4.2 Voltage Check/Adjustment (Sheet 2 of 3)

3 To access the +5Vdc and +12Vdc pots, perform the following:

Micro VP
Remove CPU cover.

CS
See section 7.2.4, Power Supply Removal or section 8.2 Power Supply Voltage Adjustments.

CS-N/D
See section A.7.2.1, Top Cover Removal and A.7.2.3, Side Panel Removal.

Perform voltage adjustments as follows:

CS, CS-N/D

4a Adjust +5Vdc pot (hole closest to fan) to correct voltage limits.

4b Adjust +12Vdc pot (hole farthest from fan) to correct voltage.
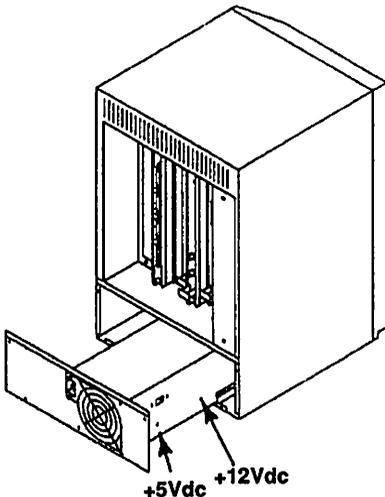
Micro VP

5a Adjust +5Vdc pot (hole closest to fan on top of power supply) to correct voltage.

5b Adjust +12Vdc pot (hole farthest from fan on top of power supply) to correct voltage.
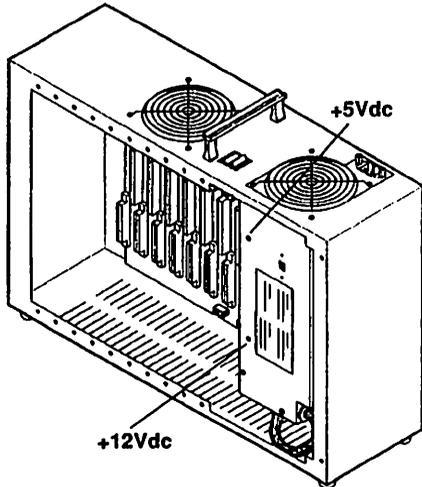
C.4.2 Voltage Check/Adjustment (Sheet 3 of 3)

WARNING

Do not open the switching power supply under any circumstance. Extremely dangerous voltages and current (in excess of 300 volts dc and unlimited current) are present within the power supply.

Do not attempt to repair the switching power supply; it is field replaceable only.

After powering down the unit and disconnecting the ac power connector from the power source receptacle, allow one minute before removing the power supply to provide adequate time for any residual voltage to drain through the bleeder resistors.

6 If any voltage is missing or the +5 vdc and/or +12 vdc can not be adjusted, remove all but one PCA and perform the adjustment procedure again. The one PCA is needed to provide a load on the power supply to allow proper reading of the voltages.

7 If the voltage can be adjusted, one or more PCAs is possibly causing the problem. However, the power supply itself should not be ruled out. If a PCA is found to be at fault, replacement of the defective PCA is required.

8 If the voltage problem exists with one PCA installed, replace that PCA with another and perform the voltage adjustment procedures again. If no change, replacement of the power supply is required. Refer to the power supply removal procedures in the applicable manual.

MicroVP
Micro VP Computer System 741-1668, section 5.5

CS
Section 7.2.4 of this manual

CS-N/D
Section A.7.2.10 of this manual

C.5 Troubleshooting

C.5.1 Diagnostics

There are three types of diagnostics that are available on the 386 Turbo. These are:

☐ Built-In Test (BIT) diagnostics that run on the CPU, MXF, and the 22C11-HS during initial power-on (power-up self tests). The status of these tests are indicated by the LEDs on the boards. If an LED on one of these boards fails to go out during power-up, the board has failed the BIT test and should be replaced. Refer to C.5.2 for more detailed information on BIT diagnostics.

☐ Customer Level diagnostics - machine level diagnostics that are built into the operating system and boot PROMs which can be run during system boot. These diagnostics are very basic and cannot be relied on to always find a problem, especially an intermittent problem. On-line or CE level diagnostics must be used for proper testing. Refer to C.5.3 for more information on Customer level diagnostics.

☐ CE Level diagnostics - are diskette based diagnostics included in 2200 Diagnostic Package 195-2956-0 Rev 2.00.00. The system must be up with the operating system loaded to run the CE level diagnostics.

This package includes diagnostics for:

● Printers/Plotters/Terminals, 732-0052B

● Magnetic Media, 732-8520A (see page C-7 'Programs/Software that look for CPU type' for changes that may be needed to run certain programs in this package)

● Telecommunications, 732-0051

● CPU/Memory Test, 732-8521 (Some tests in this package, including the memory test, were designed specifically for the older CPUs and will not work with the Turbo or the CS/386 CPU. This includes all of the boot level tests.)

All part numbers above reflect 5 1/4" DSDD diskettes.

To properly test the CPU, the Instruction Exerciser test (included in the CPU/Memory Test, 732-8521) should be run from multiple terminals, as many as possible, simultaneously. Where possible, loading the diagnostics into CPU RAM DISK, address 340, will speed up testing. CPU RAM DISK is memory available after partitions have been assigned. A good way to test memory on line would be to run a random read/write test to CPU RAM disk, 340. Make sure everyone is off the system and RAM disk is clear. It is strongly suggested the CE have their own O/S to load, configure, and test the system.

C.5 Troubleshooting

C.5.2 386 Turbo CPU BIT Diagnostics (Sheet 1 of 5)

Overview

The BIT diagnostics are used to ensure that a minimum level of hardware is functional to begin loading the O/S. Failure of these diagnostics to find a problem does not eliminate the possibility of a hardware problem. The 386 Turbo CPU BIT diagnostics run everytime the system is powered on. BIT diagnostics reside in the two 64K PROMS at locations L64 (odd) and L50 (even) of the CPU board. Minimum hardware required to run the BIT would be a Micro VP, CS, CS-N, or CS-D cabinet with:

- 386 Turbo CPU Board
- Motherboard (210-9583 or 9578 as required)
- Terminal Controller (MXE, MXD, MXF, etc.)
- 2200 Terminal (for user interface)

Note: The portion of these tests that update on the screen can be bypassed by keying RESET. BIT tests number, name and hardware tested on the CPU board are:

Test		Hardware Tested
1	80386 CPU	CPU
2	256K DRAM	1st 256K of DRAM
3	DRAM Data Bus	Data bus lines
4	DRAM Address	Address lines
5	RTC Ram Test	RTC chip
6	Parity &NMI	Parity & NMI circuit
7	Detect Interface	MXF/22C11 common memory
8	System Interrupt	Interrupt circuit
9	Memory Size	Detect memory size
A	Data Exchange	DRAM exchange
B	Bad SIMM location	Detect bad SIMM
C	Two Way Cache	Cache controller
D	Memory Test w/Cache	DRAM and Cache

Test descriptions are as follows:

80386 CPU
Verifies CPU functions
256K DRAM
DRAM Read/Write to first 256K to set up table area
DRAM Data Bus
Checks data bus for shorts/opens
DRAM Address
Checks address lines for shorts/opens
RTC User RAM
Initialize RTC and User RAM
NMI & Parity
Checks NMI and parity circuit
Detect Interface Cards
Detects MXF and/or 22C11 controllers and diagnostic status
System Interrupt
Checks interrupt circuit between CS386 CPU and all MXF and 22C11 controllers
Memory Size
Checks CPU memory size
DRAM Fast Data Exchange
Checks DRAM for data retention and address faults
Bad SIMM
Detects bad SIMM location using LSB of address
Cache Controller
Checks cache controller chip 82385 two way associate mode
Memory Test with Cache
Move EPROM program to DRAM, enables cache, and executes program

C.5 Troubleshooting

C.5.2 386 Turbo CPU BIT Diagnostics (Sheet 2 of 5)

Running 386 Turbo CPU BIT Test

To verify the Turbo CPU board is successfully running BIT test, remove the cover over the CPU board to view the LEDs located on the CPU board.

1 Power on the cabinet. The LEDs on the CPU, MXFs, and 22C11-HS should illuminate while the BIT is running, then go out indicating the BIT passed. The two LEDs on the CPU board normally go out within 1 second. On the MXF and 22C11, the LEDs should go out within 3 to 4 seconds. If either LED on the CPU board is flashing or remains on steady, the diagnostic test failed (fatal error) and the system will be hung. The CPU board must be replaced. Failure of the LED on any controller to go out also indicates a failure. Usually this would indicate the associated board should be replaced, but may also be caused by a communication failure with the CPU board.

2 If the BIT tests pass, 'DRAM xxxxKB' is displayed on the 2200 terminal, testing total memory in 64K increments.

Copyright, Wang laboratories Inc. 1991   CS386 Turbo   Rev xxxx

DRAM   xxxxKB

Cycles through memory in 64K increments without stopping until the total memory is tested; 4M, 8M, 16M, or 32M.

C.5 Troubleshooting

C.5.2 386 Turbo CPU BIT Diagnostics (Sheet 3 of 5)

3 Once the DRAM test has cycled through all of memory, the 'System Interface Control Card Status and High Speed Channel Bus' test will appear on the screen. **This will only appear if a turbo controller is installed.** The number preceeding the controller (1st and 2nd in this example) relates to the disk address (address 310 = 1st, address 320 = 2nd, address 330 = 3rd) for the 22C11-HS and the board number for the MXF as determined by switch SW1 setting on the MXF 210-9579 Terminal Controller board.

Copyright, Wang laboratories Inc. 1991   CS386 Turbo   Rev xxxx

DRAM   xxxxKB

System Interface Control Card Diagnostic Status:

    * 2nd 22C11-HS   —⟩ PASS
    * 1st 2236-MXF   —⟩ PASS

High Speed Channel Bus Test:

    * 2nd 22C11-HS   —⟩ PASS
    * 1st 2236-MXF   —⟩ PASS

22C11-HS address

MXF Board Number

System Interface Control Card Diagnostic Status and High Speed Channel Bus Test (displayed only if turbo controllers are installed). These tests should pass within a few seconds.

C.5 Troubleshooting

C.5.2 386 Turbo CPU BIT Diagnostics (Sheet 4 of 5)

4 After the System Interface Control
Card Diagnostic Status and High
Speed Channel Bus Test have
completed, the message 'Move
EPROM Memory Test to DRAM and
Enable CACHE ....' is displayed.
Memory is again cycled through in
64K increments until the total mem-
ory is tested, but this time CACHE is
enabled.

Copyright, Wang laboratories Inc. 1991   CS386 Turbo   Rev xxxx

DRAM   xxxxKB

System Interface Control Card Diagnostic Status:

      * 2nd 22C11-HS   —⟩ PASS
      * 1st 2236-MXF   —⟩ PASS

High Speed Channel Bus Test:

      * 2nd 22C11-HS   —⟩ PASS
      * 1st 2236-MXF   —⟩ PASS

Move EPROM Memory Test to DRAM and Enable CACHE ....

DRAM 1856KB

> Cycles through memory with CACHE enabled
> in 64K increments until the total memory is
> tested; 4M, 8M, 16M, or 32M. This test should
> not stop.

C.5 Troubleshooting

C.5.2 386 Turbo CPU BIT Diagnostics (Sheet 5 of 5)

Interpreting 386 Turbo CPU BIT Test

3 Any fail condition requires the replacement of the associated failed component.

Failed component in order of most likely failed unit by test:

① SIMM, CPU Board

② High Speed Controller, CPU Board

③ High Speed Controller, CPU Board

④ CPU Board

⑤ CPU Board

Copyright, Wang laboratories Inc. 1990 CS386/II Rev xxxx

| DRAM   xxxxKB |

    ① SIMM Memory and
    Memory Size Test

System Interface Control Card Diagnostic Status: ② Detect Interface Cards and their Diagnostic Status

| * 2nd 22C11-HS | —) PASS |
| * 1st 2236-MXF | —) PASS |

③ Checks Interrupt Circuit Between CPU and High Speed Controllers

High Speed Channel Bus Test:

| * 2nd 22C11-HS | —) PASS |
| * 1st 2236-MXF | —) PASS |

| Move EPROM Memory Test to DRAM and Enable CACHE .... |

| DRAM 1856KB |

⑤ Cache Memory Test

④ Checks DRAM, Cache Controller Chip and Cache Memory

---

4 Upon successful completion, the following message is displayed:

Mount System Platter
Press Reset

C.5 Troubleshooting

C.5.3 386 Turbo Customer Diagnostics (Sheet 1 of 3)

Overview

These machine level diagnostics are a user aid to help find hardware failures with the turbo card set. These tests however, cannot be depended upon to always find a problem, especially those of an intermittent nature. For more thorough testing use the On-Line or CE Level diagnostics. Refer to C.5.1 for additional information.

The 386 Turbo Customer diagnostics are run by selecting the Diagnostic pick from Terminal 1 after the initial system boot. Minimum hardware required to run these diagnostics would be a Micro VP, CS, CS-N, or CS-D cabinet with:

- 386 Turbo CPU Board
- Motherboard (210-9583 or 9578)
- Terminal Controller (MXE, MXF, MXD, etc.)
- Disk Controller
- Floppy or hard drive
- 2200 Terminal (for user interface)
- Operating System with file @DG2

The 386 Turbo customer diagnostics are diskette or hard drive based diagnostics that can be run after the CPU BIT test for additional testing of the hardware. These diagnostics test the following hardware:

- CPU boards 80386, Real Time Clock (RTC), 80385 Cache Controller, DRAM, and DRAM circuitry.

- 22C11-HS Printer/Disk Dual Controller Diagnostic Status

- 2236MXF 16-Port Terminal Controller Diagnostic Status

NOTE

386 Turbo Customer Diagnostics will loop through until interrupted by the operator by pressing 'SHIFT + RESET' or when certain error conditions are detected. The diagnostic does not stop for every error. When these diagnostics are running, it is normal for the red LEDs on all MXF (except MXF board number 1) and all 22C11-HS controllers to illuminate.

Test number, test name, and hardware tested are:

Test	Hardware Tested
1 System Interface Card	Interface Card present and diagnostics status
2 High Speed Channel Bus	Communications between CPU and High Speed Controllers
3 Parity & NMI	Parity and NMI circuitry
4 DRAM Data Bus	DRAM Data Bus
5 DRAM Double word Pattern	DRAM
6 DRAM Word Pattern	DRAM
7 DRAM Data Byte Fast Exchange	DRAM, Detect Bad SIMM

C.5 Troubleshooting

C.5.3 386 Turbo Customer Diagnostics (Sheet 2 of 3)

Running 386 Turbo System

1 After the CPU BIT diagnostics have successfully completed, the message *'Mount System Platter, Press Reset'* is displayed on terminal 1. Press **SHIFT + RESET** for 2x36DW type terminals or **RESET** for 2x36DE terminals.

2 Terminal 1 will display *'KEY SF'*. Press the special function key corresponding to the drive that contains the operating system and diagnostics. The system will start to boot from disk and the following screen will be displayed:

```
                    *** SYSTEM SOFTWARE ***

Select item with SPACE & BACKSPACE                    MEMORY xxxxK
Key RUN to Execute, Clear or PREV SCRN for previous screen.    TERMINAL 1

            ▫    Multiuser BASIC-2/Turbo

            ▫    Turbo Diagnostics
```

3 Space down to Turbo Diagnostics and press run. The CS386 Turbo Customer Diagnostic screen will be displayed and the first diagnostic test will run.

C.5 Troubleshooting

C.5.3 386 Turbo Customer Diagnostics (Sheet 3 of 3)

Test Screen Display Example:

```
              *** CS386 TURBO CUSTOMER DIAGNOSTIC ***
Name of      Copyright, Wang Laboratories, Inc., 1991    Rev 1170
test being                                              Diagnostic
run                                                     Run Count

  TEST ITEM: DRAM Data Byte Fast Exchange Test          COUNT:1

  MESSAGES:

                      DRAM 2704 KB

                      TEST PASS!!!

             Press SHIFT+RESET key to terminate Diagnostics
Message area
```

4 Errors will be displayed in the message field. All failures should be resolved. Test times with 32M memory along with the most likely failures would be:

Test Number & Test Name	Approx. Test Time with 32M (Max)	Most Likely Failed Unit
1. System Interface Card	4-5 seconds	Controller Indicated, CPU
2. High Speed Channel Bus	2 seconds	Controller Indicated, CPU
3. Parity Generator Check & NMI	2 seconds	CPU
4. CPU Memory Data Bus	2 seconds	CPU
5. DRAM Double Word Pattern	7 seconds	CPU
6. DRAM Word Pattern	16 seconds	CPU
7. DRAM Data Byte Fast Exchange	75 seconds	CPU

5 Press SHIFT+RESET to terminate diagnostics.

C.5 Troubleshooting

C.5.4 MXF Diagnostic Run-In Mode (Sheet 1 of 2)

The MXF controller has the built-in ability to run a loopback test to each of its 16 ports. To run the test:

☐ All switches SW1-SW8 on the 210-9580 must be set to Off. (➡ C.2.2) A terminal must be connected to port 1.

The system will not be usable at this time. The test will run without removing any other boards or with all boards removed including the CPU. For a port other than port 1 to pass the test, its transmit and receive lines must be shorted together. This is done at the MXF as follows:

To test each port at the end of the Octopus cable (420-0181) used with ports 3 through 16, just short pin 2 to 3. (See C.8.4)

The test will repeatedly test each channel in consecutive order. Each pass through will take 7-8 seconds. If the loopback is not present for a particular port the test will fail on that port and one (1) will be added to the error count. The test will only respond with a PASS or FAIL condition. The test screen on the first pass dependent on which ports are jumpered for loopback will look as follows: (See sheet 2 of 2)

Port	Pin
2	J4 pin 2-3
3	J3 pin 2-20
4	J3 pin 4-22
5	J3 pin 7-25
6	J3 pin 9-27
7	J3 pin 12-30
8	J3 pin 14-32
9	J3 pin 17-35
10	J2 pin 2-20
11	J2 pin 4-22
12	J2 pin 7-25
13	J2 pin 9-27
14	J2 pin 12-30
15	J2 pin 14-32
16	J2 pin 17-35

C.5.4 MXF Diagnostic Run-In Mode (Sheet 2 of 2)

MXF 16-Port External Loop Back Run-in Test: LOOP COUNT: 0
                                                ERROR COUNT: 14

                    Channel - 1 :   Console
                    Channel - 2 :   PASS
                    Channel - 3 :   FAIL
                    Channel - 4 :   FAIL
                    Channel - 5 :   FAIL
                    Channel - 6 :   FAIL
                    Channel - 7 :   FAIL
                    Channel - 8 :   FAIL
                    Channel - 9 :   FAIL
                    Channel - 10:   FAIL
                    Channel - 11:   FAIL
                    Channel - 12:   FAIL
                    Channel - 13:   FAIL
                    Channel - 14:   FAIL
                    Channel - 15:   FAIL
                    Channel - 16:   FAIL

386 TURBO

C.5.5 Troubleshooting Flowchart (Sheet 1 of 5)

```
                    ┌─────────┐
                    │  Start  │
                    └─────────┘
                         │
         ┌───────────────────────┐      Power        No         AC          Yes
         │  Power-up System.     ├──►   supply fan  ──────►   outlet OK   ─────►(A)
         └───────────────────────┘      on?                    ?                Sheet 4
                                          │                     │
         ┌───────────────────────┐       Yes                   No
         │ Replace defective board│                             │
         │   that has LED lit.    │                   ┌──────────────────────┐
         └───────────────────────┘                   │  Repair as required.  │
                    ▲ No                              └──────────────────────┘
              LEDs                       Both         No      Either       No
           on CPU &        Yes         cabinet fans ──────►  fan on   ─────►(B)
         Controllers light & ◄───────  on ?                  ?              Sheet 5
            go out                                            │
            ?                                                Yes
             Yes                                   ┌──────────────────────┐
                                                   │ Replace defective fan.│
                                                   └──────────────────────┘
              Does
             System
           Terminal 1      Yes       Diagnostics  Yes      CS-D        No
         display DRAM  ──────►       Pass?      ──────►   cabinet?  ─────►(E)
            memory                                         ?              Sheet 2
           selftest                    No                   │
             ?                                              Yes
              No                 ┌──────────────────────┐
                                 │ Interpret  error, replace│  Floppy
             Does                │ failed component. i.e.   │  LED turns off  Yes
            System               │ SIMM, MXF  Controller,   │  within one minute ─►(E)
          Terminal 1    No       │ 22C11-HS Controller, or  │  of power on    Sheet 2
         display any part ──────►│ CPU  Board.  Refer  to   │  ?
           of DRAM              │ C.5.2.                   │   │
             test              └──────────────────────┘    No
              ?                        Is
              Yes               Baud Rate set    Yes
                              correctly on Term 1 ──────►(C)
         ┌─────────────────────┐  Controller          Sheet 3
         │ Most likely failing unit│ ?
         │ 1. CPU Board         │     No            ┌──────────────────────┐
         │ 2. Term 1 Controller │                   │ Replace DPU Board,    │
         │   (MXE, MXF, MXD)    │ ┌───────────────┐ │ Floppy, or Winchester │
         └─────────────────────┘ │Correct Baud Rate.│ Drive                │
                                  └───────────────┘ └──────────────────────┘
```

7411769/C.4.5-1

'ra01.cre

C.5.5 Troubleshooting Flowchart (Sheet 2 of 5)

Sheet 1 ⬡E▸

System Terminal 1 display 'Mount System Platter, Press RESET'? —No→ **Does System Terminal 1 display any part of message?** —No→ ⬡C Sheet 3

↓Yes

Press RESET key on System Terminal 1.

↓Yes

Replace CPU board and retry.

Sheet 3 ⬡F

Does System Terminal 1 display 'SF KEY'? —No→ **System Error Displayed?** —No→

↓Yes

At System Terminal 1, press SF key for disk address that contains operating system.

↓Yes

Replace CPU Board.

Check for defective:
1. Keyboard Key (some workstations must be in upper case for Reset Key to be active.
2. Workstation controller (MXE, MXF, MXD)
3. I/O cable
4. CPU board

Sheet 3 ⬡H▸

Program loads from disk & System Terminal 1 displays '2200 System Menu? —No→ **System Error Displayed?** —No→ ⬡G Sheet 3

↓Yes

Load operating system or load and run diagnostics

↓Yes

Troubleshoot according to error listing. (See C.5.7)

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C.5.5 Troubleshooting Flowchart (Sheet 3 of 5)

Sheet 1
Sheet 2
©

Does System Terminal 1 pass power-up diagnostics ? — No → Troubleshoot System Terminal 1.

Yes

Check:
1. DC voltages in CPU
2. CPU board
3. Workstation controller (MXE, MXD, MXF)
4. Workstation I/O cable

Sheet 2
©

Is drive being accessed ? — No → Was correct SF key (SF0, 1, 2, 3, 4, or 5) pressed ? — No → Press correct SF key. (SF0, 1, 2, 3, 4, or 5)

Yes

Verify O/S disk, troubleshoot disk problem.

Yes

Did screen update with disk address after key was pressed ? — No → F Sheet 2

Yes

Unable to access drive. Troubleshoot drive problem.

H
Sheet 2

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C.5 Troubleshooting

C.5.5 Troubleshooting Flowchart (Sheet 4 of 5)

Sheet 1 Ⓐ → **117 VAC between blue and brown wires on both sides of on/off switch?** — No → **AC present between one set of blue and brown wires?** — No → Replace power supply.

Yes ↓ Replace power supply.

Yes ↓ Replace on/off switch.

Detailed Rear View

TOP (ON)
BLUE
BROWN
BOTTOM (OFF)

CS-D/N POWER-ON SWITCH WIRING DIAGRAM

FROM AC WALL OUTLET

117VAC

P/J1

BROWN — 3 — BROWN
117VAC
BLUE — 1 — BLUE

SWITCHING POWER SUPPLY

AC SWITCH
4 1
5 2

BLUE — 2 — BLUE
117VAC (SWITCHED)
BROWN — 4 — BROWN

C.5 Troubleshooting

C.5.5 Troubleshooting Flowchart (Sheet 5 of 5)

CS-D/N ONLY (CS is Similar)

Sheet 1
B ►◄ — Is +12V at fan connector ? — Yes ► Replace fan(s).

| No

Check voltage at P/J2 black and blue wires for +12V. ► +12V between blue and black wires of P/J2? — Yes ► Troubleshoot cable. Repair/replace cable.

| No

DC voltages OK? — No ► Replace power supply.

| Yes

Check cabling. Correct as required.

MICROVP

Sheet 1
B ►◄ — Is +115V at fan connector ? — Yes ► Replace fan(s).

| No

Replace power supply.

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'n05.crs

C.5 Troubleshooting

C.5.6 Intracabling Diagram

Motherboard Voltage Test Points
TP1 = -12V
TP2 = +12V
TP3 = +5V
TP4 = -5V
TP5 = Ground
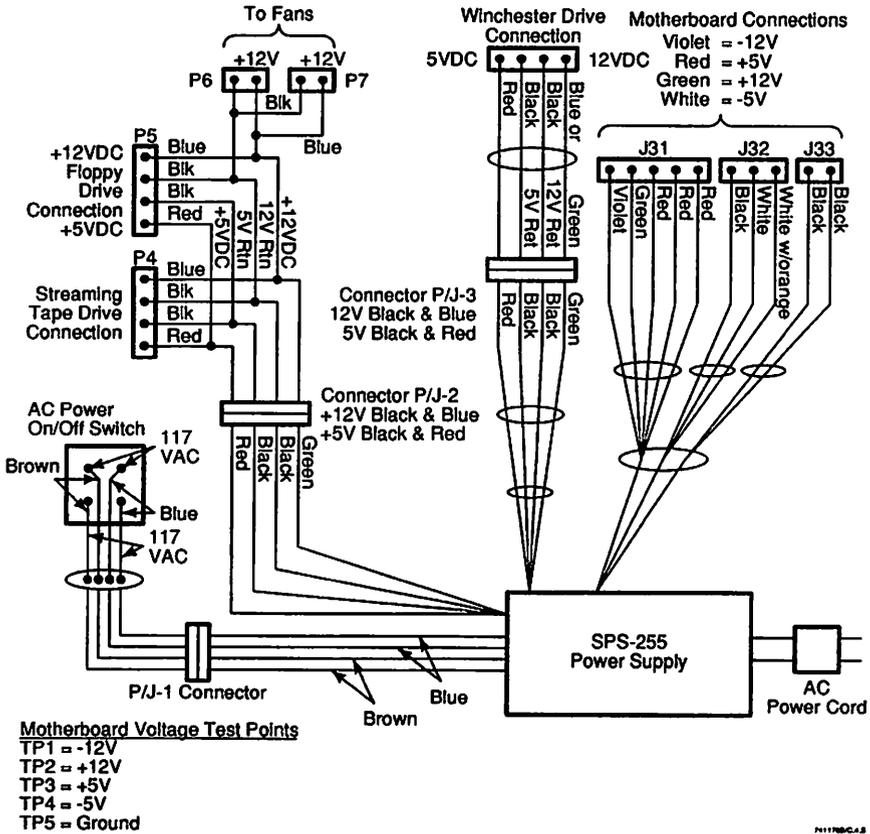
C.5 Troubleshooting

C.5.7 Troubleshooting System Errors (Sheet 1 of 3)

Most hardware errors will affect a number of different programs, not just one specific program. However, if nothing has changed or occurred out of the ordinary since the last successful use of a program now failing, most likely a hardware problem exists. If a hardware error had occurred or a program had been illogically stopped during execution, the possibility would exist of a file being left open or some part of the program being left unresolved which now could result in program errors. When troubleshooting an error, use the information in Section C.5.8 along with systematic troubleshooting procedures. If a program or operator error is indicated, rule out the possibility of a program or operator error first by finding out if the error being described actually exists as described. Have the customer call their programmer if need be. If the program has been used before, ask the customer if any problems have occurred. Have the customer run the program on a 2nd terminal/partition. Following each error listed in section C.5.8 is a listing of possible hardware that may cause the problem in order of likelihood. Other hardware could cause the problem but in most cases that possibility would be remote.

Operating System Bugs

It is possible any error could be caused by an operating system bug, but this should be the last consideration after eliminating the other likely causes. If a program has been running and neither the program or the O/S has been changed, an O/S bug is unlikely. Usually an O/S bug is repeatable. That is, if the same steps are repeated that produced the error the first time, the same error would reoccur. Repeating those steps is not always as simple as it might seem. Sometimes steps taken prior to running the failing program may factor into the problem or possibly what is happening in other partitions. Usually an O/S bug will only affect a particular program or function. All other programs unrelated to the specifics of the bug will run error free. If you feel your particular problem is an O/S bug, a call should be opened with the RSC where the problem should be duplicated and forwarded to Home Office R&D via a PTR (Problem Tracking and Reporting).

System Hangs

Hangs are usually the most difficult problems to isolate and correct because so many different things can cause them; hardware, environment, software, operating system. Most times the steps taken to clear the hang will help identify the cause. This is why it is critical to take the proper steps to clear each hang and to document each occurance. In so doing, the problem can usually be quickly isolated to a certain area. When a hang occurs the following steps should be taken.

1. Key HALT (DE terminals) or SHIFT/ HALT (DW terminals) on each termi-

C.5 Troubleshooting

C.5.7 Troubleshooting System Errors (Sheet 2 of 3)

nal hung. If the terminal is only in a program loop, a colon/cursor (:_) should return on the next line. In this case the system is not truely hung. There could be a program problem or it may be the system is just busy and it is taking more time to complete than usual. Key CONTINUE then RETURN to resume program execution. If the HALT key did not give a colon/cursor, proceed to step 2.

2. If there are any terminals that are not hung, key LISTDT then RETURN from one terminal, otherwise go to step 3. LISTDT displays the device table. The hang could be caused by a particular user or partition hogging a device while other partitions are waiting to use it. The field labeled MDT (Master Device Table) will show available addresses for the system. If any address is followed by a - number with a trailing O (O= open or hog), it indicates that entire device is hogged by the partition number shown. For example, /310-04O indicates that address 310 is hogged by partition 4, and example /320-10 would indicate that address 320 is used by partition 10 but is not hogged. If an address is hogged as indicated by a trailing 0, all other users will be unable to access until the hogging partition clears the hog. If there is no '0' following the partition number other users should be able to access disk. When an address is being used by a partition it may not always be indicated, but if it is

hogged, it will always be indicated. The PHT (Platter Hog Table) field is similar but indicates a specific disk address hogged by the partition number shown, but other addresses within that same disk unit should be accessible. Any terminals waiting to use addresses or devices hogged by other partitions will appear hung until that address or device becomes available. Go to the partition which is causing the hog to find out if there is a legitimate reason for the problem. Try to HALT the program running there if possible. If there is a problem and the program won't HALT, go to step 3. If the program does HALT and appears normal, key CONTINUE and RETURN to continue execution. Otherwise RESET could be used to clear the hogged conditions created by the partition. Doing so though could leave certain files open, and if so create software problems. Contact the programmer if unsure.

3. If one or more terminals will not respond to a HALT or SHIFT/HALT and they are not hung waiting for a hogged device or address to become available, RESET would have to be used. When there is no other way of recover, you can only RESET or power off. Normally one of two things will happen when you key RESET:

a: If when RESET is keyed, 'READY (BASIC-2) PARTITION xx' is returned to the screen, the problem was most

C.5 Troubleshooting

C.5.7 Troubleshooting System Errors (Sheet 3 of 3)

likely caused by a peripheral device, usually a disk, or an I/O controller. This normally indicates one particular terminal was hung and keying RESET on that terminal usually clears the problem and allows the other terminals to continue on. As in step 2, recheck the device table to see if any devices or addresses are hogged by keying in LISTDT and RETURN. If a partition is hogging an address, RESET that partition/terminal. Try listing and/or verifying the disk; LISTDCT/Dxx or VERIFYT/Dxx. If the disk is accessible, CLEAR the partition and restart the program if needed. Then document which terminal had to be RESET to clear the problem, what program was being used at that terminal, and if known the disk addresses involved. This information will greatly help to isolate the problem should the hangs continue. Go to step 4 if the disk is still unaccessible.

b: If RESET is keyed and the screen blanks with only a colon/cursor (:_), the terminal controller or the O/S has been blown away. If more than one terminal controller is used, RESET a terminal on a different controller. If terminals on only one controller are gone, most likely only that controller is bad or its microcode has been blown. If all terminals on two different controllers are lost, it is more likely the O/S has been lost. In either case, document which terminals were lost, power down the system and reboot (see Step 5). Problems of a very intermittent nature may indicate a power or static problem. The Turbo would be more sensitive to power and static than the 386 CPU or older 2200's because of

its much faster CPU speed. It could be also be just one particular workstation where noise is being picked up. If these problems continue but sometimes or always affect one particular controller, replace that controller first. Otherwise eliminate the CPU board, then the terminal controllers one by one and escalate the problem as necessary.

4. If you cannot access a particular disk unit or are unable to clear a hog condition from the partition issuing the hog, try powering off the disk unit. If powering off the disk unit clears the hang, the problem in most cases would be in the disk unit or the controller and not the CPU. However, if there are environmental problems at the site, disk I/O is the area that would be most sensitive to interference. There could be grounding problems or static problems with the CPU or workstations that could result in this type hang. Again be sure to document the problem with any information known. When, how it was cleared, what terminals are involved, what program, and what address. Replace the disk I/O controller board first, then the interface board(s) in the drive. Escalate as necessary. If you still can not access disk, go to step 5.

5. Power down the system. Disk drives should be made 'not ready' or powered off before the CPU is powered off. Reboot the CPU and run CE Level Diagnostics as needed (see C.5.1).

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 1 of 20)

BASIC-2 provides an extensive set of error detection features designed to automatically detect and report a wide range of error conditions. The system automatically scans program text for errors during program entry, resolution, and execution. When the system encounters an error, it displays the erroneous line with an arrow pointing to the approximate position of the error. The error number and a descriptive error message is displayed on the next line. For example,

100 DATALOAD DC#1,X
               ↑

ERROR D80: File Not Open

If the system discovers an error during text entry, it stores the erroneous line in memory. If the system encounters an error during program resolution or execution, it immediately terminates resolution or execution. The system stops error scanning when it encounters its first error. If a line contains more than one error, the system detects and reports only the first error.

Error codes are numbers preceded by a letter, which indicates the class of the error. Letter prefix, error class and issuing component are listed below:

Letter Prefix	Error Class	Issuing Component
A	Miscellaneous Errors	O/S
S	Syntax Errors	O/S
P	Program Errors	O/S
C	Computational Errors	O/S
X	Execution Errors	O/S
D	Disk Errors	O/S
I	I/O Errors	O/S
T	DS/CS-D Tape Errors	Tape Utility

Miscellaneous errors, Syntax errors, and Program errors cause execution of the program to terminate. These types of errors generally indicate incorrect syntax or program logic errors, and must be corrected before the program can be run. Computational errors, Execution errors, Disk errors, and I/O errors typically occur during program execution and are called recoverable errors. P48 is also a recoverable error. You can respond to recoverable errrors that occur during program execution without aborting the program or disrupting the display with an error message.

The following pages contain a list of all BASIC-2 error messages, including an explanation of the error and suggested recovery procedures and the possible hardware cause. Note: SIMMS have not been isolated from the CPU board for the purpose of identifying a possible hardware cause. Any failure which may be a CPU board could be due to a bad SIMM. An error which repeatedly comes up in only one partition may indicate a bad SIMM.

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 2 of 20)

Miscellaneous Errors

A00 System Error

Catch-all error for problems where the CPU cannot resolve the function required where no other error fits. Can be caused by an operator in some cases. If using SELECT H (Platter Hog), this error can occur if two users on different CPUs hog platters in the same drive and one ties up the disk and the 2nd keys RESET. If the system cannot clear the hog condition for the terminal issuing RESET within 5 seconds because the disk is busy with a FORMAT, VERIFY, MOVE, COPY, or some other command which could tie up the disk for an extended time, this error will occur. This specific cause would be normal and should not be considered a hardware problem

Possible Hardware Cause: 1) CPU Board 2) Disk Controller 3) DS/CS-D DPU Board

A01 Not Enough Memory

Not enough free space remains in memory to enter the program line or to accommodate the defined variable. You can still execute system commands (e.g., SAVE) and some Immediate mode statements. To make memory space available, enter a CLEAR P, CLEAR N, or CLEAR V command to shorten the program, reduce the number of variables defined, or increase partition size.

Possible Hardware Cause: 1) CPU Board

A02 Not Enough Memory

Not enough free space remains in memory to execute the program or Immediate mode statement. You can still execute system commands (e.g., SAVE) and some Immediate mode statements. To make memory space available, enter a CLEAR P, CLEAR N, or CLEAR V command to shorten the program, reduce the number of variables defined, or increase partition size.

Possible Hardware Cause: 1) CPU Board

A03 Not Enough Memory

Not enough free space remains in memory to accommodate the program text. To make memory space available, enter a CLEAR P, CLEAR N, or CLEAR V command to shorten the program, reduce the number of variables defined, or increase partition size.

Possible Hardware Cause: 1) CPU Board

A04 Operator Stack Overflow

FOR/NEXT loops, subroutines, or expressions are nested too deeply. Often this error occurs because the program repeatedly branches out of subroutines or loops without executing a terminating RETURN or NEXT statement. Correct the program, possibly by using a RETURN CLEAR statement to clear subroutine or loop information.

Possible Hardware Cause: 1) CPU Board

A05 Line Too Long

The program line being entered cannot be saved in one disk sector because its length exceeds 253 bytes. The line can be executed, but it cannot be saved on disk. Shorten the line by breaking it into two or more smaller lines.

Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 3 of 20)

A06 Program Protected

Protected program text in memory cannot be listed, saved, or modified, except with a LOAD RUN or CLEAR command. A LOAD RUN or CLEAR command deactivates protect mode, but it also clears program text from memory.
Possible Hardware Cause: 1) CPU Board

A07 Illegal in Immediate Mode

This statement cannot be executed in Immediate mode.
Possible Hardware Cause: 1) CPU Board

A08 Statement Illegal Here

The indicated statement cannot be used in the current context.
Possible Hardware Cause: 1) CPU Board

A09 Program not Resolved

The system cannot execute an unresolved program. Resolve the program by executing a RUN command.
Possible Hardware Cause: 1) CPU Board

Syntax Errors

S10 Missing '('

BASIC-2 syntax requires a left parenthesis.
Possible Hardware Cause: 1) CPU Board

S11 Missing ')'

BASIC-2 syntax requires a right parenthesis.
Possible Hardware Cause: 1) CPU Board

S12 Missing '='

BASIC-2 syntax requires an equal sign (=).
Possible Hardware Cause: 1) CPU Board

S13 Missing ','

BASIC-2 syntax requires a comma (,).
Possible Hardware Cause: 1) CPU Board

S14 Missing '*'

BASIC-2 syntax requires an asterisk (*) in the statement.
Possible Hardware Cause: 1) CPU Board

S15 Missing '>'

BASIC-2 syntax requires the > character.
Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 4 of 20)

S16 Missing Letter
BASIC-2 syntax requires a letter.
Possible Hardware Cause: 1) CPU Board

S17 Missing Hex Digit
BASIC-2 syntax requires a hex digit (digit from 0 to 9 or letter from A to F).
Possible Hardware Cause: 1) CPU Board

S18 Missing Relational Operator
BASIC-2 syntax requires a relational operator (<, =, >, <=, >=, <>).
Possible Hardware Cause: 1) CPU Board

S19 Missing Word
BASIC-2 syntax requires a required word (such as THEN or STEP).
Possible Hardware Cause: 1) CPU Board

S20 End Of Valid Syntax
Although syntax is correct up to the point of the error message, the system cannot comprehend the remainder of the statement.
Possible Hardware Cause: 1) CPU Board

S21 Missing Line Number
BASIC-2 syntax requires a line number.
Possible Hardware Cause: 1) CPU Board

S22 Illegal PLOT Argument
An argument in the PLOT statement is illegal.
Possible Hardware Cause: 1) CPU Board

S23 Invalid Literal
The syntax or length of the literal is invalid. A literal string must be 1 to 255 characters in length.
Possible Hardware Cause: 1) CPU Board

S24 Illegal Expression or Missing Variable
The expression syntax is illegal or a variable is missing.
Possible Hardware Cause: 1) CPU Board

S25 Missing Numeric Scalar Variable
BASIC-2 syntax requires a numeric-scalar-variable
Possible Hardware Cause: 1) CPU Board

S26 Missing Array Variable
BASIC-2 syntax requires an array-variable.
Possible Hardware Cause: 1) CPU Board

C.5.8 Error Messages and Recovery (Sheet 5 of 20)

S27 Missing Numeric Array
BASIC-2 syntax requires a numeric-array.
Possible Hardware Cause: 1) CPU Board

S28 Missing Alpha Array
BASIC-2 syntax requires an alpha-array.
Possible Hardware Cause: 1) CPU Board

S29 Missing Alpha Variable
BASIC-2 syntax requires an alpha-variable.
Possible Hardware Cause: 1) CPU Board

Program Errors
P31 DO Not Matched with ENDDO
DO and ENDO statements are not properly matched.
Possible Hardware Cause: 1) CPU Board

P32 Start>End
The starting value exceeds the ending value.
Possible Hardware Cause: 1) CPU Board

P33 Line Number Conflict
The system cannot execute the RENUMBER command because the renumbered program text cannot fit between existing program lines. Adjust the RENUMBER command parameters.
Possible Hardware Cause: 1) CPU Board

P34 Illegal Value
The value exceeds the allowed limit.
Possible Hardware Cause: 1) CPU Board

P35 No Program
Memory contains no program statements. Prior to issuing a RUN command, enter program statements or load a program.
Possible Hardware Cause: 1) CPU Board

P36 Undefined Line Number or CONTINUE Illegal
If the program references a line number that does not exist, ensure that all referenced lines exist. If the system aborts a CONTINUE command, rerun the program using a RUN command. The following circumstances prevent continuation of terminated program execution: the occurrence of a stack or memory overflow, the entry of a new variable, the execution of a CLEAR command, the modification of program text, or a reset operation.
Possible Hardware Cause: 1) CPU Board

C.5.8 Error Messages and Recovery (Sheet 6 of 20)

P38 Undefined DEFFN' Subroutine

The program references a nonexistent DEFFN' subroutine.
Possible Hardware Cause: 1) CPU Board

P39 FN's Nested Too Deeply

The system encountered more than five levels of nesting when evaluating an FN function.
Possible Hardware Cause: 1) CPU Board

P40 NEXT without FOR

The program contains a NEXT statement without a companion FOR statement or it branches into the middle of a FOR/NEXT loop.
Possible Hardware Cause: 1) CPU Board

P41 RETURN without GOSUB

The program executes a RETURN statement without first executing a GOSUB or GOSUB' statement. Either a companion GOSUB or GOSUB' does not exist, or the program branches into the middle of a subroutine.
Possible Hardware Cause: 1) CPU Board

P42 Illegal Image

The indicated image is illegal in the current context. For example, a PRINTUSING statement refers to an image that does not contain a format specification.
Possible Hardware Cause: 1) CPU Board

P43 Illegal Matrix Operand

The same array name appears on both sides of the equation in a MAT multiplication or MAT transposition statement.
Possible Hardware Cause: 1) CPU Board

P44 Matrix Not Square

The dimensions of a MAT inversion or identity operand are not equal.
Possible Hardware Cause: 1) CPU Board

P45 Incompatible Operand Dimensions

The dimensions of the operand in a MAT statement are not compatible.
Possible Hardware Cause: 1) CPU Board

P46 Illegal Microcommand

A microcommand in the specified $GIO sequence is illegal or undefined. An illegal escape sequence was sent to the Generialized Printer Driver.
Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 7 of 20)

P47 Missing Buffer Variable

A data input, output, or verify microcommand omits a $GIO statement buffer. Include a buffer in the $GIO command.
Possible Hardware Cause: 1) CPU Board

P48 Illegal Device Specification

The statement refers to an undefined file number or device address not entered into the Master Device Table. Execute a SELECT statement defining the file number, or correct the device address. This error occurs when the system tries to communicate with the device, not when the device is selected. P48 is a recoverable error. If necessary, reboot the system and add the address to the device table using SF'05 option within @GENPART.
Possible Hardware Cause: 1) CPU Board

P49 Interrupt Table Full

The program can define interrupts for a maximum of eight devices.
Possible Hardware Cause: 1) CPU Board

P50 Illegal Array Dimensions or Variable Length

The array dimensions or alpha-variable length exceeds the legal limits.
Possible Hardware Cause: 1) CPU Board

P51 Variable or Value Too Short

The length of the indicated variable or value is too short for the specified operation.
Possible Hardware Cause: 1) CPU Board

P52 Variable or Value Too Long

The length of the indicated variable or value is too long for the specified operation.
Possible Hardware Cause: 1) CPU Board

P53 Noncommon Variables Already Defined

Noncommon variables cannot be defined in a program before a COM statement. Either move all COM statements to the beginning of the program, or clear noncommon variables with a CLEAR N command.
Possible Hardware Cause: 1) CPU Board

P54 Common Variable Required

A multiple-file LOAD command requires a common variable.
Possible Hardware Cause: 1) CPU Board

P55 Undefined Variable

The indicated variable is not defined elsewhere in the program. This error usually results because a referenced array in a DIM or COM statement is improperly defined.
Possible Hardware Cause: 1) CPU Board

C.5.8 Error Messages and Recovery (Sheet 8 of 20)

P56 Subscript Out of Range
The variable subscripts exceed the defined array dimensions, or the number of subscripts does not agree with the array dimensions.
Possible Hardware Cause: 1) CPU Board

P57 Illegal STR Argument
The STR function arguments exceed the maximum defined length of the alpha-variable. Correct the STR function arguments, or redefine the alpha-variable.
Possible Hardware Cause: 1) CPU Board

P58 Illegal Field/Delimiter Specification
The $PACK or $UNPACK statement specifies an illegal field or delimiter specification.
Possible Hardware Cause: 1) CPU Board

P59 Illegal Redimension
The space required to redimension the array exceeds the space initially reserved for the array. Redimension the array to fit the required space, or adjust the DIM or CON statement to reserve additional space.
Possible Hardware Cause: 1) CPU Board

Computational Errors
C60 Underflow
The absolute value of the result was less than 1E-99 but greater than zero. The statement SELECT ERROR>60 suppresses this error and moves a default value of zero into the result.
Possible Hardware Cause: 1) CPU Board

C61 Overflow
The absolute value of the result was greater than 9.999999999999E+99. The statement SELECT ERROR>61 suppresses this error and moves a default value of $\pm$ 9.999999999999E+99 into the result.
Possible Hardware Cause: 1) CPU Board

C62 Division by Zero
Division by zero is mathematically undefined. The Statement SELECT ERROR>62 suppress this error and moves a default value of $\pm$ 9.999999999999E+99 into the result.
Possible Hardware Cause: 1) CPU Board

C63 Zero Divided By Zero or Zero Raised to Zero Power
Zero divided by zero or zero raised to the power of zero is mathematically undefined. The Statement SELECT ERROR>63 suppress this error and moves a default value of zero into the result.
Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 9 of 20)

C64 Zero Raised to Negative Power

Zero raised to a negative power is a mathematically undefined operation. The statement SELECT ERROR>64 suppresses this error and moves a default value of ±9.999999999999E+99 into the result.
Possible Hardware Cause: 1) CPU Board

C65 Negative Number Raised to Non-Integer Power

Raising a negative number to a noninteger power is a mathematically undefined operation. The statement SELECT ERROR>65 suppresses this error and moves a default value of the absolute value of the number raised to the negative power into the result.
Possible Hardware Cause: 1) CPU Board

C66 Square Root of Negative Value

The square root of a negative value is mathematically undefined. The statement SELECT ERROR>66 statement suppresses this error and moves a default value of SQR(ABS(X)), where X is the negative value, into the result.
Possible Hardware Cause: 1) CPU Board

C67 LOG of 0

The LOG of zero is mathematically undefined. The statement SELECT ERROR>67 statement suppresses this error and moves a default value of -9.999999999999E±99 into the result.
Possible Hardware Cause: 1) CPU Board

C68 LOG of Negative Value

The LOG of a negative number is mathematically undefined. The statement SELECT ERROR>68 statement suppresses this error and moves a default value of the LOG into the result.
Possible Hardware Cause: 1) CPU Board

C69 Argument Too Large

The absolute value of the SIN, COS, or TAN function is greater than or equal to 1E+10 and the system cannot evaluate this function; or, the absolute value of the ARCSIN, ARCCOS, or ARCTAN argument is greater than 1.0, and the value of this function is mathematically undefined. The statement SELECT ERROR>69 suppresses this error and moves a default value of zero into the result.
Possible Hardware Cause: 1) CPU Board

Execution Errors

X70 Insufficient Data

The DATA statement does not contain enough data values to satisfy READ or RESTORE statement requirements. Correct the program to supply additional data, or modify the READ or RESTORE statement.
Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 10 of 20)

X71 Value Exceeds Format

The PACK or CONVERT image does not specify enough integer digits to express the value of the number being packed or converted.
Possible Hardware Cause: 1) CPU Board

X72 Singular Matrix

A MAT inversion operand is singular and cannot be inverted. Include a normalized determinant parameter in the MAT INV statement, and check the determinant following the conversion.
Possible Hardware Cause: 1) CPU Board

X73 Illegal INPUT Data

The value requested by an INPUT statement is in an illegal format. Reenter the data in the correct format, or stop program execution by pressing the RESET key and then RUN the program again. Alternately, to avoid the entry of illegal data, substitute a LINPUT statement for the INPUT statement, and verify operator-entered data within the program.
Possible Hardware Cause: 1) CPU Board

X74 Wrong Variable Type

The variable type (alpha or numeric) and the data type do not correspond. Correct the program or data, or ensure that the proper file is being accessed.
Possible Hardware Cause: 1) CPU Board

X75 Illegal Number

The format of the indicated number is illegal.
Possible Hardware Cause: 1) CPU Board

X76 Buffer Exceeded

The buffer variable is too small or too large for the specified operation.
Possible Hardware Cause: 1) CPU Board

X77 Invalid Partition Reference

The partition referenced by SELECT @PART or $RELEASE TERMINAL is not defined or the name specified by DEFFN @PART has already been used. Use the proper partition name and wait for the global partition to be defined.
Possible Hardware Cause: 1) CPU Board

X78 Printer Driver Error

An error was detected with the print drivers. The error also results from an invalid driver table name. The error is also returned if you attempt to associate more than 15 device addresses with printer driver tables or when an address associated with the printer driver tables is used more than once. To recover, change the incorrect address parameter.
Possible Hardware Cause: 1) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 11 of 20)

X79 Invalid Password

The password entered does not match the password set when the system was configured with the @GENPART utility.
Possible Hardware Cause: 1) CPU Board

Disk Errors

D80 File Not Open

The file operation cannot be performed upon a closed file.
Possible Hardware Cause: 1) 22C11-HS High Speed Disk Controller 2) CPU Board

D81 FileFull

No more information can be written into the indicated file. Correct the program, or transfer the file to another platter, reserving additional space on the new platter for this file.
Possible Hardware Cause: 1) 22C11-HS High Speed Disk Controller 2) CPU Board

D82 File Not Found

The file name does not exist, or a data file was loaded as a program file or a program file as a data file. Ensure that the file name is entered correctly; ensure that the proper disk is mounted; and ensure that the correct disk drive is being accessed.
Possible Hardware Cause: 1) CPU Board 2) 22C11-HS High Speed Disk Controller

D83 File Already Exists

The file name already exists in the Catalog Index. Use a different name, or catalog the file on a different platter.
Possible Hardware Cause: 1) CPU Board 2) 22C11-HS High Speed Disk Controller

D84 File Not Scratched

A file must be scratched before it can be renamed or written over.
Possible Hardware Cause:1) 22C11-HS High Speed Disk Controller 2) CPU Board

D85 Index Disk Full

The Catalog Index contains no space for new names. Scratch unwanted files and compress the catalog using a MOVE statement, or mount a new disk platter and create a new catalog.
Possible Hardware Cause:1) 22C11-HS High Speed Disk Controller 2) CPU Board

D86 Catalog End Error

The defined Catalog Area ends within the Catalog Index or has no more available space to store information. This usually occurs because a MOVE END statement tries to move the end of the Catalog Area to the area already occupied by cataloged files. Correct the SCRATCH DISK and MOVE END statement, or increase the size of the Catalog Area by executing a MOVE END command. Alternately, scratch unwanted files and compress the catalog using a MOVE statement, or mount a new disk platter and create a new catalog.
Possible Hardware Cause:1) 22C11-HS High Speed Disk Controller 2) CPU Board

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 12 of 20)

D87 No End-of-File
Because neither a DATASAVE DC END nor a DATASAVE DA END statement recorded an end-of-file record in the file, the DSKIP END statement cannot locate an end-of-file record. Write an end-of-file trailer after the last data record in the file.
Possible Hardware Cause:1) 22C11-HS High Speed Disk Controller 2) CPU Board

D88 Wrong Record Type
The system encountered a program record when a data record was expected or vice versa. Ensure that the proper drive and file is accessed.
Possible Hardware Cause:1) CPU Board

D89 Sector Address Beyond End-of-File
A DATALOAD DC or DATASAVE DC statement accesses a sector address beyond the end-of-file. This error can be caused by accessing a disk platter that has been randomly written to for test purposes or has been copied from a disk of greater size. Press RESET and run the program again. If the error persists, use a different platter or reformat the platter.
Possible Hardware Cause:1) Disk Interface Board 2) 22C11-HS High Speed Disk Controller 3) CPU Board

I/O ERRORS

I90 Disk Controller Error
The system aborts the disk operation because the controller responded improperly at the beginning of the operation. Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and all cables are properly connected.
Possible Hardware Cause:1) Disk Controller 2) Disk Interface Board(s) 3) Turbo CPU 4) Drive

I91 Disk Drive Not Ready
The disk unit is not ready for access. Make certain that the program addresses the correct disk. Also, make sure that the disk unit is on and in run mode, and all cables are properly connected. Press RESET and rerun the program. If the error recurs, power the disk unit off and then back on and rerun the program. This error is normal if the disk drive is powered on but not ready.
Possible Hardware Cause:1) Disk Drive 2) Disk Interface Board(s)

I92 Timeout Error
A device did not respond to the system. If the device is a disk, the system aborts the disk operation. Press RESET and rerun the program again. If the error recurs, ensure that the disk has been formatted.
Possible Hardware Cause:1) Disk Drive Interface 2)Disk Controller 2) Disk Drive

C.5.8 Error Messages and Recovery (Sheet 13 of 20)

I93 Format Error

The system detects an invalid sector header as read from the disk platter. If a disk operation is in progress, the platter may need to be reformatted. If the formatting is in progress, the surface of the platter may be flawed. Reformat the disk platter; if the error recurs, replace the platter. The error can also occur if the user attempts to access a disk formatted for use on a different type of system.

Possible Hardware Cause:1) Disk Media 2) Disk Drive (possibly alignment) 3) Disk Interface Board(s)

I94 Disk Controller Error

The system aborts the disk operation because the controller did not receive the disk commands correctly. Press RESET and rerun the program. If the error recurs, make certain that the disk unit is on and all cables are properly connected.

For those disks with a format key, this error message also can indicate that the format key is engaged. Disk operations cannot be performed until formatting is turned off with the format key.

For SCSI Controllers, the controller aborts the operation due to an illegal SCSI command or request. Verify that the SCSI unit is on and that all disks are configured correctly.

Possible Hardware Cause:1) Disk Interface Board(s) 2) Disk Controller 3) CPU Board

I95 Device Error (Seek Error or Platter Protected)

The disk cannot perform the requested operation. Repeat the operation. If performing a write operation, make certain that the disk is not write-protected. If the error recurs, power the disk off and back on, and again perform the operation.

Possible Hardware Cause:1) Disk Drive 2) Disk Interface Board(s)

I96 Data Error

For read operations, the checksum calculations (CRC or ECC) indicate that the data read is incorrect. For disk drives that perform ECC, the attempt to correct errors was unsuccessful. If the same sectors intermittently or solidly fail, rewrite the data; the read sector may have been corrupted. If read errors recur, reformat the platter.

For write operations, the LRC calculation indicates that the data sent to the disk is incorrect. The data has not been written correctly. Repeat the write operation. If the write error recurs, make certain that all disk cables are properly connected.

Possible Hardware Cause:1) Disk Media 2) Disk Drive (possibly alignment) 3) Disk Interface Board(s)

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 14 of 20)

I97 LRC Error

A longitudinal redundancy check error occurred while a sector was being written or read. An LRC error usually indicates a transmission error between the disk and the CPU. Press RESET and rerun the program. If the error recurs, rewrite the flawed sector; the sector may have been previously written incorrectly.

Possible Hardware Cause: 1) Disk Interface Board(s) 2) Disk Controller 3) Disk Drive 4) CPU Board

I98 Illegal Sector Address or No Platter

The indicated sector is not on the disk platter, or the specified drive contains no platter. Ensure that the correct drive is being accessed. Correct the program statement, or ensure that the diskette is inserted into the drive.

Possible Hardware Cause: 1) Disk Drive 2) Disk Interface Board(s) 3) Disk Controller

I99 Read-After-Write-Error

The comparison of read-after-write to a disk sector failed, usually indicating a defective platter. Rewrite the information; the data may have been previously written incorrectly. If the error recurs, replace the platter.

Possible Hardware Cause: 1) Disk Drive 2) Disk Interface Board(s) 3) Disk Controller

TAPE COMMAND ERROR CODES

Each time you issue a command to the streaming tape cassette drive, the CS-D/N sends a return code. The return code indicates whether or not the CS-D/N completed the command. If not successful, the return code provides error information.

If an error occurs while accessing the disk in response to a Backup Sectors or Restore Sectors tape command, the command returns the following errors.

Some of the errors encountered with tape commands are the same as the corresponding I/O errors. See the section entitled I/O Errors for a discussion of the following error conditions.

- I91 Disk Drive Not ready
- I92 Format Error
- I95 Device Error
- I96 Data Error
- I98 Illegal Sector Address or No Platter
- I99 Read-After-Write Error

NOTE: Unlike the other errors previously described in this section, tape errors are generated by the Tape Utility program and not the operating system.

The following return codes apply to the tape cassette device.

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 15 of 20)

T10 No Tape Cassette
Meaning
There is no cassette in the tape cassette drive.
Action
Make sure that you insert a tape cassette into the drive before issuing tape commands.
Possible Hardware Cause:1) Tape Drive 2) Tape Interface Board (DPU)

T11 No Tape Cassette Drive
Meaning
There is no tape cassette drive.
Action
The CS-D/N cannot perform the tape command without an operational tape cassette drive.
Possible Hardware Cause:1) Tape Drive 2) Tape Interface Board (DPU)

T12 Write Protect
Meaning
The CS-D/N cannot perform the write operation with a write-protected tape cassette.
Action
To write to the tape cassette, unprotect it.
Possible Hardware Cause:1) Tape Drive 2) Incompatible Tape 3) Tape Interface Board (DPU)

T13 End of Tape
Meaning
The CS-D/N encountered the end of tape. If reading, there is no more data on the tape. If writing, there is no available space on the tape.
Action
Cease the read/write operation. The tape utilities normally handles this problem.
Possible Hardware Cause:1) Tape Drive 2) Tape Problem 3) Tape Interface Board (DPU)

T14 Unrecoverable Data Error
Meaning
The CS-D/N cannot perform the read or write operation.
Action
Make sure that you loaded the right cassette, 45Meg is high density, 150Meg is extra high density. Retry the operation. If the error occurs again, power the CS-D/N off (when not in use), back on, and retry the operation. If the error persists, try the operation with a different tape cassette.
Possible Hardware Cause: 1) Tape (wrong type) 2) Tape Drive 3) Tape Interface Board (DPU)

C.5.8 Error Messages and Recovery (Sheet 16 of 20)

T15 Bad Data Block
Meaning
The CS-D/N could not read the next data block on tape.
Action
Remount the tape and try the operation again from the beginning. If the error persists, try a different tape cassette.
Possible Hardware Cause: 1) Tape 2) Tape Drive 3) Tape Interface Board (DPU)

T16 No Data Trying to Restore or Append To a Blank Tape
Meaning
There is no more data on the tape to read.
Action
This error may occur if you try to append to a virgin tape. You must always erase a blank or new tape on the first use.
Possible Hardware Cause: 1) Tape Drive 2) Tape 3) Tape Interface Board (DPU)

T17 No Data
Meaning
There is no more data on the tape to read.
Action
Make sure that you mounted the correct tape cassette.
Possible Hardware Cause: 1) Tape 2) Tape Drive 3) Tape Interface Board (DPU)

T1A File Mark Read
Meaning
A file mark was read from the tape.
Action
Verify the file mark was written on the tape.

T1B Illegal Command
Meaning
The command issued is not a legal tape command. May also occur if trying to write to a write-protected tape.
Action
Correct the program. Verify the tape is not write-protetcted.
Possible Hardware Cause: 1) CPU Board 2) Disk Controller 3) Tape Interface Board (DPU)

T1C Power On/RESET
Meaning
The tape drive was reset in the middle of an operation.
Action
Retry the operation.
Possible Hardware Cause: 1) Tape Drive 2) Tape Interface Board (DPU) 3) Tape Power Supply

C.5 Troubleshooting

T20 Invalid Number of File Marks
Meaning
The number of file marks specified must be 1 to 15.
Action
Correct the program.

T23 Insufficient Buffer Space
Meaning
You may have defined too large a RAMdisk and the system cannot perform tape operations.
Action
Deallocate the RAMdisk (making sure you save all the needed data elsewhere) and retry the tape operation. If the RAMdisk is not causing the problem, then the system did not release the tape buffer (probably because the system aborted a tape operation). To release buffer space, issue a REWIND TAPE command. If the error persists, power the unit housing the tape drive off (when not in use) and back on.
Possible Hardware Cause: 1)Tape Interface Board (DPU) 2) Tape Drive

T24 Tape Drive Error
Meaning
A tape drive bus parity error occurred.
Action
Try the operation again from the beginning. If the error persists, turn the unit off and back on (when not in use) and retry.
Possible Hardware Cause: 1) Tape Interface Board (DPU) 2) Tape Drive 3) Disk Controller

T26 LRC Error
Meaning
The longitudinal redundancy check (LRC) on the data sent is not correct.
Action
Retransfer the data using the REREAD command for tape reading or WRITE BLOCK command for tape writing.
Possible Hardware Cause: 1) Tape Drive 2) Tape Interface Board (DPU)

T27 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.
Possible Hardware Cause: 1) Clean Heads and Drive Rollers 2) Tape 3) Tape Drive

C.5.8 Error Messages and Recovery (Sheet 18 of 20)

T30 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T31 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T32 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T33 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T34 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T35 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 19 of 20)

T36 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T37 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T38 Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T3A Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T3B Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T3C Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

C.5 Troubleshooting

C.5.8 Error Messages and Recovery (Sheet 20 of 20)

T3D Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

T3E Tape Device Error
Meaning
An expected device fault occurred.
Action
Retry the operation. If the error continues, turn the unit off and back on (when not in use) and try again.

C.5 Troubleshooting

C.5.9 Basic Commands (To Aid In Troubleshooting) (Sheet 1 of 5)

The following is a quick reference to a list of commands that can aid the CE in testing, troubleshooting, and isolating problems. In most cases the commands should be self-explanatory to those familiar with the product line. No com- mand should be used which may affect customer data unless the ramifications of using the command are understood. Refer to the *Multiuser BASIC-2 Language Reference* manual, part number 715-4080F for more information.

Command	Description
$INIT"SYSTEM"	Causes the sysem to reboot bringing all users down and displaying 'Mount System Platter, Press RESET' on the screen. Must be on terminal 1. All users must complete operations before issuing this command or data corruption could result. SYSTEM is the default password with all virgin Wang operating systems. It can be changed by the operator during boot. See C.7.10 step 15 for additional information.
CLEAR	Completely clears memory on the partition being used.
CLEARP line#,line#	Clears only the program lines from the 1st line number up to and including the 2nd line number.
LIST	Displays the program now in memory on the screen one screen at a time. Key RETURN for subsequent screens.
LISTDT	Displays the contents of the device table on the screen. The device table shows the default addresses for console input and output, CI and CO, and for INPUT, PRINT, PLOT, and LIST commands. The MDT (master device table) field identifies defined addresses. In this field, if an address is followed by a two digit number (indicates the partition using the address) with an 'O' for open on the end, the entire device at that address is hogged. If there is no 'O' after the two digit number, the address is being heavily used by the partition number indicated but the device is not hogged.

C.5 Troubleshooting

C.5.9 Basic Commands (To Aid in Troubleshooting) (Sheet 2 of 5)

Command	Description
LISTDT (continued)	The PHT (platter hog table) indentifies platter addresses being hogged if using SELECT H ON. This field only exists on Turbo and 386 CPU's. See C.1.5, sheet 3 of 4, "Programs in 'NEW' or '386' Format" for additional information. If an address is followed by a dash (-) and a number, it is being hogged by the partition whose number is shown. The PDT (printer device table) identifies what printer drivers are available to the partition being used, the associated printer address, and if the driver is on or off. Refer to C.7.10, step 6, item 3 for additional information on drivers.
LIST SELECT	Similiar to LISTDT in that it lists the default addresses for the console, PRINT, LIST, PLOT and DISK for partition used, but also shows the current defaults for 'OLD' or 'NEW' format and platter hog. See C.1.5, page 3 of 4 and page 4 of 4 for more information on 'OLD' and 'NEW' format. This command is only supported on the Turbo and 386 CPUs.LIST SELECT xxx Changes the default address for the LIST command to the address given. The screen, address 005, is the default address at power up.
LIST V	Prints to the screen a cross reference of all variables used in the current program in memory for this partition.RENUMBER TRACE Renumbers the program lines in memory by 10. Programmers aid which causes the system to print out variable names and values each time they change. It also displays line numbers each time a program branch is done.
PRINT"abcde...."	Will print to the screen exactly what is written within the " "s.
PRINT ERR	Will print on the screen the last error that occurred since the last RESET or CLEAR.

C.5.9 Basic Commands (To Aid in Troubleshooting) (Sheet 3 of 5)

Command	Description
PRINT #CPU	Prints on the screen the CPU number. This number is used with 'platter hog' (SELECT H ON) in a multi-CPU environment. It identifies to the disk which CPU the partition hogging a platter is coming from. See Section C.7.10, step 6 item 2, for additional information. The CPU number only exists on the 386 and Turbo CPUs.
PRINT #ID	Will print on the screen the CPU ID# which can be used by programmers to protect their programs. This number is hard coded in the CPU board boot PROMs.
PRINT #PART	Prints the partition number for the terminal being used on the screen.
PRINT #TERM	Prints the physical terminal number for the terminal in use on the screen.
RENUMBER	Renumbers the program lines in memory by 10.
TRACE	Programmers aid which causes the system to print out variable names and values each time they change. It also displays line numbers each time a program branch is doen.
TRACE OFF	Shuts the TRACE command off.
SELECT LIST xxx (y)	Changes the default address for all the LIST command to the address given. The screen, address 005, is the default address at power up.
SELECT PRINT xxx (y)	Changes the default address for all PRINT commands to address xxx. y is the line length. If y is not given the default is 80. The default address at power up is 005, which is the screen (CRT).

C.5.9 Basic Commands (To Aid in Troubleshooting)
(Sheet 4 of 5)

Command	Description
Disk Related Commands	
SELECT DISK Dxx	Sets the disk default address to the address given for the partition being used. When this is done, this address is used for any disk command for which an address is not specified. The address from which the system boots from is the default address unless otherwise specified.
$FORMAT DISK T/Dxx	Formats address given, all data is cleared and sector headers rewritten.
VERIFYT/Dxx, (X,Y)	Where X = the 1st sector to verify and Y the last. Will read all sectors from X to Y at the address given. If a sector cannot be read the message 'Error in Sector x' is returned.COPYT/Dxx,(X,Y)TOT/Dxx,(Z). Copies all data from 1st address given starting at sector X to and including Y to the 2nd address given starting at sector Z. COPY creates an exact duplicate of the data read. All sectors on the 2nd disk will be overwritten starting at sector Z for as many sectors as defined by X and Y.
LIST DCT/Dxx	Displays the index of the disk address showing file names, type (program or data), where the file starts and ends on disk, and how many sectors it is using and still has available. One screen is displayed at a time. Key RETURN for additional screens.
LOAD DCT/Dxx, "program"	Reads the program specified from the address given into memory. Memory should be cleared before loading the new program as any non-conflicting program line(s) will remain.
SAVE T/Dxx, "program"	Reads the program currently in memory and writes it to the disk address given using the program name in quotes. There must be space in the index and catalog of the disk given and the program name cannot already exist at that address or an error will be returned. Existing data on the disk is not affected.

C.5 Troubleshooting

C.5.9 Basic Commands (To Aid in Troubleshooting) (Sheet 5 of 5)

Command	Description
MOVET/Dxx, TOT/Dxx,	Takes data off the 1st address file by file and saves these files on the 2nd address. Scratched files will not be moved. Index is reorganized by the system at the new address for optimum accessing. The address being written to must have an index and catalog area large enough to hold the files being moved. All data that was on the disk being written will be lost.
MOVET/Dxx,"filename"TOT/Dxx	Reads the program or data file from the 1st address and writes it to the 2nd address. There must be room in the index and catalog of the 2nd disk or an error will occur. Existing data is not affected on the 2nd address is not affected on either disk.MOVE END T/DXX = X Changes the last sector for address given to sector x. X must be beyond where the last file ends or an error is returned. Data in the catalog area is not affected.
SCRATCH DISK T/Dxx, LS=X,END=Y	Creates a new index of X number of sectors at the address given. The Y parameter is the last sector of the catalog of which the files to be stored cannot go beyond. All data that was at this address before the SCRATCH will now be inaccessible.
SCRATCH/Dxx, "filename'	Designates a file as obsolete. When LISTing disk an S will precede the file type identifying it as scratched. Scratched files are not moved with the MOVE command.
RENAME T/Dxx, "oldname"TO"newname"	Changes the name of the file at the address given.

C.6 Parts Replacement

C.6.1 CS-Turbo Motherboard 210-9583 (Sheet 1 of 2)

To remove

1 Power down the system, disk drives first then CPU.

2 Remove CPU board cover.

3 Remove CPU, all PCAs and blank I/O panel covers.

NOTE

Only the Turbo motherboard, CPU Board, and SIMM replacement are discussed in the parts replacement section. Refer to the base manual for parts replacement procedures for other components (e.g. power supply, etc.). If upgrading a CS to a Turbo, see Section C.7.2.

4 Remove Dc power harness from motherboard connectors J31, J32, and J33.
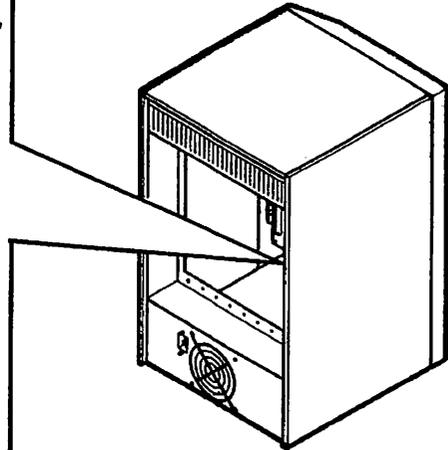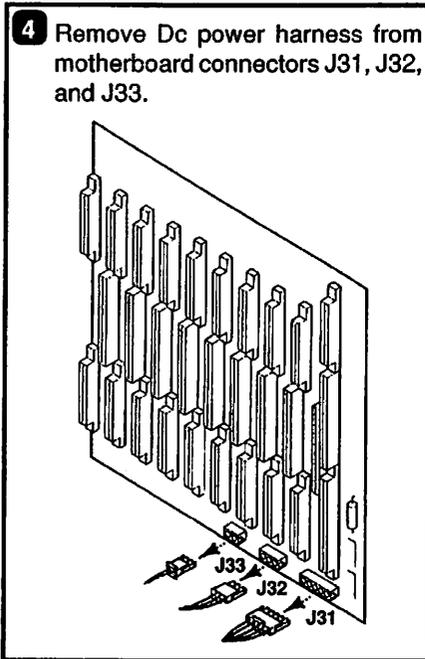
C.6 Parts Replacement

C.6.1 CS-Turbo Motherboard 210-9583 (Sheet 2 of 2)

5 Remove eight screws securing motherboard to chassis. Remove motherboard.

To install

NOTE

On some early versions of the 210-9583 motherboard, some screw holes may not line up. In that case, insert the two screws for the center of the I/O section (locations E and F), but do not tighten. Start screws at locations C, D, and B. Holes for screws A, G, and H will not line up. Tighten the five screws. This will provide adequate support.

1 Complete installation by reversing removal steps 1 through 5.

C.6 Parts Replacement

C.6.2 MicroVP Turbo Motherboard 210-9583 (Sheet 1 of 2)

To remove

1 Power down any disk drives first, then the CPU.

2 Remove CPU board cover and CPU board.

3 Note all I/O board cable locations and orientation and remove all I/O controllers and blank I/O panel covers.

4 Disconnect motherboard power supply cables from connectors J31, J32 and J33.

NOTE

Only the Turbo motherboard, CPU Board, and SIMM replacement are discussed in the parts replacement section. Refer to the *Micro VP Computer System* manual (741-1668) for parts replacement procedures for other components (e.g. power supply, etc.). If upgrading a MicroVP to a Turbo, see Section C.7.4.
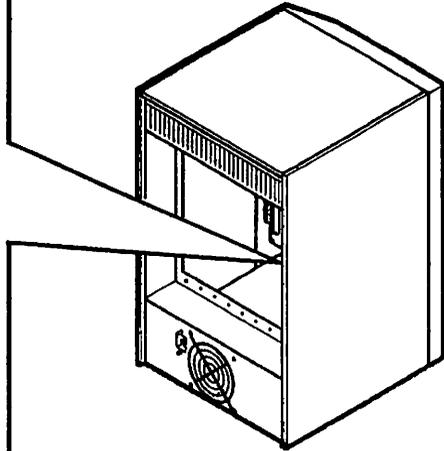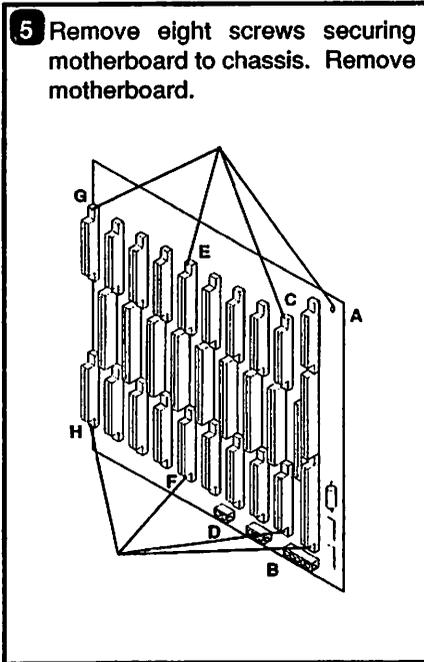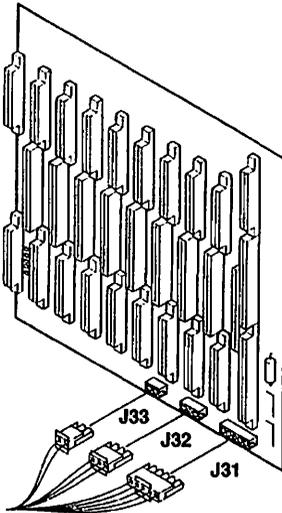
5 Remove all retaining screws securing motherboard to chassis. Remove motherboard.
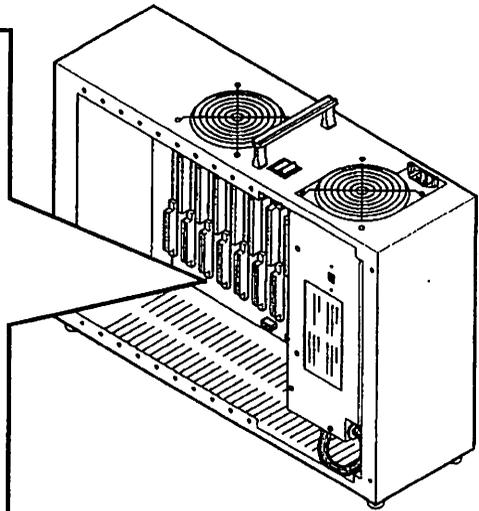
C.6 Parts Replacement

C.6.2 MicroVP Turbo Motherboard 210-9583 (Sheet 2 of 2)

To Install

NOTE

On some early versions of the 210-9583 motherboard, some screw holes may not line up. In that case, secure the motherboard as described in steps 1 through 5 below, else reverse steps 1 through 5 of the removal procedure on sheet 1 of 2.

For earlier version motherboards with screw holes that do not line up, perform the following:

1 Line up the screw holes for the CPU board slot connectors. Install screws in the top hole of the top connector, J1, and the bottom hole of the bottom connector, J21. Do not tighten.

2 Install screws in the top and bottom I/O connectors for the furthest slot from the CPU board that lines up. This should be the third slot from the end, connectors J8 and J28. Do not tighten.

3 Install screws in the top and bottom I/O connectors for the closest slot to the CPU board that lines up. This should be the third slot from the CPU, connectors J4 and J24.

4 Tighten all screws. Install any remaining screws in holes that line up in a balanced pattern from top to bottom and side to side.

5 Complete installation by reversing removal steps 1 through 4.

C.6 Parts Replacement

C.6.3 CS-N/D Turbo Motherboard 210-9578 (Sheet 1 of 2)

To remove

1 Power down cabinet and remove top cover, front cover, and side covers. (➡ A.7.1, A.7.2, and A.7.3)

2 Note all I/O board cable locations and orientation and switch settings and remove all I/O controllers and blank I/O panel covers.

> ### NOTE
> Refer to the Appendix A, section A.7.2 for parts replacement procedures for other CS-N/D components. See section C.7.3 if upgrading a CS-N/D to Turbo.

3 Remove LED cable from connector J34.

J34

Mounting Rails

J33
J32
J31

4 Remove Dc power harness from motherboard connectors J31, J32, and J34.
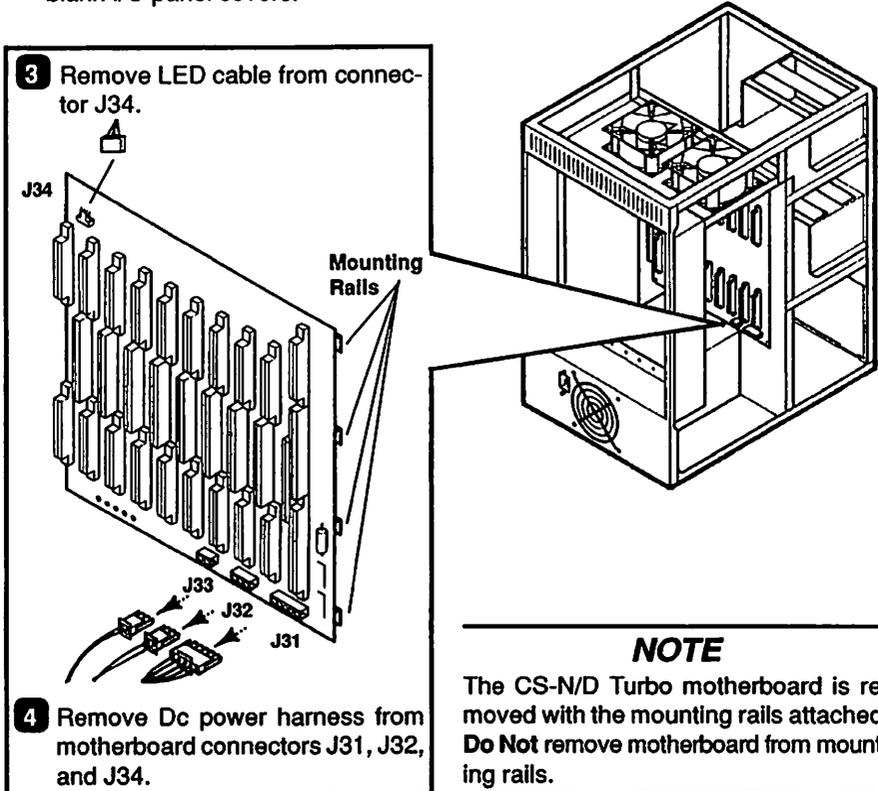
> ### NOTE
> The CS-N/D Turbo motherboard is removed with the mounting rails attached. **Do Not** remove motherboard from mounting rails.

C.6 Parts Replacement

C.6.3 CS-N/D Turbo Motherboard 210-9578 (Sheet 2 of 2)

5 Remove the five screws securing motherboard/mounting rails to the sheet metal dividing the front from the back of the cabinet.

Screw Locations

Sheet Metal Divider

(Viewed from front of cabinet)

Chassis Lower Rear Rail

6 Slide motherboard up to free the mounting rails from the lip that supports them and remove it from the chassis.

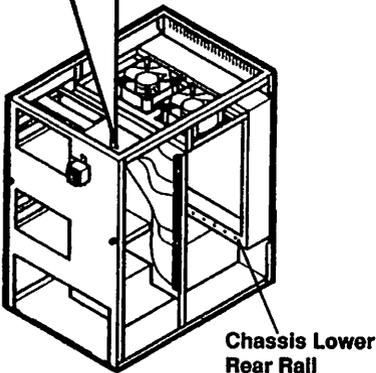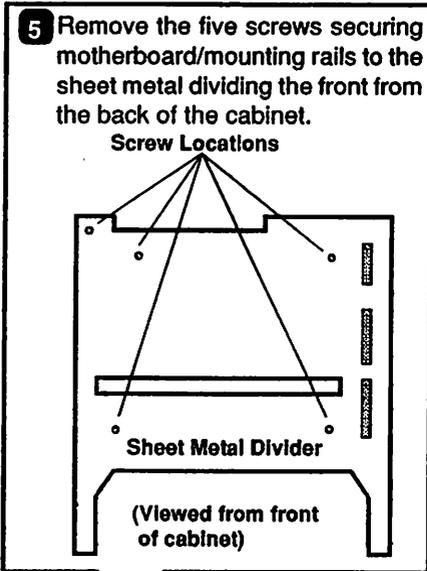### To Install

NOTE
The Motherboard must be properly aligned in the chassis to ensure the I/O controllers make good connector contact. Be sure to follow the 'To install' procedures.

1 Position replacement motherboard so that the mounting rails are seated on the lips provided on the sheet metal divider in the chassis. Install mounting screws but do not tighten. The motherboard may have to be moved slightly for proper alignment.

2 Insert two I/O controllers (that have hold down screws) in the first and last I/O slots, centering the controllers' connector contacts with the motherboard's I/O connector contacts.

3 Position the motherboard so the controller hold down screws align with the mating holes in the chassis's rear rail. Tighten both controllers' hold down screws. Make sure the screws tighten without resistance to ensure proper alignment.

4 Securely tighten motherboard/ mounting rail screws.

5 Reverse removal steps 1 thru 4 to complete installation.

C.6 Parts Replacement

C.6.4 386 Turbo CPU Board Replacement

To remove

NOTE

When replacing a defective CPU board, remove the SIMMs from the defective CPU board and install on replacement CPU. Verify replacement CPU board is set for correct memory configuration.

1 Power down system and disconnect ac power.

2 CS, CS-D/N
Remove two screws securing rear door assembly. Remove door assembly and disengage CPU board's securing brackets.
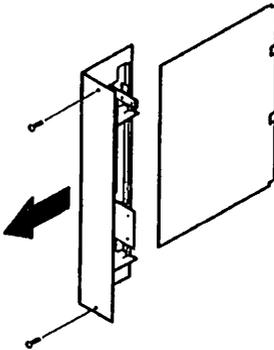
MicroVP
Remove four screws securing cover over CPU board and remove cover.

3 Remove CPU board.

4 Remove SIMMs (➡ C.6.5) from defective CPU board and install on replacement CPU board.

CS, CS-D/N
Shown
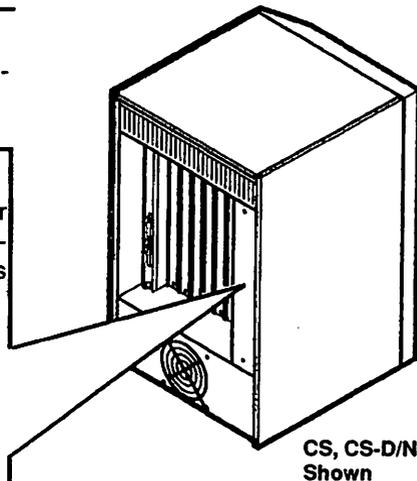
To Install

1 Verify memory configuration, jumpers, and switch settings (➡ C.2.1) of replacement CPU board.

2 Reverse steps 1 thru 3 of removal procedures.

C.6 Parts Replacement

C.6.5 386 Turbo CPU Board SIMM Replacement

To remove

1 Remove CPU board from chassis (➡C.6.4).

NOTE

Because the SIMMs are located so close together when fully loaded, all SIMMS should be removed starting at the top (L3) down to the SIMM being replaced to prevent damage.

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2 Remove SIMM by bending posts studs away from SIMM and tilting SIMM backwards and out of socket.
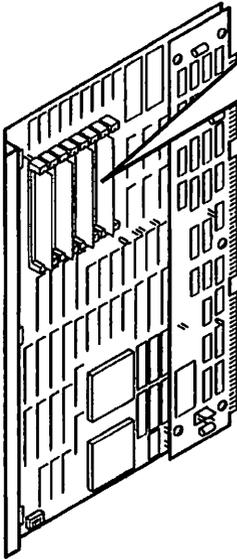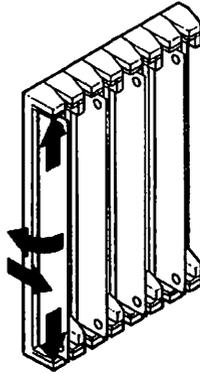
To install

Before installing replacement SIMMs, verfiy all the SIMMs are the same memory size (1MB or 4MB) and same speed (70ns standard, usually indicated by a -70 on the chip). SIMMs that can be installed according to configuration are either:

337-4533 - SIMM 1MB, 70ns
or
337-4535 - SIMM 4MB, 70ns

C.7 Installation

C.7.1 386 TURBO Upgrades

The 386 Turbo upgrade can be installed in existing MicroVP cabinets, CS cabinets, CS-N cabinets, and CS-D cabinets. The upgrade kit number and upgrade kit components are as follows:

CS Turbo   CEI Number 200-6009

Upgrades any CS, VLSI or 386, to a 4MB CS-TURBO. Upgrade kit includes:

- 210-9583   Motherboard
- 210-9576A CPU Board, 4MB
- 458-5194   CPU Door Assembly
- CS-Turbo Rail Kit (See C.9.2)
- BASIC-2/Turbo Operating System Rev 1.0
    - 734-8446   1.2MB
    - 731-8026/7/8   360KB
- 615-5051   Turbo ID Label

CS-N Turbo   CEI Number 200-6008

Upgrades any CS-N, VLSI or 386, to a 4MB CS-N TURBO. (Note same components as CS-D Turbo.) Upgrade kit includes:

- 210-9578   Motherboard (with mounting rails)
- 210-9576A CPU Board, 4MB
- 458-5026   CPU Door Assembly
- BASIC-2/Turbo Operating System Rev 1.0
    - 734-8446   1.2MB
    - 731-8026/7/8   360KB
- 615-5051   Turbo ID Label

NOTE

All upgrade kits for existing CPUs come with 4MB memory. CPU memory upgrades are available to upgrade the basic memory size of 4MB to 8MB, 16MB, or 32MB. Refer to C.7.5 for memory upgrade information.

CS-D Turbo   CEI Number 200-6007

Upgrades any CS-D, VLSI or 386, to a 4MB CS-D TURBO. (Note same components as CS-N Turbo.) Upgrade kit includes:

- 210-9578   Motherboard (with mounting rails)
- 210-9576A CPU Board, 4MB
- 458-5026   CPU Door Assembly
- BASIC-2/Turbo Operating System Rev 1.0
    - 734-8446   1.2MB
    - 731-8026/7/8   360KB
- 615-5051   Turbo ID Label

MicroVP Turbo CEI Number 200-6006

Upgrades any MicroVP, VLSI or 386, to a 4MB MicroVP TURBO. Upgrade kit includes:

- 210-9583   Motherboard
- 210-9576A CPU Board, 4MB
- MicroVP Rail Kit (see C.9.4)
- BASIC-2/Turbo Operating System Rev 1.0
    - 734-8446   1.2MB
    - 731-8026/7/8   360KB
- 615-5051   Turbo ID Label

C.7 Installation

C.7.2 CS-Turbo Upgrade (Sheet 1 of 3)

NOTES

1. Before beginning the upgrade, read section C.1.3 on Hardware Compatibility and section C.1.5 on Software Compatibility. There could be some changes required to the customer's software that they need to be aware of before the upgrade. Without these changes, some existing programs may not execute properly.

2. Verify all necessary hardware has been delivered (➡ C.7.1 for Turbo kit component listing). Next, find out from the customer the specifics on configuring the hardware; disk and printer addresses for the High Speed Controllers, special Baud Rate setting for terminals, etc..

1 Ensure all users are logged off the system and all tasks are completed. The customer should backup all software.

2 Power down disk drives first then the CPU. Remove the ac power.

3 Remove CPU door assembly and CPU board. The CPU door assembly and CPU board will not be re-used. (➡ 7.2.1 of base manual)

4 Remove all controllers and blank I/O panels from I/O section. Note cabling and controller switch settings. (➡ 7.2.2 of base manual)
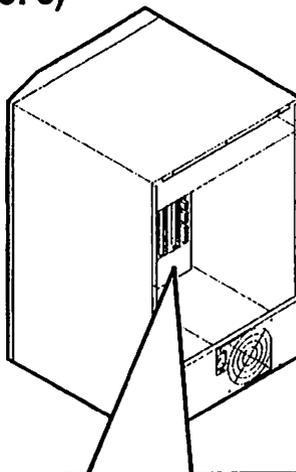
5 Disconnect power cables from motherboard connectors J22, J23, and J24.

Spacers
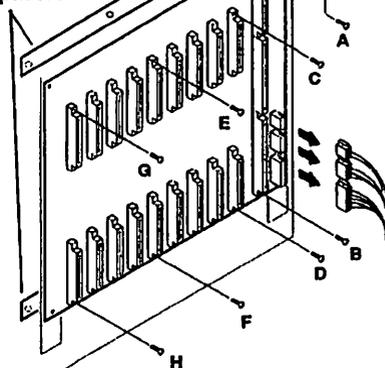
6 Remove eight screws securing motherboard to chassis. Remove motherboard. Note: There may be spacers behind the mother-board to raise it. These will not be used with the Turbo motherboard.

C.7 Installation

C.7.2 CS-Turbo Upgrade (Sheet 2 of 3)

NOTE

CS motherboard 210-8176 will not be reinstalled.

I/O Rail 451-2782

I/O Rail 451-2782

7 Install Turbo motherboard 210-9583 into chassis and secure with the screws removed in step 6. Note: With some early version of the motherboards, screws A, G, and H (see sheet 1 of 3) may not line up. However, the other five screws should provide adequate support. Do not tighten any screws until all are started. Refer to C.6.1 CS-Turbo Motherboard Replacement.

8 Connect power cables to motherboard connectors J31, J32, and J33. (Refer to C.6.1)

9 Verify 386 Turbo CPU board is properly configured for memory size and install in CPU slot. (Refer to C.2.1)

10 Clean the lip of the chassis around the I/O section. Remove the backing from the tape on both ends of the top I/O rail (451-2782). Align the top I/O rail holes with the I/O controller mounting holes in chassis top lip. Firmly press I/O rail in place.
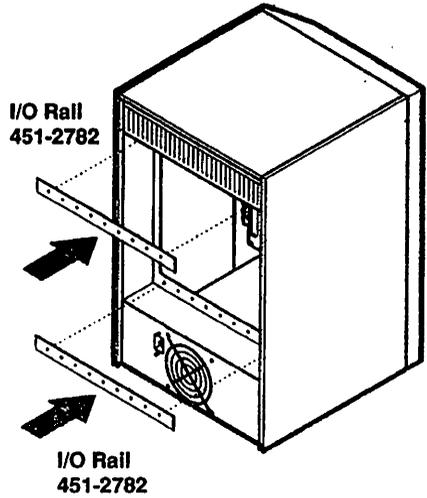
11 Repeat step 10 for bottom I/O rail.

12 Install all I/O controllers to be used, verifying switch settings and cabling. Refer to C.2.2 and C.2.3 for switch settings for the High Speed MXF 16 Port Controller and the 22C11-HS Printer/Disk Controller. Install blank I/O panels removed in step 4 as needed.

NOTE

There could be a problem securing some I/O controllers to the chassis because their screws may not be long enough. New 1 inch thumbscrews (650-9529) are available and should be used.

C.7 Installation

C.7.2 CS-Turbo Upgrade (Sheet 3 of 3)

13 Install the new door assembly (458-5194) over the CPU board. Secure with two screws.

Side Rail
451-0830

CPU Door
458-5194

Side Rail
451-0830

15 Remove the backing from the tape on both ends of the other side rail. Align side rail with the lip that divides the I/O section from the CPU section. Butt the rail up against the first controller or blank I/O panel installed in the first I/O slot. Firmly press side rail in place.

14 Remove the backing from the tape on both ends of one of the side rails (452-0830). Align side rail with the chassis lip on left side of I/O section and butt it against the I/O controller or blank I/O panel installed in last I/O slot. Firmly press side rail in place. Note: The side rails are strictly to pass FCC regulations for emissions.

17 Reconnect power.

18 Boot the system using the Turbo operating system. Run diagnostics to verify hardware is operational.

C.7 Installation

C.7.3 CS-N/D Turbo Upgrade

NOTES

1. Before beginning the upgrade, read section C.1.3 on Hardware Compatibility and section C.1.5 on Software Compatibility. There could be some changes required to the customer's software that they need to be aware of before the upgrade. Without these changes, some existing programs may not execute properly.

2. Verify all necessary hardware has been delivered (➡ C.7.1 for Turbo kit component listing). Next, find out from the customer the specifics on configuring the hardware; disk and printer addresses for the High Speed Controllers, special Baud Rate settings for terminals, etc..

1 Ensure all users are logged off the system and all tasks are completed. The customer should backup all software.

2 Power down the disk drives, then power down the CPU. Remove the ac power.

3 Remove CPU door assembly and CPU board. The rear door assembly and CPU board will not be reused. (➡ A7.2.5 of base manual)

4 Remove all controllers and blank I/O panels from I/O section. Note cabling and controller switch settings. (➡ 7.2.2 of base manual)

5 Remove cabinet top cover, front cover, and both side covers. (➡ A.7.2.1, A.7.2.2, A.7.2.3)

6 Disconnect all cables from motherboard. Remove motherboard (210-9560) by removing the screws that hold the metal motherboard rails on the motherboard to the metal wall that divides the front and back of cabinet (➡ C.6.3) Do not remove screws securing motherboard to its rails. CS-N/D motherboard (210-9560) will not be re-installed.

7 Install Turbo motherboard 210-9578. (➡ C.6.3. sheet 2 of 2 for motherboard alignment procedures)

8 Verify Turbo CPU board is properly configured for memory size and jumpers, and switch settings are correct. (➡ C.2.1 for switch and jumper setting and SIMM loading.) Install CPU.

9 Install all controllers/blank panels removed in step 4, verifying switch settings and cabling.

10 Install new rear door assembly (458-5026) and secure with two screws. (➡ C.6.4.)

11 Install side covers, front cover, and top cover removed in step 5. Reconnect ac power.

12 Boot the system using the Turbo operating system. Run diagnostics to verify hardware is operational.

C.7 Installation

C.7.4 MicroVP Turbo Upgrade (Sheet 1 of 3)

NOTES

1. Before beginning the upgrade, read section C.1.3 on Hardware Compatibility and section C.1.5 on Software Compatibility. There could be some changes required to the customer's software that they need to be aware of before the upgrade. Without these changes, some existing programs may not execute properly.

2. Verify all necessary hardware has been delivered (➡ C.7.1 for Turbo kit component listing). Next, find out from the customer the specifics on configuring the hardware; disk and printer addresses for the High Speed Controllers, special Baud Rate setting for terminals, etc..

1 Ensure all users are logged off the system and all tasks are completed. The customer should backup all software.

2 Power down the disk drives, then power down the CPU. Remove the ac power.

3 Remove cover over CPU board. Remove CPU board.

4 Remove all controllers and blank I/O panels from I/O section. Note cabling and controller switch settings.

5 Disconnect all cables (P22, P23, and P24) from motherboard.

6 Remove all screws securing motherboard to chassis (➡ C.6.2). Remove motherboard. **Note motherboard 210-8176 will not be re-used.**

7 Install the 210-9583 Turbo motherboard using the screws removed in step 6.

NOTE

For earlier version motherboards with screw holes that do not line up, perform steps 8 through 11, else go to step 12.

8 Line up the screw holes for the CPU board connectors. Install screws in the top hole of the top connector, J1, and the bottom hole of the bottom connector, J21. Do not tighten.

9 Install screws in the top and bottom I/O connectors for the furthest slot from the CPU board that lines up. This should be the third slot from the end, connectors J8 and J28. Do not tighten.
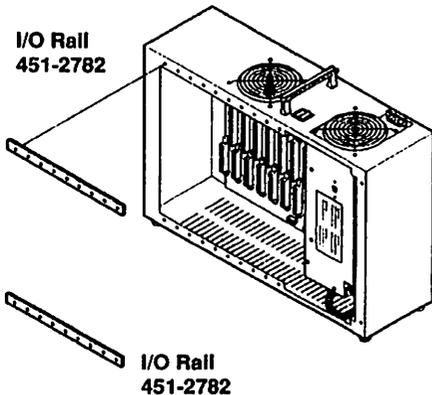
10 Install screws in the top and bottom I/O connectors for the closest slot to the CPU board that lines up. This should be the third slot from the CPU, connectors J4 and J24.

11 Tighten all screws. Install any remaining screws in holes that line up in a balanced pattern from top to bottom and side to side.

386 TURBO

C.7 Installation

C.7.4 MicroVP Turbo Upgrade (Sheet 2 of 3)

12 Connect power supply cables to motherboard connectors J32, J33, and J34.

13 Verify 386 Turbo CPU board is properly configured for memory size and install in CPU slot. (Refer to C.2.1)

14 Clean the lip of the chassis around the I/O section. Position the cabinet on its back side. Remove the backing from the tape on both ends of the top I/O rail (451-2782). Align the top I/O rail holes with the I/O controller mounting holes in chassis top lip. Position I/O rail in place.

16 Install all I/O controllers to be used, verifying switch settings and cabling. Refer to C.2.2 and C.2.3 for switch settings for the High Speed MXF 16 Port Controller and the 22C11-HS Printer/Disk Controller. Install blank I/O panels removed in step 4 as needed.

17 Remove the backing from the tape on both ends of the I/O side rail (452-0830). Firmly press rail against the chassis lip, centering it and butting it up against the I/O board or blank I/O panel installed in the last I/O slot.
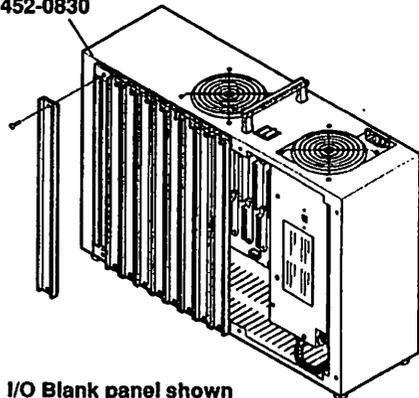
NOTE

There could be a problem securing some I/O controllers to the chassis because their screws may not be long enough. New 1 inch thumbscrews (650-9529) are available and should be used.

**I/O Rail
451-2782**

**I/O Rail
451-2782**

15 Repeat step 14 for bottom I/O rail.

**I/O Side Rail
452-0830**

**I/O Blank panel shown
removed for illustration purposes.**

C.7 Installation

C.7.4 MicroVP Turbo Upgrade (Sheet 3 of 3)

18 Remove the hex-shaped extension posts from the chassis used for the screws that hold down the CPU cover.

19 Position the top and bottom rails for the CPU cover (451-2781) on the lip of the CPU, lining up the screw holes.

Top Rail 451-2781

Outer Rail 455-0290

Bottom Rail 451-2781

20 Position the outer rail (455-0290) for the CPU cover on the chassis lip between the top and bottom CPU cover rails, as shown.

21 With the holes in the rails lined up with the holes in chassis for the CPU cover, reinstall the hex-shaped extension posts for the CPU cover removed in step 18.

22 Install CPU cover.

23 Reconnect ac power.

24 Boot the system using the Turbo operating system. Run diagnostics to verify hardware is operational.

C.7 Installation

C.7.5 386 Turbo CPU Board Memory Upgrade

NOTE

After completing a CPU board memory upgrade, return replaced SIMM devices to logistics stockroom.

The following CPU board memory Upgrade Kits (UJ) are available to upgrade the system memory during the initial 386 Turbo upgrade.

- UJ-6059 - 4MB to 8MB memory upgrade
  Contents: four 1MB SIMMs

- UJ-6060 - 4MB to 16MB memory upgrade
  Contents: four 4MB SIMMs

- UJ-6061 - 4MB to 32MB memory upgrade
  Contents: eight 4MB SIMMs

The following CPU board memory Upgrade Kits (UJ) are available to upgrade the system memory after the 386 Turbo has been installed.

- UJ-6067 - 4MB to 8MB memory upgrade
  Contents: four 1MB SIMMs

- UJ-6068 - 4MB to 16MB memory upgrade
  Contents: four 4MB SIMMs

- UJ-6069 - 4MB to 32MB memory upgrade
  Contents: eight 4MB SIMMs

- UJ-6070 - 8MB to 16MB memory upgrade
  Contents: four 4MB SIMMs

- UJ-6071 - 8MB to 32MB memory upgrade
  Contents: eight 4MB SIMMs

- UJ-6072 - 16MB to 32MB memory upgrade
  Contents: four 4MB SIMMs

Refer to the following sections for SIMM loading configurations and switch settings.

C.7.6   CPU Board 4MB SIMM Loading

C.7.7   CPU Board 8MB SIMM Loading

C.7.8   CPU Board 16MB SIMM Loading

C.7.9   CPU Board 32MB SIMM Loading

C.7 Installation

C.7.6 CPU Board 4MB SIMM Loading (Standard Configuration)

4MB SIMM Configuration (Standard)

L3 L5 L10 L15 L18 L24 L29 L35

■ **1MB SIMM**
  377-4533

□ **No SIMM**

SW1
Memory Size Select

On

1 2 3 4

o o o x

□ = Switch Position
x = Contacts Closed
o = Contacts Open
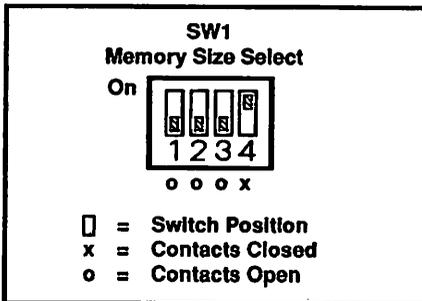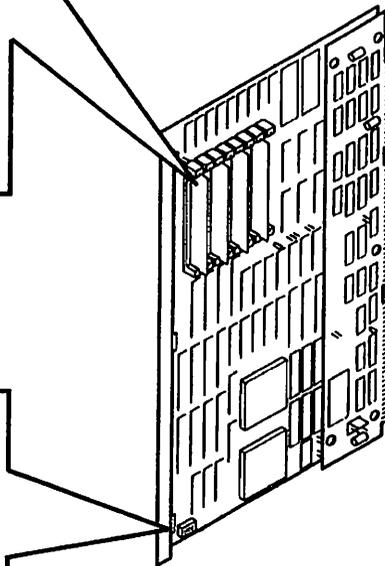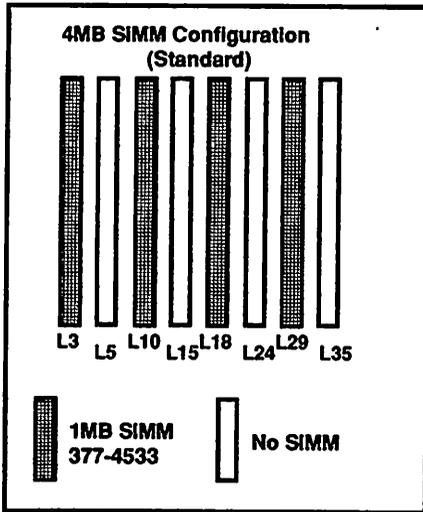
C.7 Installation

C.7.7 CPU Board 8MB SIMM Loading
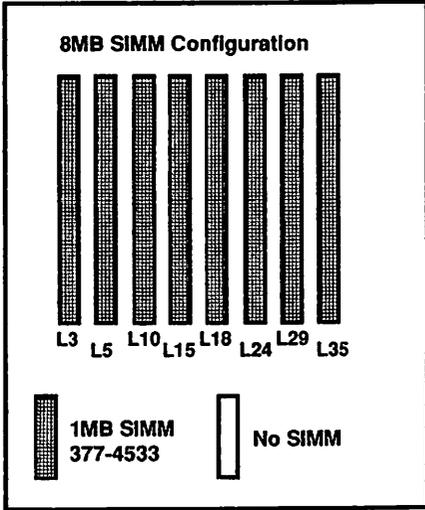
1 Install 1MB SIMMs in locations L3, L5, L10, L15, L18, L24, L29, and L35.

2 Verify Memory Size Select Switch SW1 is set as shown.

8MB SIMM Configuration

L3 L5 L10 L15 L18 L24 L29 L35

1MB SIMM 377-4533   No SIMM

SW1
Memory Size Select
On
1 2 3 4
o o o x

[] = Switch Position
x = Contacts Closed
o = Contacts Open

C.7 Installation

C.7.8 CPU Board 16MB SIMM Loading

1 Install 4MB SIMMs in locations L3, L10, L18, and L29.

2 Verify Memory Size Select Switch SW1 is set as shown.

16 MB SIMM Configuration

L3 L5 L10 L15 L18 L24 L29 L35

| | 4MB SIMM 377-4535 | | No SIMM |

SW1
Memory Size Select

On

1 2 3 4

o o o o

☐ = Switch Position
x = Contacts Closed
o = Contacts Open

741-1769-A **C-93** **COMPANY CONFIDENTIAL**
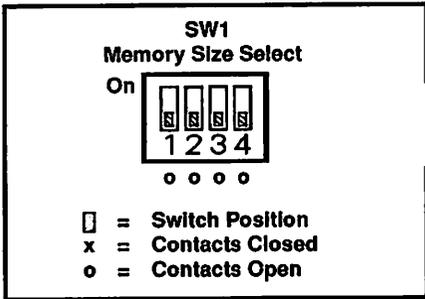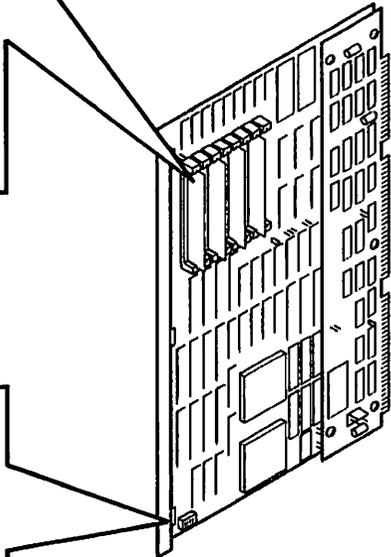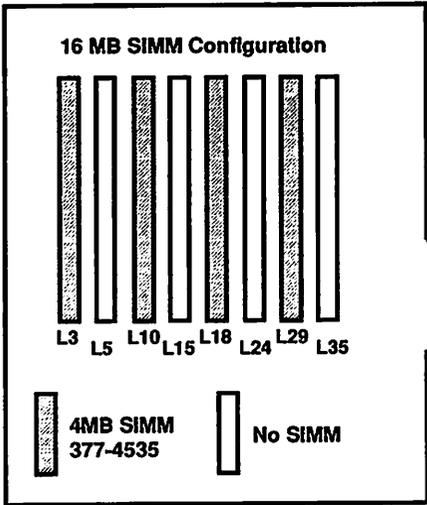
C.7 Installation

C.7.9 CPU Board 32MB SIMM Loading

1 Install 4MB SIMMs in locations L3, L5, L10, L15, L18, L24, L29, and L35.

2 Verify Memory Size Select Switch SW1 is set as shown.

32 MB SIMM Configuration

L3 L5 L10 L15 L18 L24 L29 L35

▨ **4MB SIMM**
377-4535

▢ **No SIMM**

SW1
Memory Size Select

On

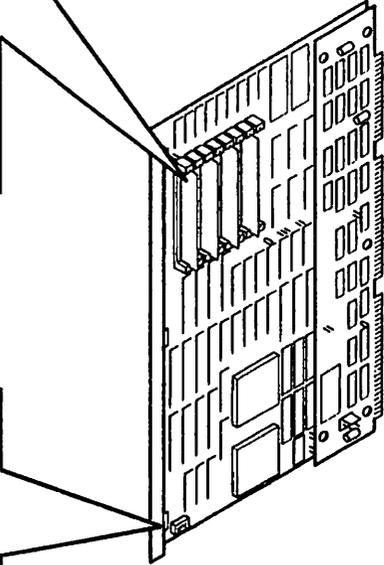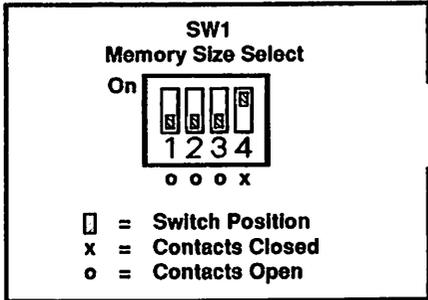1 2 3 4

o o o o

▯ = Switch Position
x = Contacts Closed
o = Contacts Open
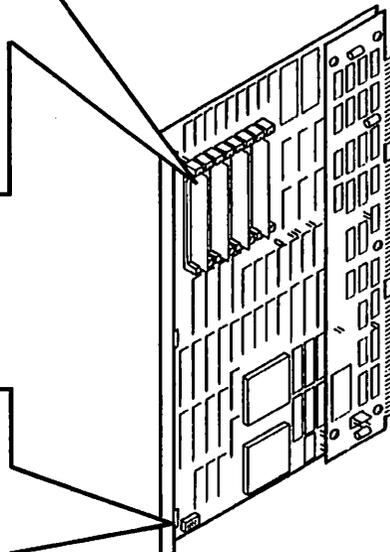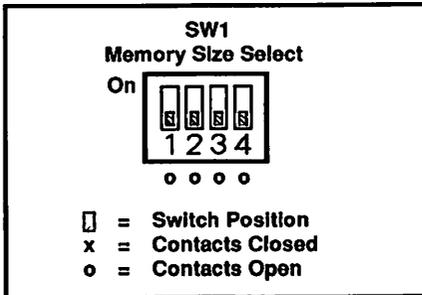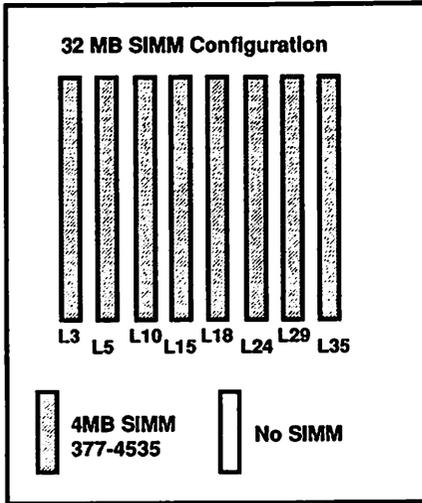
C.7.10   Initial System Power Up (Sheet 1 of 8)

Section 9.7.2 of this manual discusses loading the operating system and configuring the partitions. Since that was written, several operating systems have been released as well as the 386 and 386 Turbo CPUs. With the newer releases, changes have been made to the program '@GENPART' used to configure the system. They include the addition of the CPU number, Printer drivers, and for the Turbo, increasing the available partitions and terminal possibilities to 64. This section will only discuss those differences and the steps to create a standard configuration on the Turbo. It is assumed that a standard Wang Turbo O/S is being used which has not been set up for auto-load. The auto-load feature is used by many programmers to load a preset configuration with programs to multiple terminals avoiding the necessity of stepping through '@GENPART' every time the system is booted. For additional detail on '@GENPART' refer to section 9.7.2 or to the *BASIC-2 Utilities Reference* manual, 715-3949.

Initial Power Up or Warm Boot

1 Once the system has been powered on and passes self-test (➡ C.5.2) or a warm boot ($INIT"SYSTEM") is done, the message:

MOUNT SYSTEM PLATTER
PRESS RESET

should be displayed on terminal 1.

If this does not occur refer to C.5.2 for information on Turbo self-test diagnostics or to section C.5.5 for troubleshooting flowcharts.

2 If booting from a floppy, install the Turbo O/S disk in the floppy at this time. Key RESET if using a 2x36DE terminal, or SHIFT/RESET for a 2x36DW type terminal. **'Key SF'?'** should appear on the screen.

3 Press the SF' (Special Function) key corresponding to the address from which you will boot from. The address choices are limited to:

SF'00 = D11 or 310
SF'01 = D10 or B10
SF'02 = D21 or 320
SF'03 = D20 or B20
SF'04 = D31 or 330
SF'05 = D30 or B30

Once pressed, the address selected will be momentarily displayed, then the file '@@' will be loaded from the selected drive.

NOTE

If a non-existent drive address is selected the screen will hang with 'KEY SF'?@@ /3x0'. If the address exists but does not contain the O/S file '@@', the message 'SYSTEM ERROR (DISK 0082)' will be displayed. Key RESET again and press the correct SF' key or install the O/S disk in the floppy drive.

C.7 Installation

C.7.10 Initial System Power Up (Sheet 2 of 8)

4 Upon successfully completing the load, the following screen will display the option of selecting the BASIC-2 Turbo O/S or diagnostics.

*** SYSTEM SOFTWARE ***

Select item with SPACE & BACKSPACE   MEMORY xxxxK
Key RUN to Execute, Clear or PREV SCRN for previous screen.   TERMINAL 1

■ Multiuser BASIC-2/Turbo

□ Turbo Diagnostics

---

5 Use the Space Bar if needed to select Multiuser BASIC-2/Turbo and press RUN. The following message will be displayed briefly on the screen:

Loading: Multi-User Basic-2/Turbo Release x.x

NOTE

If using a 360K O/S disk to boot from, a change of diskettes will be needed to load '@GENPART'. Because of the size of some of the O/S files required, the O/S no longer will fit on one 360K disk. Disk 1 of 3 will be used for the initial boot and should bring terminal 1 to READY but will give an error D82 (file not found) trying to load '@GENPART'. At that time, insert disk 2 of 3 and key: LOADDCT"@GENPART" then RETURN. Some features of '@GENPART' such as selecting printer drivers may not be usable because needed files may be on one of the other two diskettes.

C.7.10   Initial System Power Up (Sheet 3 of 8)

6 Within one minute the screen should update with the Partition Generation Program menu. At this time there should be a list of any existing configurations as well as a 'current' (last used) configuration.

NOTE

The circled numbers (①) denote changes from the older CS/2200 operating system. These changes are described in the associated paragraphs.

```
           ***Multiuser BASIC-2 Partition Generation Program ***
                     Copr, Wang Laboratories, Inc.  19xx
       ①                                      ②   List of Options:
O.K.    Configuration  (#Partitions)   (CPU Number)   '00 - clear partitions
 y         current        (xx)            (xx)         '01 - clear device table
 y         TURBO          (xx)            (xx)         '02 - divide mem evenly
           VLSI           (xx)            (xx)    ④  ┌ '04 - edit partitions
                                                     '05 - edit device table
                                                     '06 - edit $MSG
                                                 ③  ┌ '07 - select prntr drvr
                                                     '08 - load configuration
                                                     '09 - save configuration
                                                     '10 - delete configuration
                                                     '11 - edit CPU number
                                                     '15 - execute
                                                     Press FN/TAB to exit

     Configuration 'current' loaded.  Name of configuratic          _____
```

There are four basic changes from the older CS/2200 Operating System as shown in section 9.7.2 (page 9-25). The following is a brief description of those changes. Go to step 7 to continue boot.

1. **O.K. Field** - The left-most field on the screen (step 6) is a field headed with 'O.K.'. Each configuration listed will either be marked 'y' or will be blank. The purpose of this field is to identify which configurations agree with the CPU type (Turbo, 386, or VLSI) being used. The current '@GENPART' program is compatible with all three and it is possible to have all three operating systems merged on the same disk. If the configuration has a 'y' in this field, it is compatible to the CPU being used. This does not indictate the configuration falls within the memory size of this system or anything else, but only that the CPU type matches. This field can only be modified by the system.

C.7 Installation

C.7.10 Initial System Power Up (Sheet 4 of 8)

2. **CPU Number Field** - The CPU Number field is the fourth vertical column listed when the configurations are displayed. It is needed only in a multi-CPU environment with disk drives (only the DS, CS-D drives, and SCSI when released) that support 'platter hog' (SELECT H ON). Its purpose is to identify to a disk which CPU the hogging partition resides on. Otherwise, the disk interface has no way of telling if partition x is from CPU 1 or CPU 2. The absence or use of the same CPU number in a multi-CPU system could result in the same partition number from a 2nd CPU being able to access a platter hogged by a partition in the first CPU. Only the CS/386 and Turbo use the CPU number and support platter hog. SELECT H is not recommended for multi-CPU systems if any one CPU is non-386 because of the potential partition conflict. The CPU number has no other purpose and does not normally provide any additional security beyond what has been stated. If SELECT H is not used, the CPU number is basically ignored.

There are two ways to enter a CPU number. If SF'00 is pressed, the first question asked is: 'CPU number (1 - 31)?'. The second way would be to key SF'11, which would bring up the same question. **Note: When the CPU is up, the CPU number can be checked by keying in: PRINT #CPU then RETURN.**

3. **'07 - Select Printer Driver** - The use of printer drivers allows the 2200 user to connect a variety of industry standard printers which use a Centronics interface to the system and have it function properly with existing 2200 print commands and programs. When using any of the PM0xx printers offered on 2200, a printer driver is normally required. The printer driver translates the standard 2200 escape or hex codes used for any of the various printer functions such as top of form, expanded print, pitch, etc. and converts them to the code needed for that specific printer to perform the function. Without the printer driver, for example, most of these printers will normally not linefeed and all lines on a page will overprint each other. Step 14 describes the procedure for installing a printer driver.

4. **Editing partitions and/or terminals beyond the first 16** - This is new as this is the first 2200 O/S to support more than 16 partitions/terminals. There is only one way to see the partitions beyond the first 16. This is done by editing a partition number beyond 16. The partitions will always be listed in groups of 16, with the first partition displayed always being either 1, 17, 33, or 49. To edit any partition or terminal within a configuration, key SF'04 - to edit partitions. The following should be displayed:

C.7 Installation

C.7.10   Initial System Power Up (Sheet 5 of 8)

Edit which partition (default = x)?

Key in the partition number from 1 to 64 and press RETURN or just press return to edit the default. If the partition number is changed, the system will update the partitions shown if needed and repeat the ·question. Once the user keys RETURN to acknowledge the partition number is correct, an asterisk (*) will be placed next to the entry and the entry will be highlighted. The following questions will then display one at a time with there current settings shown as the default.

Partition size? enter mem size in K & RET or RETURN if ok.
Terminal number?   enter new terminal # & RET or RET if ok.
Enable Programming? Y or N and RET, or RETURN if correct.
Program to load?   optional prog to load & RET or RET if ok.

Exit partition editing by selecting another SF' option.

Creating a Standard Configuration

7 To create a standard system for system testing proceed as follows:

Key SF' 00   (to clear partitions)

CPU number (1 - 31)? (displays on screen)

8 Enter a CPU number from 1 - 31. In a single CPU environment any number can be used. If this CPU is sharing a disk with other 2200 386 CPUs, the CPU number must be different from the other machines. See step 6, item 4 for detailed information. Enter number from 1 - 31 and press RETURN.

No. of terminals?   (displays on screen)

C.7.10 Initial System Power Up (Sheet 6 of 8)

9 Enter the number of terminals to be used. This will determine the number of physical terminal ports activated. (64 is the maximum, 32 is the recommended maximum for users without a SCSI controller.) Enter the number of terminals and press RETURN.

No. of partitions in system?
                    (displayed on screen)

10 For CE use, make the number of partitions equal to the number of terminals entered. Enter the same number used with terminals (step 9) and press RETURN. The screen updates with up to the first 16 partitions/terminals shown and available memory displayed at the top.

11 Key SF' 02 - to divide memory evenly.

Divide how much program memory (default = xxxx K)?
(displayed on screen where xxxx will be the total available memory)

12 Input 100 times the number of terminals/partitions selected (e.g. 10 terminals times 100 would be 1000). This number cannot exceed the amount of available memory in K shown as the default. Enter ##00 and press RETURN. Each terminal/partition will then be shown with 100.00K.

13 Key SF' 05 - to edit device table. The device table will be displayed. **An address must be shown here for every non-terminal port in the I/O section of the CPU to enable that port when the boot is completed.** If a controller is used when the system is up which is not associated with an address in this table, a P48 error will likely occur. At minimum, the following entries should exists:

/310, /320, /330, /340,
/215, /216, /217

NOTE
Do not enter any other disk address other than 310, 320, 330 and 340. This will enable all legal disk drives including any DS or CS-D tape drive(s). See C.1.5, Software Compatibility, under Device Table for additional information.

If the device table is ok as is, go to step 14. To add a device:

Edit which entry (default = 1)?

will be displayed at the bottom of the screen.

① Enter the number of the first open entry and RETURN or RETURN to edit default. The selected entry will be highlighted with an asterisk (*) to the left of it.

C.7.10   Initial System Power Up (Sheet 7 of 8)

② Enter the address (/xxx) and press RETURN.

③ Press RETURN to make it accessible to all partitions.

Repeat ① through ③ to add another address or proceed to step 14.

Installing a Printer Driver (optional)

🔢 The purpose of printer drivers is discussed in step 6, item 3. If no changes are required, proceed to step 15. To add a printer driver perform the following:

Key SF'07 - to check or add a printer driver

The Printer Driver Table will be displayed with 15 possible entries. At the bottom of the screen the following message will be displayed:

Edit which driver entry (default = 1)?

Press RETURN to edit the default entry or type in the number for the first blank entry from 1 to 15 and press RETURN. An asterisk (*) will appear to the left of the entry to be edited. At the bottom of the screen the following message will be displayed:

Enter Driver Table Name: (enter '0' to del from config)?

The following printers are supported and are listed with the available driver. The print driver comes with the O/S.

Printer	Driver
DM-50/30	@DM50/V0
PM016	@PM016V3
PM018	@PM018V3
LDP8	@LASRJV1
PM010	@PM010V2
PM017	@PM017V3
PM060	@PM060V0
LCS15	@LASRJV1

Additional printer drivers will be added to the O/S in the future to support new printers as they become available. Contact 2200 Product Support for new printers being offered.

These printer drivers are actually data files on disk. To use a printer driver, the file name must exist in the index of the O/S disk being used. If booting the Turbo from a 360K diskette, there may be problems selecting print drivers as with 360K disks, the Turbo O/S requires three diskettes. The complete Turbo O/S comes on three 360K diskettes or one 1.2 M diskette.

Enter the driver name and press RETURN.

C.7 Installation

C.7.10 Initial System Power Up (Sheet 8 of 8)

The driver name must be on the disk being booted from or an appropriate message will be displayed. If the name is found, it is placed in the table after keying RETURN. At the bottom of the screen the message:

Enter Associated Printer Address:

will be displayed. Enter the address, 215, 216, 217, or 204 and press RETURN. If address 204 is used, the system will then ask to 'Enter Terminal No. (between 1 and 64)'.

Enter the terminal's physical port number and press RETURN. Only one driver entry can be made for 215, 216, or 217 or for any 1 terminal number with 204. After entering either 215, 216, 217, or the terminal number for 204, the system will default to editing the next table entry. Add another entry if needed. The system is limited to 15 printer drivers. When all necessary entries have been made to the Printer Driver Table proceed to step 15.

15 Key SF'15 - to execute (load) configuration

Check config. OK to execute (Y or N)?

will be displayed on the bottom of the screen. If the configuration is incorrect go to step 7. If the configuration is correct, press Y and RETURN. The following message displays on the bottom of the screen:

Reconfiguration Password? SYSTEM

NOTE:
The password used here is the word used in quotes with $INIT to do a warm boot: $INIT"SYSTEM".

Press RETURN.

All configured terminals should come up with:

READY (BASIC-2) PARTITION xx

The system is up and ready for use.

C.8 Functional Description

C.8.1 386 Turbo Components Major Functions

Turbo CPU Board 210-9576A

9576 Motherboard
- Intel 80386 33 MHz microprocessor
- Intel 82385 33 MHz Cache controller
- 64 KB 2-way Cache RAM
- 4, 8, 16, or 32 M data memory
- 32 bit high speed bus to interface with new Turbo controllers
- Bootstrap PROMS for intial boot of CPU and for power-up diagnostics
- 66.67 MHz oscillator which generates all necessary clocks for the CPU

9577 Daughterboard
- Interfaces with standard 8 bit 2200 I/O bus
- Real-Time clock (RTC) with built-in battery

MXF 16 Port Terminal Controller 212-9717

9579 High Speed I/O Processor
- 80286 12.5 MHz microprocessor
- Controls all communications between the CPU and devices on High Speed bus
- Controls all communications with devices on high speed bus independently from the CPU board
- Controls and acknowledges interrupts from both the CPU and all devices connected to the controller
- 256 K common memory

- Bootstrap PROMS for built-in testing and device specific coding
- 32 bit high speed data bus for communicating with the CPU
- 16 bit data bus for communicating with peripheral controller board
- 25 MHz clock providing controller timing

9580 Terminal Controller
- Compatible with all existing 2200 terminals supported by the MVP/LVP and all newer 2200 systems
- Interfaces with all attached terminals
- Contains baud rate switches
- Communicates with I/O processor board via 16 bit data bus

22C11-HS High Speed Printer/Disk Controller 212-9718

9579 High Speed I/O Processor
- Same as 9579 for MXF board (listed above)

9581 Peripheral Controller
- Uses standard 2200 Centronics interface supporting all existing 2200 printers
- Uses standard 2200 Disk Interface which supports the DS and the 2275
- Contains Mux port for connection to 2275MUX board or MUX Extender
- Communicates with I/O processor board via 16 bit data bus
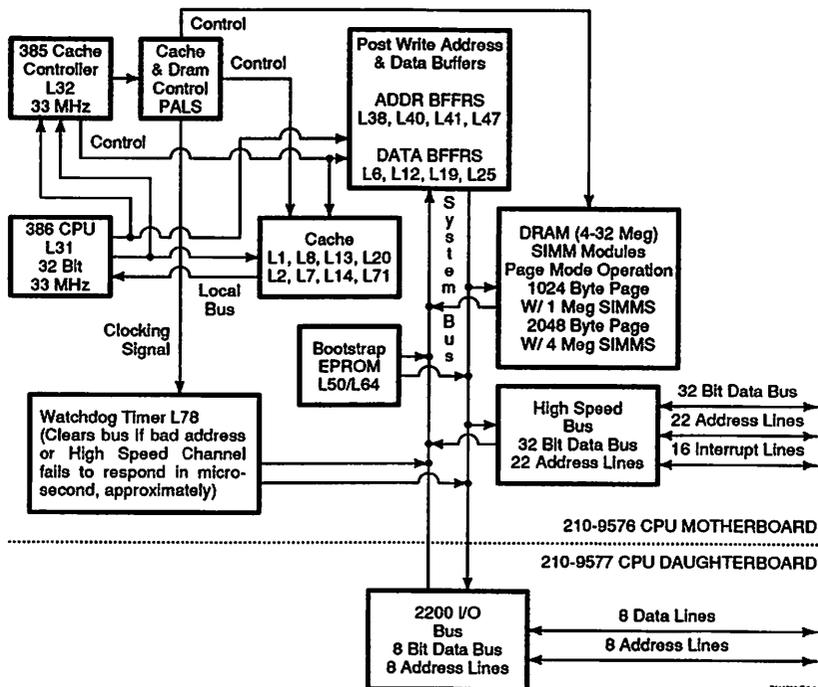
386 TURBO

C.8 Functional Description

C.8.2 CPU Board 210-9576-A Block Diagram

Overview

The 386 Turbo CPU consists of a motherboard and daughterboard. The daughterboard interfaces the CPU to the standard 2200 bus using an 8 bit data bus and 8 address lines. On the motherboard, a new high speed bus consisting of a 32 bit data bus, 22 address lines, and 16 interrupt lines is used to interface with the new high-speed controllers (MXF 16 Port Terminal controller, Printer/Disk Dual Controller, etc.) via a new motherboard (210-9583 for CS and MicroVP and 210-9578 for CS-N and CS-D).

386 Turbo CPU major components are:
- 80386 CPU running at 33 MHz
- 80385 cache controller
- Real time clock with built-in battery
- 4 - 32 MB main memory using either 1 MB SIMMs supporting 1024 byte page or 4 MB SIMMs supporting 2048 byte page
- High speed 32 bit bus supporting high speed devices, 22C11-HS & 2236MXF
- Standard 2200 8 bit bus
- 256 KB control memory
- 64 KB 2-way cache
- Bootstrap PROM for intial boot and power up diagnostics

385 Cache Controller L32 33 MHz

Cache & Dram Control PALS

Control

Post Write Address & Data Buffers
ADDR BFFRS
L38, L40, L41, L47
DATA BFFRS
L6, L12, L19, L25

386 CPU L31 32 Bit 33 MHz

Cache
L1, L8, L13, L20
L2, L7, L14, L71

Local Bus

Clocking Signal

Bootstrap EPROM L50/L64

System Bus

DRAM (4-32 Meg) SIMM Modules Page Mode Operation 1024 Byte Page W/ 1 Meg SIMMS 2048 Byte Page W/ 4 Meg SIMMS

Watchdog Timer L78 (Clears bus if bad address or High Speed Channel fails to respond in microsecond, approximately)

High Speed Bus 32 Bit Data Bus 22 Address Lines

32 Bit Data Bus
22 Address Lines
16 Interrupt Lines

210-9576 CPU MOTHERBOARD

210-9577 CPU DAUGHTERBOARD

2200 I/O Bus 8 Bit Data Bus 8 Address Lines

8 Data Lines
8 Address Lines

C.8 Functional Description

C.8.3 High Speed I/O Processor Board Block Diagram

(MXF 16-Port Terminal Controller and Printer/Disk Dual Controller)

Overview

The High Speed I/O Processor board is common to both the MXF 16-Port Terminal Controller and the Printer Disk Dual Controller. The only difference between the two are the two PROMS used at locations L7 and L14. Major functions of the High Speed I/O Processor are:

- 80286 CPU running at 12.5 MHz
- High-speed bus interface, interfaces to 386 Turbo CPU
- 256 KB common memory
- Local I/O bus interface, interfaces MXF terminal controller or printer/disk controller

MXF 16-Port Terminal Controller and Printer/Disk Dual Controller major functions are:

MXF 16-Port Terminal Controller

- Supports up to 16 terminals per controller, maximum of 4 controllers per system (64 terminals)
- Controls terminal baud rates

Printer/Disk Dual Controller

- Supports 1 disk port or 1 Mux port and 1 printer port
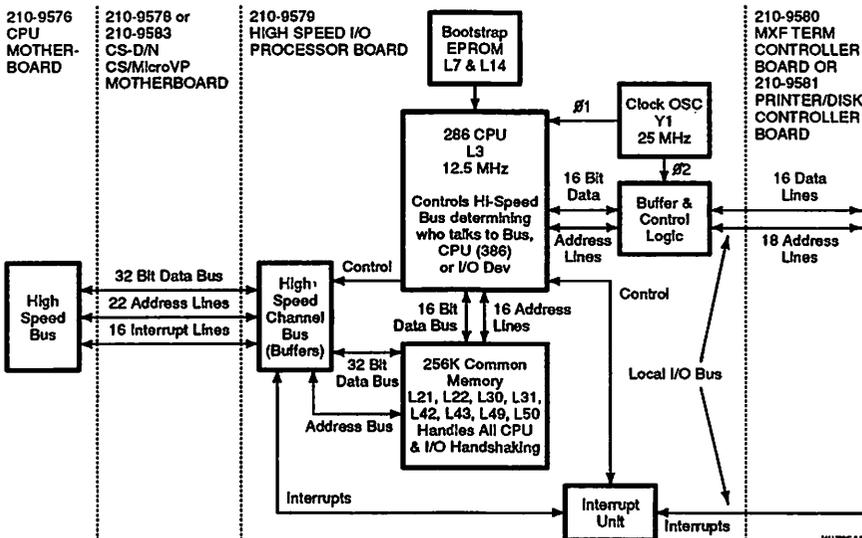
C.8 Functional Description

C.8.4 Octopus (421-0181) Cable Pin-Out

'A' Position

'B' Position
(labled 1 thru 7)
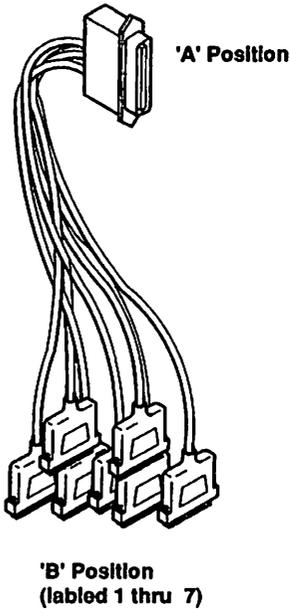
'A' Pos.	Signal Name	'B' Pos.
19	GND	P1-7
1	IP-A	P1-5
2	RXD-A	P1-3
20	TXD-A	P1-2
3	GND	P1-1
21	GND	P2-7
23	IP-B	P2-5
22	RXD-B	P2-3
4	TXD-B	P2-2
5	GND	P2-1
8	GND	P3-7
6	IP-C	P3-5
7	RXD-C	P3-3
25	TXD-C	P3-2
24	GND	P3-1
26	GND	P4-7
28	IP-D	P4-5
27	RXD-D	P4-3
9	TXD-D	P4-2
10	GND	P4-1
13	GND	P5-7
11	IP-E	P5-5
12	RXD-E	P5-3
30	TXD-E	P5-2
29	GND	P5-1
31	GND	P6-7
33	IP-F	P6-5
32	RXD-F	P6-3
14	TXD-F	P6-2
15	GND	P6-1
18	GND	P7-7
16	IP-G	P7-5
17	RXD-G	P7-3
35	TXD-G	P7-2
34	GND	P7-1

C.9 Illustrated Parts

C.9.1 CPU Board
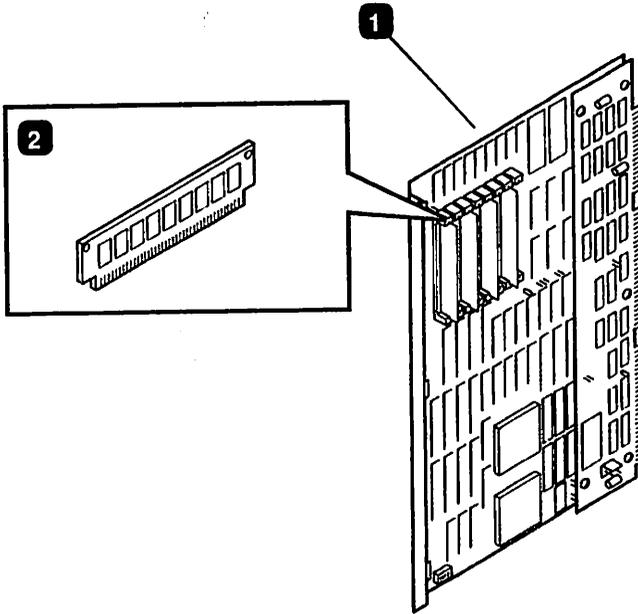
Item	Part Number	Description
1	210-9576-A	CPU Board, (no SIMMs loaded)
2	377-4533	1 MB SIMM, 70 nsecond
	377-4535	4 MB SIMM, 70 nsecond

C.9 Illustrated Parts

C.9.2 CS-Turbo Upgrade (200-6009)
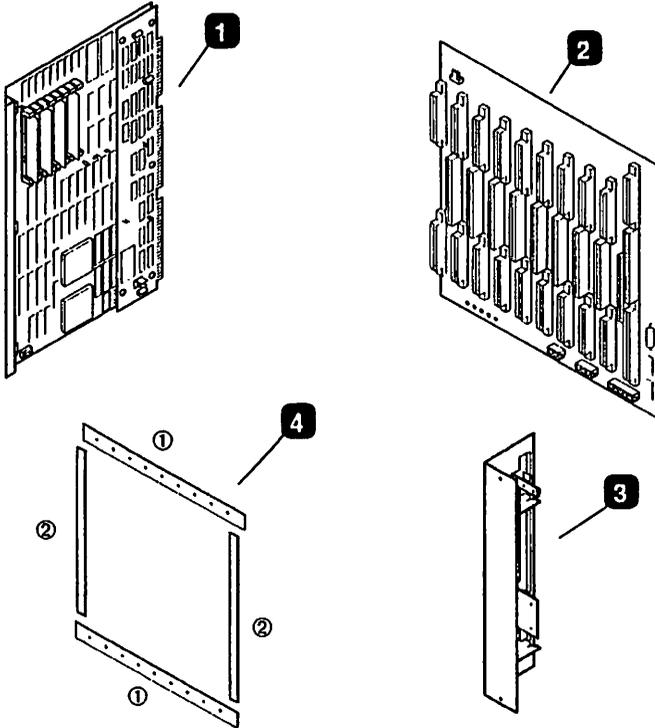
Item	Part Number	Description
1	210-9576-A	CPU Board, 4 MB Memory
2	210-9583	Turbo Motherboard
3	458-5194	CPU Door Assembly (CS only)
4		CS-Turbo Rail Kit
	① 451-2782	I/O Rail, 2 each (top and bottom)
	② 451-0830	Side Rail, 2 each

C.9 Illustrated Parts

C.9.3 CS-N (200-6008)/CS-D (200-6007)Turbo Upgrade
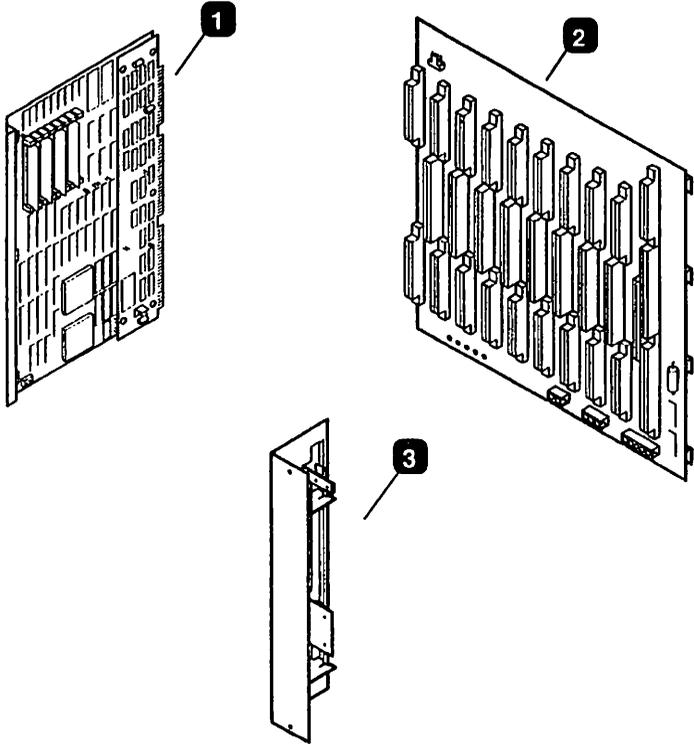
Item	Part Number	Description
1	210-9576-A	CPU Board, 4 MB Memory
2	210-9578	Turbo Motherboard
3	458-5026	CPU Door Assembly (CS-D/N only)

C.9 Illustrated Parts

C.9.4 Micro VP (200-6006)Turbo Upgrade
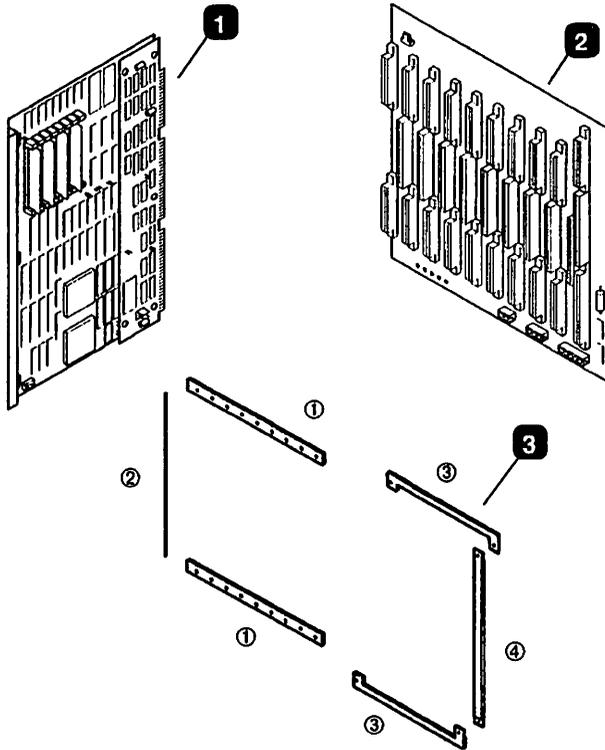
Item	Part Number	Description
1	210-9576-A	CPU Board, 4 MB Memory
2	210-9583	Turbo Motherboard
3		Micro VP Turbo Rail Kit
	① 451-2782	I/O Rails (top and bottom), 2 each
	② 452-0830	Side Rail, I/O section
	③ 451-2781	CPU/Power Supply Rails (top and bottom), 2 each
	④ 455-0290	CPU/Power Supply Outer Rail

C.9 Illustrated Parts

C.9.5 High-Speed Controllers
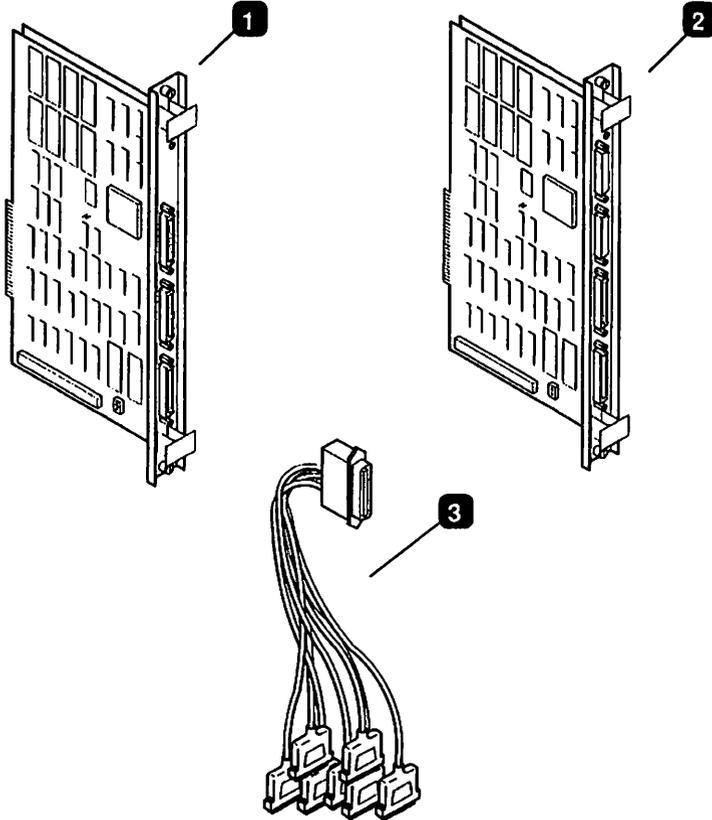
Item	Part Number	Description
1	212-9718	Printer/Disk Dual Controller (22C11-HS)
2	212-9717	MXF 16-Port Terminal Controller
3	421-0181	Octopus Cable

C.9 Illustrated Parts

C.9.6 Cross Reference Parts List (Maximum per CPU)

Qty	Part Number	Description	FRU	Where Used
1	210-9576-A (210-9576 (210-9577	CPU/Memory PCA (no SIMMs) CPU Processor/Motherboard Daughterboard (interface to old bus)	x	Turbo Only Turbo CPU board only) Turbo CPU board only)
4 or 8	377-4533	1 MB SIMM Module	X	Turbo, VS, PCs
4 or 8	377-4535	4 MB SIMM Module	X	Turbo, VS6000
1 to 4	212-9717 (210-9579 (210-9580	MXF 16 Port Terminal Controller High Speed I/O Processor Terminal Controller	X	Turbo Only MXF, 22C11-HS*) MXF Only)
8	421-0181	MXF 7 Port Octopus Cable (2 per MXF Controller)	X	MXF Only
1 to 3	212-9718 (210-9579 (210-9581	22C11-HS Printer/Disk Controller High Speed I/O Processor Peripheral Controller	X	Turbo Only MXF, 22C11-HS*) 22C11-HS Only)
1	210-9578	Turbo Motherboard (CS-N/D)	X	CS-N, CS-D (CS/386, (Turbo and VLSI CPUs)
1	210-9583	Turbo Motherboard (CS & MicroVP)	X	CS, MicroVP (Turbo (& CS/386 CPUs only)
1	458-5026	CPU Door Cover (New)		Turbo CS-D, CS-N
2 2 1	451-2782 452-0830 458-5194	**Rail Kit for CS** Top/Bot Rails for I/O Bds. Side Rails for I/O Section CPU Door Cover (New)		Turbo CS or MicroVP Turbo CS or MicroVP Turbo CS Only
2 1 2 1	451-2782 452-0830 451-2781 455-0290	**Rail Kit for MicroVP** Top/Bot Rails for I/O Bds. Side Rails for I/O Section Top/Bot Rails for CP/PS Cover Outer Rail for CPU/PS Cover		Turbo CS or MicroVP Turbo CS or MicroVP Turbo MicroVP Only Turbo MicroVP Only
2 per I/O Bd.	650-9529	1 inch Thumbscrews for I/O Boards installed in CS and MicroVP	X	CS, MicroVP Turbo

* The 210-9579 is used with both the MXF and 22C11-HS controllers. The only difference between the two applications would be the PROMS loaded on the board at locations L7 and L14.

386 TURBO SCSI CONTROLLER

APPENDIX D
CONTENTS

386 TURBO SCSI CONTROLLER

D.1 Introduction

D.1.1 Overview

The 22C11-SCSI controller (212-9727) is an intelligent controller designed to provide an industry-standard interface to the CS/386 Turbo CPU. The controller consists of two PCBs: a high-speed I/O processor board, which contains an 80286 processor that controls all I/O to any attached SCSI device or printer, and a SCSI/printer controller board, which handles all communication to any attached device.

The SCSI/printer controller contains two common SCSI connectors: J4, located externally on the bottom half of the outer rail, and J5, located just behind J4. These connectors provide an A Cable connection for either a 50-pin shielded amphenol connector (J4), or a 50-pin ribbon cable (J5). The board also contains a standard 2200 Centronics printer interface, J1, located on the top of the rail. Printing from this port uses a 256K cache buffer and is controlled by the 80286 processor, freeing the CPU to do other tasks and enhancing performance.

Other features of the 386 Turbo SCSI Controller include:

- Allows faster and larger capacity SCSI disk and tape drives to be used

- Uses SCSI drives and cabinets that are used with the VS (SSM SCSI Storage Module, MDSC Mini Data Storage Cabinet)

- Allows multiple sectors to be read as quickly as one sector was read previously (If reading only one sector, throughput is minimized)

- Fully compatible with BASIC-2 disk commands

- ANSI X3.131-1986-compatible SCSI port

- 2 MB dedicated, on-board cache

- Support for up to seven SCSI devices (eight including the SCSI controller)

- Support for up to 29 hard disk addresses, two floppy drives and one tape/controller

- Supports 3-byte addressing (allows use of a surface greater than 16M)

386 TURBO SCSI CONTROLLER

D.1 Introduction

D.1.2 Specifications

Physical Specifications
(mother/daughter board combination)

Height: 14.9 in. (35.3 cm.)
Width: 1.15 in. (2.9 cm)
Depth: 8.32 in. (21.1 cm)

Maximum SCSI I/O data cable length:
    18.75 ft. (6 m.)

Power Requirements

Voltage:
    115 Vac ±12 Vac @ 60 Hz (±0.5 Hz)
    230 Vac ±24 Vac @ 50 Hz (±0.5 Hz)

Input Current:
    2.0 amps @ 115 Vac 60 Hz (operating)
    1.0 amps @ 230 Vac 50 Hz (operating)

Leakage Current:
    0.2 amps @ 115 Vac 60 Hz
    0.2 amps @ 230 Vac 50 Hz

Input Power:
    170 Watts, 230 Voltamps

Power Factor:
    0.75? lagging

Environmental Requirements

Relative Humidity:
    10% - 90% (storage, packed)
    20% - 80% (operating)

Ambient Temperature:
    60° - 90°F (16° - 28°C)
Storage:
    0° - 120°F (-17° - 50°C)
Wet Bulb Temperature:
    75°F max. (24.4°C)

Heat Dissipation:
    581 BTU/hr. (146.4 KgCal/hr.)

386 TURBO SCSI CONTROLLER

D.1 Introduction

D.1.3 Configuration Requirements

The following list specifies hardware and software requirements for the 22C11-SCSI controller:

● Turbo CPU

● SSM-C SCSI storage module or MDSC mini data storage module

● Turbo General Release 1.10.00 (291-1001A)c

● 2200 diagnostics package 2.00.00 or greater (195-2956-0) (5.25" diskette, 732-8520A)

● DISK UTILITIES VER 1.1   731-8015D (5¼" 320K DISKETTE)

Also, the maximum SCSI cable length from controller to last device is 18.75 feet.

What about "new" Utilities?
Do They come on a diskette?
Or are they part of diagnostics parKage?

386 TURBO SCSI CONTROLLER

D.2 Settings (Sheet 1 of 4)

High-Speed I/O Processor 210-9579
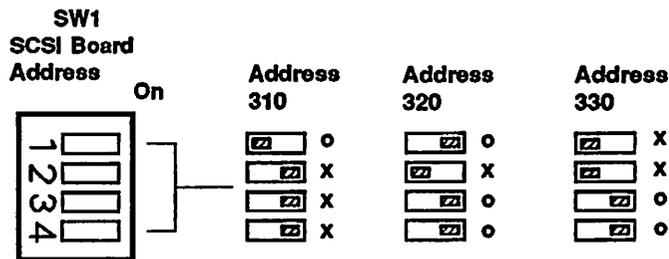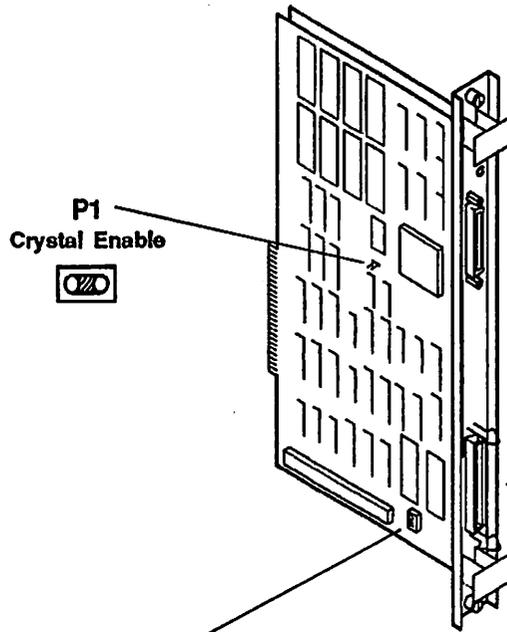
P1
Crystal Enable

SW1
SCSI Board
Address

	On	Address 310	Address 320	Address 330
1		o	o	x
2		x	x	x
3		x	o	o
4		x	o	o

▨ = Switch Position
x = Contacts Closed = On
o = Contacts Open= Off

386 TURBO SCSI CONTROLLER

D.2 Settings (Sheet 2 of 4)

SCSI Controller 210-9582
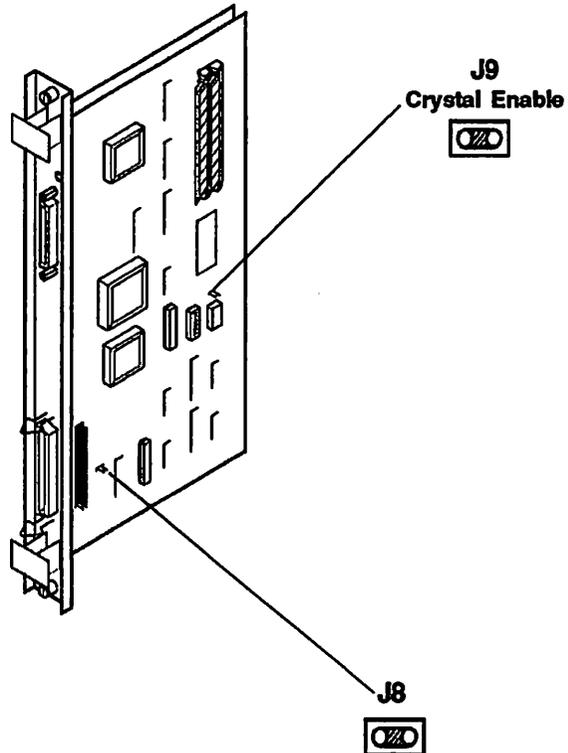
386 TURBO SCSI CONTROLLER

D.2 Settings (Sheet 3 of 4)

SCSI Controller 210-9582

Printer Address

SW1

On

	Address 215	Address 216	Address 217
O/S 1.15 Early version PROMs	o	o	x
	x	x	o
	o	x	o
	x	o	x

	Address 215	Address 216	Address 217
O/S 1.18 and higher R0 PROMs date code 7/7 or later	o	x	o
	x	o	x
	o	o	x
	x	x	x

⊡ = Switch Position
x = Contacts Closed = On
o = Contacts Open= Off

386 TURBO SCSI CONTROLLER

D.2 Settings (Sheet 4 of 4)

SCSI Controller 210-9582

SW1

SCSI ID

On
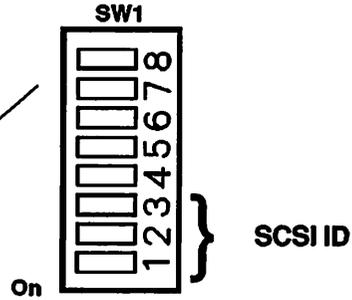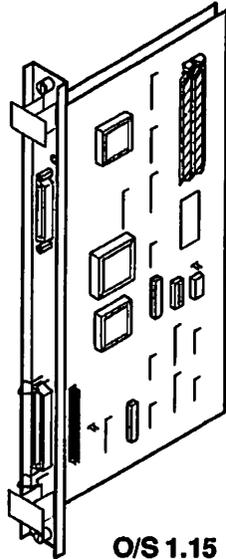
**O/S 1.15
Early version
PROMs**

SCSI ID 7	SCSI ID 6	SCSI ID 5	SCSI ID 4
x	x	x	x
x	x	o	o
x	o	x	o

SCSI ID 3	SCSI ID 2	SCSI ID 1	SCSI ID 0
o	x	o	o
x	o	o	o
x	x	x	o

**SW1 switch 4
Cache Enable
(On)**

**O/S 1.18 and
higher
R0 PROMs
date code 7/7
or later**

SCSI ID 7	SCSI ID 6	SCSI ID 5	SCSI ID 4

SCSI ID 3	SCSI ID 2	SCSI ID 1	SCSI ID 0

**SW1 switch 4
Cache Enable
(Off)**

⬚ = Switch Position
x = Contacts Closed = On
o = Contacts Open = Off

386 TURBO SCSI CONTROLLER

D.3 Operation

D.3.1 The Boot Process

The boot procedure for the 22C11-SCSI controller is similar to existing systems, except that the SCSI unit must be powered up first and all SCSI devices should be allowed to complete any self-tests. Normally, this process is completed within 15 seconds (multiple drives in a single cabinet may take longer). Many drives signal completion with a clicking noise, and the drive LED goes out.

Once all drives within a unit complete their self-tests, the CPU can be powered on. After 10 - 15 seconds (in a system with one drive), the CPU communicates with the drive. The drive LED ususally blinks twice during this time.

If using a 5.25" SCSI floppy, only DOS formatted (512K byte sectors) 2200 diskettes are compatible. To format a 1.2M DS floppy, choose "Format Disk Platter" from the operating system main menu. After entering the floppy address, you will be prompted to choose "DOS format." If set up properly, a boot from the SCSI floppy can be done before configuring the drives.

NOTES

When booting the CPU, RESET should not be keyed until the CPU communicates with the drive. The system may not properly recognize the drive.

If using a SCSI floppy, additional tests are done during the boot process. Allow up to one minute for these tests to complete.

D.3 Operation

D.3.2 Software Setup

SCSI drives must be configured through software. A utility program included with the Turbo operating system has a menu pick called SCSI Configuration, and also updated versions of the Tape Backup and Restore programs.

The SCSI Configuration program walks the user through the steps necessary to initially setup the drive, including a low level SCSI format and configuring the hard drive for various platter sizes.

From one to fifteen master addresses (D11 - D1F, D21 - D2F, or D31 - D3F) or from one to fourteen slave addresses (D51 - D5F, D61 - D6F, or D71 - D7F) are allowed, with a maximum of 29 hard disk addresses per controller. The first master and slave addresses (D10, D20, D30, and D70) are reserved for floppy drives, and the last slave addresses (D5F, D6F, or D7F) are reserved for tape.

After configuring the drive, all surfaces should be formatted using the standard 2200 format ($FORMATDISKT/Dxx). A 16M surface can be formatted in a matter of seconds, depending upon drive speed.

If the drive is reconfigured, a low level SCSI format and a 2200 format should be done to ensure that the new surfaces are completely clean (2200 formatting overwrites any code written to the disk with the SCSI format).

Backup and restore to SCSI tape procedures are similar to DS tape procedures; however, because tape drives currently available write in serial format and do not have separate directory tracks, a tape cannot be appended using backup.

386 TURBO SCSI CONTROLLER

D.4 Troubleshooting

D.4.1 Preventive Maintenance and Diagnostics

Scheduled preventive maintenance is not required; however, if a hardware failure occurs, the requirements of the customer engineer are:

- A working familiarity with the 2200 hardware and O/S

- Skillful cause analysis at the system level

- Knowledge of 2200 system diagnostics

- A working knowledge of SCSI drives

There are three types of diagnostics available to the CE:

Built-in self test--runs automatically when the system is powered up. The 22C11-SCSI controller has an LED that lights during power up and goes out if the controller passes the built-in self-test. If the LED remains lit, a board failure has occurred and it should be replaced.

CE level diagnostics--2200 diagnostics package 2.00.00 or greater (195-2956-0) (5.25" diskette, 732-8520A) is required to troubleshoot the 22C11-SCSI controller. The system must be up and the operating system loaded to run the CE level diagnostics.

Customer diagnostics--machine level diagnostics built into the operating sytem that run cursory tests to all Turbo-specific controllers to check status during boot (if RESET is keyed). Other tests, which can be selected using PF keys during boot, check communication between the controller and the CPU.

386 TURBO SCSI CONTROLLER

D.5 Illustrated Parts

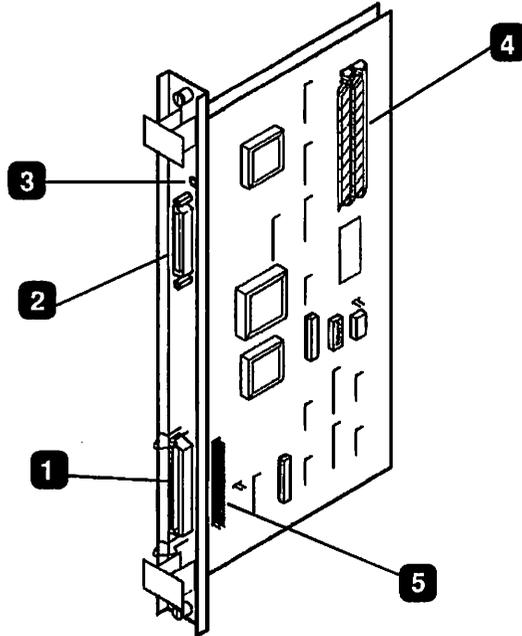## D.5.1 210-9579 High-Speed I/O Processor Component Locations
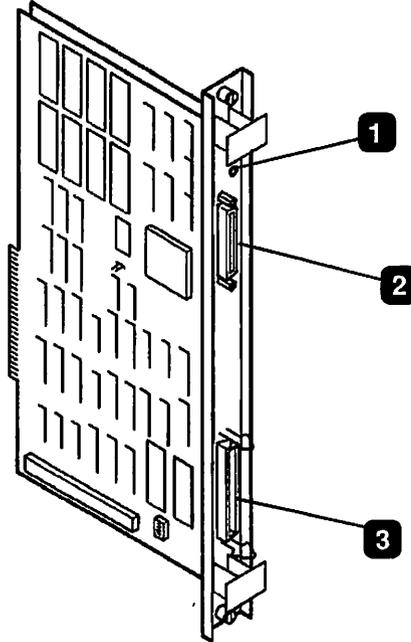
Item	Location	Description
1	LED1	Drive activity indicator
2	J1	Printer port
3	J4	SCSI port

386 TURBO SCSI CONTROLLER

D.5 Illustrated Parts

D.5.2 210-9582 SCSI Controller Component Locations

Item	Location	Description
1	J4	SCSI port
2	J1	Printer port
3	LED1	Drive activity indicator
4	Lx, Ly	SIMM
5	J5	SCSI port

need location #s Part #s and Type of Simm
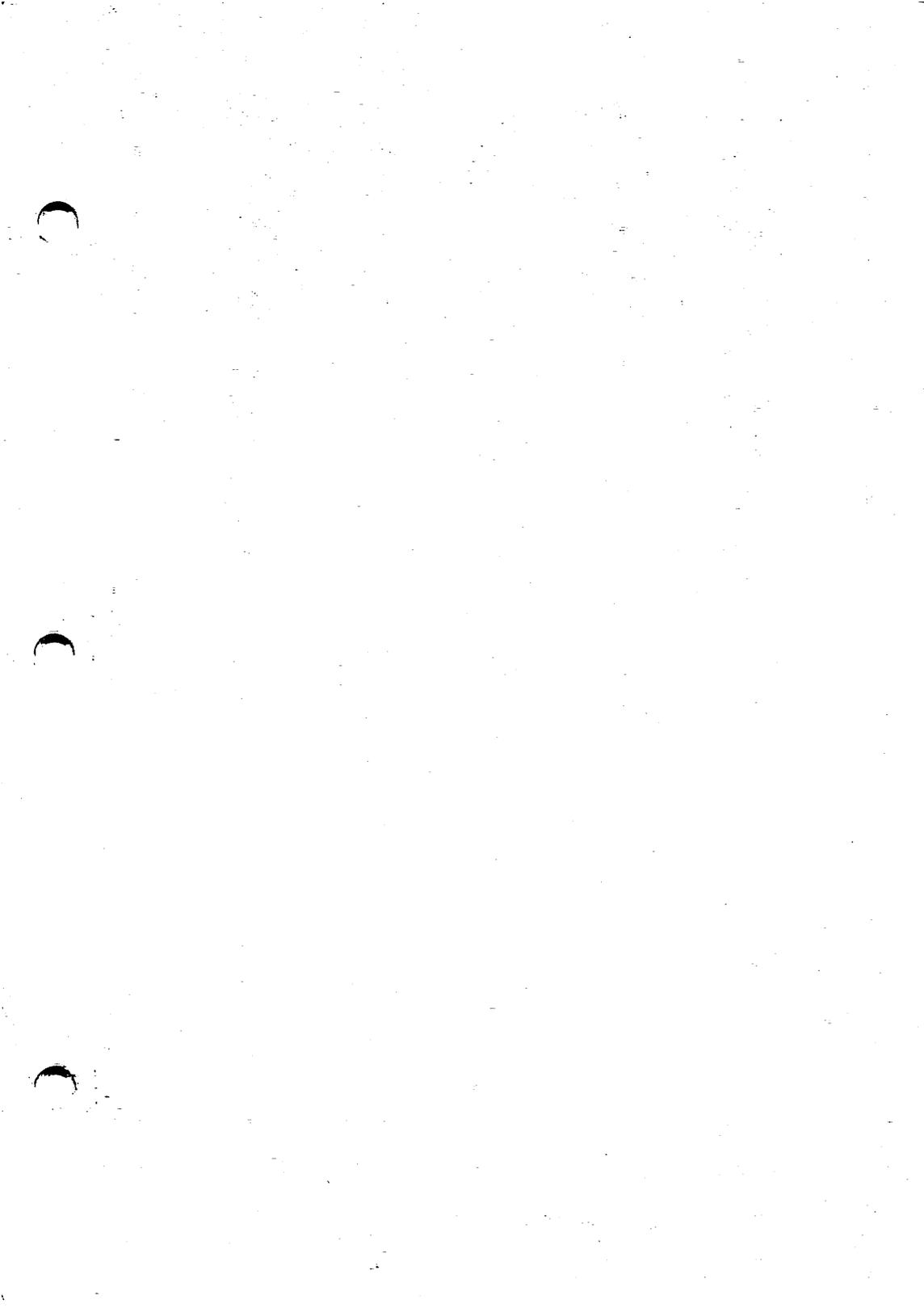
WANG

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