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M28

Service Manual



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PERSONAL
COMPUTER



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● **M28**

Service Manual

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PREFACE

This manual is intended for field engineers that have to install and maintain the M28 Personal Computer.

SUMMARY

This manual describes the installation procedures for the M28 system and its optional modules, the diagnostic programs executed on power-up and the removal and reassembly procedures for the main modules making up the M28 system. The last chapter contains some information on the basic operations which can be effected with the MS-DOS operating system.

DISTRIBUTION: Internal (Z)

REFERENCES:

M28	- Hardware Architecture and Function	code: 4108290 T
M28	- Spare Parts Catalogue	code: 4108300 Y
PC	- Goldstar 12" Monochromatic Video Unit	
	General Service Manual	code: 4111570 N
PC	- Video Display Units	
	General Service Manual	code: 4108020 Z

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CONTENTS

PAGE

1. FUNCTIONAL DESCRIPTION

1-1	<u>GENERAL</u>
1-6	<u>SYSTEM CONFIGURATION</u>
1-8	<u>BASIC MODULE EXTERNAL INDICATORS AND CONTROLS</u>
1-10	<u>DESCRIPTION OF MODULES</u>
1-10	BASIC MODULE
1-10	MOTHERBOARD
1-14	CENTRAL PROCESSOR UNIT (CPU)
1-14	MEMORY (RAM and EPROM)
1-14	PARALLEL INTERFACE
1-14	SERIAL INTERFACE
1-15	TIMER
1-15	CMOS-RAM CHIP WITH BATTERY BACK-UP
1-15	DMA AND INTERRUPT CONTROLLERS
1-16	KEYBOARD INTERFACE
1-17	INDIGENOUS DISPLAY CONTROLLER
1-21	BUS EXPANSION BOARD
1-25	MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER
1-26	HARD DISK CONTROLLER
1-28	HARD DISK UNIT
1-29	MINI-FLOPPY DISK DRIVES
1-30	POWER SUPPLY

PAGE	
1-31	MONOCHROME DISPLAY
1-32	KEYBOARD
1-34	PRINTERS AND OTHER PERIPHERALS
1-35	OPTIONS
1-35	COLOUR DISPLAY
1-36	OPTIONAL BOARDS
1-36	ENHANCED GRAPHICS COLOUR BOARD (EGC)
1-40	MEMORY EXPANSION BOARD
1-43	MULTIPOINT BOARD
1-46	<u>LIST OF CONFIGURATIONS</u>
	<u>2. INSTALLATION PROCEDURES</u>
2-1	<u>INTRODUCTION</u>
2-1	<u>SITE PREPARATION</u>
2-2	<u>INPUT AC ELECTRICAL CHARACTERISTICS</u>
2-2	<u>OUTPUT DC ELECTRICAL CHARACTERISTICS</u>
2-3	<u>ENVIRONMENTAL REQUIREMENTS</u>
2-3	<u>PHYSICAL CHARACTERISTICS</u>
2-3	<u>DIMENSIONS</u>
2-3	<u>POWER ABSORBED BY THE SYSTEM</u>
2-4	<u>INSTALLATION</u>
2-4	UNPACKING THE SYSTEM
2-5	INSTALLING THE BASIC MODULE AND MONOCHROME DISPLAY
2-9	<u>SETTINGS</u>
2-11	INSTALLING A PRINTER WITH PARALLEL INTERFACE
2-12	INSTALLING A PRINTER WITH SERIAL INTERFACE
2-14	<u>SYSTEM SWITCH AND JUMPER SETTINGS</u>
2-14	MOTHERBOARD JUMPERS

PAGE		PAGE
2-19	DISPLAY CONTROLLER	3-27
2-20	MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER BOARD	3-28
2-21	HARD DISK CONTROLLER BOARD	3-29
2-22	5.25 INCH MINI-FLOPPY DISK DRIVE	3-30
2-30	HARD DISK UNIT	3-31
2-32	TAPE DRIVE	3-32
	3. <u>OPTION INSTALLATION</u>	3-33
3-1	<u>INTRODUCTION</u>	3-34
3-2	<u>PRELIMINARY AND FINAL OPERATIONS</u>	3-35
3-3	REMOVING THE TOP COVER	3-36
3-5	REMOVING THE BOTTOM COVER	3-37
3-7	IDENTIFYING BOARD POSITION	3-38
3-12	INSERTING AND SECURING THE OPTIONAL BOARD	3-39
3-15	REMounting THE TOP COVER	3-40
3-17	REMounting THE BOTTOM COVER	3-41
3-19	RECONNECTING THE BASIC MODULE	3-42
3-20	UPGRADING MOTHERBOARD MEMORY FROM 512 KB TO 1 MB	3-43
3-24	INSTALLING THE COLOUR DISPLAY	3-44
3-25	INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE BASIC MODULE	3-45
3-26	INSTALLATION PROCEDURE	3-46
3-35	INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE EXPANSION BOX	3-47
3-36	INSTALLATION PROCEDURE	3-48
3-51	INSTALLING THE 80287 NUMERIC PROCESSOR EXTENSION	3-49
3-54	<u>INSTALLING THE MOUSE ADAPTER</u>	3-50
3-54	MATERIAL REQUIRED	3-51
3-54	INSTALLATION PROCEDURE	3-52
3-57	<u>INSTALLING THE MULTIPOINT BOARD (SIC 2832)</u>	3-53

PAGE	
3-57	MATERIAL REQUIRED
3-58	INSTALLATION PROCEDURE
3-60	CONFIGURATION
3-61	<u>INSTALLING THE TAPE DRIVE</u>
3-61	MATERIAL REQUIRED
3-62	INSTALLATION PROCEDURE
3-66	<u>INSTALLING THE EXPANSION GRAPHICS AND COLOUR BOARD (EGC)</u>
3-66	MATERIAL REQUIRED
3-67	INSTALLATION PROCEDURE
3-72	<u>INSTALLING THE MEMORY EXPANSION BOARD</u>
3-72	MATERIAL REQUIRED
3-72	INSTALLATION PROCEDURE
3-75	CONFIGURATIONS
3-77	UPGRADING MEMORY EXPANSION BOARD
	<u>4. POWER-UP DIAGNOSTICS</u>
4-1	<u>INTRODUCTION</u>
4-1	<u>MAIN CHARACTERISTICS OF THE TESTS</u>
4-3	<u>REQUIREMENTS FOR CORRECT TEST EXECUTION</u>
4-4	<u>OPERATING PROCEDURES</u>
4-5	<u>FUNCTIONAL DESCRIPTION OF THE POWER-UP DIAGNOSTICS</u>
4-6	SHUTDOWN DIAGNOSTICS
4-6	PRIMITIVE DIAGNOSTICS
4-6	ADVANCED DIAGNOSTICS
4-6	CONFIGURATION DIAGNOSTICS
4-7	<u>DETAILED DESCRIPTION OF THE POWER-UP DIAGNOSTICS</u>
4-8	SHUTDOWN DIAGNOSTICS
4-11	SHUTDOWN DIAGNOSTICS FLOW CHART

PAGE	
4-12	PRIMITIVE DIAGNOSTICS
4-16	PRIMITIVE DIAGNOSTICS FLOW CHART
4-18	ADVANCED DIAGNOSTICS
4-30	ADVANCED DIAGNOSTICS FLOW CHART
4-35	CONFIGURATION DIAGNOSTICS
4-43	CONFIGURATION DIAGNOSTICS FLOW CHART
4-48	PRIMITIVE DIAGNOSTICS ERROR ROUTINE (PDER)
4-49	PDER FLOW CHART
4-50	ADVANCED DIAGNOSTICS ERROR HANDLING ROUTINE (ADER)
4-52	ADER FLOW CHARTS
4-54	BURNIN TEST COMPLETION ROUTINE (BTCR)
4-55	BTCR FLOW CHART
4-56	<u>SUMMARY OF MESSAGES</u>
4-56	MESSAGES DISPLAYED AT THE END OF SUCCESSFUL TESTS
4-57	ERROR MESSAGES
4-63	<u>HOW TO DETERMINE THE FAULTY MEMORY CHIP</u>
4-64	REFERENCE TABLE
4-68	<u>NO ERROR MESSAGES DISPLAYED</u>
	<u>5. MAINTENANCE</u>
5-1	<u>INTRODUCTION</u>
5-2	<u>SIGNAL ADJUSTMENTS</u>
5-2	POWER SUPPLY ADJUSTMENTS
5-3	MINI-FLOPPY DISK CONTROLLER BOARD VCO ADJUSTMENTS
5-10	<u>DISASSEMBLY AND ASSEMBLY OF MAIN MODULES</u>
5-11	REMOVING THE BASIC MODULE TOP COVER
5-13	REMOVING THE BOTTOM COVER
5-15	REMOVING THE REAR PANEL

PAGE

5-16	REMountING THE TOP COVER
5-18	REMountING THE BOTTOM COVER
5-20	REMountING THE REAR PANEL
5-21	REPLACING THE POWER SUPPLY UNIT
5-23	REPLACING THE FAN
5-24	REPLACING THE MOTHERBOARD
5-26	REPLACING THE BUS EXPANSION BOARD
5-28	REPLACING THE DISPLAY CONTROLLER BOARD
5-31	REPLACING THE MINI-FLOPPY DISK DRIVE
5-33	REPLACING THE HARD DISK UNIT
5-36	REPLACING THE HARD DISK CONTROLLER BOARD
5-37	REPLACING THE MINI-FLOPPY DISK CONTROLLER BOARD
5-38	REPLACING THE BATTERY
5-39	REPLACING THE FRONT PANEL
5-42	REPLACING THE TAPE DRIVE

6. SOFTWARE OVERVIEW

6-1	<u>DISK OPERATING SYSTEMS</u>
6-1	MS-DOS
6-1	XENIX
6-3	<u>USING MS-DOS</u>
6-4	KEYBOARD INSTALLATION AND NATIONAL VARIATIONS
6-5	CREATING AN AUTOEXEC.BAT FILE FOR KEYBOARD DRIVER AND FONT
6-6	HOW TO FORMAT ON DUAL-DRIVE VERSIONS
6-7	HOW TO FORMAT ON SINGLE-DRIVE VERSIONS
6-8	<u>FORMAT COMMAND</u>
6-10	<u>VOLUMES</u>
6-10	<u>FILES</u>

PAGE	
6-10	FILE NAMES
6-11	<u>DIRECTORIES</u>
6-12	LISTING VOLUMES
6-13	<u>FILE MANIPULATION</u>
6-13	COPYING FILES ON DUAL-DRIVE VERSIONS
6-14	DELETING A FILE ON DUAL-DRIVE VERSIONS
6-14	SOME SPECIAL FILES
6-14	THE INITIALIZATION FILE
6-15	<u>COPYING MINI-FLOPPY DISKS</u>
6-15	APPLICATION SOFTWARE MINI-FLOPPY DISKS
6-15	COPY-PROTECTION
6-15	MAKING BACKUPS
6-16	MAKING A BACKUP ON DUAL-DRIVE VERSIONS
6-17	MAKING BACKUPS ON A SINGLE-DRIVE VERSION
6-18	<u>OTHER MS-DOS FACILITIES</u>
6-22	<u>USING MS-DOS WITH THE HARD DISK</u>
6-22	INTRODUCTION
6-23	HOW TO SET UP THE HARD DISK FOR MS-DOS ONLY
6-25	HOW TO PARTITION THE HARD DISK
6-32	<u>ERROR MESSAGES</u>

1. FUNCTIONAL DESCRIPTION

CONTENTS

PAGE

1. FUNCTIONAL DESCRIPTION

1-1	<u>GENERAL</u>
1-6	<u>SYSTEM CONFIGURATION</u>
1-8	<u>BASIC MODULE EXTERNAL INDICATORS AND CONTROLS</u>
1-10	<u>DESCRIPTION OF MODULES</u>
1-10	BASIC MODULE
1-10	MOTHERBOARD
1-14	CENTRAL PROCESSOR UNIT (CPU)
1-14	MEMORY (RAM and EPROM)
1-14	PARALLEL INTERFACE
1-14	SERIAL INTERFACE
1-15	TIMER
1-15	CMOS-RAM CHIP WITH BATTERY BACK-UP
1-15	DMA AND INTERRUPT CONTROLLERS
1-16	KEYBOARD INTERFACE
1-17	INDIGENOUS DISPLAY CONTROLLER
1-21	BUS EXPANSION BOARD
1-25	MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER
1-26	HARD DISK CONTROLLER
1-28	HARD DISK UNIT
1-29	MINI-FLOPPY DISK DRIVES
1-30	POWER SUPPLY

PAGE

1-31	MONOCHROME DISPLAY
1-32	KEYBOARD
1-34	PRINTERS AND OTHER PERIPHERALS
1-35	OPTIONS
1-35	COLOUR DISPLAY
1-36	OPTIONAL BOARDS
1-36	ENHANCED GRAPHICS COLOUR BOARD (EGC)
1-40	MEMORY EXPANSION BOARD
1-43	MULTIPOINT BOARD
1-46	<u>LIST OF CONFIGURATIONS</u>

FUNCTIONAL DESCRIPTION

GENERAL

The Olivetti Personal Computer is a desk top unit and in its standard configuration contains three parts:

- Basic module
- CRT display
- Keyboard

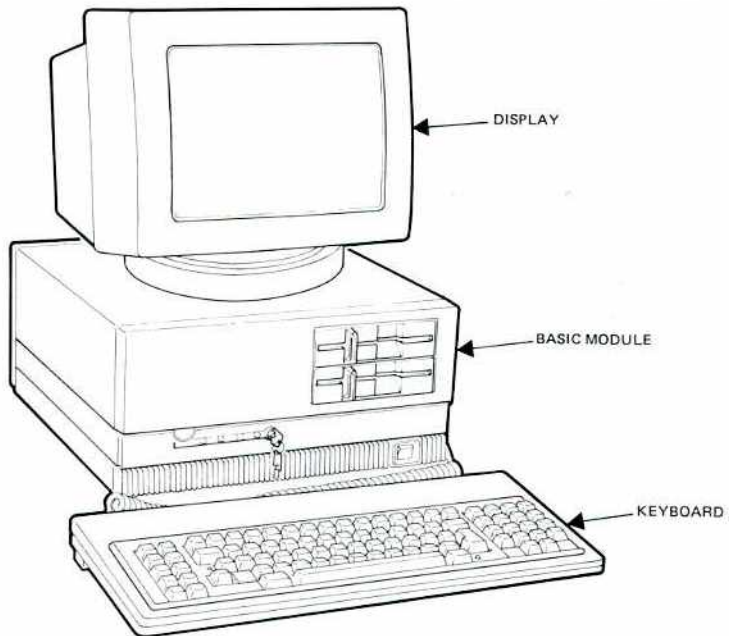


Fig. 1-1 PC Basic Module, Display, and Keyboard

The basic module houses the motherboard, display controller, bus expansion board, mini-floppy disk and tape drive controller board, hard disk controller board, front panel interface and the power supply.

Data storage is in the form of a 5.25 inch mini-floppy disk drive and a hard disk drive. Space is also provided for an optional drive which may be another mini-floppy disk drive, or a tape drive.

The display can either be monochrome or colour.

The motherboard is the printed circuit board which takes up most of the bottom of the basic module case and is placed with its component side facing downwards.

The motherboard comprises an 80286 microprocessor and the associated logic, the memory and the control circuits for serial and parallel and keyboard interfaces. The motherboard has two edge connectors (J7 and J8) into which the display controller board is inserted.

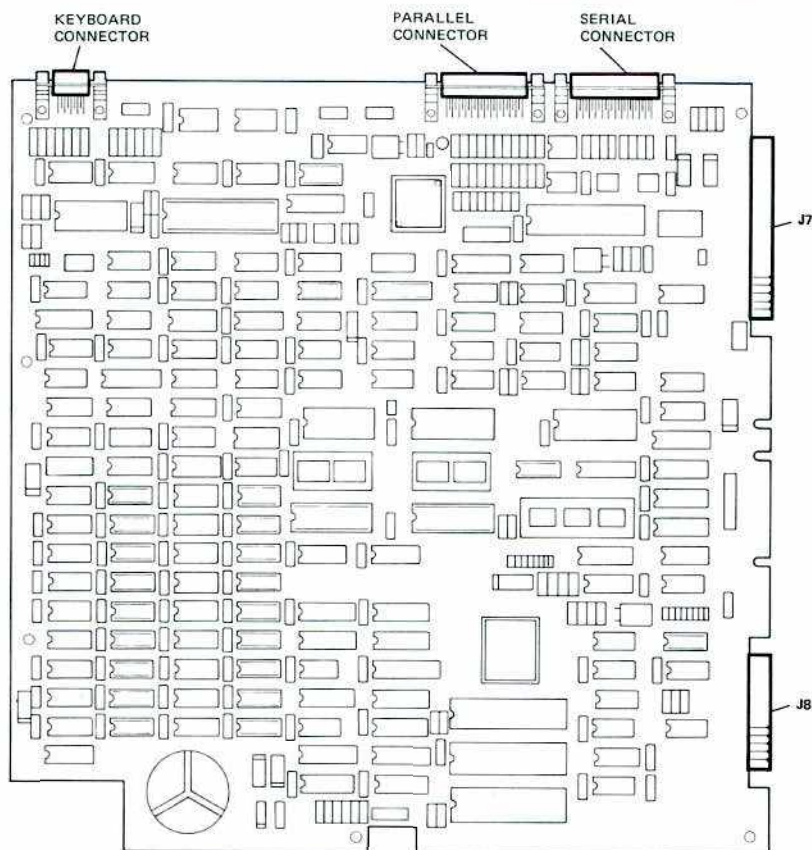


Fig. 1-2 Motherboard

FUNCTIONAL DESCRIPTION

The display controller, known as the indigenous board, can support both the monochrome display and the colour display. An additional enhancement board, referred to as the enhanced graphics colour board (EGC) can be connected to this display controller.

The bus expansion board fits into the display controller one plane above the motherboard. The bus expansion board provides space for system expansion. Up to 7 boards of the following type can be inserted on the bus expansion board:

- An Olivetti board
- Four 16-bit industry standard compatible boards
- Two 8-bit industry standard compatible boards (which can also be inserted in any of the other five slots).

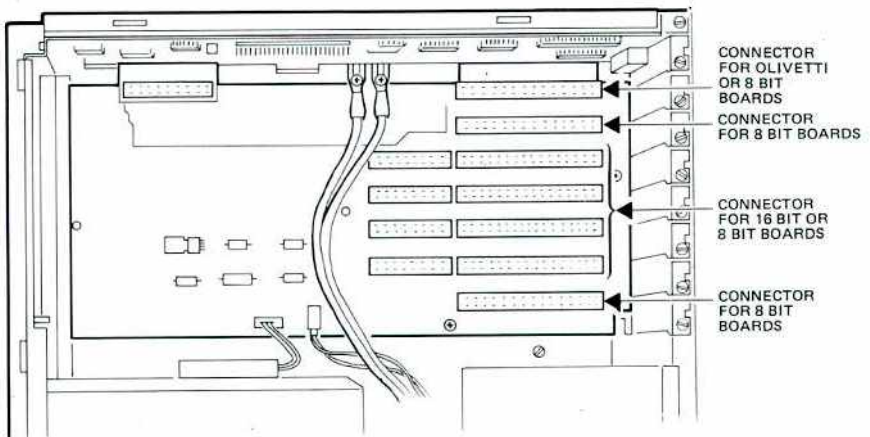


Fig. 1-3 Bus Expansion Board

The power supply is housed in a metal box at the rear of the basic module, behind the magnetic disk drives. It provides the correct D.C. voltages for all the logic circuits.

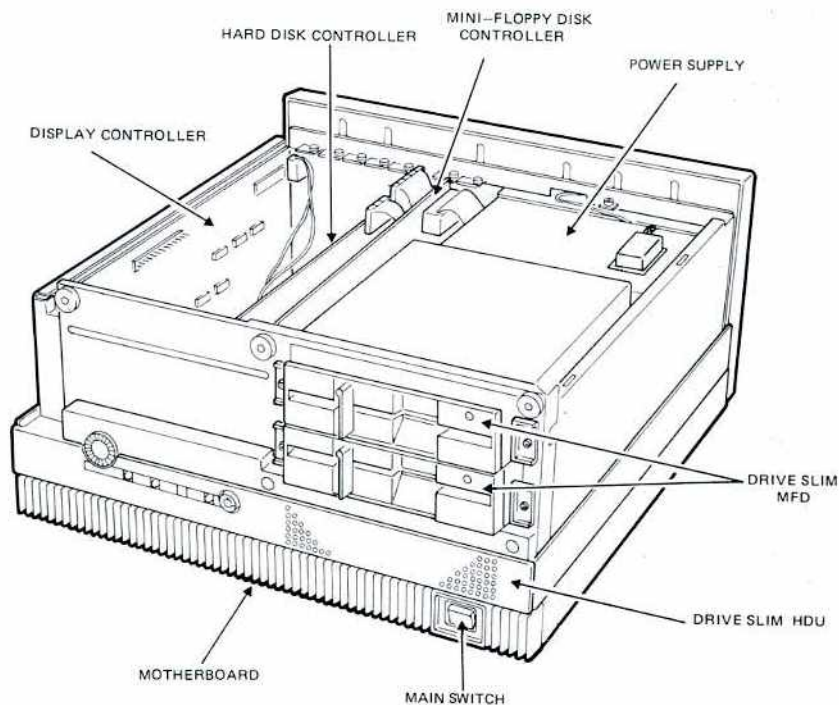


Fig. 1-4 Basic Module

The keyboard cable is attached to a connector at the rear of the basic module. This shielded cable has 5 wires: one line for the +12 VDC, two ground wires, a bidirectional data line and a line for the clock. It is approximately 2 metres long and is coiled like a telephone handset cable.

FUNCTIONAL DESCRIPTION

The basic module has the following connectors at the rear:

- Keyboard connector
 - Serial connector
 - Parallel connector
 - Power connectors (Two)
 - Display connector
-

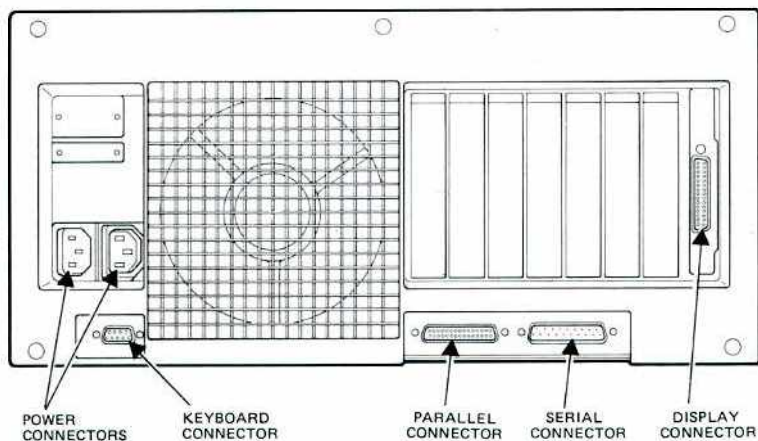


Fig. 1-5 Basic Module Connectors

SYSTEM CONFIGURATION

The system is available in various configurations in order to meet the requirements of the customer, and the chosen configuration can be expanded with numerous options.

Figure 1-6 is a simplified block diagram of the system.

A self-powered expansion box can be connected to the basic module; this can contain a 360 KB mini-floppy disk drive or a tape drive, or both.

The table at the end of this chapter lists the basic configurations available and the expansion options.

FUNCTIONAL DESCRIPTION

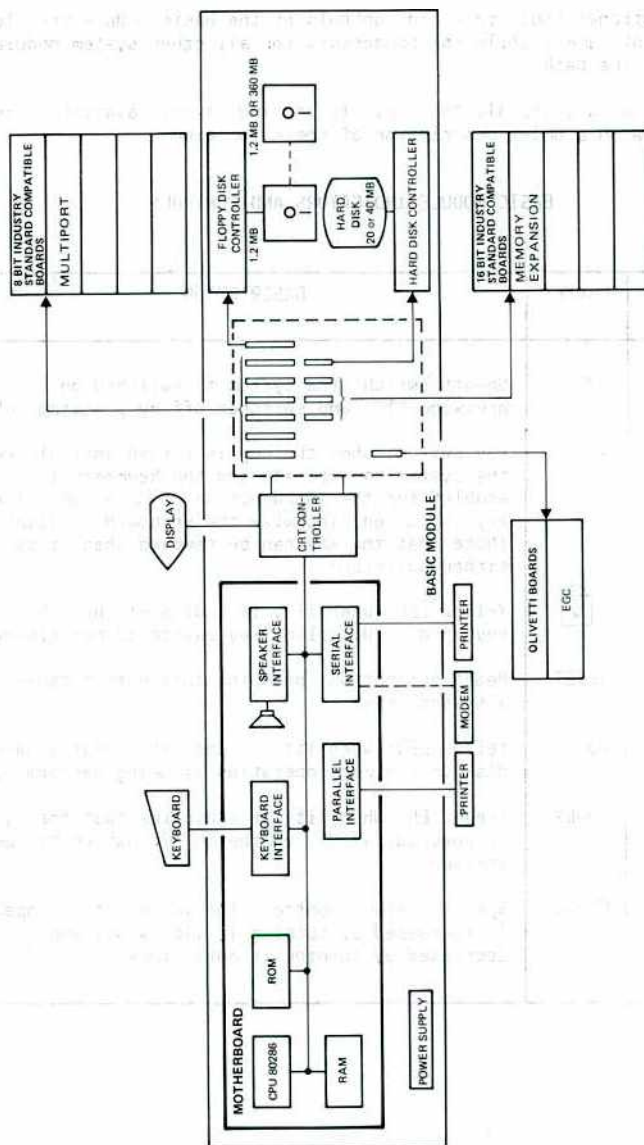


Fig. 1-6 PC Simple Block Diagram

BASIC MODULE EXTERNAL INDICATORS AND CONTROLS

All the external indicators and controls of the basic module are located on the front panel, while the connectors for all other system modules are located at the back.

The table below lists all the controls and indicators available to the operator, with a brief description of their function.

BASIC MODULE INDICATORS AND CONTROLS

Refs. in Fig. 1-7	NAME	DESCRIPTION
1	0/1	On-off switch: the system is switched on by pressing "1", and switched off by pressing "0".
2	---	Key switch: when the key is turned anti-clockwise the system can operate and the keyboard is enabled for the introduction of data; when the key is turned clockwise the keyboard is disabled. (Note that the key can be removed when it is in either position).
3		Yellow LED: when lit, it indicates that the keyboard is disabled (key switch turned clockwise)
4	RESET	Reset pushbutton: pressing this button causes a system reset.
5	HDU	Yellow LED: when lit, it indicates that a hard disk unit access operation is being performed.
6	POWER	Green LED: when lit, it indicates that the system is powered, as "1" of the on-off switch has been pressed.
7		Speaker volume control: the volume of the speaker is increased by turning it clockwise, and decreased by turning it anti-clockwise.

FUNCTIONAL DESCRIPTION

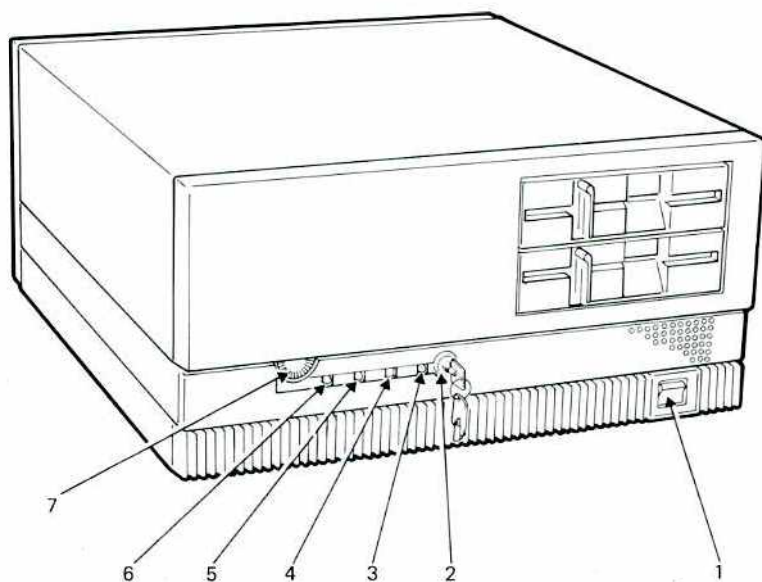


Fig. 1-7 Front Panel

DESCRIPTION OF MODULES

BASIC MODULE

The basic module contains the following parts:

- The motherboard
- The indigenous display controller
- The bus expansion board
- The hard disk controller board
- The mini-floppy disk controller board
- The hard disk unit
- The mini-floppy disk drive
- The power supply.

These parts are briefly described in the following sections.

MOTHERBOARD

The motherboard is located at the base of the basic module, and comprises the following parts:

- the central processor unit (CPU), made up of the 80286 microprocessor, an 80287 numeric processor extension (optional) and the 82288 bus controller
- The RAM and EPROM memories
- The parallel interface
- The serial interface
- The timer
- The CMOS-RAM chip with battery back-up
- The DMA and interrupt controllers
- The keyboard controller.

A number of jumpers are used to configure the system.

Figure 1-8 shows the motherboard connectors and the signal names of each connector.

FUNCTIONAL DESCRIPTION

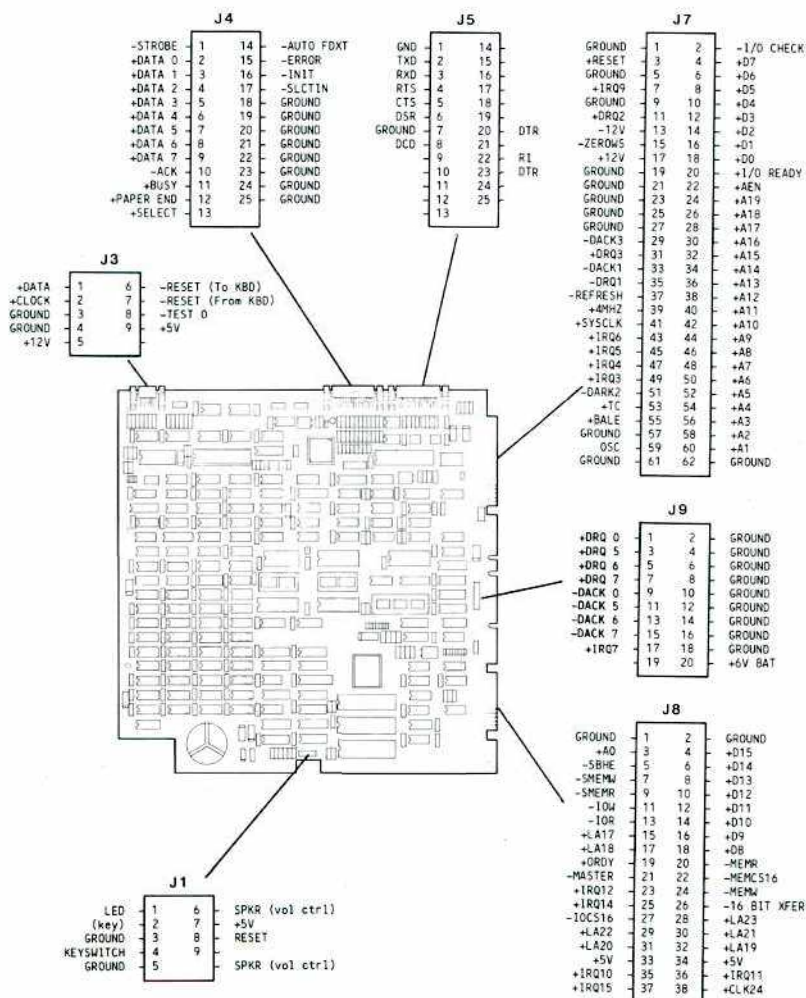


Fig. 1-8 Motherboard Connectors

Figure 1-9 shows the physical location of the principal motherboard circuits.

These are:

- 1 - 80286 CPU
- 2 - Numeric Processor Extension
- 3 - 16450 UART
- 4 - RAM Area
- 5 - EPROM (higher byte)
- 6 - EPROM (lower byte)
- 7 - 8237 DMA Controllers
- 8 - 8259A Interrupt Controllers
- 9 - 8742 Keyboard Controller
- 10 - 8254 Timer
- 11 - Jumper Block JU1
- 12 - Jumper Block JU2
- 13 - Jumper Block JU3
- 14 - Jumper JU4
- 15 - Jumper JU5
- 16 - 82288 Bus Controller
- 17 - CMOS-RAM Chip
- 18 - FE2000 Parallel Interface Controller

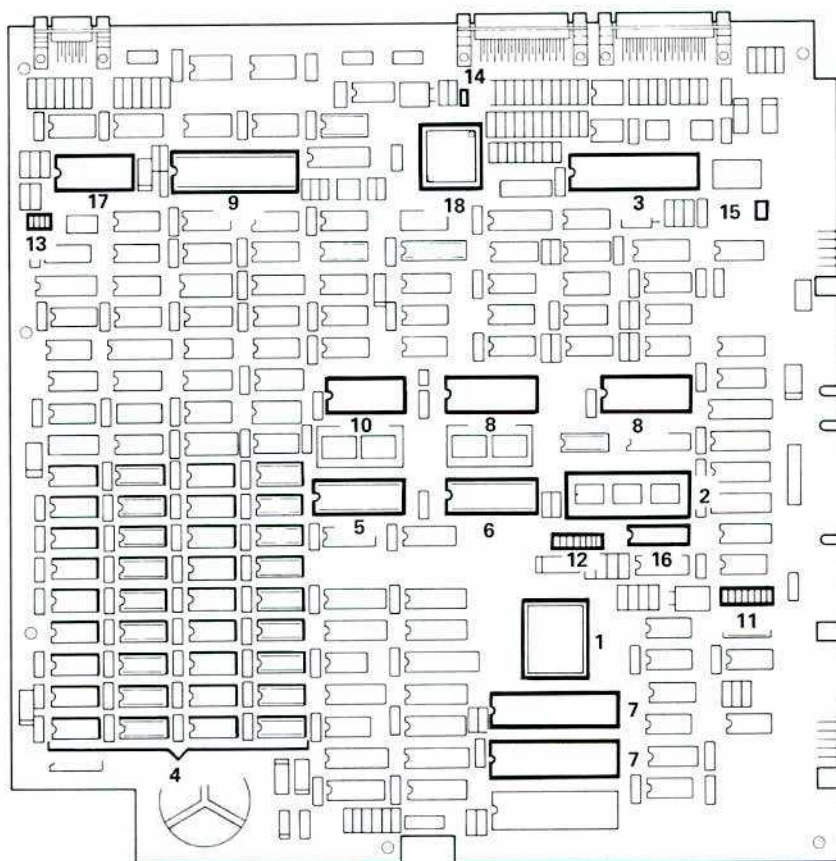


Fig. 1-9 Motherboard IC Circuits

CENTRAL PROCESSOR UNIT (CPU)

The PC uses an advanced microprocessor, the 16-bit 8 MHz 80286. The 80286 is the heart of the motherboard. Also present on the motherboard is a socket for the optional 80287 microprocessor, which is an Arithmetic Processor Unit.

Some of the features of the 80286 CPU are:

- 24 address bits and 16 data bits
- Virtual addressing capability to 1 GB of memory
- Integrated memory handling

MEMORY (RAM and EPROM)

In the standard configuration the PC holds 512 KB of Random Access Memory (RAM) and 32 KB of Erasable Programmable Read Only Memory (EPROM).

The RAM chips used in the PC are dynamic 256Kx1 chips. The 512 KB of motherboard RAM is expandable to 1 MB with the insertion of 18 256Kx1 chips.

The 32 KB of EPROM contain:

- Power on diagnostics
- Power on bootstrap
- Drivers for keyboard, HDU, mini-floppy disk, and other peripherals
- Initialization programs for Large Scale Integration (LSI) chips

PARALLEL INTERFACE

The parallel interface provides the PC with a Centronics-like parallel port for connecting to a printer. Some of the printers which can be connected are listed on the following pages.

SERIAL INTERFACE

The PC has a standard serial channel to support serial communications. The LSI serial communication chip used is the 16450 UART, which provides one RS 232 asynchronous channel.

FUNCTIONAL DESCRIPTION

TIMER

The timer is a programmable device that has three independent channels:

- Channel 0 is used as a real time clock
- Channel 1 is used to time and request refresh cycles from the DMA channel
- Channel 2 is used to support the tone generator for the audio speaker, which is physically located on the motherboard.

CMOS-RAM CHIP WITH BATTERY BACK-UP

The battery backed up CMOS-RAM chip is used to store the device flags present in the system and to provide real time (i.e. seconds, minutes, hours, the date, etc.) for the system. Since it is backed up by battery, the real time is still kept, even if the system power is turned off.

DMA AND INTERRUPT CONTROLLERS

The PC motherboard has 2 DMA controller circuits (8237), which are cascade-connected, so that a total of 7 DMA channels are available.

One of the two circuits is used for 8-bit transfers, and the other for 16-bit transfers.

Channel 0 is used for dynamic system memory refresh. This is a dedicated channel and is not jumper selectable.

Channels 1 and 3 are available on the I/O expansion bus; channel 3 is normally used by the hard disk controller, and both are jumper selectable.

Channel 2 is reserved for the mini-floppy disk controller.

The motherboard has 2 interrupt controller circuits (8259A), which are cascade connected to a total of 16 interrupts:

- IRQ0 used for the timer
- IRQ1 used for the keyboard controller
- IRQ2 used for the cascade connection of the two interrupt controllers
- IRQ3 used by a board inserted in one of the expansion slots
- IRQ4 used for the serial controller located on the motherboard and for the expansion slots
- IRQ5 used by a board inserted in one of the expansion slots
- IRQ6 used for the mini-floppy disk controller and for the expansion slots
- IRQ7 used for the parallel interface and the expansion slots
- IRQ8 used for the calendar
- IRQ9 used by a board inserted in one of the expansion slots
- IRQ10 used by a board inserted in one of the expansion slots
- IRQ11 used by a board inserted in one of the expansion slots
- IRQ12 used by a board inserted in one of the expansion slots
- IRQ13 used for the 80287 numeric processor extension
- IRQ14 used for the hard disk controller and for the expansion slots
- IRQ15 used by a board inserted in one of the expansion slots.

KEYBOARD INTERFACE

This device is used to provide the interface between the system and the keyboard. The Intel 8742 chip is the integrated circuit used as controller. It converts the system parallel data to serial data for the keyboard and vice-versa.

FUNCTIONAL DESCRIPTION

INDIGENOUS DISPLAY CONTROLLER

The indigenous display controller provides the interface between the display and the system as well as the hardware associated with the generation of graphics and text.

The indigenous board has 4 female connectors, which accommodate the motherboard and the bus expansion board. It is always present.

- 640 x 400 monochrome graphics
- 640 x 200 industry standard monochrome graphics
- 80 x 25 industry standard compatible characters (each character is 8 x 16 dots)
- 320 x 200 industry standard colour graphics
- 40 x 25 industry standard compatible characters.

The tables below list the signals present on the various board connectors. For further information on their meaning, refer to the Theory of Operation and Hardware Architecture manuals.

CONNECTORS J1 AND J2

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	GROUND
+A0: address bit A0	3	4	+D15: data bit 15
-SBHE: Bus High Enable	5	6	+D14: data bit 14
-SMEMW: Memory Write	7	8	+D13: data bit 13
-SMEMR: Memory Read	9	10	+D12: data bit 12
-IOW: I/O Write	11	12	+D11: data bit 11
-IOR: I/O Read	13	14	+D10: data bit 10
+LA17: address bit A17	15	16	+D9: data bit 9
+LA18: address bit A18	17	18	+D8: data bit 8
+ORDY: Olivetti Ready	19	20	-MEMR: Memory Read
-MASTER: Master	21	22	-MEMCS16: 16-bit Memory Cycle
+IRQ12: Interrupt Request 12	23	24	-MEMW: Memory Write
+IRQ14: Interrupt Request 14	25	26	-16BCH: 16-bit Channel Flag
-IOCS16: 16-bit I/O Cycle	27	28	+LA23: address bit A23
+LA22: address bit A22	29	30	+LA21: address bit A21
+LA20: address bit A20	31	32	+LA19: address bit A19
+5V: +5 VDC power supply	33	34	+5V: +5 VDC power supply
+IRQ10: Interrupt Request 10	35	36	+IRQ11: Interrupt Request 11
+IRQ15: Interrupt Request 15	37	38	+CLK24: 24 MHz clock

CONNECTORS J3 AND J4

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	-I/OCHCK: I/O Channel Check
+RESET: Reset	3	4	+D7: data bit 7
GROUND	5	6	+D6: data bit 6
+IRQ9: Interrupt Request 9	7	8	+D5: data bit 5
GROUND	9	10	+D4: data bit 4
+DRQ2: DMA Request 2	11	12	+D3: data bit 3
-12V: -12 VDC power supply	13	14	+D2: data bit 2
-ZEROWS: Zero Wait States	15	16	+D1: data bit 1
+12V: +12 VDC power supply	17	18	+D0: data bit 0
GROUND	19	20	+I/OREADY: I/O Channel Ready
GROUND	21	22	+AEN: Address Enable
GROUND	23	24	+A19: address bit A19
GROUND	25	26	+A18: address bit A18
GROUND	27	28	+A17: address bit A17
-DACK3: DMA Acknowledge 3	29	30	+A16: address bit A16
+DRQ3: DMA Request 3	31	32	+A15: address bit A15
-DACK1: DMA Acknowledge 1	33	34	+A14: address bit A14
+DRQ1: DMA Request 1	35	36	+A13: address bit A13
-REFRESH: Refresh	37	38	+A12: address bit A12
+4MHZ: 4 MHz Clock	39	40	+A11: address bit A11
+SYSCLK: 8 MHz Clock	41	42	+A10: address bit A10
+IRQ6: Interrupt Request 6	43	44	+A9: address bit A9
+IRQ5: Interrupt Request 5	45	46	+A8: address bit A8
+IRQ4: Interrupt Request 4	47	48	+A7: address bit A7
+IRQ3: Interrupt Request 3	49	50	+A6: address bit A6
-DACK2: DMA Acknowledge 2	51	52	+A5: address bit A5
+TC: Terminal Count	53	54	+A4: address bit A4
+BALE: Address Latch Enable	55	56	+A3: address bit A3
GROUND	57	58	+A2: address bit A2
OSC: 14.31818 MHz Clock	59	60	+A1: address bit A1
GROUND	61	62	GROUND

FUNCTIONAL DESCRIPTION

CONNECTOR J5

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
HSYNC: Horizontal Sync.	1 14	GROUND
ID0: Display Identification	2 15	GROUND
VSNC: Vertical Sync.	3 16	GROUND
R(D1): Video Data	4 17	GROUND
G(D2): Video Data	5 18	GROUND
B(D0): Video Data	6 19	GROUND
HIGHLIGHT: Highlight	7 20	GROUND
Not used	8 21	GROUND
Not used	9 22	PCLK: Pixel Clock
ID1: Display Identification	10 23	BLANKING: Blanking
MODE0: Mode Select 0	11 24	+15V: +15 VDC power supply
MODE1: Mode Select 1	12 25	+15V: +15 VDC power supply
-DEGAUSS: Col. Dis. Degauss	13	

CONNECTOR J6

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
Not used	1 2	-LPCLR: Light Pen Clear Str.
Not used	3 4	Not used
Not used	5 6	Not used
- LPSET: Light Pen Set Str.	7 8	Not used
SPARESTB: Spare Strobe	9 10	Not used
Not used	11 12	Not used
Not used	13 14	LPSW: Light Pen Switch
LUTWSTB: Look-up Tab. Wr. St	15 16	Not used
LPSTB: Light Pen Strobe	17 18	Not used
MONID1: Monitor Identificat.	19 20	MODEWSTB2: Mode Wr. Strobe 2
Not used	21 22	Not used
-EXPAND1: Expans. Identif.	23 24	Not used
-EXPAND0: Expans. Identif.	25 26	Not used
Not used	27 28	Not used
EXPH: Expansion Highlight	29 30	Not used
EXPR: Expansion Red	31 32	Not used
EXPB: Expansion Green	33 34	Not used
EXPB: Expansion Blue	35 36	Not used
-VRAMREQ: Displ. DRAM Req.	37 38	Not used
MONID0: Monitor Identificat.	39 40	Not used
Not used	41 42	Not used
Not used	43 44	MODEWSTB1: Mode Wr. Strobe 1
Not used	45 46	-BLANKING: Blanking
PCLKIN: Pixel Clock In	47 48	Not used
Not used	49 50	Not used

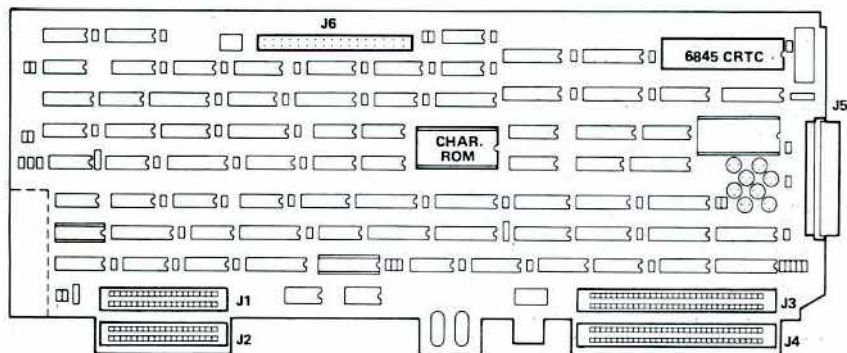


Fig. 1-10 Indigenous Display Controller Board

FUNCTIONAL DESCRIPTION

BUS EXPANSION BOARD

The bus expansion board, which plugs into the female connectors on the indigenous display controller board, has 7 expansion slots to allow optional boards to be connected to the system.

The tables below list the signals present on the board expansion connectors. For further information on their meaning, refer to the Theory of Operation and Hardware Architecture manuals.

CONNECTOR P1

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
GROUND	1 2	-I/OCHCK: I/O Channel Check
+RESET: Reset	3 4	+D7: data bit 7
+5V: +5 VDC power supply	5 6	+D6: data bit 6
+IRQ9: Interrupt Request 9	7 8	+D5: data bit 5
-5V: -5 VDC power supply	9 10	+D4: data bit 4
+DRQ2: DMA Request 2	11 12	+D3: data bit 3
-12V: -12 VDC power supply	13 14	+D2: data bit 2
-ZEROWS: Zero Wait States	15 16	+D1: data bit 1
+12V: +12 VDC power supply	17 18	+D0: data bit 0
GROUND	19 20	+I/OREADY: I/O Channel Ready
-SMEMW: Memory Write	21 22	+AEN: Address Enable
-SMEMR: Memory Read	23 24	+A19: address bit A19
-IOW: I/O Write Command	25 26	+A18: address bit A18
-IOR: I/O Read Command	27 28	+A17: address bit A17
-DACK3: DMA Acknowledge 3	29 30	+A16: address bit A16
+DRQ3: DMA Request 3	31 32	+A15: address bit A15
-DACK1: DMA Acknowledge 1	33 34	+A14: address bit A14
+DRQ1: DMA Request 1	35 36	+A13: address bit A13
-REFRESH: Refresh	37 38	+A12: address bit A12
+4MHZ: 4 MHz Clock	39 40	+A11: address bit A11
+IRQ7: Interrupt Request 7	41 42	+A10: address bit A10
+IRQ6: Interrupt Request 6	43 44	+A9: address bit A9
+IRQ5: Interrupt Request 5	45 46	+A8: address bit A8
+IRQ4: Interrupt Request 4	47 48	+A7: address bit A7
+IRQ3: Interrupt Request 3	49 50	+A6: address bit A6
-DACK2: DMA Acknowledge 2	51 52	+A5: address bit A5
+TC: Terminal Count	53 54	+A4: address bit A4
+BALE: Address Latch Enable	55 56	+A3: address bit A3
+5V: +5 VDC power supply	57 58	+A2: address bit A2
OSC: 14.31818 MHz Clock	59 60	+A1: address bit A1
GROUND	61 62	+A0: address bit A0

CONNECTORS P2 TO P7

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	-I/OCHCK: I/O Channel Check
+RESET: Reset	3	4	+D7: data bit 7
+5V: +5 VDC power supply	5	6	+D6: data bit 6
+IRQ9: Interrupt Request 9	7	8	+D5: data bit 5
-5V: -5 VDC power supply	9	10	+D4: data bit 4
+DRQ2: DMA Request 2	11	12	+D3: data bit 3
-12V: -12 VDC power supply	13	14	+D2: data bit 2
-ZEROWS: Zero Wait States	15	16	+D1: data bit 1
+12V: +12 VDC power supply	17	18	+D0: data bit 0
GROUND	19	20	+I/OREADY: I/O Channel Ready
-SMEMW: Memory Write	21	22	+AEN: Address Enable
-SMEMR: Memory Read	23	24	+A19: address bit A19
-IOW: I/O Write Command	25	26	+A18: address bit A18
-IOR: I/O Read Command	27	28	+A17: address bit A17
-DACK3: DMA Acknowledge 3	29	30	+A16: address bit A16
+DRQ3: DMA Request 3	31	32	+A15: address bit A15
-DACK1: DMA Acknowledge 1	33	34	+A14: address bit A14
+DRQ1: DMA Request 1	35	36	+A13: address bit A13
-REFRESH: Refresh	37	38	+A12: address bit A12
SYSCLK: 8 MHz Clock	39	40	+A11: address bit A11
+IRQ7: Interrupt Request 7	41	42	+A10: address bit A10
+IRQ6: Interrupt Request 6	43	44	+A9: address bit A9
+IRQ5: Interrupt Request 5	45	46	+A8: address bit A8
+IRQ4: Interrupt Request 4	47	48	+A7: address bit A7
+IRQ3: Interrupt Request 3	49	50	+A6: address bit A6
-DACK2: DMA Acknowledge 2	51	52	+A5: address bit A5
+TC: Terminal Count	53	54	+A4: address bit A4
+BALE: Address Latch Enable	55	56	+A3: address bit A3
+5V: +5 VDC power supply	57	58	+A2: address bit A2
OSC: 14.31818 MHz Clock	59	60	+A1: address bit A1
GROUND	61	62	+A0: address bit A0

FUNCTIONAL DESCRIPTION

CONNECTORS P8 AND P9

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
GROUND	1 2	GROUND
+A0: address bit A0	3 4	+D15: data bit 15
-SBHE: Bus High Enable	5 6	+D14: data bit 14
-SMEMW: Memory Write	7 8	+D13: data bit 13
-SMEMR: Memory Read	9 10	+D12: data bit 12
-IOW: I/O Write	11 12	+D11: data bit 11
-IOR: I/O Read	13 14	+D10: data bit 10
GROUND	15 16	+D9: data bit 9
GROUND	17 18	+D8: data bit 8
+ORDY: Olivetti Ready	19 20	Not used
GROUND	21 22	Not used
Not used	23 24	Not used
Not used	25 26	-16BCH: 16-bit Channel Flag
Not used	27 28	Not used
Not used	29 30	Not used
Not used	31 32	GROUND
+5V: +5 VDC power supply	33 34	+5V: +5 VDC power supply
GROUND	35 36	GROUND
Not used	37 38	+CLK24: 24 MHz Clock

CONNECTORS P10 TO P14

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
-MEMCS16: 16-bit Mem. Cycle	1 2	+SBHE: Bus High Enable
-IOCS16: 16-bit I/O Cycle	3 4	+LADR23: address bit A23
+IRQ10: Interrupt Request 10	5 6	+LADR22: address bit A22
+IRQ11: Interrupt Request 11	7 8	+LADR21: address bit A21
+IRQ12: Interrupt Request 12	9 10	+LADR20: address bit A20
+IRQ15: Interrupt Request 15	11 12	+LADR19: address bit A19
+IRQ14: Interrupt Request 14	13 14	+LADR18: address bit A18
-DACK0: DMA Acknowledge 0	15 16	+LADR17: address bit A17
+DRQ0: DMA Request 0	17 18	-MEMR: Memory Read Command
-DACK5: DMA Acknowledge 5	19 20	-MEMW: Memory Write Command
+DRQ5: DMA Request 5	21 22	+D8: data bit D8
-DACK6: DMA Acknowledge 6	23 24	+D9: data bit D9
+DRQ6: DMA Request 6	25 26	+D10: data bit D10
-DACK7: DMA Acknowledge 7	27 28	+D11: data bit D11
+DRQ7: DMA Request 7	29 30	+D12: data bit D12
+5V: +5 VDC power supply	31 32	+D13: data bit D13
-MASTER: Master	33 34	+D14: data bit D14
GROUND	35 36	+D15: data bit D15

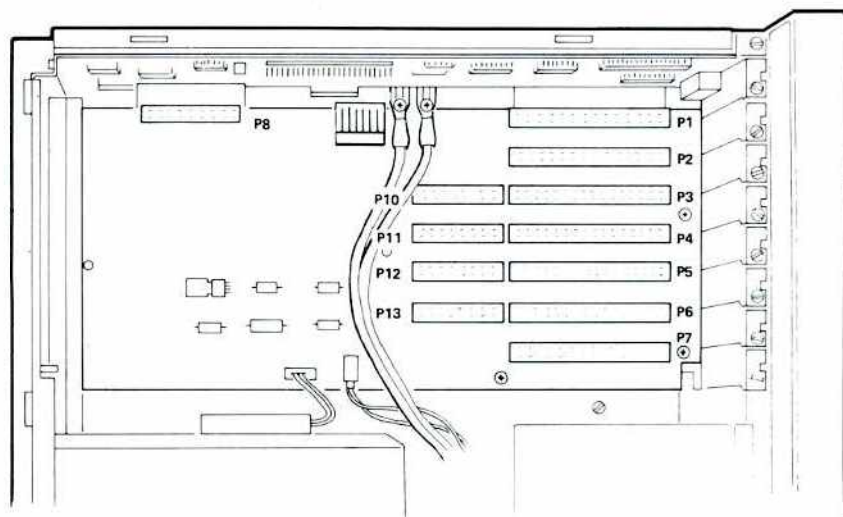


Fig. 1-11 Bus Expansion Board

FUNCTIONAL DESCRIPTION

MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER

The mini-floppy disk and tape drive controller contains all the logic and control circuitry needed to control and record data onto, or read data from mini-floppy disks or from a tape drive. The controller board is physically located on the bus expansion board and its main component is the 765 mini-floppy disk controller.

The table below lists the signals present on the board connector. For further information on their meaning, refer to the Theory of Operation and Hardware Architecture manuals.

CONNECTOR J2

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
GROUND	1	2 -RDCRT: Reduced Write Current
GROUND	3	4 Not used
GROUND	5	6 -SELE3: Drive Select 3
GROUND	7	8 -INDX: Index
GROUND	9	10 -MOT01: Motor Enable
GROUND	11	12 -SELE2: Drive Select 2
GROUND	13	14 -SELE1: Drive Select 1
GROUND	15	16 -MOT02: Motor Enable
GROUND	17	18 -DIR: Direction
GROUND	19	20 -STEP: Step
GROUND	21	22 -WRTDA: Write Data
GROUND	23	24 -WRTEN: Write Enable
GROUND	25	26 -TRK00: Track 00
GROUND	27	28 -WRTprt: Write Protect
GROUND	29	30 -RDATA: Read Data
GROUND	31	32 -S1SELE: Side 1 Select
GROUND	33	34 DKCHG: Diskette Change

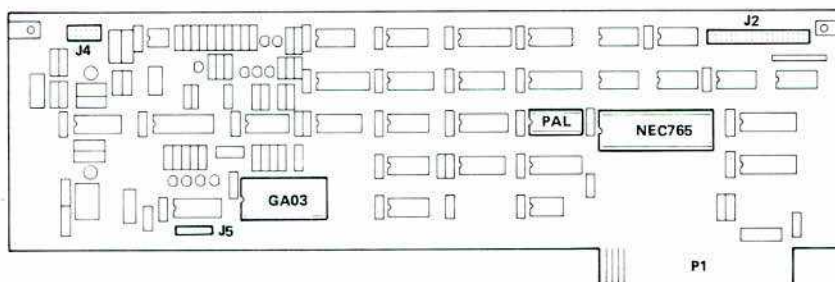


Fig. 1-12 Mini-floppy Disk Controller Board

HARD DISK CONTROLLER

The hard disk controller interfaces the PC to the hard disk unit. It ensures proper operation of the hard disk unit and error handling. It receives commands from the PC, decodes them, and then initializes and monitors the hardware as the command is executed and returns the status back to the PC. The hard disk controller board is physically located on the bus expansion board in the basic module.

The tables below list the signals present on the board connectors. For further information on their meaning, refer to the Theory of Operation and Hardware Architecture manuals.

CONNECTOR J1

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	-HS3/-RWC: Head Sel.3/Red.Cur.
GROUND	3	4	-HS2: Head Select 2
GROUND	5	6	-WG: Write Gate
GROUND	7	8	-SC: Seek Complete
GROUND	9	10	-TK000: Track 000
GROUND	11	12	-WF: Write Fault
GROUND	13	14	-HS0: Head Select 0
GROUND	15	16	Not used
GROUND	17	18	-HS1: Head Select 1
GROUND	19	20	-INDEX: Index Pulse
GROUND	21	22	-DRDY: Drive Ready
GROUND	23	24	-STEP: Step Pulse
GROUND	25	26	-DS0: Drive Select 0
GROUND	27	28	-DS1: Drive Select 1
GROUND	29	30	Not used
GROUND	31	32	Not used
GROUND	33	34	-DIRIN: Direction In

FUNCTIONAL DESCRIPTION

CONNECTORS J2 AND J3

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
Not used	1	2	GROUND
Not used	3	4	GROUND
Not used	5	6	GROUND
Not used	7	8	GROUND
Not used	9	10	GROUND
GROUND	11	12	GROUND
+MFM WRITE: data written	13	14	-MFM WRITE: data written
GROUND	15	16	GROUND
+MFM READ: data read	17	18	-MFM READ: data read
GROUND	19	20	GROUND

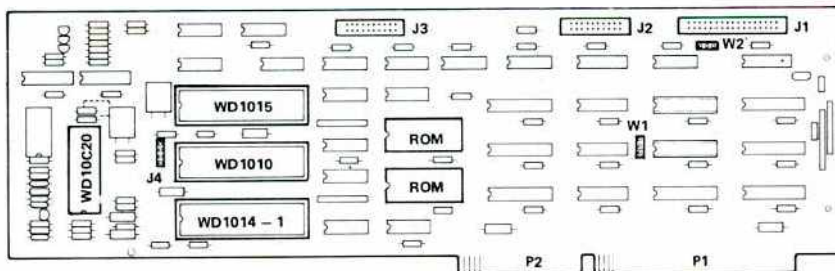


Fig. 1-13 Hard Disk Controller Board

HARD DISK UNIT

Two different models of hard disk units can be used on the system:

- 20 MB slim hard disk unit
- 40 MB full hard disk unit

The table below shows the main technical characteristics of the hard disk unit.

20 MB UNIT	40 MB UNIT
- Input voltage: . +12 VDC $\pm 5\%$. + 5 VDC $\pm 5\%$ - Current absorbed: 3 A (max) - Power: 18 W - Dimensions: .Depth : 208 mm (8.18") .Width : 146 mm (5.76") .Height : 41.5 mm (1.62")	- Power dissipated at rest: 26 W - Power dissipated during positioning: 32 W - Dimensions: .Depth : 203 mm (8") .Width : 146 mm (5.76") .Height : 82.6 mm (3.25") - Weight: 2.7 kg

FUNCTIONAL DESCRIPTION

MINI-FLOPPY DISK DRIVES

The PC uses two different types of 5.25 inch mini-floppy disk drives:

- 360 KB slim mini-floppy disk drive
- 1.2 MB slim mini-floppy disk drive

At least one mini-floppy disk drive must always be present on a PC system.

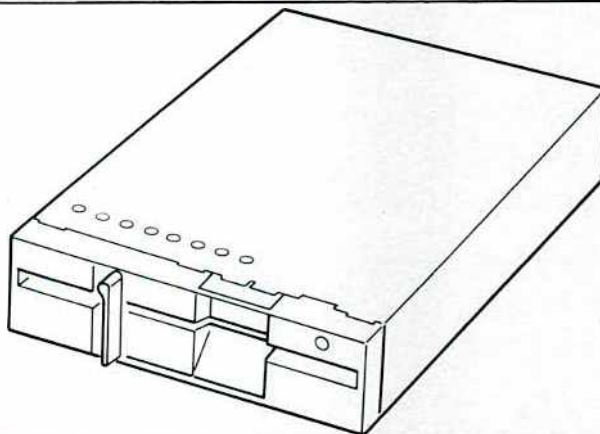


Fig. 1-14 Slim Mini-Floppy Disk drive

The table below shows the main technical characteristics of the mini-floppy disk drives.

1.2 MB DRIVE	360 KB DRIVE
Power supply: +12 VDC $\pm 10\%$ 0.27 A +5 VDC $\pm 5\%$ 0.47 A	Power supply: +12 VDC $\pm 10\%$ 0.94 A (max) +5 VDC $\pm 5\%$ 0.6 A (max)
Power dissipated: at rest : 2.9 W during operation: 5.6 W	Power dissipated: at rest : 1.95 W during operation: 5 W
Dimensions: height : 41.5 mm width : 146.1 mm depth : 203.2 mm	Dimensions: height : 41.5 mm width : 146.1 mm depth : 203.2 mm
Weight: 1.5 kg	Weight: 1.3 kg

POWER SUPPLY

The system power supply is housed in a metal box behind the drives in the basic module.

It supplies all the direct currents needed by the system circuits.

The main technical characteristics of the power supply are listed below:

- Monophase, alternating input voltage between 100 to 120 Volts or 200 to 240 Volts (jumper selectable)
- Permanent driftings of nominal input voltages within $\pm 10\%$
- Nominal operating frequency of 50 Hz or 60 Hz
- Maximum allowed power-on current of 20 A
- Maximum line impedance of 0.5 Ohms
- Acoustic sound level less than 33 dBA.

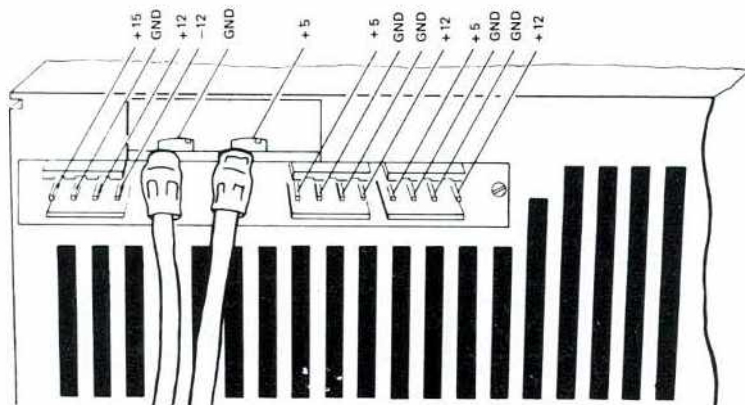


Fig. 1-15 Power Supply Output Connectors

FUNCTIONAL DESCRIPTION

MONOCHROME DISPLAY

The monochrome display is attached to the basic module by means of a cable which serves as a signal and power cable. The display may either sit on top of the basic module or on a nearby tabletop or desk. Both brightness and contrast adjustment controls are located at the front of the display and so are easily accessible to the operator.

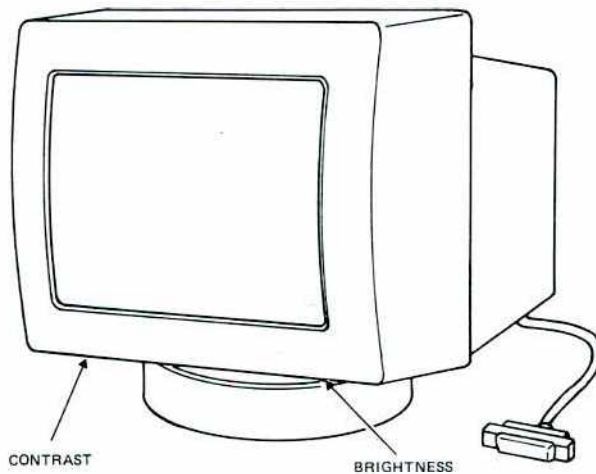


Fig. 1-16 Monochrome Display

Characteristics:

Size:	80 x 25 (also possible: 64 x 16)
Attributes:	blinking, reverse, highlight, hide, underline
Resolution (graph. mode):	640 x 400, 640 x 200 or 320 x 200 pixels
Pixel rate:	24 MHz or 19.6 MHz or 12 MHz
Vertical Drive:	Screen refreshed at 60 Hz, 400 lines of vertical resolution and 640 lines horizontal
Horizontal Drive:	Positive level, TTL compatibility at a frequency of 25.6 KHz
Power supply:	15 VDC - 1.25 A
Power dissipated:	18.75 W

KEYBOARD

An 86-key Olivetti keyboard can be connected to the PC, and an interface for a mouse can be inserted on this keyboard.

The keyboard is connected to a connector at the rear of the basic module, via a cable approximately 2 metres long.

The keyboard can be divided into three parts:

- A keypad on the left with 10 function keys, the use of which is defined by the user via software
- A central part with a standard typewriter layout
- A keypad on the right with numeric and control keys.

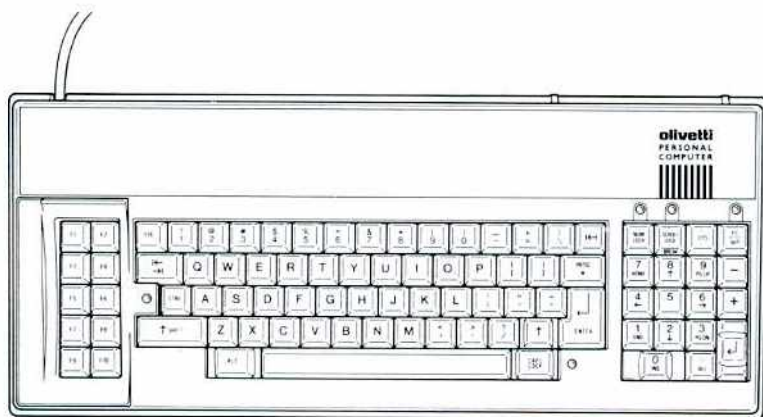


Fig. 1-17 PC Keyboard

FUNCTIONAL DESCRIPTION

The PC can support the following national keyboards:

Italian	Swedish/Finnish
USA ASCII	Latin/Greek
French	Latin/Hebrew
British	Danish
German	Norwegian
Spanish (1)	Swiss
Spanish (2)	Portuguese

The table below shows the main characteristics of the keyboard.

Dimensions	Length : 466 mm Height : 30 mm Depth : 195 mm
Weight	2.0 Kg.
Connector	"Cannon" 9-pin D-type
Keyboard module	4 or 8 degrees of tilting 86 low profile keys Automatic repeat function with programmable speed Intel 8049 microprocessor 5 LEDs Generation of scansion code for key pressing and release
Temperature	From +10 to +40 degrees C From 15 to 85% relative humidity (non-condensing)
Power supply	+12 VDC
Power	1.56 W

PRINTERS AND OTHER PERIPHERALS

The peripherals and printers that can be connected to the PC are listed in the table below. Some printers, as can be seen from the table, are connected with either a serial or parallel interface.

TYPE	SERIAL INT.	PARALLEL INT.
PR 15 B	X	X
PR 17 B	X	X
PR 19 B	X	X
PR 320 B	X	X
PR 340 B	X	X
PR 38 B	X	X
MOUSE	X	

X = Available

FUNCTIONAL DESCRIPTION

OPTIONS

COLOUR DISPLAY

The colour display is attached to the PC by means of two cables - a signal cable and a power cable. The display has a 12 inch (305 mm) CRT. The display may sit either on top of the basic module or on a nearby table top or desk.

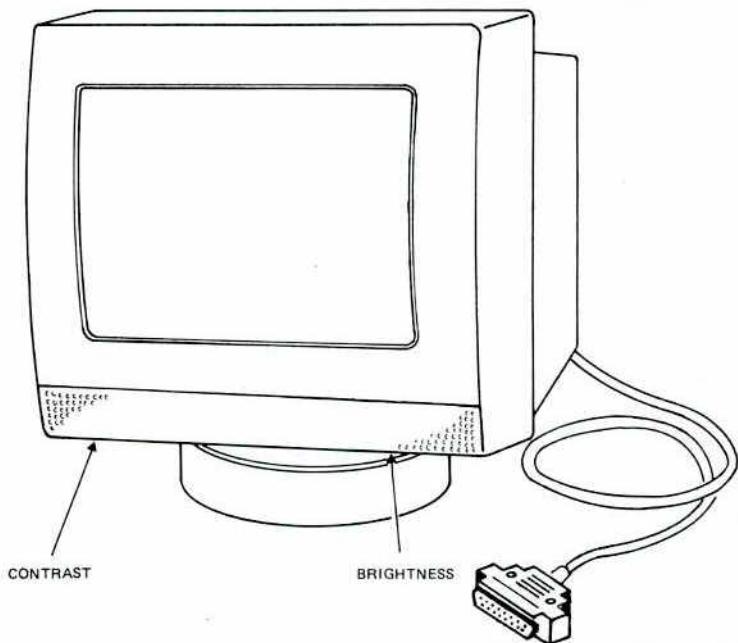


Fig. 1-18 Colour Display

Characteristics

Displays up to 16 colours

8 x 16 character matrix

Video Signal:

Red, green and blue video signals and intensity are all independent

Vertical Drive:

Screen refreshed at 60 Hz with 400 vertical lines of resolution

Horizontal Drive:

Positive, TTL compatibility at a frequency of 15.75 KHz

Power supply: 100 - 240 VAC; 50 - 60 Hz

Absorption: 98 W max.

OPTIONAL BOARDS

The optional boards supported by the PC can be divided into three categories:

1. Olivetti expansion boards
2. 8-bit industry standard PC compatible boards
3. 16-bit industry standard PC compatible boards

ENHANCED GRAPHICS COLOUR BOARD (EGC)

The EGC board is an Olivetti expansion board which is placed in the first expansion slot on the bus adapter, next to the indigenous board. It is connected to the indigenous board by means of a flat cable, and supports both monochrome and colour displays. Its main features are:

- Up to 3 additional 640 x 400 bit planes
- Software controlled colour look up table
- High resolution (16 x 16) characters
- Hardware smooth scroll
- Ability to display characters and graphics simultaneously

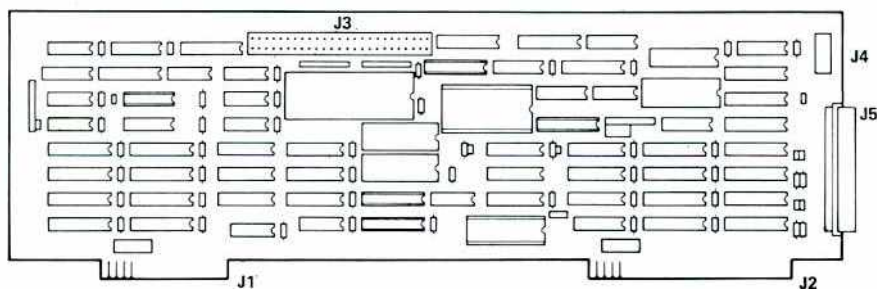


Fig. 1-19 Enhanced Graphics Colour Board

FUNCTIONAL DESCRIPTION

The tables below list the signals present on the board connectors. For further information on their meaning, refer to the board manual.

CONNECTOR J1

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	GROUND
+A0: address bit A0	3	4	+D15: data bit 15
-SBHE: Bus High Enable	5	6	+D14: data bit 14
Not used	7	8	+D13: data bit 13
-SMEMR: Memory Read	9	10	+D12: data bit 12
-IOW: I/O Write	11	12	+D11: data bit 11
-IOR: I/O Read	13	14	+D10: data bit 10
Not used	15	16	+D9: data bit 9
Not used	17	18	+D8: data bit 8
+ORDY: Olivetti Ready	19	20	Not used
Not used	21	22	Not used
Not used	23	24	Not used
Not used	25	26	-16BCH: 16-bit Channel Flag
Not used	27	28	Not used
Not used	29	30	Not used
Not used	31	32	Not used
+5V: +5 VDC power supply	33	34	+5V: +5 VDC power supply
GROUND	35	36	GROUND
Not used	37	38	CLK19: Z8000 Clock

CONNECTOR J2

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	Not used
+RESET: Reset	3	4	+D7: data bit 7
+5V: +5 VDC power supply	5	6	+D6: data bit 6
Not used	7	8	+D5: data bit 5
Not used	9	10	+D4: data bit 4
Not used	11	12	+D3: data bit 3
Not used	13	14	+D2: data bit 2
Not used	15	16	+D1: data bit 1
Not used	17	18	+D0: data bit 0
GROUND	19	20	Not used
Not used	21	22	+AEN: Address Enable
Not used	23	24	Not used
Not used	25	26	Not used
Not used	27	28	Not used
Not used	29	30	+A16: address bit A16
Not used	31	32	+A15: address bit A15
Not used	33	34	+A14: address bit A14
Not used	35	36	+A13: address bit A13
-DACK0: DMA Acknowledge 0	37	38	+A12: address bit A12
+4MHZ: 4 MHz Clock	39	40	+A11: address bit A11
Not used	41	42	+A10: address bit A10
Not used	43	44	+A9: address bit A9
Not used	45	46	+A8: address bit A8
Not used	47	48	+A7: address bit A7
Not used	49	50	+A6: address bit A6
Not used	51	52	+A5: address bit A5
Not used	53	54	+A4: address bit A4
Not used	55	56	+A3: address bit A3
+5V: +5 VDC power supply	57	58	+A2: address bit A2
Not used	59	60	+A1: address bit A1
GROUND	61	62	Not used

FUNCTIONAL DESCRIPTION

CONNECTOR J3

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
Not used	1 2	-LPCLR: Light Pen Clear Str.
Not used	3 4	Not used
Not used	5 6	Not used
-LPSET: Light Pen Set Str.	7 8	Not used
SPARESTB: Spare Strobe	9 10	Not used
Not used	11 12	Not used
Not used	13 14	Not used
LUTWSTB: Look-up Tab. Wr. St.	15 16	Not used
Not used	17 18	Not used
MONID1: Monitor Identificat.	19 20	MODEWSTB2: Mode Wr. Strobe 2
Not used	21 22	Not used
-EXPAND1: Expans. Identif.	23 24	Not used
-EXPAND0: Expans. Identif.	25 26	Not used
Not used	27 28	Not used
EXPH: Expansion Highlight	29 30	Not used
EXPR: Expansion Red	31 32	Not used
EXPG: Expansion Green	33 34	Not used
EXPB: Expansion Blue	35 36	Not used
-VRAMREQ: Displ. DRAM Req.	37 38	Not used
MONID0: Monitor Identificat.	39 40	Not used
Not used	41 42	GROUND
Not used	43 44	MODEWSTB1: Mode Wr. Strobe 1
Not used	45 46	Not used
PCLKIN: Pixel Clock In	47 48	Not used
Not used	49 50	Not used

CONNECTOR J5

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
HSYNC: Horizontal Sync.	1 14	GROUND
ID0: Display Identification	2 15	GROUND
VSNC: Vertical Sync.	3 16	GROUND
R(D1): Video Data	4 17	GROUND
G(D2): Video Data	5 18	GROUND
B(D0): Video Data	6 19	GROUND
HIGHLIGHT: Highlight	7 20	GROUND
Not used	8 21	GROUND
Not used	9 22	PCLK: Pixel Clock
ID1: Display Identification	10 23	BLANKING: Blanking
MODE0: Mode Select 0	11 24	+15V: +15 VDC power supply
MODE1: Mode Select 1	12 25	+15V: +15 VDC power supply
-DEGAUSS: Col. Dis. Degauss	13	

MEMORY EXPANSION BOARD

The memory expansion board allows the system RAM to be expanded by adding up to 2 MB of memory for each board inserted.

The board is made up of 4 memory banks of 512 KB each. The first of these is always full of memory chips, while the others can be filled later to bring the memory to a maximum capacity of 2 MB. The unused banks can be disabled by means of the relevant switches.

As well as disabling unused banks, some switches on the board also permit the board's operating mode ("direct" mode or "split" mode) and the board's starting address to be established.

The memory expansion board is a 16-bit industry standard compatible board and can be inserted in any of the three relative slots on the bus expansion board which is free.

The tables overleaf list the signals present on the board connectors. For further information on their meaning, refer to the board manual.

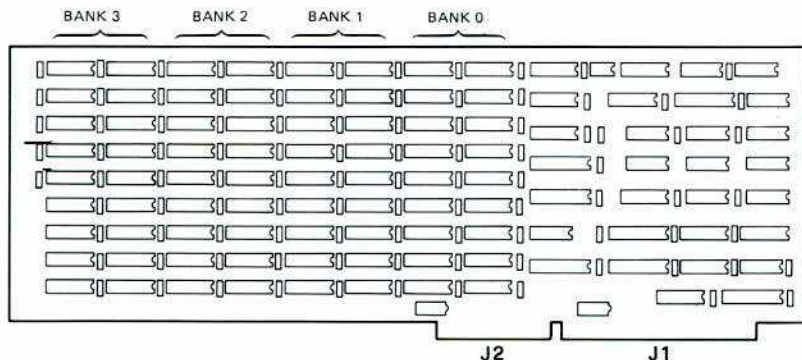


Fig. 1-20 Memory Expansion Board

FUNCTIONAL DESCRIPTION

CONNECTOR J1

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
GROUND	1	2	-I/OCHCK: I/O Channel Check
+RESET: Reset	3	4	+D7: data bit 7
+5V: +5 VDC power supply	5	6	+D6: data bit 6
Not used	7	8	+D5: data bit 5
Not used	9	10	+D4: data bit 4
Not used	11	12	+D3: data bit 3
Not used	13	14	+D2: data bit 2
Not used	15	16	+D1: data bit 1
Not used	17	18	+D0: data bit 0
GROUND	19	20	Not used
-SMEMW: Memory Write	21	22	Not used
-SMEMR: Memory Read	23	24	Not used
Not used	25	26	+A18: address bit A18
Not used	27	28	+A17: address bit A17
Not used	29	30	+A16: address bit A16
Not used	31	32	+A15: address bit A15
Not used	33	34	+A14: address bit A14
Not used	35	36	+A13: address bit A13
-REFRESH: Refresh	37	38	+A12: address bit A12
SYSCLK: 8 MHz Clock	39	40	+A11: address bit A11
Not used	41	42	+A10: address bit A10
Not used	43	44	+A9: address bit A9
Not used	45	46	+A8: address bit A8
Not used	47	48	+A7: address bit A7
Not used	49	50	+A6: address bit A6
Not used	51	52	+A5: address bit A5
Not used	53	54	+A4: address bit A4
+BALE: Address Latch Enable	55	56	+A3: address bit A3
+5V: +5 VDC power supply	57	58	+A2: address bit A2
Not used	59	60	+A1: address bit A1
GROUND	61	62	+A0: address bit A0

CONNECTOR J2

SIGNAL/DESCRIPTION	PIN		SIGNAL/DESCRIPTION
-MEMCS16: 16-bit Mem. Cycle	1	2	+SBHE: Bus High Enable
Not used	3	4	+LADR23: address bit A23
Not used	5	6	+LADR22: address bit A22
Not used	7	8	+LADR21: address bit A21
Not used	9	10	+LADR20: address bit A20
Not used	11	12	+LADR19: address bit A19
Not used	13	14	+LADR18: address bit A18
Not used	15	16	+LADR17: address bit A17
Not used	17	18	-MEMR: Memory Read Command
Not used	19	20	-MEMW: Memory Write Command
Not used	21	22	+D8: data bit D8
Not used	23	24	+D9: data bit D9
Not used	25	26	+D10: data bit D10
Not used	27	28	+D11: data bit D11
Not used	29	30	+D12: data bit D12
+5V: +5 VDC power supply	31	32	+D13: data bit D13
Not used	33	34	+D14: data bit D14
GROUND	35	36	+D15: data bit D15

FUNCTIONAL DESCRIPTION

MULTIPOINT BOARD

The multiport board has been designed to provide the system, in a XENIX operating environment, with four additional asynchronous serial ports. If a cable with four 25-pin connectors is connected to the board, four serial devices can be connected to the system.

The multiport board is an 8-bit industry standard compatible board and can be inserted in any of the expansion slots of the bus expansion board.

The tables overleaf list the signals present on the board and cable connectors. For further information on their meaning, refer to the board manual.

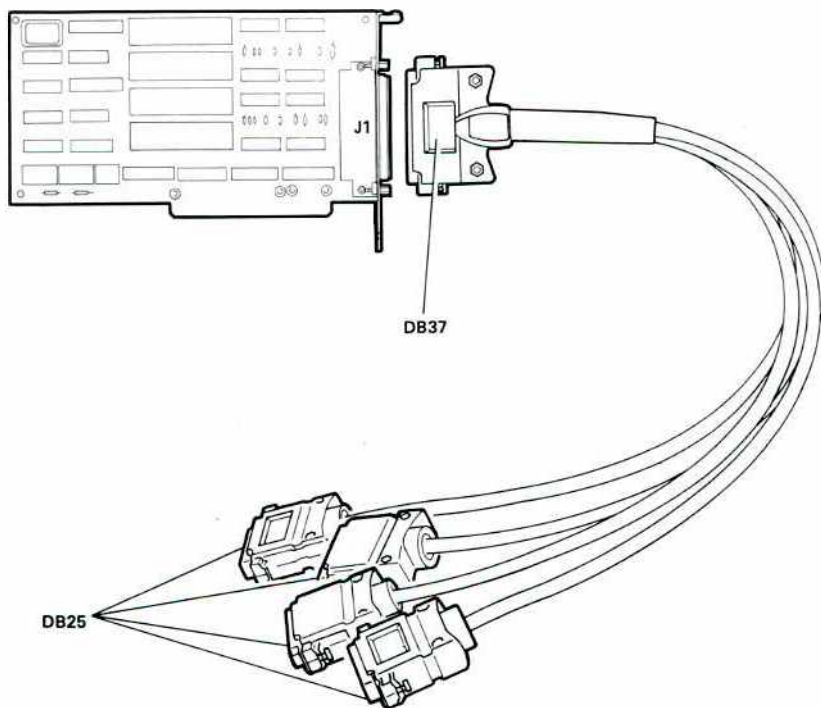


Fig. 1-21 Multiport Board and Connection Cable

CONNECTORS J1 AND DB37

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
Not used	1 20	Ring indicator Channel 3
Data Carrier Detect Channel 3	2 21	Data terminal ready Channel 3
Signal ground Channel 3	3 22	Data set ready Channel 3
Clear to send Channel 3	4 23	Request to send Channel 3
Receive data Channel 3	5 24	Transmit data Channel 3
Ring indicator Channel 4	6 25	Data carrier detect Channel 4
Data terminal ready Channel 4	7 26	Signal ground Channel 4
Data set ready Channel 4	8 27	Clear to send Channel 4
Request to send Channel 4	9 28	Receive data Channel 4
Transmit data Channel 4	10 29	Ring indicator Channel 2
Data carrier detect Channel 2	11 30	Data terminal ready Channel 2
Signal ground Channel 2	12 31	Data set ready Channel 2
Clear to send Channel 2	13 32	Request to send Channel 2
Receive data Channel 2	14 33	Transmit data Channel 2
Ring indicator Channel 1	15 34	Data carrier detect Channel 1
Data terminal ready Channel 1	16 35	Signal ground Channel 1
Data set ready Channel 1	17 36	Clear to send Channel 1
Request to send Channel 1	18 37	Receive data Channel 1
Transmit data Channel 1	19	

CONNECTORS DB25

SIGNAL/DESCRIPTION	PIN	SIGNAL/DESCRIPTION
Chassis ground	1 14	Not used
Transmit data	2 15	Not used
Receive data	3 16	Not used
Request to send	4 17	Not used
Clear to send	5 18	Not used
Data set ready	6 19	Not used
Signal ground	7 20	Data terminal ready
Data carrier detect	8 21	Not used
Not used	9 22	Ring indicator
Not used	10 23	Not used
Not used	11 24	Not used
Not used	12 25	Not used
Not used	13	

FUNCTIONAL DESCRIPTION

The table below lists the connections between connector DB37 and the four connectors DB25.

PIN OF DB37	CHANNEL 1	PIN OF CONNECTORS DB25		CHANNEL 4
		CHANNEL 2	CHANNEL 3	
1	--	--	--	--
2	--	--	8	--
3	--	--	7	--
4	--	--	5	--
5	--	--	3	--
6	--	--	--	22
7	--	--	--	20
8	--	--	--	6
9	--	--	--	4
10	--	--	--	2
11	--	8	--	--
12	--	7	--	--
13	--	5	--	--
14	--	3	--	--
15	22	--	--	--
16	20	--	--	--
17	6	--	--	--
18	4	--	--	--
19	2	--	--	--
20	--	--	22	--
21	--	--	20	--
22	--	--	6	--
23	--	--	4	--
24	--	--	2	--
25	--	--	--	8
26	--	--	--	7
27	--	--	--	5
28	--	--	--	3
29	--	22	--	--
30	--	20	--	--
31	--	6	--	--
32	--	4	--	--
33	--	2	--	--
34	8	--	--	--
35	7	--	--	--
36	5	--	--	--
37	3	--	--	--

LIST OF CONFIGURATIONS

The table below shows the basic configurations available and the main expansion options; for each item the table gives the relative code number, the random code needed to order it and a brief description.

DESCRIPTION	CODE	RANDOM CODE	NOTES
Basic module with: - 512 KB RAM - One 1.2 MB MFD - One 20 MB HDU	CPU 2801	50081 Y	Expandable with: - 512 KB of RAM - second 360 KB or 1.2 MB MFD, or 20 MB STC
Basic module with: - 512 KB RAM - One 1.2 MB MFD - One 20 MB HDU - One 20 MB STC	CPU 2806	50286 Y	Expandable with: - 512 KB of RAM
Basic module with: - 512 KB RAM - One 1.2 MB MFD - One 40 MB HDU	CPU 2813	50888 T	Expandable with: - 512 KB of RAM - second 360 KB or 1.2 MB MFD, or 20 MB STC
Basic module with: - 512 KB RAM - One 1.2 MB MFD - One 40 MB HDU - One 20 MB STC	CPU 2807	50287 S	Expandable with: - 512 KB of RAM
Basic module with: - 1 MB RAM - One 1.2 MB MFD - One 70 MB HDU	CPU 2814	50878 E	Must be used with STU 2860
Self-powered expansion box with one 60 MB STC	STU 2860	50879 Y	Expandable with: - One MFD
Self-powered expansion box with one 360 KB MFD	MFD 2837	50604 Z	Expandable with: - One 20 MB STC
Memory expansion kit with 512 KB of RAM	EXM 2853	50153 L	To expand the memory of the system modules and the memory expansion board

FUNCTIONAL DESCRIPTION

DESCRIPTION	CODE	RANDOM CODE	NOTES
Memory expansion board with 512 KB of RAM	MEM 2852	50152 J	Expandable up to 2 MB with the insertion of 1, 2 or 3 memory expansion kits
360 KB MFD	MFD 2836	50136 J	To expand the basic module (CPU 2801) and the expansion box (STU 2860)
1.2 MB MFD	MFD 2811	50111 P	To expand the basic module (CPU 2801) and the expansion box (STU 2860)
20 MB STC	STC 2821	50282 Q	To expand the basic module (CPU 2801)
RS 232 multiport board	SIC 2832	50132 Z	----
80287 coprocessor	MAC 2887	50187 Z	----
Green monochrome display	DSM 2812 V	50112 R	----
Black/white monochrome display	DSM 2812 B	50113 K	----
Amber monochrome display	DSM 2812 A	50114 V	----
Colour display	DSM 2812 C	50115 X	----
86 key keyboard	ANK 2886	50186 X	----
Mouse adapter kit	MIK 2825	50377 E	To be used with mouse GRD 2469

Notes:

- MFD = mini-floppy disk drive
- STC = tape drive
- HDU = hard disk unit.

2. INSTALLATION PROCEDURES

CONTENTS

PAGE

2. INSTALLATION PROCEDURES

2-1	<u>INTRODUCTION</u>
2-1	<u>SITE PREPARATION</u>
2-2	<u>INPUT AC ELECTRICAL CHARACTERISTICS</u>
2-2	<u>OUTPUT DC ELECTRICAL CHARACTERISTICS</u>
2-3	<u>ENVIRONMENTAL REQUIREMENTS</u>
2-3	<u>PHYSICAL CHARACTERISTICS</u>
2-3	<u>DIMENSIONS</u>
2-3	<u>POWER ABSORBED BY THE SYSTEM</u>
2-4	<u>INSTALLATION</u>
2-4	UNPACKING THE SYSTEM
2-5	INSTALLING THE BASIC MODULE AND MONOCHROME DISPLAY
2-9	<u>SETTINGS</u>
2-11	INSTALLING A PRINTER WITH PARALLEL INTERFACE
2-12	INSTALLING A PRINTER WITH SERIAL INTERFACE
2-14	<u>SYSTEM SWITCH AND JUMPER SETTINGS</u>
2-14	MOTHERBOARD JUMPERS
2-19	DISPLAY CONTROLLER
2-20	MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER BOARD
2-21	HARD DISK CONTROLLER BOARD
2-22	5.25 INCH MINI-FLOPPY DISK DRIVE
2-30	HARD DISK UNIT
2-32	TAPE DRIVE

INSTALLATION PROCEDURES

INTRODUCTION

This chapter deals with the site preparation and the requirements for the environment in which the system is to be installed. It also contains the procedures to be followed for the correct installation of the system and shows the various configurations available.

SITE PREPARATION

The system operates reliably in a typical office environment, but the following points should be taken into consideration when choosing a suitable site.

1. THE PC MUST BE PLUGGED INTO AN EARTHED POWER SUPPLY.
Unearthed machines do not work properly and can be a safety hazard. If the PC is not plugged into an earthed circuit the following problems may be experienced:
 - Improper program operation
 - Unreadable disks
 - Expensive machine damage.
2. The PC should, when possible, be isolated from sources of electrical noise, and from devices that may cause excessive voltage level variations. Some common sources of electrical noise are:
 - Air conditioners and powerful fans
 - Transformers and alternators
 - Large brush type or induction motors (such as those used in elevators)
 - Radio and TV transmitters, signal generators and high frequency security devices.

Note: Some of the normal small office machines (typewriters, small copiers, calculators, etc.) are allowed on the same line, provided they do not cause excessive interference on the line.
3. The PC should be placed in a relatively dust-free place. Dust, dirt and smoke can cause excess wear on moving surfaces, short and open circuits (especially in the presence of high humidity) and read/write errors on the disk.
4. The PC should be placed away from heat and direct sunlight. Unusually high temperatures and low humidity can cause static problems.
5. THE PC IS COOLED BY A FAN AT THE REAR. THIS AREA MUST BE KEPT CLEAR OF PAPERS OR OTHER MATERIALS THAT WOULD OBSTRUCT AIR FLOW.

INPUT AC ELECTRICAL CHARACTERISTICS

The PC input electrical characteristics are as follows:

1. Monophase, alternating voltage with the following nominal voltages: 100 to 120 Volts or 200 to 240 Volts. The voltage ranges can be selected by a jumper in the power supply unit, and the fuse must be changed (from 250 V - 5 A for voltages of 100 to 120 Volts and from 250 V - 3.2 A for voltages of 200 to 240 Volts).
2. Permanent driftings of input voltage: $\pm 10\%$. Consequently the two ranges of operation are: 90 to 132 Volts; 180 to 264 Volts.
3. Nominal frequency : 50 Hz or 60 Hz in the same model without any variation.
4. Frequency driftings $\pm 5\%$

OUTPUT DC ELECTRICAL CHARACTERISTICS

VOLTAGE	TOLERANCE	DIRECT CURRENT MIN/MAX	MAX RESIDUAL RIPPLE
+ 5 V	$\pm 5\%$	8/24 Amperes	50 mVp-p
+ 12 V	$\pm 5\%$	1/5.4 Amperes	100 mVp-p
+ 15 V	$\pm 10\%$	0.2/2.6 Amperes	250 mVp-p
- 12 V	$\pm 5\%$	0.05/0.6 Amperes	100 mVp-p

Note: the peak current of the +12 V can reach 6.7 Amperes.

The maximum power output is 230 W.

INSTALLATION PROCEDURES

ENVIRONMENTAL REQUIREMENTS

Operating environment:

- Temperature: 10 to 32.2 degrees C (50 to 90 F)
- Relative humidity: 20% to 80%

Non-operating environment

- Temperature: -40 to +60 degrees C (-40 to +140 F)
- Relative humidity: 5% to 95%

PHYSICAL CHARACTERISTICS

WEIGHT:

- Basic module with floppy disk drive and HDU: 16 Kg (35.2 lbs)
- Display: 9 Kg (19.8 lbs)

DIMENSIONS

- Basic module: Width: 38 cm (14.96")
Height: 19 cm (7.48")
Depth: 42 cm (16.53")
- Display: Width: 33.4 cm (13.36")
Height: 26 cm (10.4")
Depth: 31 cm (12.4")

POWER ABSORBED BY THE SYSTEM

The power absorbed by a system with a standard configuration (512 KB of RAM, one 1.2 MB mini-floppy disk drive, one 360 KB mini-floppy disk drive, one 20 MB hard disk unit, a keyboard and monochrome display) is 142 W.

INSTALLATION

UNPACKING THE SYSTEM

The main components of the system are the basic module, the display and the keyboard.

These components are packed in polystyrene shells and then in shipping cartons. The shells are to protect the modules from damage during transportation. To unpack the PC, follow the procedure set out below:

1. Open the shipping cartons and remove the top part of the shell.
-

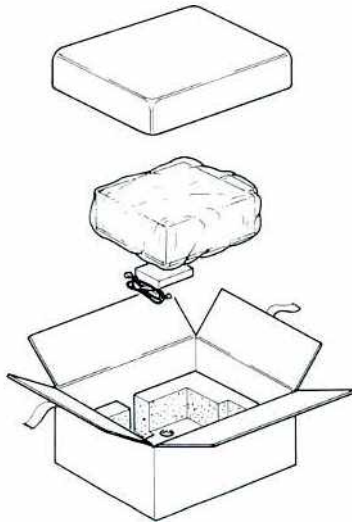


Fig. 2-1 Opening the Shipping Cartons and Taking Out the Contents

2. Take the various system components out of the protective plastic covers.
3. Keep the packing material in a dry place for use when repacking the system.

INSTALLATION PROCEDURES

INSTALLING THE BASIC MODULE AND MONOCHROME DISPLAY

Tools required: Medium sized flat blade screwdriver

1. Place the basic module in a horizontal position as shown below.

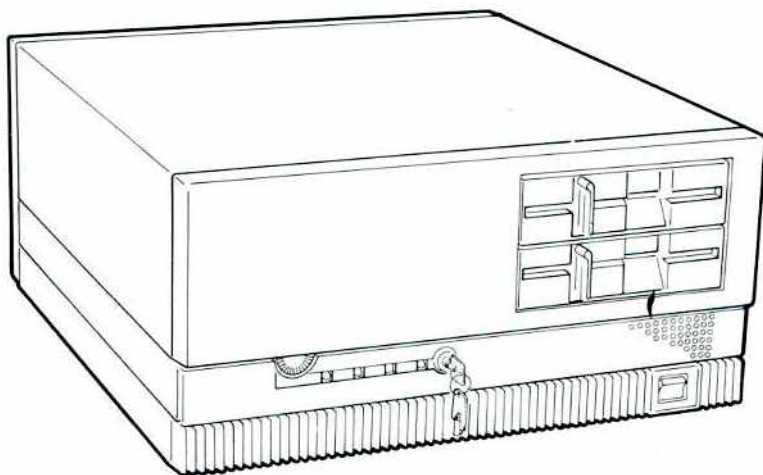


Fig. 2-2 Basic Module in Position

2. Place the keyboard next to the basic module and insert the keyboard cable plug into the keyboard socket at the rear of the basic module. Tighten the two screws on the plug to secure the connection.

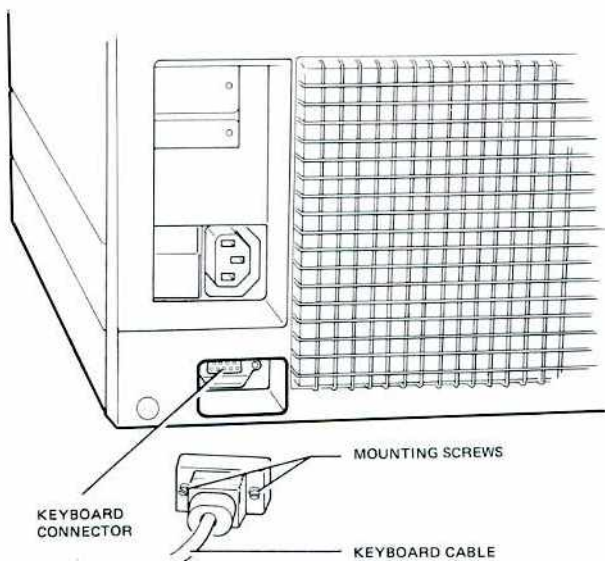


Fig. 2-3 Connection of Keyboard

INSTALLATION PROCEDURES

3. Place the display on the basic module or next to it.

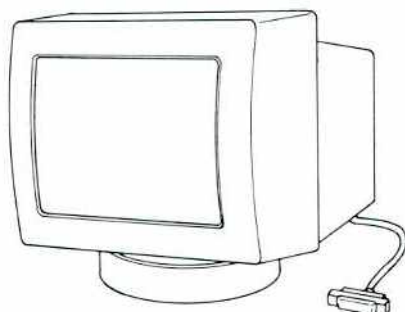


Fig. 2-4 PC Display

4. Insert the display cable into the basic module socket (see figure below). Tighten the two screws on the male connector to secure this connection.

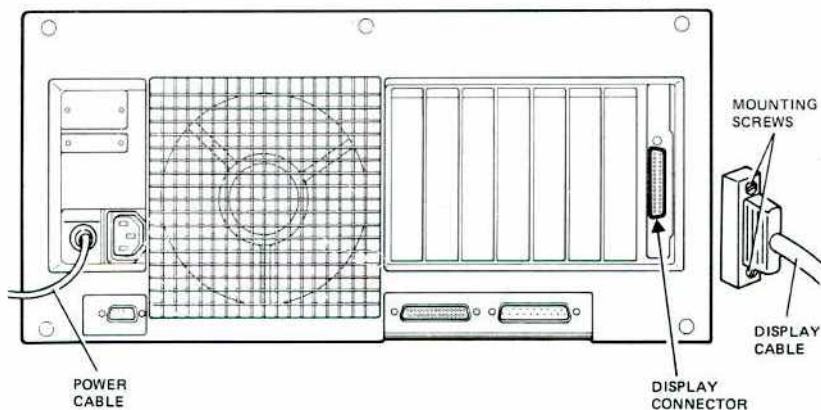


Fig. 2-5 Connection of Display and Power Cables

5. Set the basic module power switch to OFF.

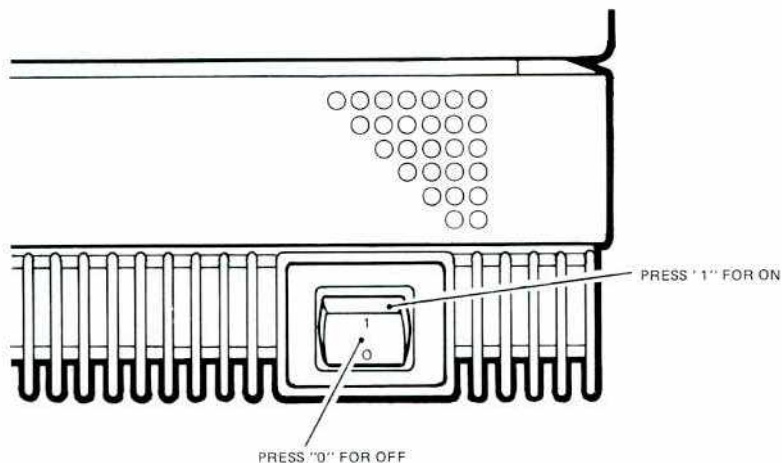


Fig. 2-6 Setting Power Switch to OFF

CAUTION: ENSURE THAT THE VOLTAGE INDICATED ON THE LABEL AT THE REAR OF THE BASIC MODULE CORRESPONDS TO THE VOLTAGE OF THE POWER OUTLET TO BE USED.

6. Connect the system power cable first to the basic module, then to the wall outlet.

SETTINGS

CAUTION: If the system is being installed for the first time, the System Setup program, contained in the system test and customer test diskettes, should be run before carrying out the operations listed below, in order to define the contents of the CMOS-RAM.

Insert the system diskette in drive A (upper drive). The basic module power switch and the key switch can now be set to ON. The green LED on the front panel of the basic module should light up; if it does not, check the power outlet immediately.

When the system is switched on, a series of tests are executed to check that the basic components are functioning correctly. The time taken by these tests depends on the configuration of the PC.

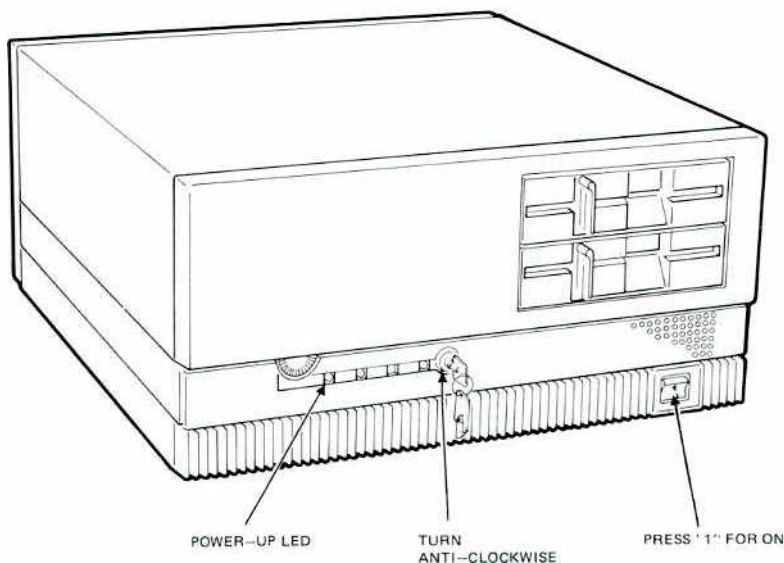


Fig. 2-7 Setting the Power Switch and Key Switch

If an MS-DOS system diskette has been inserted in drive A and the power-up diagnostics run successfully, a message similar to the following should appear on the display:

Resident Diagnostics Rev x.xx

CPU (i80286)	Pass
ROM Checksum	Pass
Memory Refresh	Pass
Keyboard Controller	Pass
Base Memory:	xxx KB
Expansion Memory:	xxx KB
Total Memory:	xxx KB
Parity Circuitry	Pass
Interrupt Controllers	Pass
DMA Controllers	Pass
Keyboard	Pass
Clock/Calendar	Pass
CPU Protected Mode	Pass
CMOS RAM	Pass
Fixed Disks:	1 Present
Floppy Disks:	1 Present

Primary Bootstrap

Microsoft MS-DOS version 3.10
Copyright 1981, 1985 Microsoft Corp.

Rev. 3.03

Current date is mm-dd-19yy
Enter new date:
Current time is hh:mm:ss
Enter new time:

A>

If after a couple of minutes the screen remains blank, adjust the brightness control of the display until an image appears. If the power-up diagnostics do not complete successfully, an error code should appear on the display. Refer to Chapter 4 for a detailed account of these diagnostics.

The system should not be switched on and off unnecessarily. If something goes wrong during system operation, the user should first press the following three keys together:

<CTRL> <ALT>

This simulates switching the system off and then on again. If this has no effect, the RESET button located at the front of the basic module should be pressed.

INSTALLING A PRINTER WITH PARALLEL INTERFACE

Parallel printers are connected to the basic module via a Centronics parallel interface. The cable used for such a connection is the same for all parallel printers. One of the cable connectors plugs into the relevant connector at the rear of the basic module, and the other connector fits into the plug at the back of the printer.

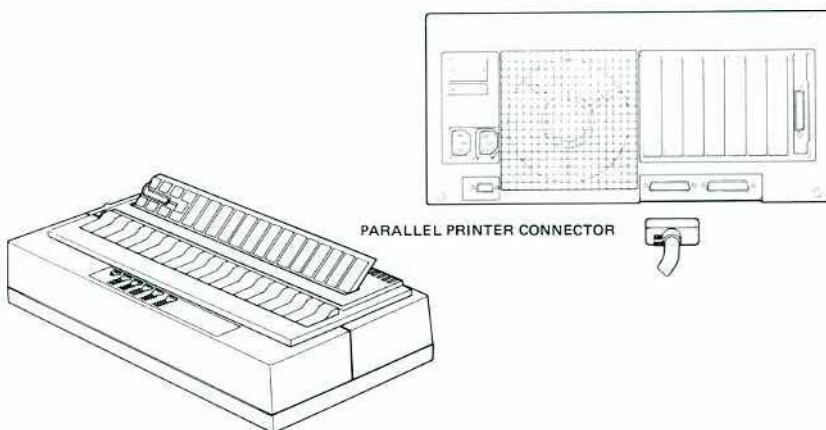


Fig. 2-8 Connecting a Parallel Printer to the PC

The mains cable of the printer must be connected to a suitable power outlet, AFTER IT HAS BEEN VERIFIED THAT THE VOLTAGE INDICATED ON THE LABEL OF THE PRINTER CORRESPONDS TO THE VOLTAGE OF THE POWER OUTLET TO BE USED.

Motherboard jumper JU1-6 must be installed for the printer to be enabled by the system. No software operations are necessary to connect a parallel printer. Before connection, the printer jumpers must be set correctly. The jumper diagrams for the various types of printers can be found in the specific printer manuals.

INSTALLING A PRINTER WITH SERIAL INTERFACE

Serial printers are connected to the basic module via the serial interface. Refer to the relevant printer manuals for details of jumper settings on each type of printer.

The cable used for this connection is the same for all serial printers. One of the cable connectors plugs into the relevant connector at the rear of the basic module, and the other cable connector fits into the plug at the rear of the printer.

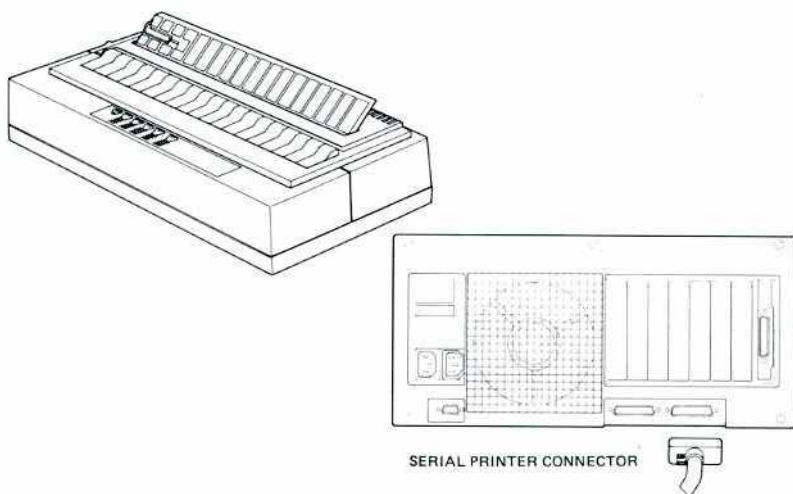


Fig. 2-9 Connecting a Serial Printer to the PC

The mains cable of the printer must be connected to a suitable power outlet, AFTER IT HAS BEEN VERIFIED THAT THE VOLTAGE INDICATED ON THE LABEL OF THE PRINTER CORRESPONDS TO THE VOLTAGE OF THE POWER OUTLET TO BE USED.

Motherboard jumper JU1-7 must not be installed for the printer to be enabled by the system. Before using a serial printer, some parameters have to be set via software, and in MS-DOS environments, the "MODE COM" command must be used to set the RS 232 port.

INSTALLATION PROCEDURES

MODE COM:

The syntax of this command is:

```
MODE COMn:baud(,parity(,databits,(stopbits(,P))))
```

where:

- n can be either of the following values:
 - 1 = standard RS 232 port on motherboard
 - 2 = second RS 232 port.
- baud can be any one of the following values:
 - 110, 150, 300, 600, 1200, 2400, 4800 or 9600
 - only the first two digits need to be input.
- parity can be any one of the following values:
 - E (even parity)
 - O (odd parity)
 - N (none)
 - the default value is E.
- databits can be either 7 or 8
- the default value is 7.
- stopbits can be either 1 or 2
- for all baud rates except 110, the default value is 1.
- P Eliminates timeout errors.

The baud rate must always be input, while the other parameters are optional. It is advisable to use the parameter P.

Example: MODE COM1:11,0,8,1
(Baud rate 110, odd parity, 8 bits per character, 1 stop bit).

The MODE LPT command, which sets the printer parameters, may also be used with serial printers.

```
MODE LPT#:(chars)(,spacing)
```

where:

- # printer number (1, 2 or 3)
 - chars number of characters per line
 - spacing vertical spacing in number of lines per inch (6 or 8)
- Example: MODE LPT1:132,8 (Printer 1, 132 characters, 8 lines per inch).

SYSTEM SWITCH AND JUMPER SETTINGS

The PC has jumpers and switches located on the various boards and units. These are used to set certain system characteristics.

The following abbreviations are used in the description of these settings:

P = jumper present

NP = jumper not present

MOTHERBOARD JUMPERS

The motherboard has the following jumpers: JU1, JU2, JU3, JU4 and JU5. These jumpers are set as shown in the following pages.

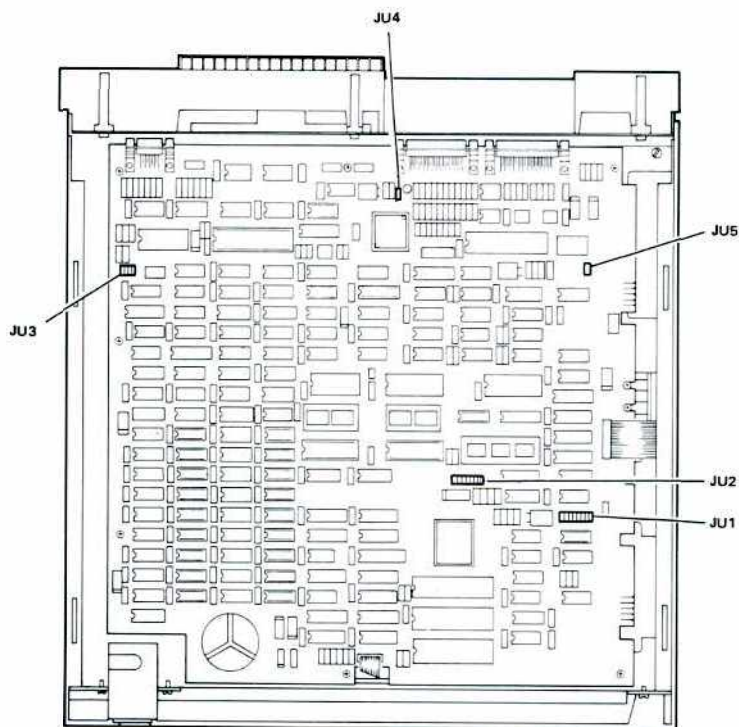


Fig. 2-10 Motherboard Jumpers

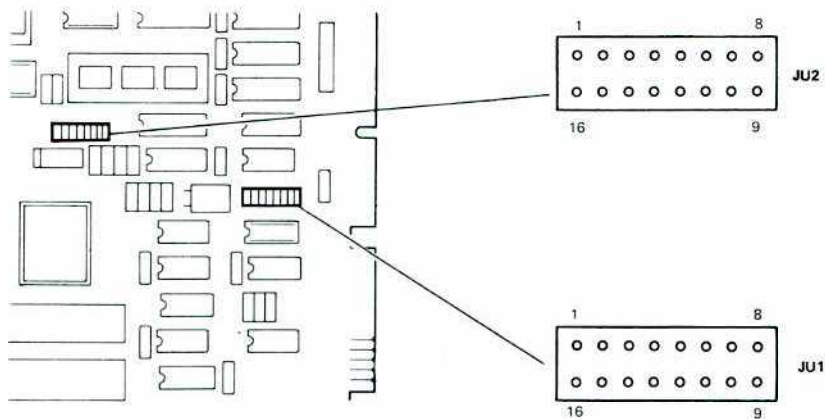


Fig. 2-11 JU1 and JU2

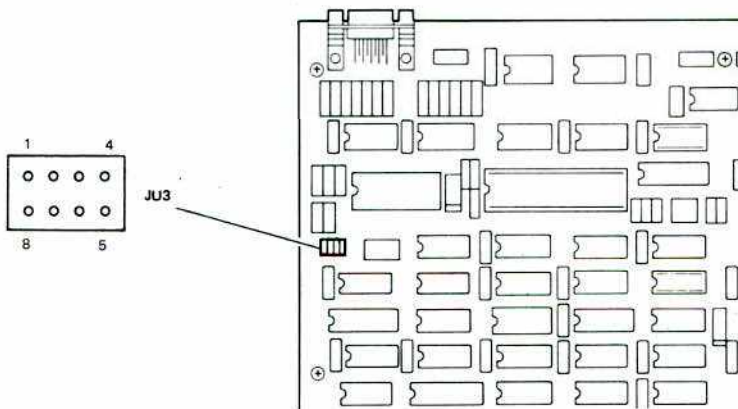


Fig. 2-12 JU3

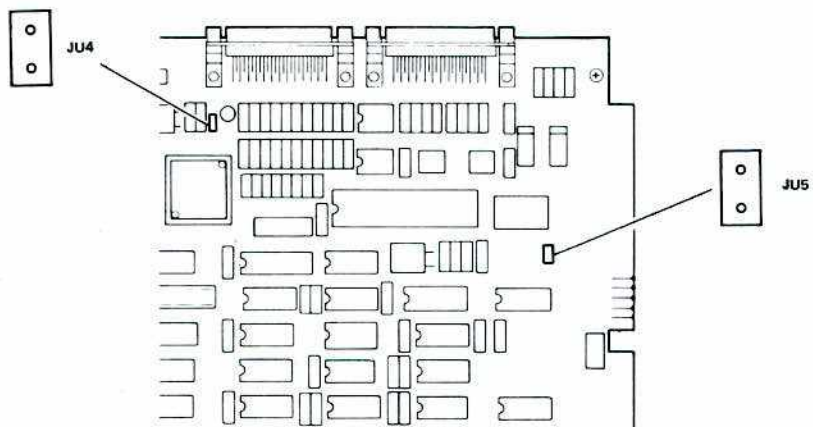


Fig. 2-13 JU4 and JU5

INSTALLATION PROCEDURES

JU1

1-16	2-15	3-14	4-13	5-12	6-11	7-10	8-9	FUNCTION
P	X	X	X	X	X	X	X	512 KB total mem. on motherboard
NP	X	X	X	X	X	X	X	1024 KB total mem. on motherboard
X	P	NP	X	X	X	X	X	add. user EPROM type 2764 or 27128
X	NP	P	X	X	X	X	X	add. user EPROM type 27256
X	X	X	P	NP	X	X	X	BIOS EPROM type 27128
X	X	X	NP	P	X	X	X	BIOS EPROM type 27256
X	X	X	X	X	P	X	X	Enables parallel port
X	X	X	X	X	NP	X	X	Disables parallel port
X	X	X	X	X	X	P	X	Disables serial port
X	X	X	X	1	X	NP	X	Enables serial port

Note:

X = don't care condition
 mem. = memory
 add. = additional
 P = jumper present
 NP = jumper not present

JU2

1-16	2-15	3-14	4-13	5-12	6-11	7-10	8-9	FUNCTION
P	NP	NP	P	X	X	X	X	80287 with clock at 5.33 MHz
NP	P	P	NP	X	X	X	X	80287 with clock at 8 MHz
X	X	X	X	P	NP	X	X	Indigenous display controller only.
X	X	X	X	NP	P	X	X	Indigenous display controller and EGC board

Note:

X = don't care condition
 P = jumper present
 NP = jumper not present

JU3

1-8	2-7	3-6	4-5	FUNCTION
NP	X	X	X	Only used in production. Usually not present
X	P	X	X	Indigenous display controller
X	NP	X	X	Monochrome display controller
X	X	P	X	Only used in production. Usually present

Note:

X = don't care condition
 P = jumper present
 NP = jumper not present

JU4 : Only used in production. Usually present.

JU5 : Only used in production. Usually present.

INSTALLATION PROCEDURES

DISPLAY CONTROLLER

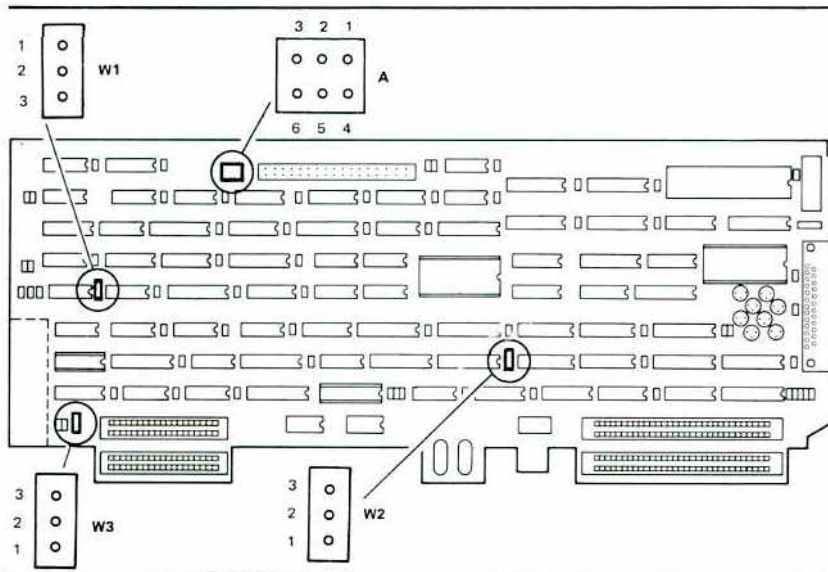


Fig. 2-14 Display Controller Board Jumpers

The following jumpers are present on the display controller board: a group of jumpers called A and three single jumpers called W1, W2 and W3. The table below shows the position of each jumper.

GROUP A:	JUMPER PRESENT	MEANING
	2-3 5-6	Only indigenous display controller board present.
	2-3 4-5-6	Indigenous display controller and E.G.C. board present.

W1 : 1-2 = display controller board disabled
 2-3 = display controller board enabled

W2 : 1-2 always present
 2-3 never present

W3 : 1-2 never present
 2-3 always present

MINI-FLOPPY DISK AND TAPE DRIVE CONTROLLER BOARD

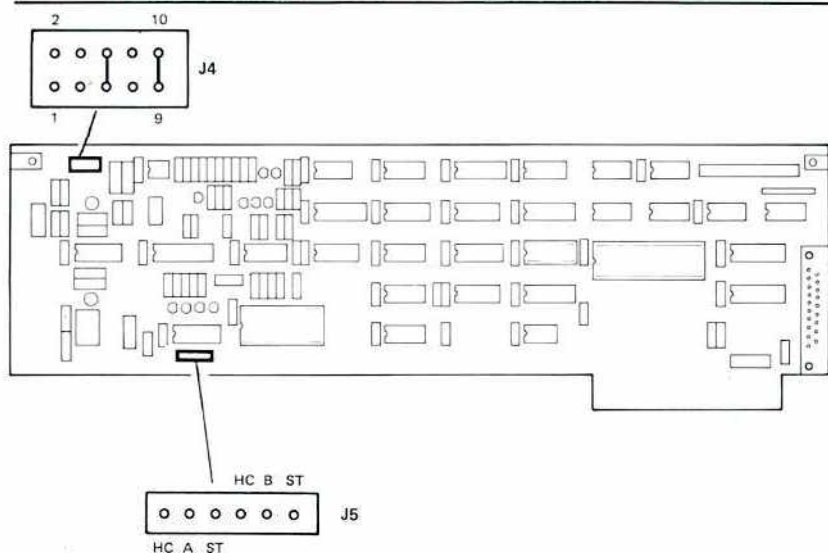


Fig. 2-15 Mini Floppy-Disk and Tape Drive Controller

The board contains three jumper blocks: J3, J4 and J5. Jumper J3 is only used if the board is mounted on an M24 SP; J4 is only used for test purposes - for normal operation, jumpers 5-6 and 9-10 are installed; J5 is used on the PC to establish the type of mini-floppy disk drive mounted (standard or high density).

The table below defines the positions of jumper J5.

JUMPER PRESENT	DEFINITION
HC-A	Drive A high density (1.2 MB)
ST-A	Drive A standard (360 KB)
HC-B	Drive B high density (1.2 MB)
ST-B	Drive B standard (360 KB)

HARD DISK CONTROLLER BOARD

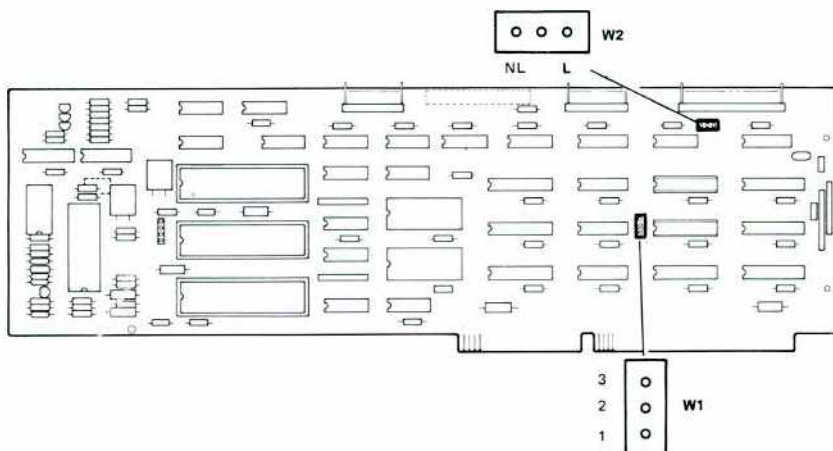


Fig. 2-16 Hard Disk Controller Board

The hard disk controller board has two jumpers which allow the I/O address (W1) and the operating mode (W2) of the board to be defined.

Jumper W1 allows the installation of two hard disk controller boards in the same system.

The table below shows the definition of the jumper positions.

JUMPER	POSITION	DESCRIPTION
W1	1 - 2	Basic primary address 1F0 selected
W1	2 - 3	Basic secondary address 170 selected
W2	L	Latched operating mode selected
W2	NL	Non-latched operating mode selected

The board has no jumpers to define the type of hard disk installed, as this data is stored in the CMOS-RAM configuration and is defined when the system is first installed.

Jumper W1 is normally in position 1-2 and jumper W2 in position NL.

5.25 INCH MINI-FLOPPY DISK DRIVE

The drives on the PC must both be configured in the following way:

- Drive 2
- Head loading controlled by the MOTOR ON signal
- Drive LED comes on when the DRIVE SELECT signal is activated

The insertion of resistors depends on the number of drives installed in the system, as follows:

- If a single drive is installed in the system, resistors must be present on the single drive
- If two drives are installed in the system, resistors must only be present on the last drive of the chain (drive A).

The signal cable from the mini-floppy disk controller board is connected to drive B and then to drive A. Signals on pins 10 to 16 of the signal cable are swapped between drive B and drive A as follows:

10 to 16
11 to 15
12 to 14
13 to 13
14 to 12
15 to 11
16 to 10

The tables overleaf show the jumper settings on the various types of drives which can be installed in the system. The following information is given for each jumper:

- The function activated when the jumper is present
- The configuration if the drive is the only drive installed in the system, or if it is drive A of a system without an expansion box
- The configuration if the drive is drive B of the system, or if it is drive A in a system with an expansion box.

INSTALLATION PROCEDURES

JUMPERS FOR 1.2 MB TOSHIBA DRIVE (ND-08DE)

JUMPER	FUNCTION	SINGLE DRIVE OR DRIVE A WITHOUT BOX	DRIVE B OR DRIVE A WITH BOX
MUX	Drive is always selected	not present	not present
D1	Drive 1	not present	not present
D2	Drive 2	present	present
D3	Drive 3	not present	not present
D4	Drive 4	not present	not present
HD	Head loading controlled by DRIVE SELECT signal	not present	not present
HM	Head loading controlled by MOTOR ON signal	present	present
LD	LED comes on with DRIVE SELECT signal	present	present
P5	LED comes on with DRIVE SELECT and READY signals	not present	not present
TM	Terminators are inserted	present	not present
DE	Motor rotation speed is 360 rpm	present	present
DX	Motor rotation speed is 300 rpm	not present	not present
SR	Signal on pin 34 is the READY signal	not present	not present
DC	Signal on pin 34 is the DISK CHANGE signal	present	present

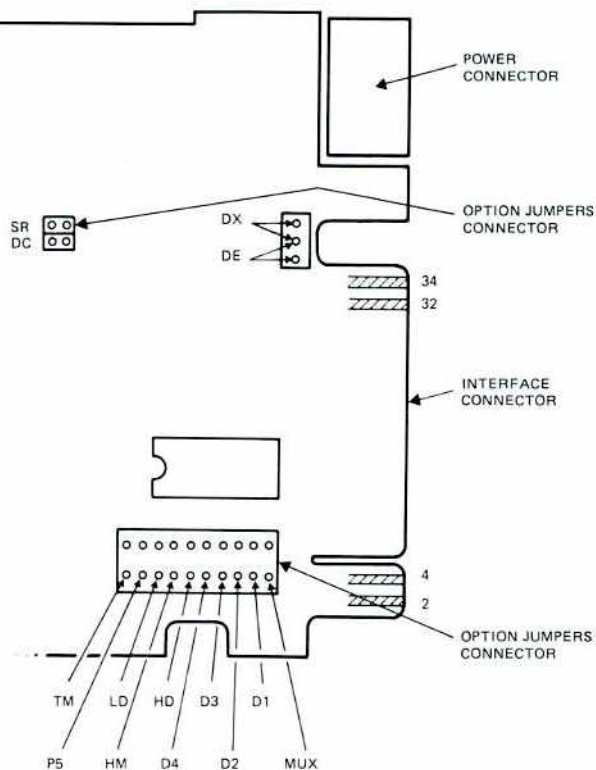


Fig. 2-17 Jumpers for Drive ND-08DE

INSTALLATION PROCEDURES

JUMPERS FOR 1.2 MB PANASONIC DRIVE (JU-475-2CGN)

JUMPER	FUNCTION	SINGLE DRIVE OR DRIVE A WITHOUT BOX	DRIVE B OR DRIVE A WITH BOX
TM	Resistors inserted	present	not present
DS4	Drive 4	not present	not present
DS3	Drive 3	not present	not present
DS2	Drive 2	present	present
DS1	Drive 1	not present	not present
DS	Enables drive select in a multidrive system	present	present
MX	Drive always selected	not present	not present
AT	Enables drive for use in the system	present	present
AX	Latched by DS signal	not present	not present
RDY	Standard READY signal	not present	not present
LR	Stored READY signal	not present	not present
DC	Latched door disturb	present	present
DO	Door open	not present	not present
BX	Dual speed	not present	not present
CX	Single speed	present	present
IRD	Internal READY signal	not present	not present
SP	DISK CHANGE Step	present	present
IX	DISK CHANGE Index	not present	not present
DD	DISK CHANGE drive select	not present	not present

JUMPER	FUNCTION	SINGLE DRIVE OR DRIVE A WITHOUT BOX	DRIVE B OR DRIVE A WITH BOX
UA	LED comes on when IN USE signal is stored	not present	not present
DA	LED comes on with DRIVE SELECT signal	present	present
OA	LED comes on with IN USE or DRIVE SELECT signal	not present	not present
HA	LED comes on with IN USE and DRIVE SELECT signals	not present	not present
MM	Enables drive motor with the MOTOR ON signal	present	present
MS	Enables drive motor with the DRIVE SELECT signal	not present	not present

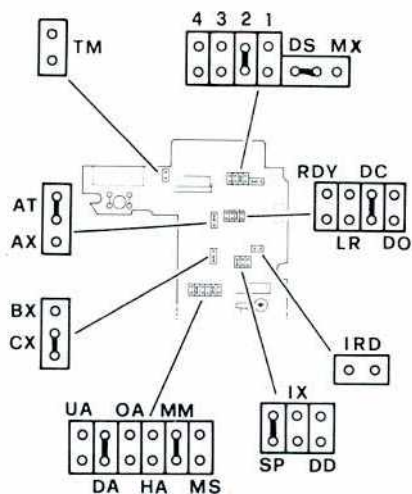


Fig. 2-18 Jumpers for Drive JU-475-2CGN

INSTALLATION PROCEDURES

JUMPERS FOR 360 KB TOSHIBA DRIVE (ND-04DT)

JUMPER	FUNCTION	SINGLE DRIVE OR DRIVE A WITHOUT BOX	DRIVE B OR DRIVE A WITH BOX
RY	Signal on pin 34 of the connector is the READY signal	present	present
D1	Drive 1	not present	not present
D2	Drive 2	present	present
D3	Drive 3	not present	not present
D4	Drive 4	not present	not present
LD	LED comes on with the DRIVE SELECT signal	present	present
L1	LED comes on with the DRIVE SELECT and READY signals	not present	not present
TM	Terminators inserted	present	not present

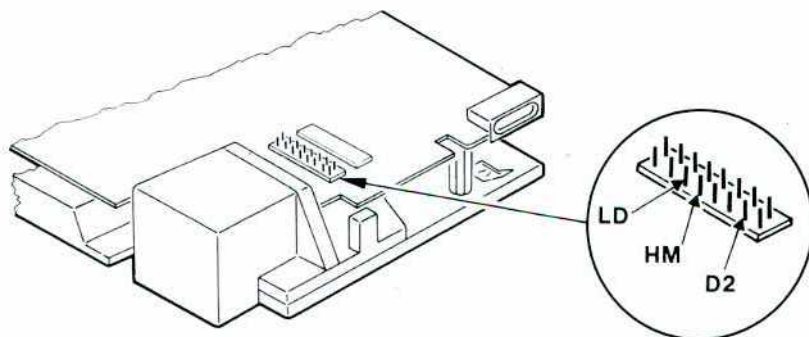


Fig. 2-19 Jumpers for Drive ND-04DT

JUMPERS FOR 360 KB PANASONIC DRIVE (JU-455-5CGN)

JUMPER	FUNCTION	SINGLE DRIVE OR DRIVE A WITHOUT BOX	DRIVE B OR DRIVE A WITH BOX
RY	Signal on pin 34 of the connector is the READY signal	present	present
DS1	Drive 1	not present	not present
DS2	Drive 2	present	present
DS3	Drive 3	not present	not present
DS4	Drive 4	not present	not present
TM	Resistors inserted	present	not present
MM	Enables the drive motor with the MOTOR ON signal	present	present
MS	Enables the drive motor with the DRIVE SELECT signal	not present	not present
UA	LED comes on when the IN USE signal is stored	not present	not present
DA	LED comes on with the DRIVE SELECT signal	present	present
DS	Enables drive select in a multidrive system	present	present
MX	Drive always selected	not present	not present
RD	Enables the READY signal	present	present
DC	Latched door disturb	not present	not present
WP	WRITE PROTECT signal	present	present

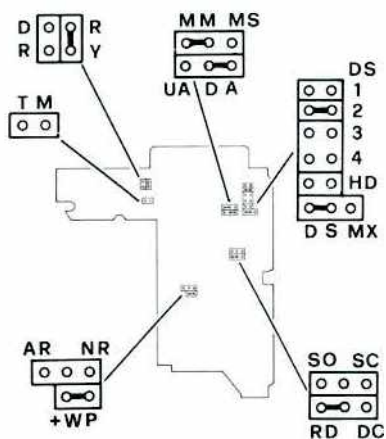


Fig. 2-20 Jumpers for Drive JU-455-5CGN

HARD DISK UNIT

The hard disk unit present in the system must be configured as DRIVE C. The unit has various jumpers and switches which should be used to define the correct operating mode.

A block of four jumpers in particular are used to establish the operating mode, and there are four switches to establish the number of the unit. The tables below show the definition of each jumper and switch.

JUMPER	FUNCTION
1-2	Used for testing purposes. Usually present
3-4	Used for testing purposes. Usually absent
5-6	If jumper is present, the HDU is radially connected if jumper is not present, the HDU is daisy-chain connected
7-8	Reserved; usually absent

SWITCH				FUNCTION
SW1	SW2	SW3	SW4	
ON	OFF	OFF	OFF	Selects unit 1
OFF	ON	OFF	OFF	Selects unit 2
OFF	OFF	ON	OFF	Selects unit 3
OFF	OFF	OFF	ON	Selects unit 4

Normally only jumper 1-2 is present and unit 1 is selected.

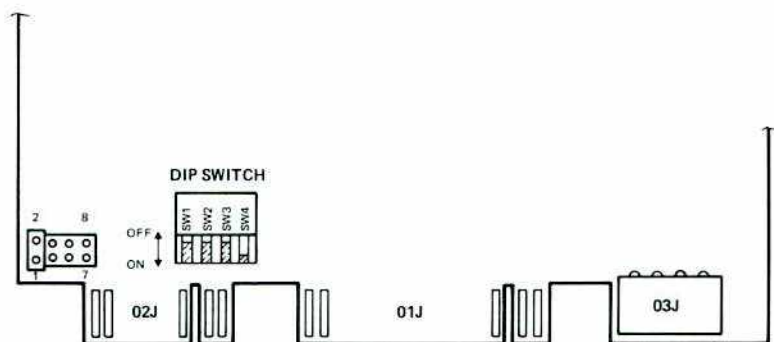


Fig. 2-21 HDU Jumpers and Switches

TAPE DRIVE

If a tape drive is installed in the system, it must always be configured as drive 4, and the resistors must be removed.

The table below shows the meaning of the various jumpers when present on the unit, and their positions when this drive is installed in the system.

JUMPER	DESCRIPTION	POSITION
1-2	Drive 1 select	not present
3-4	Drive 2 select	not present
5-6	Drive 3 select	not present
7-8	Drive 4 select	present
9-10	Resistors inserted	not present

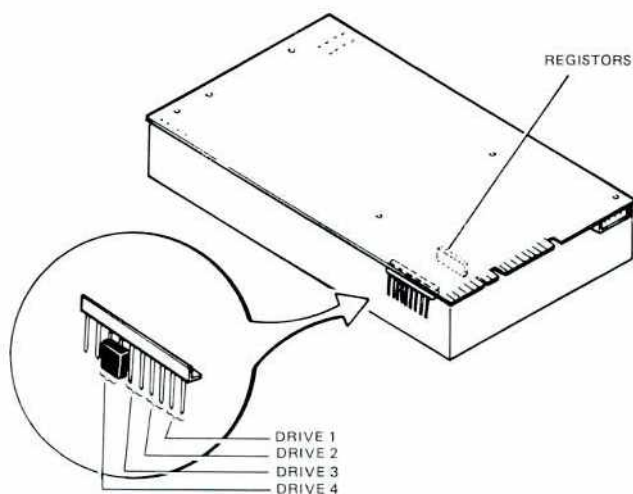


Fig. 2-22 Tape Drive Jumpers and Resistors

2. OPTION INSTALLATION

CONTENTS

PAGE

3. OPTION INSTALLATION

3-1	<u>INTRODUCTION</u>
3-2	<u>PRELIMINARY AND FINAL OPERATIONS</u>
3-3	REMOVING THE TOP COVER
3-5	REMOVING THE BOTTOM COVER
3-7	IDENTIFYING BOARD POSITION
3-12	INSERTING AND SECURING THE OPTIONAL BOARD
3-15	REMountING THE TOP COVER
3-17	REMountING THE BOTTOM COVER
3-19	RECONNECTING THE BASIC MODULE
3-20	UPGRADING MOTHERBOARD MEMORY FROM 512 KB TO 1 MB
3-24	INSTALLING THE COLOUR DISPLAY
3-25	INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE BASIC MODULE
3-26	INSTALLATION PROCEDURE
3-35	INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE EXPANSION BOX
3-36	INSTALLATION PROCEDURE
3-51	INSTALLING THE 80287 NUMERIC PROCESSOR EXTENSION
3-54	<u>INSTALLING THE MOUSE ADAPTER</u>
3-54	MATERIAL REQUIRED
3-54	INSTALLATION PROCEDURE
3-57	<u>INSTALLING THE MULTIPOINT BOARD (SIC 2832)</u>

PAGE	
3-57	MATERIAL REQUIRED
3-58	INSTALLATION PROCEDURE
3-60	CONFIGURATION
3-61	<u>INSTALLING THE TAPE DRIVE</u>
3-61	MATERIAL REQUIRED
3-62	INSTALLATION PROCEDURE
3-66	<u>INSTALLING THE EXPANSION GRAPHICS AND COLOUR BOARD (EGC)</u>
3-66	MATERIAL REQUIRED
3-67	INSTALLATION PROCEDURE
3-72	<u>INSTALLING THE MEMORY EXPANSION BOARD</u>
3-72	MATERIAL REQUIRED
3-72	INSTALLATION PROCEDURE
3-75	CONFIGURATIONS
3-77	UPGRADING MEMORY EXPANSION BOARD

INTRODUCTION

This chapter contains the installation instructions for the options that can be purchased for the PC. These options are sometimes referred to as upgrades. Read the procedures carefully before installing the options.

In addition to the installation procedure, all possible configurations are given for each option.

The following upgrades and installations are described in this section:

- Upgrading motherboard memory from 512 KB to 1 MB by chip insertion
- Installation of the colour display
- Installation of the second mini-floppy disk drive in the basic module and in the expansion box
- Installation of the 80287 numeric processor extension
- Installation of the mouse adapter
- Installation of the multiport board
- Installation of the tape drive
- Installation of the EGC board
- Installation of the memory expansion board
- Upgrading memory expansion board.

PRELIMINARY AND FINAL OPERATIONS

Certain operations which are standard for all options should be followed to ensure correct installation. These operations consist of the following basic procedures:

- Removing the top and/or bottom cover of the basic module
- Identifying the position in which to insert an optional board
- Inserting and securing the board in the basic module
- Replacing the covers of the basic module
- Reconnecting the basic module.

These operations are described in detail in the following sections.

OPTION INSTALLATION

REMOVING THE TOP COVER

The top cover of the basic module is removed in the following way:

1. Set the power switch on the basic module and on all external devices to OFF.
2. Unplug the basic module power cable from the wall outlet.
3. Disconnect all the cables connected to the basic module.
4. Remove the display and all external devices from the basic module.
5. With a flat blade screwdriver, loosen the three top cover mounting screws located at the top of the basic module rear panel.

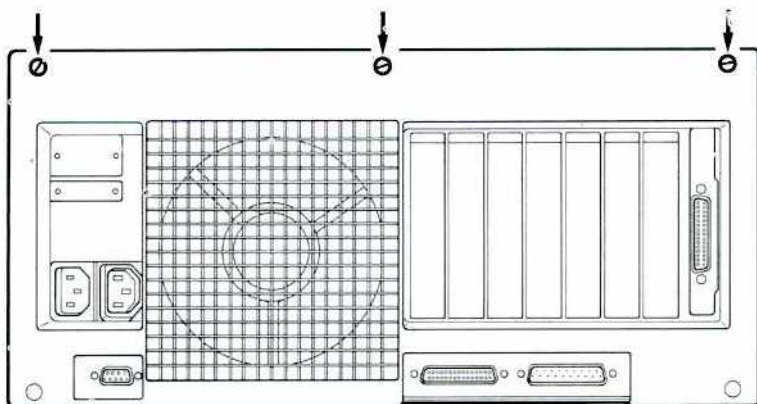


Fig. 3-1 Top Cover Mounting Screws

6. Remove the top cover by pushing it towards the front of the basic module and then lifting it out.
-

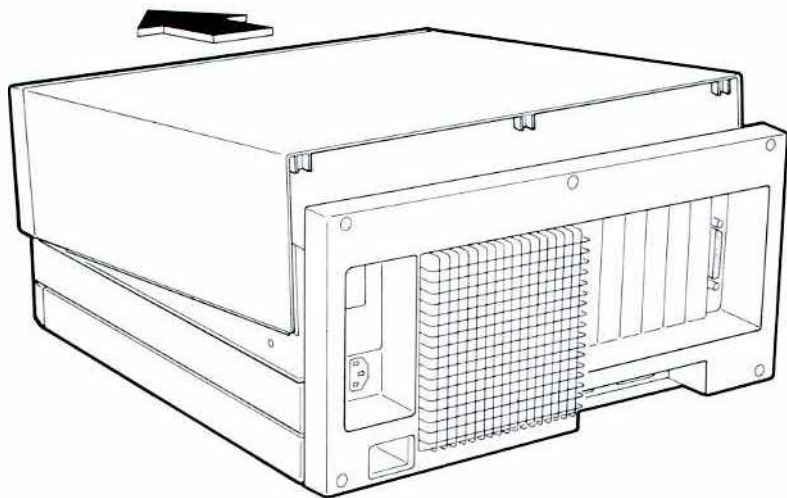


Fig. 3-2 Removing the Top Cover

OPTION INSTALLATION

REMOVING THE BOTTOM COVER

The bottom cover of the basic module is removed in the following way:

1. Set the power switch on the basic module and on all external devices to OFF.
2. Unplug the basic module power cable from the wall outlet.
3. Disconnect all the cables connected to the basic module.
4. Remove the display and all external devices from the basic module.
5. Turn the basic module upside down.
6. With a flat blade screwdriver, loosen the two bottom cover mounting screws located at the bottom of the basic module rear panel.

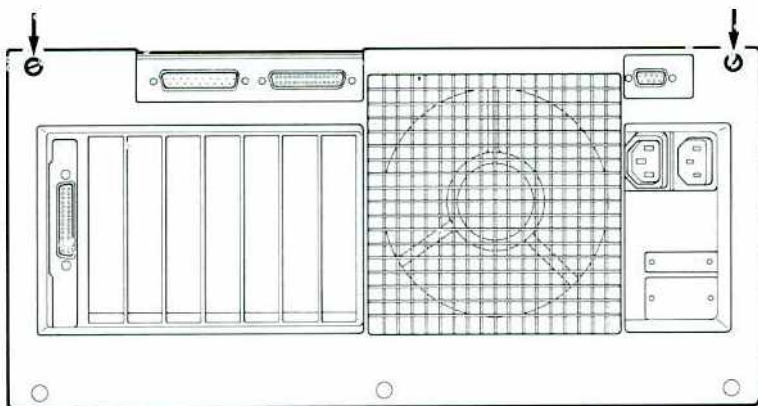


Fig. 3-3 Bottom Cover Mounting Screws

7. Remove the bottom cover by pushing it towards the front of the basic module and then lifting it out.

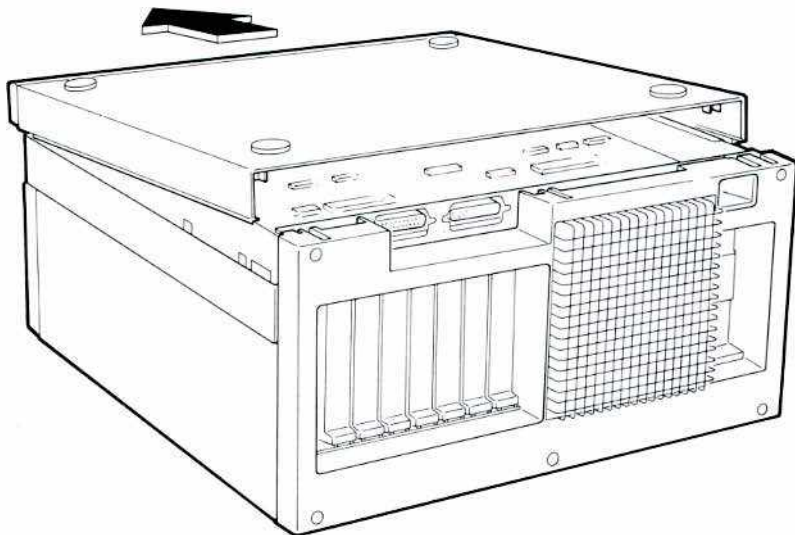


Fig. 3-4 Removing the Bottom Cover

OPTION INSTALLATION

IDENTIFYING BOARD POSITION

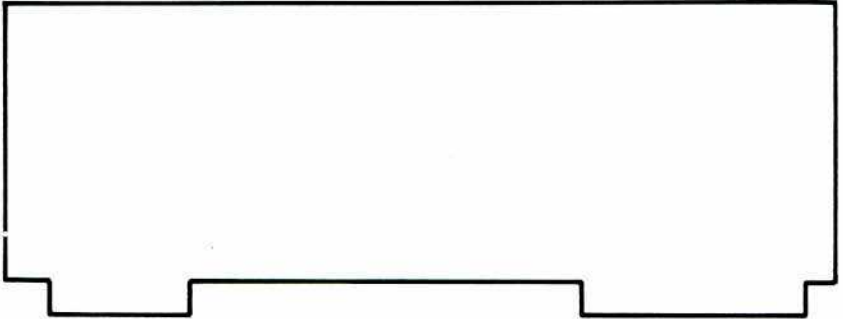
When a board is to be inserted in the basic module, the position in which this board can be inserted must be identified. This depends on the type of board which is to be installed.

The following three types of boards can be inserted in the PC:

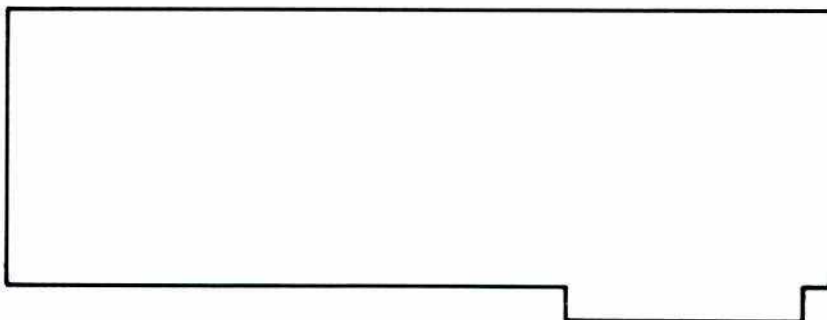
- Olivetti boards
- 8-bit industry standard compatible boards
- 16-bit industry standard compatible boards.

The procedure below shows how to distinguish the type of board which is to be installed:

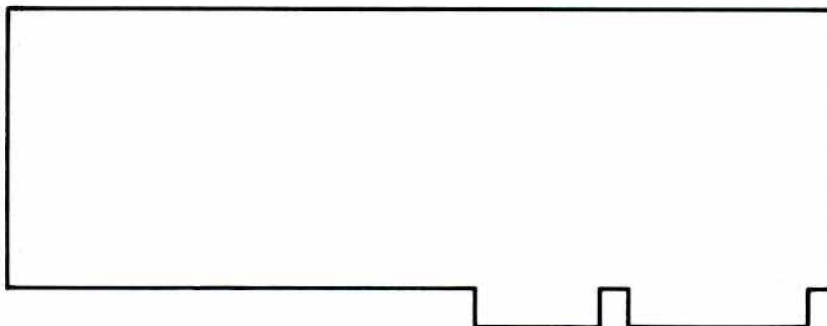
1. Hold the board so that the electronic chips mounted on it can be seen.
2. Observe the board profile.
3. If the profile is similar to the one shown below, it is an Olivetti board.



4. If the profile is similar to the one shown below, it is an 8-bit industry standard compatible board.



5. If the profile is similar to the one shown below, it is an 16-bit industry standard compatible board.



OPTION INSTALLATION

Once it has been established which type of board it is, proceed as follows to identify the position in which to insert the board:

1. Locate the bus expansion board in the basic module.

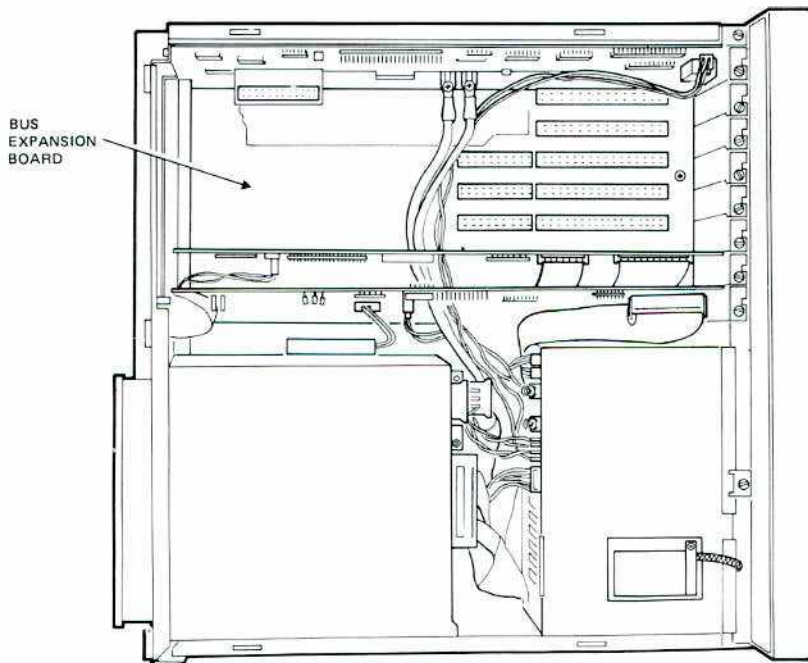


Fig. 3-5 Locating the Bus Expansion Board

2. Note that there are seven rows of connectors on the bus expansion board into which the optional boards can be inserted. The first two rows, near the mini-floppy disk drive slots, are used for the mini-floppy disk drive controller board and the hard disk controller board, thus five rows of connectors are free for the optional boards.

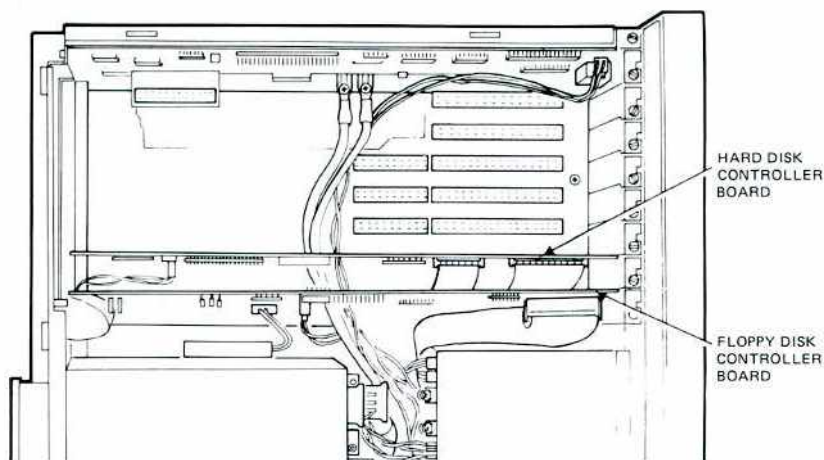


Fig. 3-6 Bus Expansion Board

OPTION INSTALLATION

3. The optional board to be installed can be inserted in one of the free rows, according to the following criteria:

- An Olivetti board is inserted in row 7
- A 16-bit industry standard compatible board can be inserted in row 3, 4 or 5
- An 8-bit industry standard compatible board can be inserted in row 3, 4, 5, 6 or 7.

Note that the connector rows are numbered progressively starting from the right, but the numbering is not shown on the board.

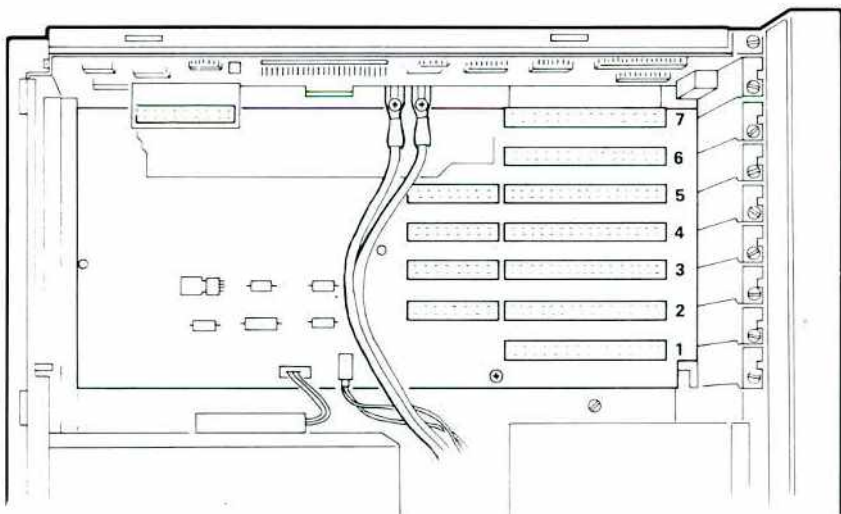


Fig. 3-7 Connector Rows on the Bus Expansion Board

INSERTING AND SECURING THE OPTIONAL BOARD

When the basic module top cover has been removed, the optional board has been configured as indicated in the relative installation procedure and the board position has been identified, the board should then be inserted in the bus expansion board as described below:

1. Using a flat blade screwdriver, loosen the screw securing the expansion slot cover for the required connectors to the rear panel and remove the cover.

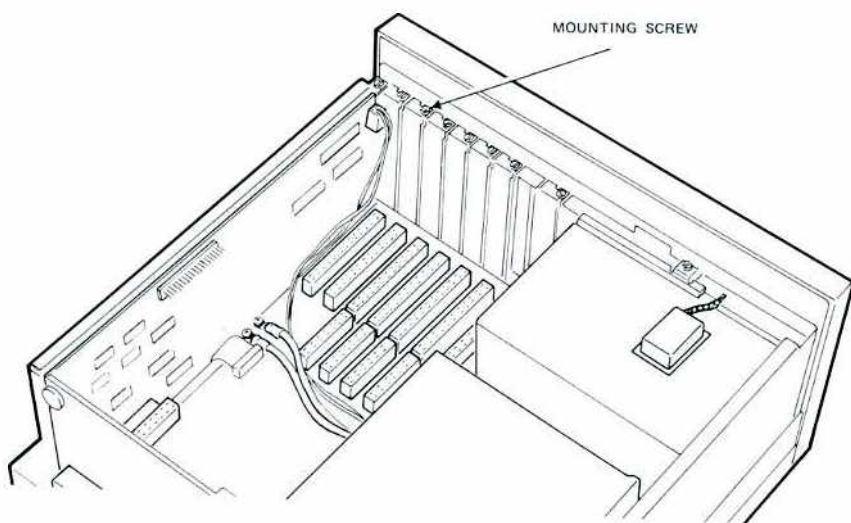


Fig. 3-8 Removing the Slot Cover

2. Hold the optional board by the top edges in such a way that the electronic chips mounted on it are facing the mini-floppy disk drive slots.

OPTION INSTALLATION

3. Align the board with the selected connector row and insert it in the relative connectors by pressing downwards.
-

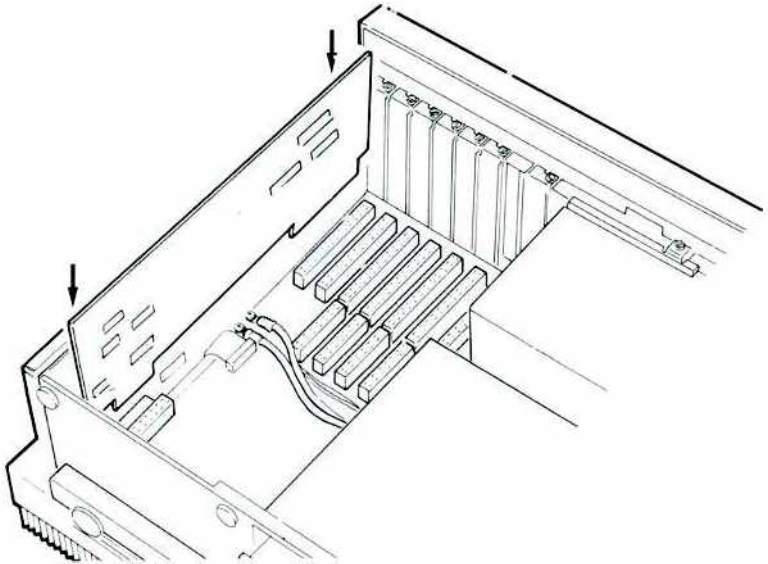


Fig. 3-9 Inserting the Optional Board

4. Align the hole of the optional board retaining bracket with the one on the basic module rear panel and secure the bracket with the screw removed in step 1, tightening it with the flat blade screwdriver.

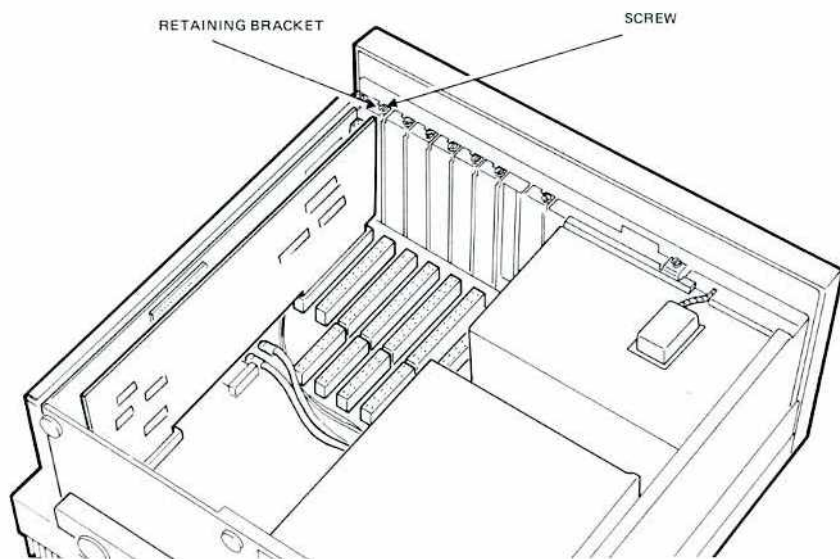


Fig. 3-10 Securing the Board

OPTION INSTALLATION

REMountING THE TOP COVER

The top cover of the basic module is remounted in the following way:

1. Insert the top cover on the basic module and push it right up to the rear panel.

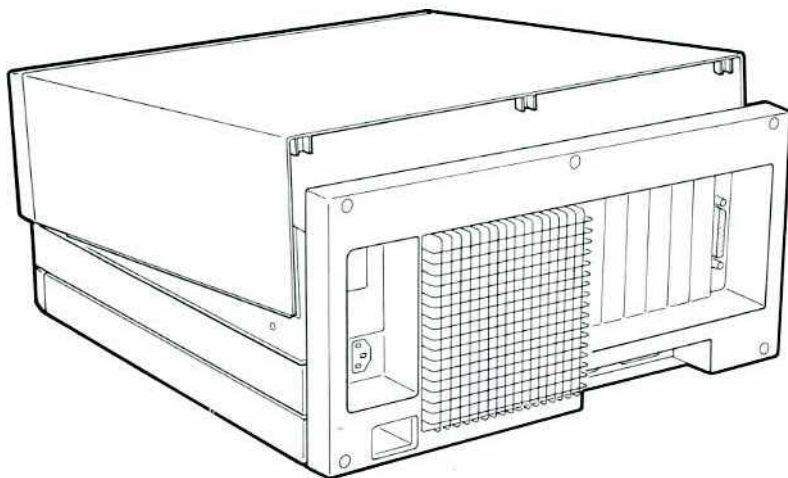


Fig. 3-11 Inserting the Top Cover

2. Tighten the three mounting screws located at the top of the basic module rear panel.

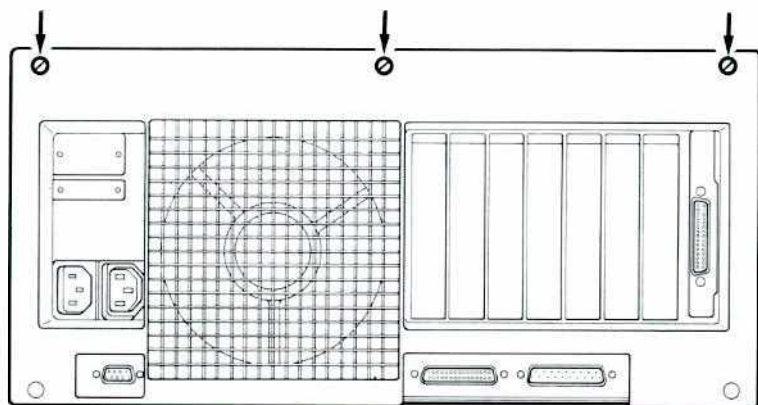


Fig. 3-12 Top Cover Mounting Screws

REMOUNTING THE BOTTOM COVER

The bottom cover of the basic module is remounted in the following way:

1. Turn the basic module upside down.
2. Insert the bottom cover on the basic module and push it right up to the rear panel.

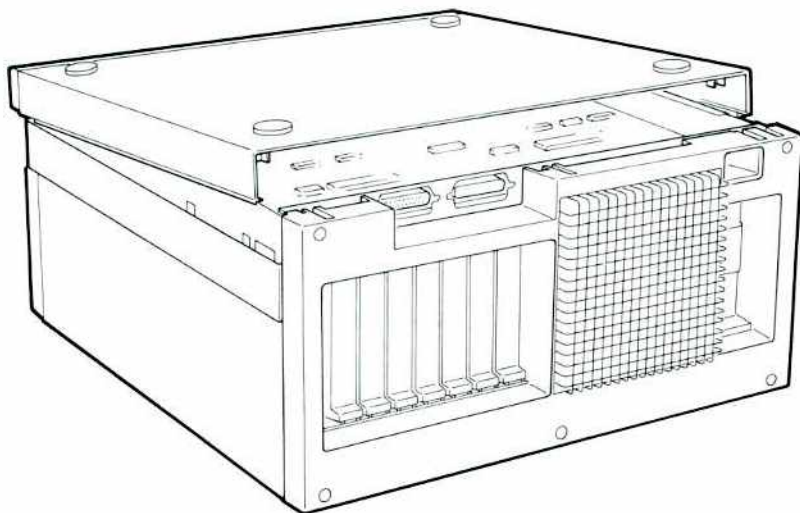


Fig. 3-13 Inserting the Bottom Cover

3. Tighten the two mounting screws located at the bottom of the basic module rear panel.

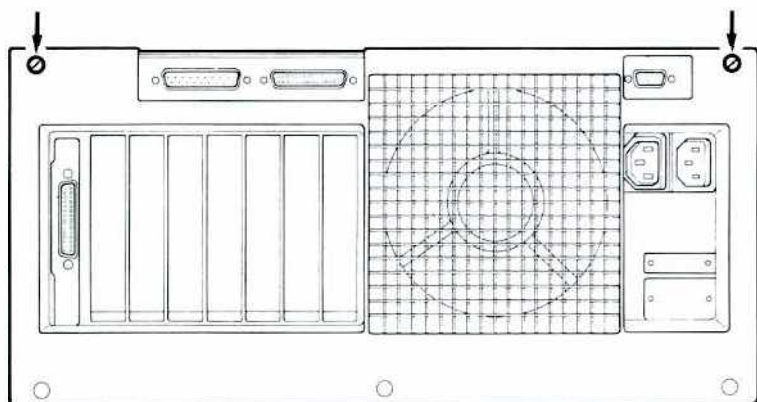


Fig. 3-14 Bottom Cover Mounting Screws

4. Return the basic module to its correct position.

OPTION INSTALLATION

RECONNECTING THE BASIC MODULE

When the option has been installed in the basic module and the covers have been remounted, the basic module must be connected as before. The figure below shows the connections which may be effected on the basic module.

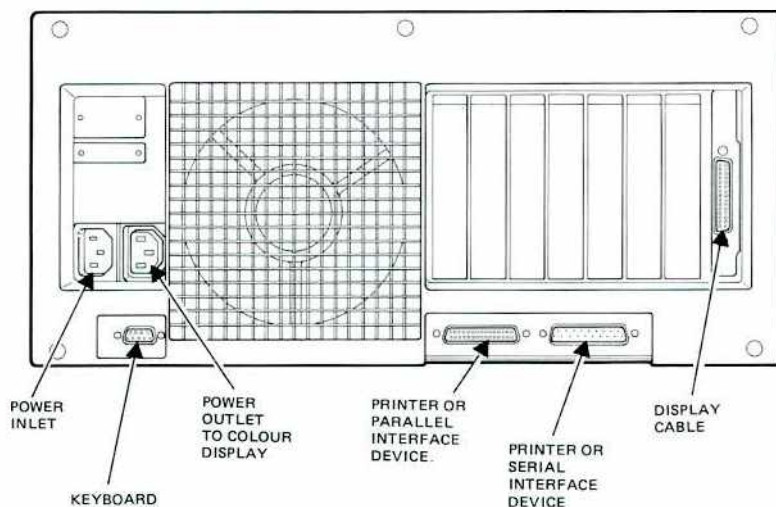


Fig. 3-15 Basic Module Connections

UPGRADING MOTHERBOARD MEMORY FROM 512 KB TO 1 MB

This section describes the procedures to upgrade the motherboard memory from 512 KB to 1 MB. Read the instructions carefully to ensure a smooth and easy connection.

Note: At the end of the installation procedure, the System Setup program must be run to define the correct contents of the CMOS-RAM. Note that the correct memory size is automatically defined simply by recalling the System Setup and then exiting by pressing the ESC key.

MATERIAL REQUIRED

- System with 512 KB on motherboard bank 0
- 18 256Kx1 RAM chips
- Medium sized flat blade screwdriver

OPTION INSTALLATION

INSTALLATION PROCEDURE

1. Remove the basic module bottom cover as described in the relevant section.
 2. Locate bank 1 on the motherboard.
-

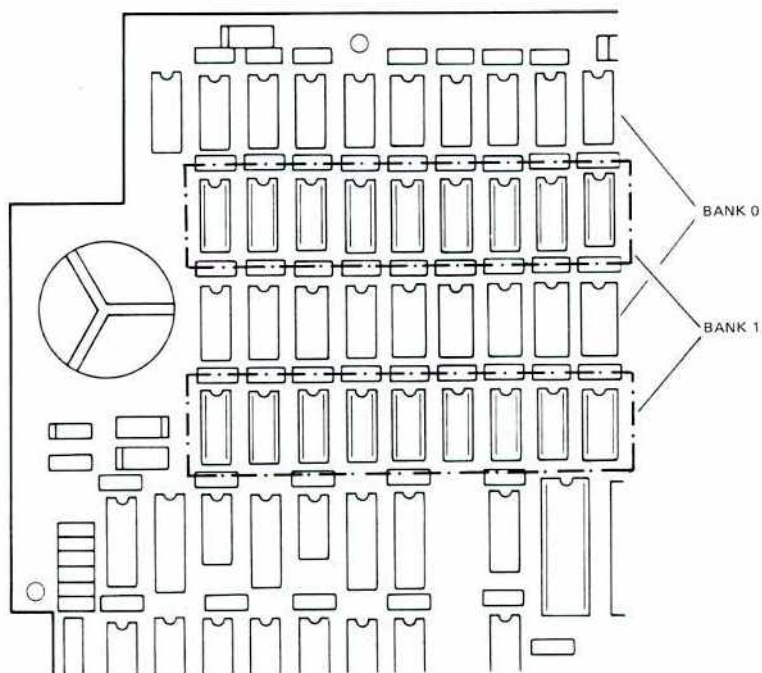


Fig. 3-16 Location of Bank 1 on the Motherboard

3. When installing the 256Kx1 memory chips in the sockets, ensure that pin 1 of the chip is located in the same direction as pin 1 of the other memory chips already installed in bank 0.

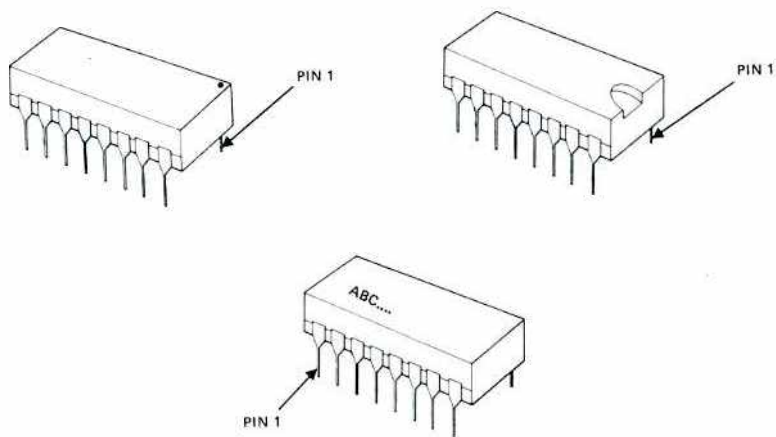


Fig. 3-17 Pin 1 Location on Various ICs

4. Align the RAM pins (A) with the socket (B) and gently insert the RAM chips into the socket.

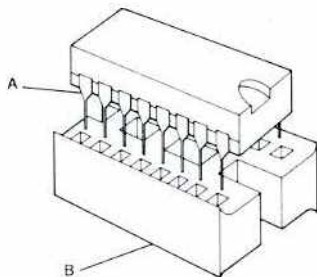


Fig. 3-18 Chip Insertion

OPTION INSTALLATION

5. Repeat step 4 for the remaining 17 sockets in bank 1 on the motherboard.
6. Remove jumper 1-16 of JU1.

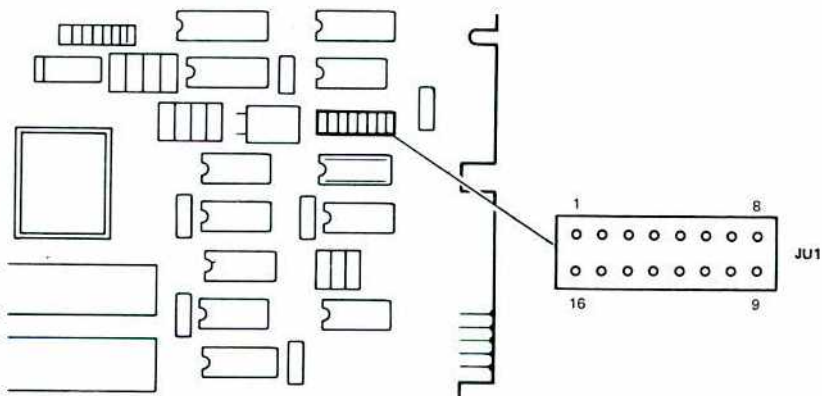


Fig. 3-19 JU1

7. Replace the basic module bottom cover and reconnect the basic module as described in the relevant sections.

INSTALLING THE COLOUR DISPLAY

This section describes how to install the colour display. Read the instructions carefully to ensure a smooth and easy connection.

MATERIAL REQUIRED

- Medium sized flat blade screwdriver
- Colour display with signal and power cables

INSTALLATION PROCEDURE

1. Set the power switch on the basic module to OFF.
2. Connect the display signal cable to the display controller connector at the rear of the basic module.
3. Connect the display power cable to the power connector at the rear of the basic module.

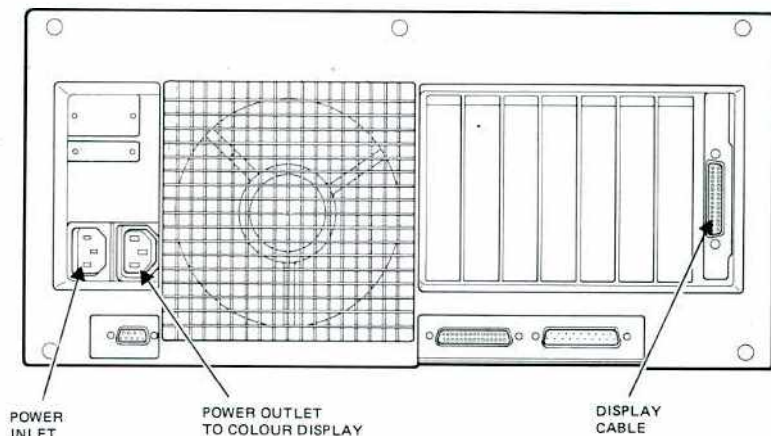


Fig. 3-20 Installing the Colour Display

4. Reconnect the basic module as described in the relevant section.

OPTION INSTALLATION

INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE BASIC MODULE

This section describes how to install the second mini-floppy disk drive in the basic module.

Note: The procedure set out below applies to either a second high density drive (1.2 MB) or to a second standard drive (360 KB). The System Setup program must be run at the end of the installation procedure.

MATERIAL REQUIRED

- System with one mini-floppy disk drive
- Second mini-floppy disk drive
- Guides
- Medium sized flat blade screwdriver
- Philip's screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module top cover as described in the relevant section.
2. Check that the second drive is set correctly for installation:
 - For high density drives (1.2 MB) ND-08DE, jumpers D2, LD, DE, DC and HM only must be present
 - For high density drives (1.2 MB) JU-475-2CGN, jumpers DS2, DS, DC, AT, CX, SP, DA and MM only must be present
 - For standard drives (360 KB) ND-04DT, jumpers D2, LD and HM only must be present
 - For standard drives (360 KB) JU-455-5CGN, jumpers RY, DS2, MM, WP, RD, DS and DA only must be present.

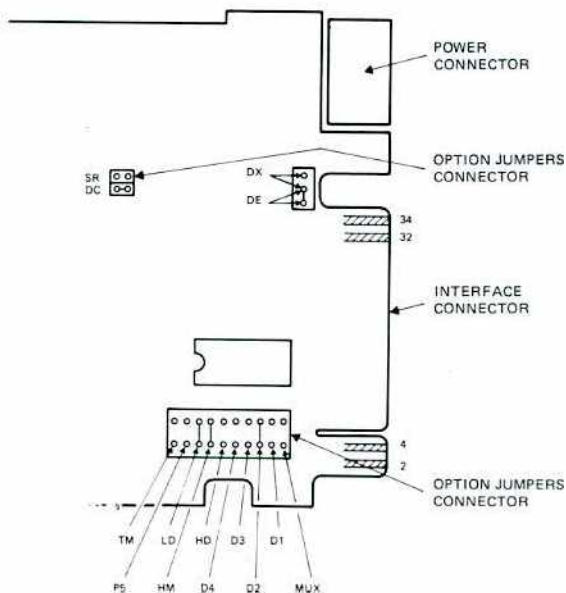


Fig. 3-21 Position of Jumpers for High Density Drive (1.2 MB) ND-08DE

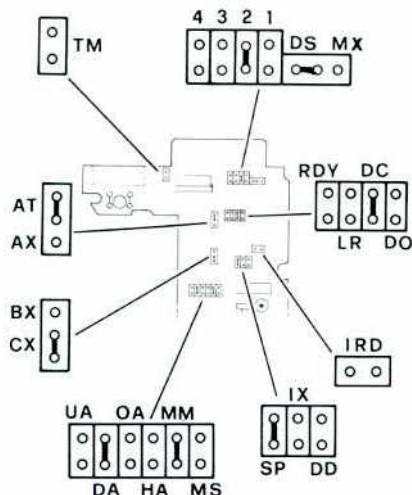


Fig. 3-22 Position of Jumpers for High Density Drive (1.2 MB) JU-475-2CGN

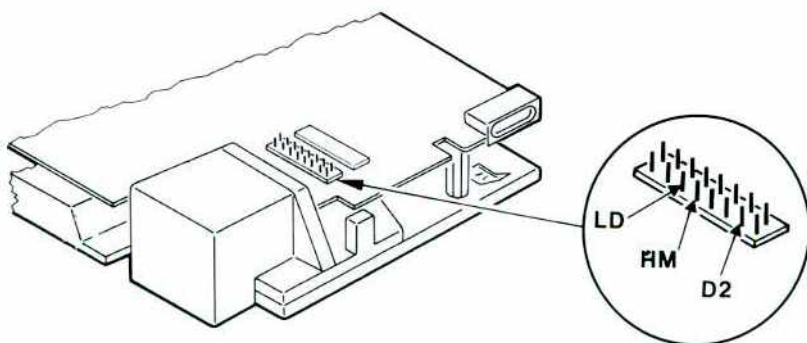


Fig. 3-23 Position of Jumpers for Standard Drive (360 KB) ND-04DT

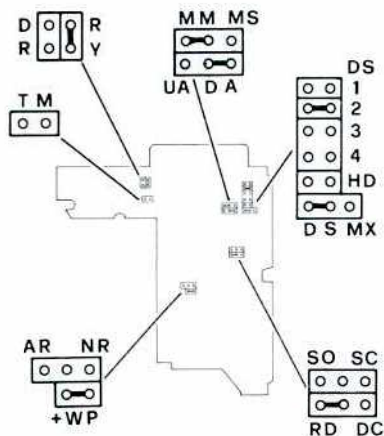


Fig. 3-24 Position of Jumpers for Standard Drive (360 KB) JU-455-5CGN

- Secure the two short guides contained in the kit to the sides of the drive with two screws.

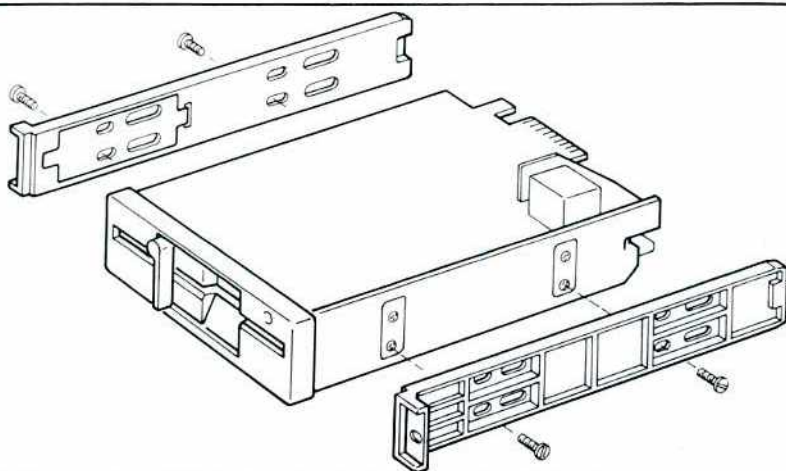


Fig. 3-25 Securing the Guides

OPTION INSTALLATION

4. Insert the second drive in the basic module by sliding it along the guides under the first drive.

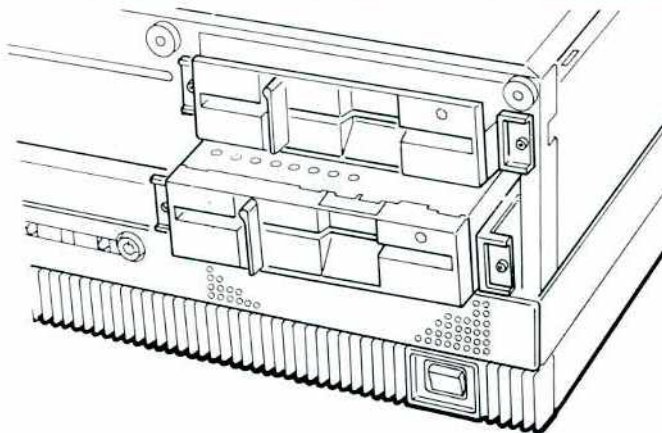


Fig. 3-26 Inserting the Drive

5. Insert the free plug of the signal cable (the flat cable coming from the first drive) into the connector of the second drive.

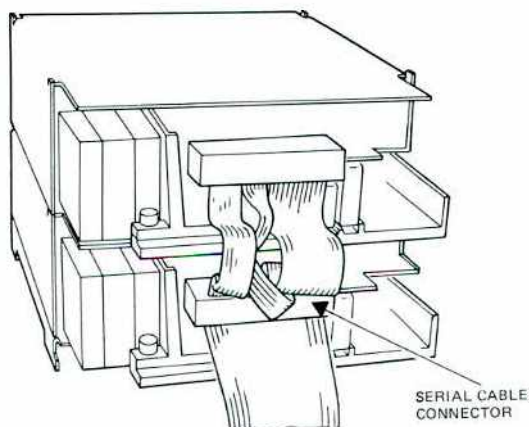


Fig. 3-27 Connecting the Signal Cable

6. Connect the power cable supplied with the second drive from the drive to the connector on the power supply unit.

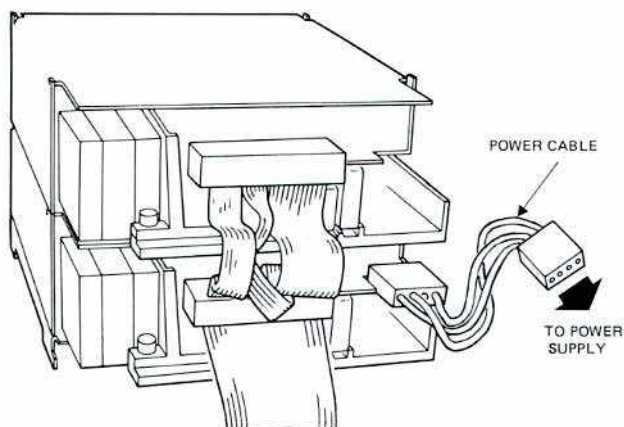


Fig. 3-28 Connecting the Power Cable

7. Using the Philip's screwdriver, secure the second drive onto the basic module chassis by tightening the two screws located on the front panel of the drive.

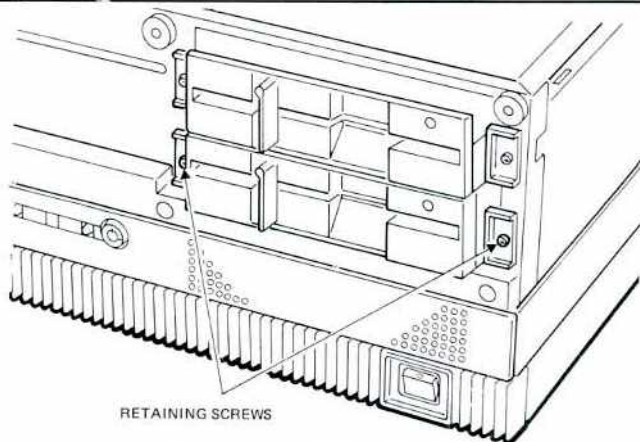


Fig. 3-29 Securing the Drive to the Chassis

OPTION INSTALLATION

8. Unplug the signal cable (flat cable) from the mini-floppy disk controller board.
 9. Using the flat blade screwdriver, loosen the screw securing the board retaining bracket to the basic module rear panel.
-

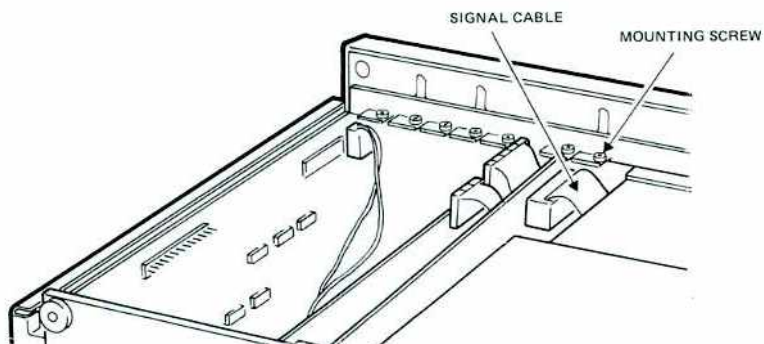


Fig. 3-30 Signal Cable and Board Mounting Screw

10. Hold the board by the top edges and remove it from its slot by pulling it upwards.

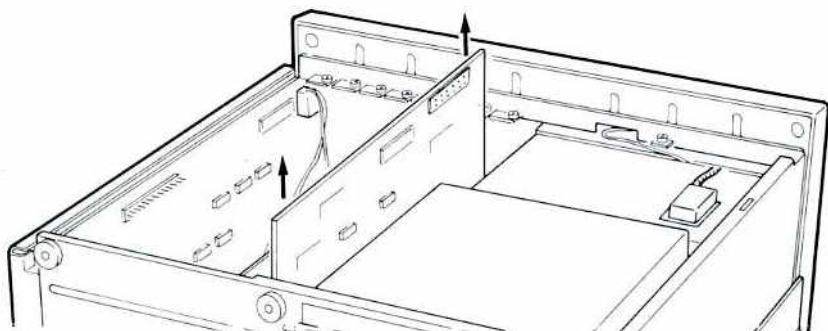


Fig. 3-31 Removing the Controller Board

11. Check that jumpers J5 on the controller board are set correctly:

- From HC to B if the second drive is high-density (1.2 MB)
- From B to ST if the second drive is standard (360 KB).

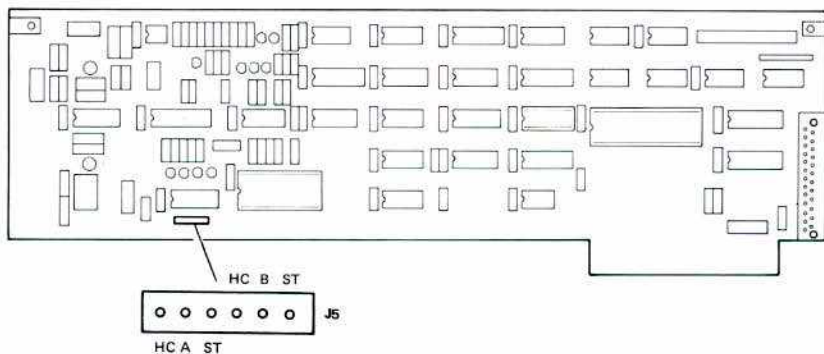


Fig. 3-32 Position of J5 Jumpers of the Controller Board

OPTION INSTALLATION

12. Hold the controller board by the top edges and reinsert in its original position by pushing it firmly into the slot in the bus expansion board. Note that the controller board chips must be turned towards the drive slot.

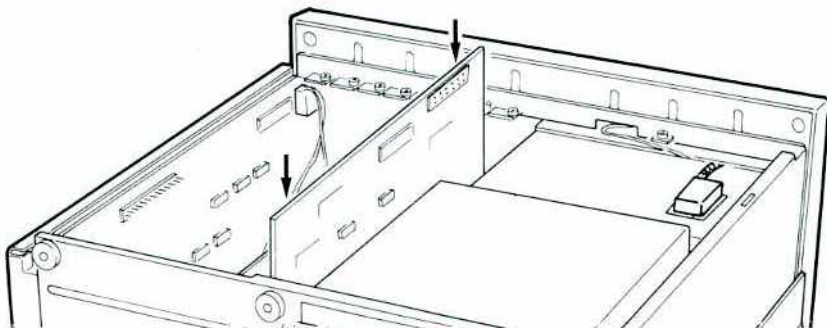


Fig. 3-33 Inserting the Controller Board

13. With the flat blade screwdriver, tighten the retaining bracket mounting screw to the basic module rear panel.

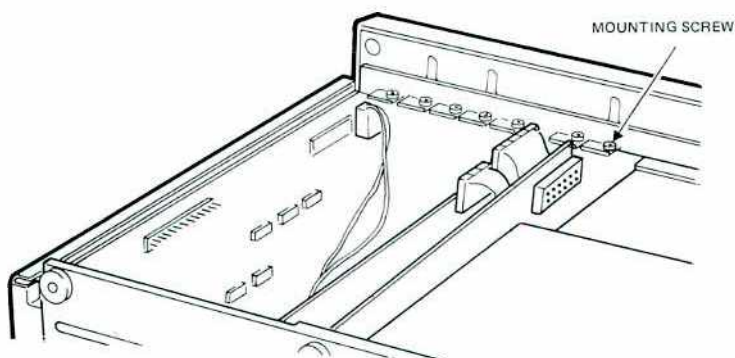


Fig. 3-34 Securing the Board

14. Reinsert the signal cable (flat cable) plug into the controller board connector.
-

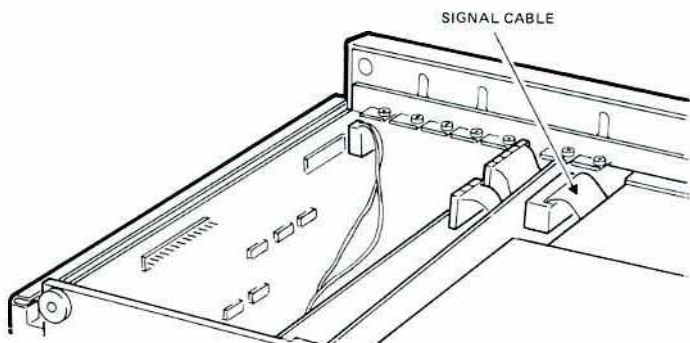


Fig. 3-35 Connecting the Signal Cable to the Controller Board

15. Remount the basic module top cover and reconnect as described in the relevant sections.

OPTION INSTALLATION

INSTALLING THE SECOND MINI-FLOPPY DISK DRIVE IN THE EXPANSION BOX

This section describes how to install the second mini-floppy disk drive in the expansion box.

Note: The procedure set out below applies to either a second high density drive (1.2 MB) or to a second standard drive (360 KB). At the end of the installation procedure, the System Setup program must be run.

MATERIAL REQUIRED

- System with one mini-floppy disk drive
- Expansion box with tape drive
- Second mini-floppy disk drive
- Guides
- Medium sized flat blade screwdriver
- Philip's screwdriver

INSTALLATION PROCEDURE

1. Set the power switch on the basic module to OFF.
 2. Unplug the power cable.
 3. Remove the expansion box top cover by loosening the two screws at the back of the box and the screw at the bottom, sliding it towards the front of the box and then lifting it out.
-

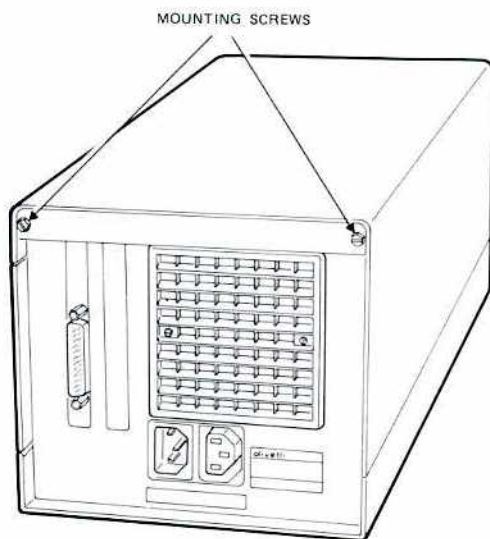


Fig. 3-36 Rear Mounting Screws

OPTION INSTALLATION

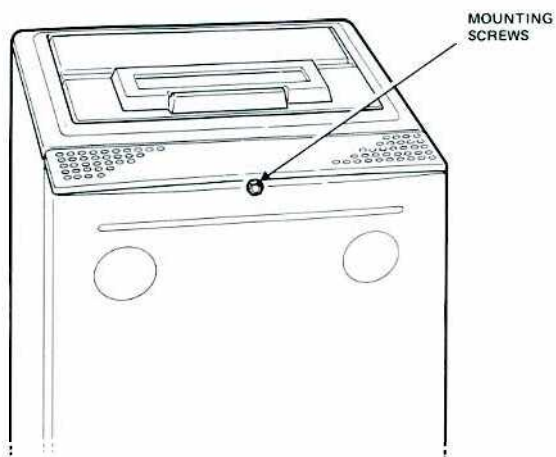


Fig. 3-37 Lower Mounting Screws

4. Remove the drive slot cover from the expansion box top cover by loosening the three mounting screws inside the top cover. Reinsert the screws in their original position once the slot cover has been removed.

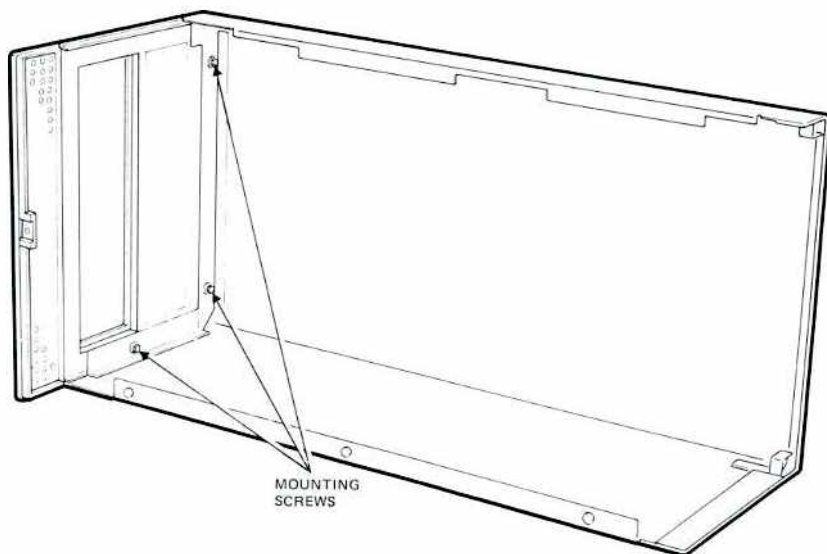


Fig. 3-38 Slot Cover Mounting Screws

OPTION INSTALLATION

5. Loosen the two mounting screws from the metal plate covering the inside of the expansion box and remove the cover from the box.

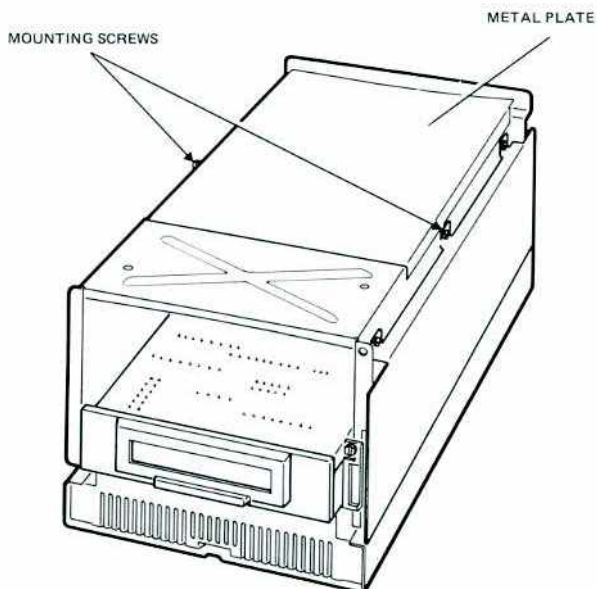


Fig. 3-39 Metal Plate Mounting Screws

6. Check that the second drive is set correctly for installation:

- For high density drives (1.2 MB) ND-08DE, jumpers D2, LD, DE, DC and HM only must be present
- For high density drives (1.2 MB) JU-475-2CGN, jumpers DS2, DS, DC, AT, CX, SP, DA and MM only must be present
- For standard drives (360 KB) ND-04DT, jumpers D2, LD and HM only must be present
- For standard drives (360 KB) JU-455-5CGN, jumpers RY, DS2, MM, WP, RD, DS and DA only must be present.

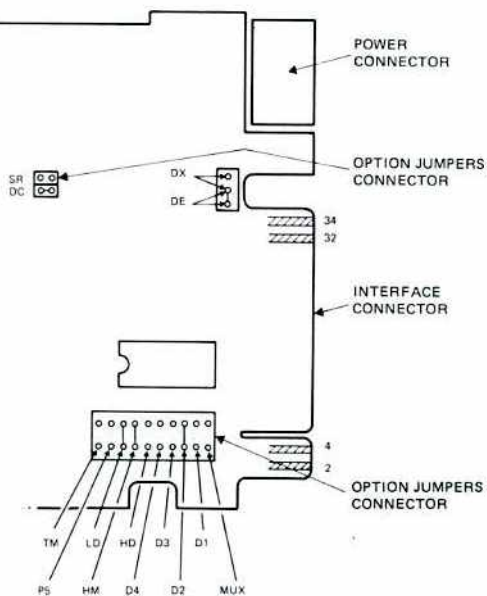


Fig. 3-40 Position of Jumpers for High Density Drive (1.2 MB) ND-08DE

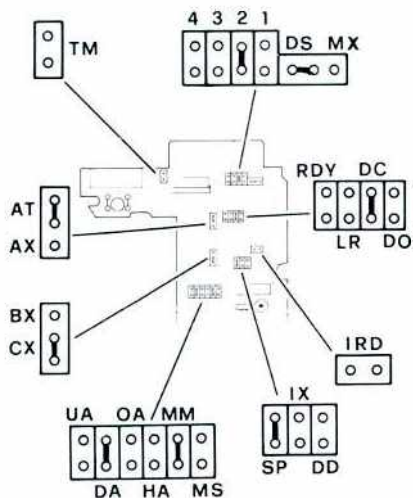


Fig. 3-41 Position of Jumpers for High Density Drive (1.2 MB) JU-475-2CGN

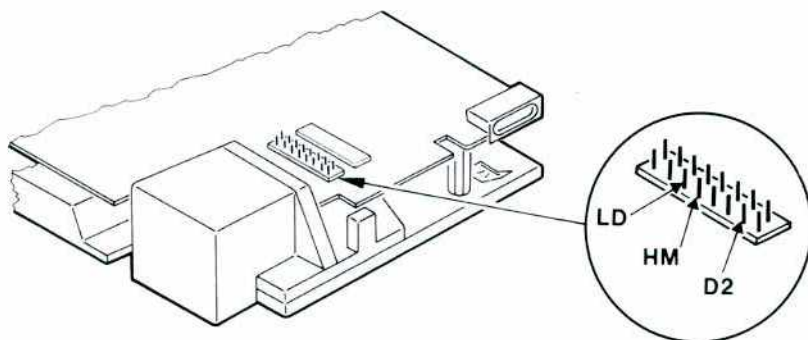


Fig. 3-42 Position of Jumpers for Standard Drive (360 KB) ND-04DT

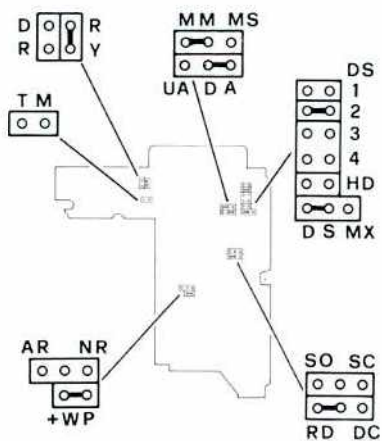


Fig. 3-43 Position of Jumpers for Standard Drive (360 KB) JU-455-5CGN

7. Secure the two short guides contained in the kit to the sides of the drive with two screws.

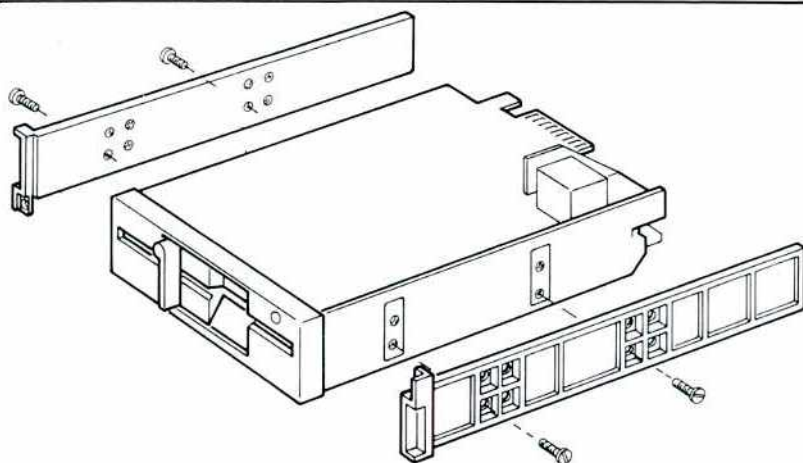


Fig. 3-44 Securing the Guides

OPTION INSTALLATION

8. Insert the second drive in the expansion box by sliding it along the guides above the tape drive.
-

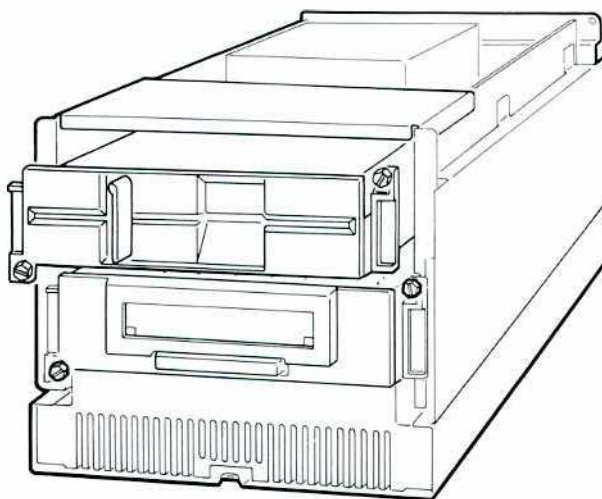


Fig. 3-45 Inserting the Drive

9. Insert the free plug of the signal cable (the flat cable coming from the tape drive) into the connector of the disk drive.

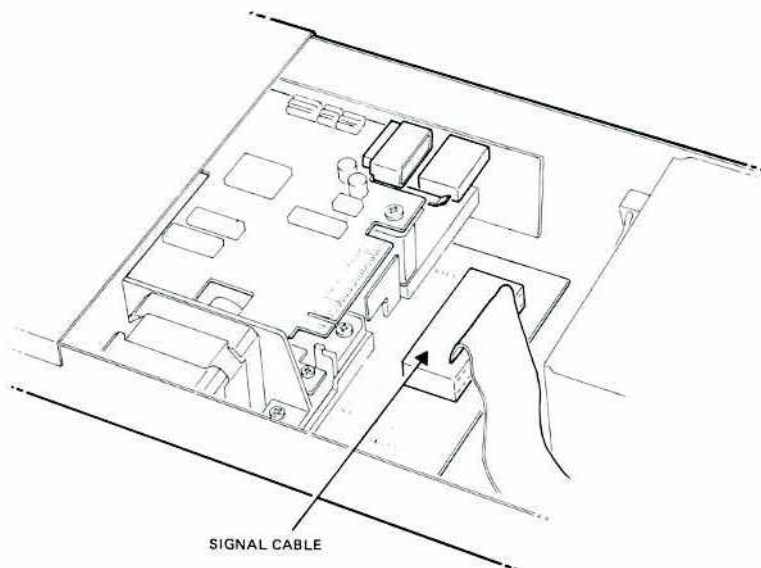


Fig. 3-46 Connecting the Signal Cable

OPTION INSTALLATION

10. Connect the power cable from the power supply to the corresponding drive connector.
 11. Connect the power supply ground cable to the drive connector.
-

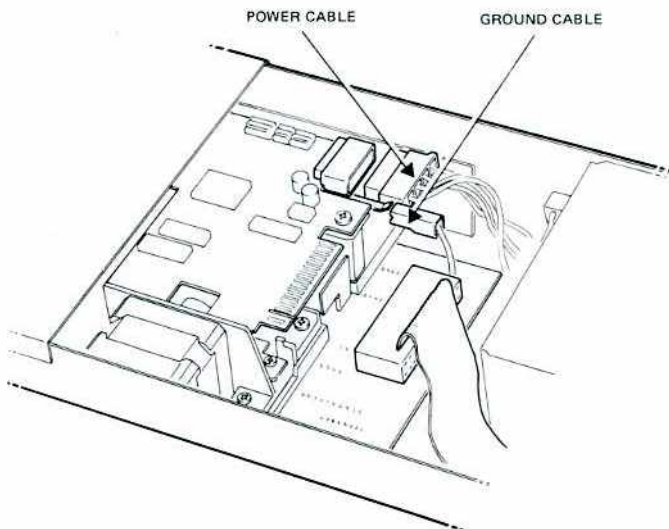


Fig. 3-47 Connecting the Power and Ground Cables

12. Using the Philip's screwdriver, secure the drive onto the expansion box chassis by tightening the two screws located on the front panel of the drive.
-

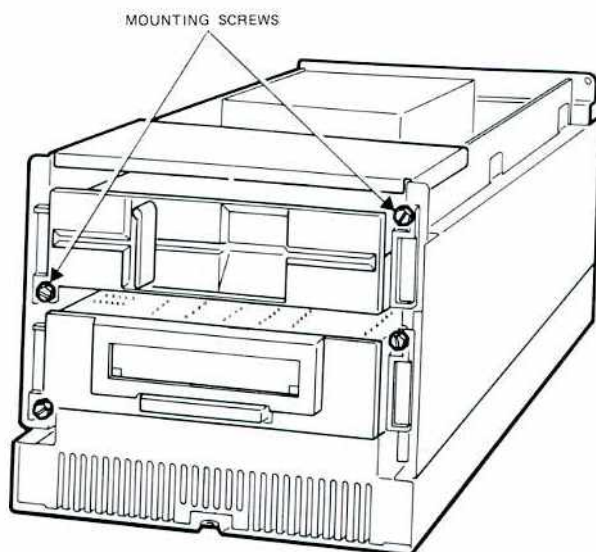


Fig. 3-48 Securing the Drive to the Chassis

OPTION INSTALLATION

13. Replace the metal cover and then the top cover of the expansion box.
14. Remove the top cover of the basic module as described in the relevant section.
15. Unplug the signal cable (flat cable) from the mini-floppy disk controller board.
16. Using the flat blade screwdriver, loosen the screw securing the board retaining bracket to the basic module rear panel.

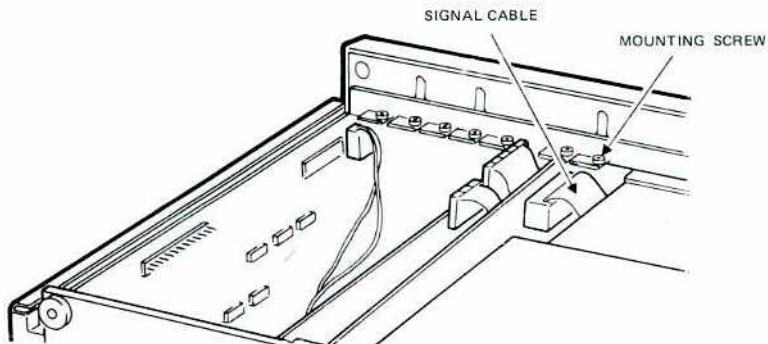


Fig. 3-49 Signal Cable and Board Mounting Screw

17. Hold the board by the top edges and remove it from its slot by pulling it upwards.

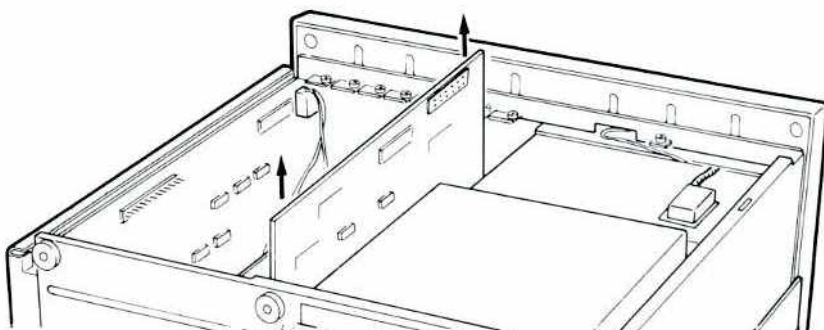


Fig. 3-50 Removing the Controller Board

18. Check that jumpers J5 on the controller board are set correctly:

- From HC to B if the second drive is high-density (1.2 MB)
- From B to ST if the second drive is standard (360 KB).

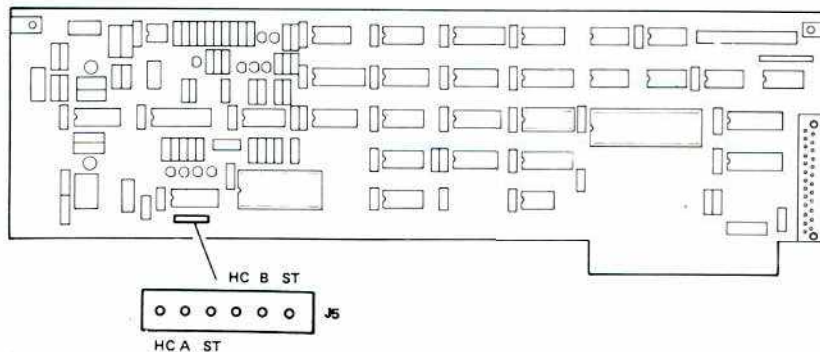


Fig. 3-51 Position of J5 Jumpers of the Controller Board

OPTION INSTALLATION

19. Hold the controller board by the top edges and reinsert it in its original position by pushing it firmly into the slot in the bus expansion board. Note that the controller board chips must be turned towards the drive slot.

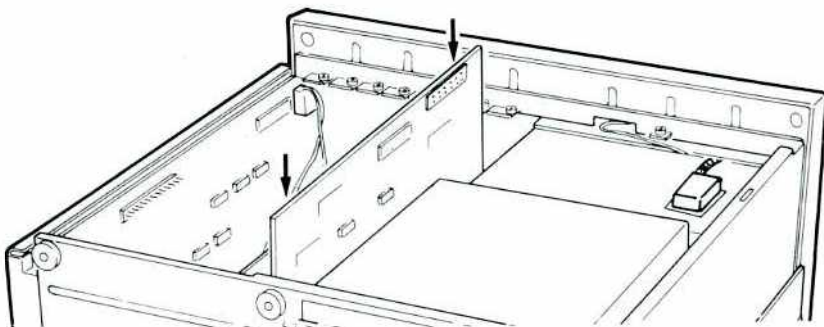


Fig. 3-52 Inserting the Controller Board

20. With the flat blade screwdriver, tighten the retaining bracket mounting screw to the basic module rear panel.

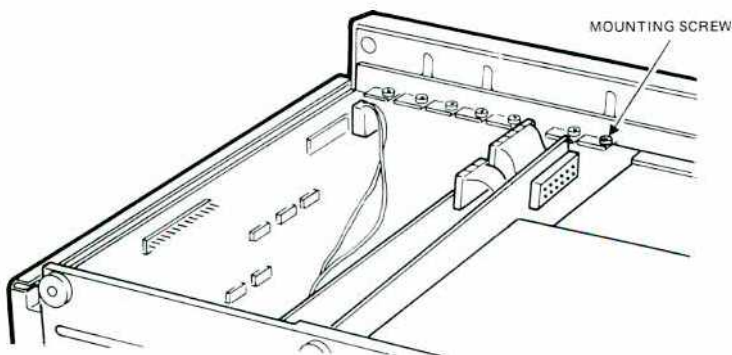


Fig. 3-53 Securing the Board

21. Reinsert the signal cable (flat cable) plug into the controller board connector.
-

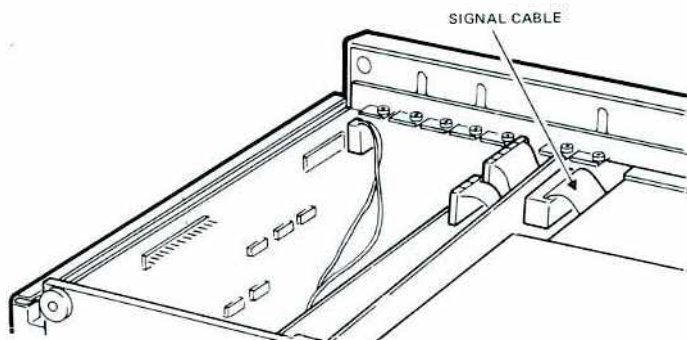


Fig. 3-54 Connecting the Signal Cable to the Controller Board

22. Remount the basic module top cover and reconnect as described in the relevant sections.

OPTION INSTALLATION

INSTALLING THE 80287 NUMERIC PROCESSOR EXTENSION

This section describes the installation procedure for the 80287 numeric processor extension (NPX). Read the instructions carefully to ensure a smooth and easy connection.

Note: the System Setup program must be run at the end of the installation procedure.

MATERIAL REQUIRED

- 80287 NPX
- Medium sized flat blade screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module bottom cover as described in the relevant section.
 2. Locate the socket in which the 80287 is to be inserted.
-

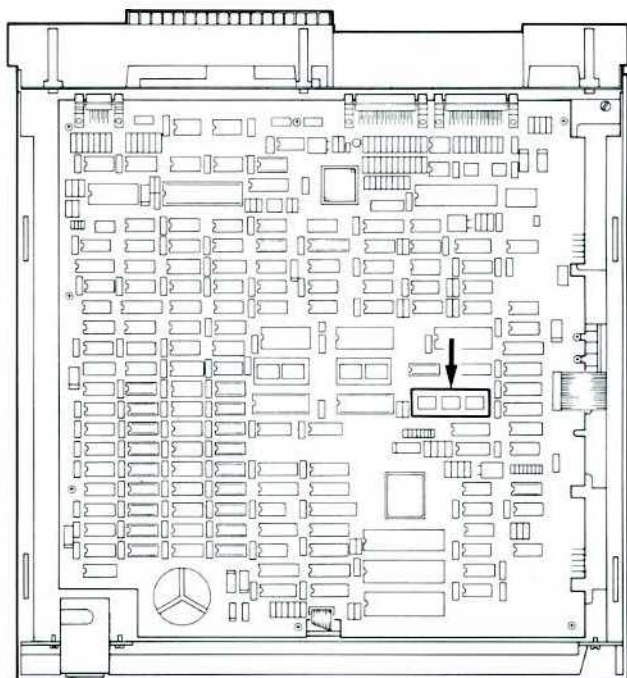


Fig. 3-55 Location of 80287 Socket

3. Align the 80287 chip pins with the socket and gently insert the chip into the socket. Ensure that pin 1 of the chip is located in the same direction as pin 1 of the other chips already installed on the motherboard.

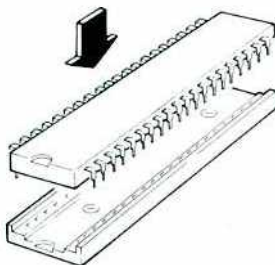


Fig. 3-56 Chip Insertion

4. Set jumpers 1-16, 2-15, 3-14 and 4-13 of JU2 on the motherboard in accordance with the clock required for the NPX (see Chapter 2).

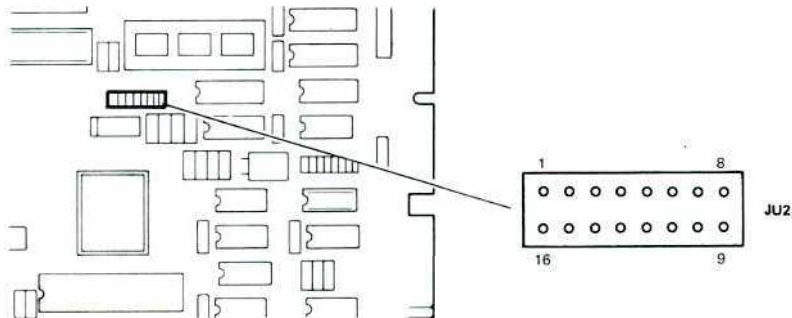


Fig. 3-57 JU2

5. Remount the basic module bottom cover and reconnect the basic module as described in the relevant sections.

INSTALLING THE MOUSE ADAPTER

This section describes the installation procedure for the mouse adapter. Follow the instructions carefully for a smooth and easy installation.

MATERIAL REQUIRED

- Mouse adapter

INSTALLATION PROCEDURE

1. Set the power switch on the basic module and all external devices to OFF.
2. With the keyboard turned towards the operator in normal working position, locate the protective plastic cover of the adapter connector.

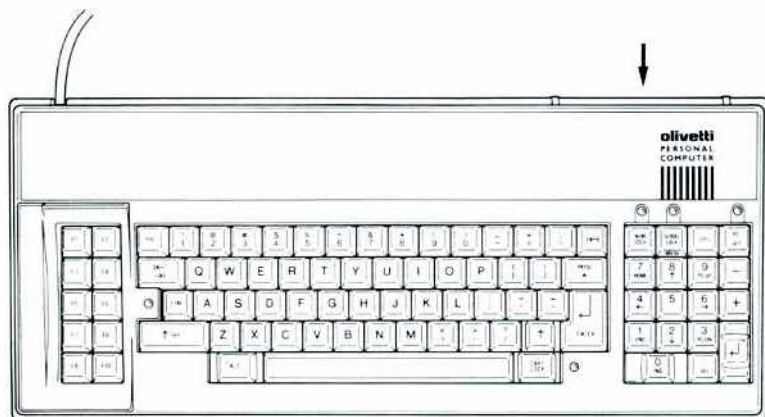


Fig. 3-58 Locating the Mouse Adapter Connector

OPTION INSTALLATION

3. Remove the protective plastic cover from the keyboard.
-

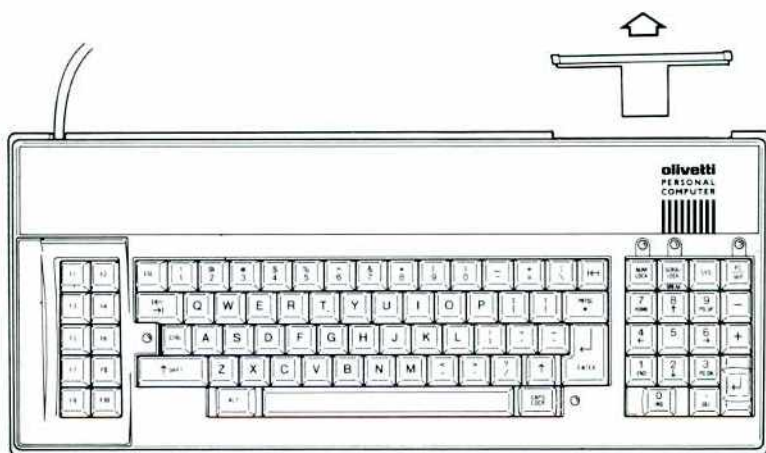


Fig. 3-59 Removing the Protective Plastic Cover

4. By exerting uniform pressure, insert the mouse adapter in the keyboard connector.
-

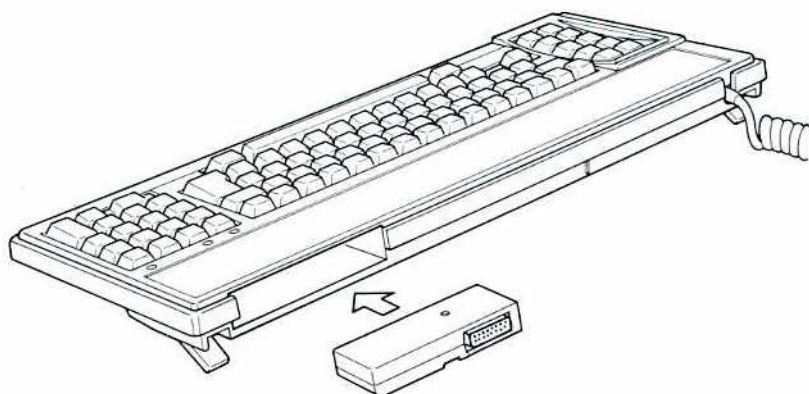


Fig. 3-60 Inserting the Mouse Adapter

Note: The keyboard is now ready for a mouse to be inserted into the connector protruding from the adapter.

INSTALLING THE MULTIPOINT BOARD (SIC 2832)

This section describes the installation procedure for the multipoint board (SIC 2832). Read the instructions carefully to ensure a smooth and easy connection.

MATERIAL REQUIRED

- Multipoint board
- Extension cable with standard 25-pin connectors
- Medium sized flat blade screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module top cover as described in the relevant section.
2. Set the switches on the board as shown in the figure below. Note that the setting changes according to whether a single board or two boards are installed in the system.

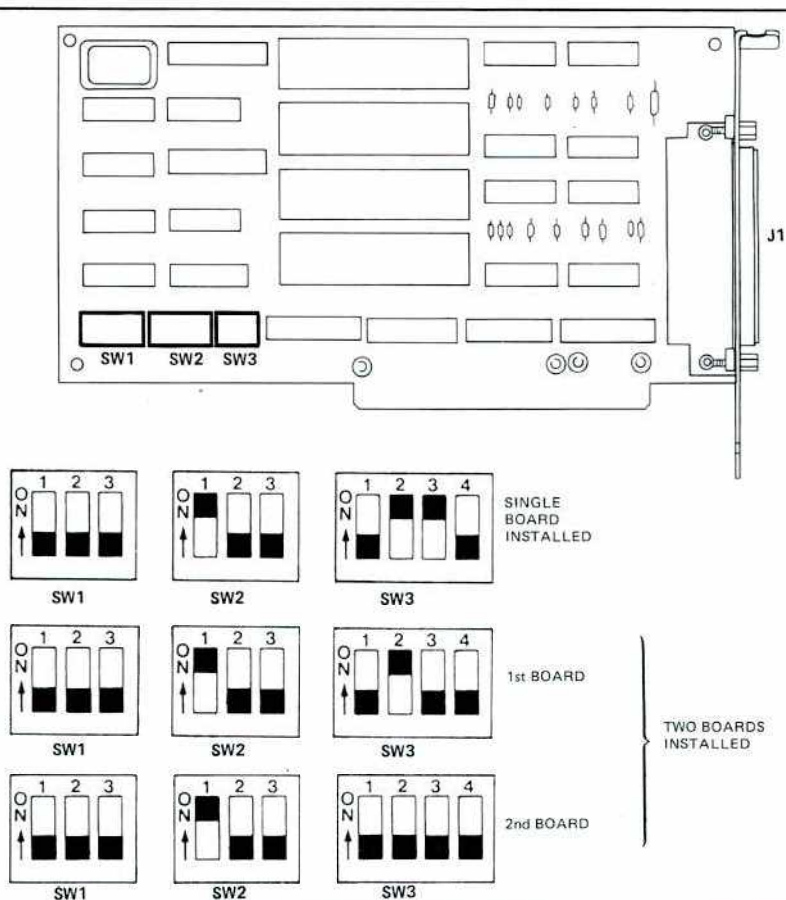


Fig. 3-61 Multiport Board DIP-switch Settings

OPTION INSTALLATION

3. Identify the position in which the multiport board can be inserted, insert it and secure it as described in the relevant sections.
4. Replace the basic module top cover as described in the relevant section.
5. Plug connector J5 of the cable supplied with the kit into the multiport board socket protruding from the rear panel and tighten the two screws of the connector to ensure connection. Four different serial devices can now be connected to the other four connectors of the cable.

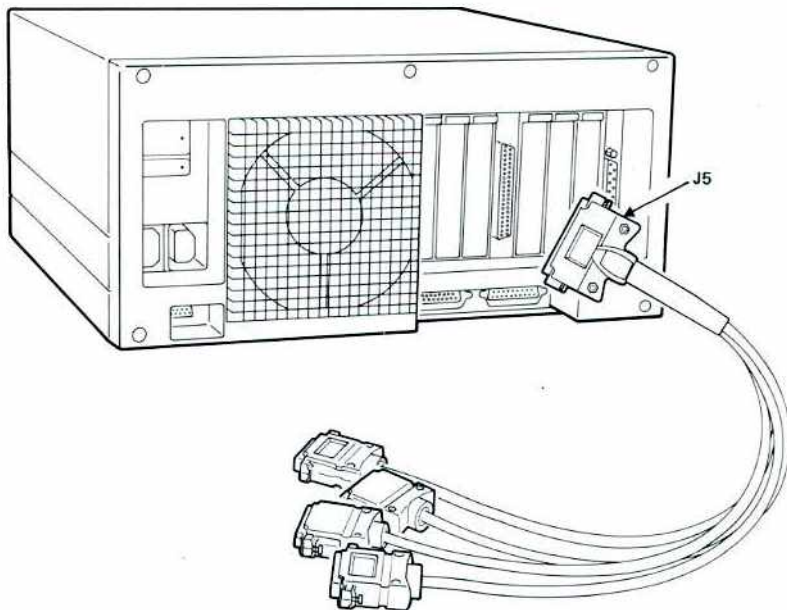


Fig. 3-62 Connection of the Cable to the Board

6. Reconnect the basic module as described in the relevant section.

CONFIGURATION

The multiport board can be configured in various ways by setting DIP-switches SW1, SW2 and SW3. The table below shows the function activated by each switch. For further details on the definition of the switches, refer to the board manual.

SW1 SWITCH NUMBER	FUNCTION ACTIVATED WITH SWITCH IN POSITION ON
1	Interrupt request no. 2 (IRQ2)
2	Interrupt request no. 3 (IRQ3)
3	Interrupt request no. 4 (IRQ4)

SW2 SWITCH NUMBER	FUNCTION ACTIVATED WITH SWITCH IN POSITION ON
1	Interrupt request no. 5 (IRQ5) (Default)
2	Interrupt request no. 6 (IRQ6)
3	Interrupt request no. 7 (IRQ7)

The switches of SW3 are used to establish the operating mode (compatible or expanded) of the board and the I/O addresses the board responds to.

OPTION INSTALLATION

INSTALLING THE TAPE DRIVE

This section describes how to install the tape drive. Read the instructions carefully to ensure a smooth and easy connection.

MATERIAL REQUIRED

- PC with a single mini-floppy disk drive
- Tape drive
- Power cable
- Philip's screwdriver
- Medium sized flat blade screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module top cover as described in the relevant section.
2. Remove the plastic cover of the third expansion slot on the top cover by pressing it firmly towards the back.
3. Check that the tape drive is set correctly for installation. Jumper DS4 must be installed on pins ~~7~~ and ~~8~~. The jumper between pins 9 and 10 must not be installed. Check that resistor A is not installed.

3 5 or 4

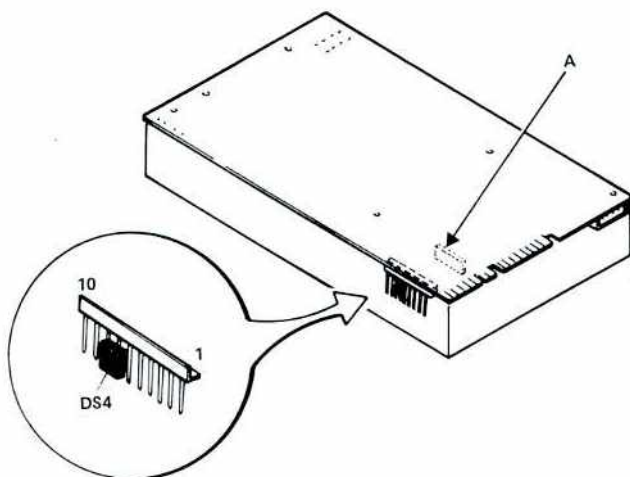


Fig. 3-63 Tape Drive Jumpers and Resistor

OPTION INSTALLATION

4. Insert the tape drive in the basic module by sliding it along the guides under the mini-floppy disk drive.

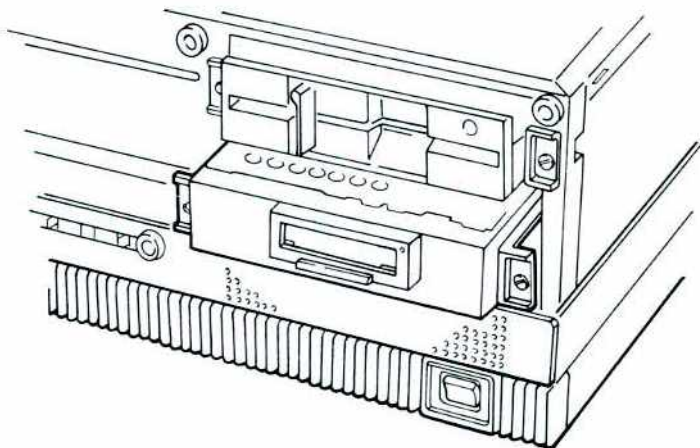


Fig. 3-64 Inserting the Tape Drive

5. Plug the free connector of signal cable B (the flat cable from the mini-floppy disk drive) into the tape drive socket, with the words "THIS SIDE UP" facing upwards.
6. Connect power cable C, supplied with the kit, from the tape drive to power supply connector D.

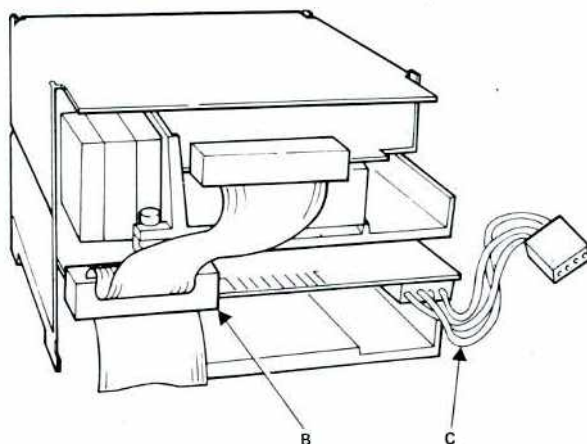


Fig. 3-65 Tape Drive Connections

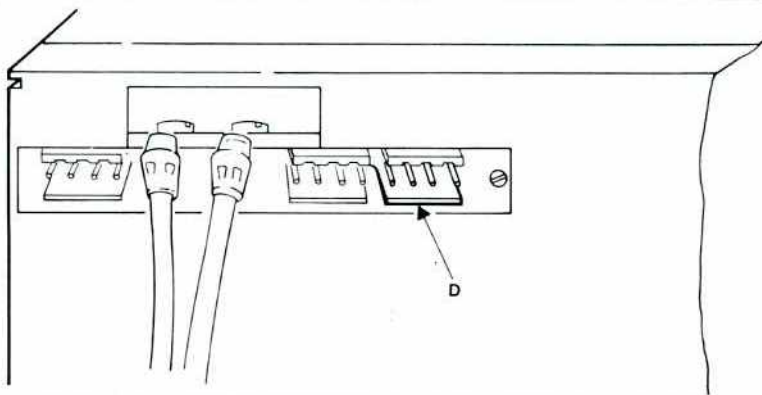


Fig. 3-66 Power Supply Connector

OPTION INSTALLATION

7. Using the Philip's screwdriver, secure the tape drive to the basic module by tightening the two screws E located on the front panel of the drive.

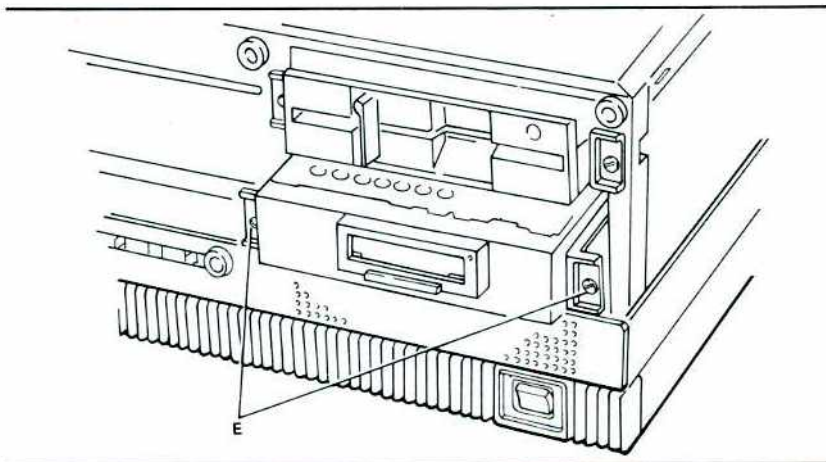


Fig. 3-67 Inserting and Securing the Tape Drive

8. Remount the basic module top cover and reconnect as described in the relevant sections.

INSTALLING THE EXPANSION GRAPHICS AND COLOUR BOARD (EGC)

This section describes how to install the EGC board. Read the instructions carefully to ensure a smooth and easy connection.

Note: the System Setup program must be run at the end of the installation procedure.

MATERIAL REQUIRED

- EGC board
- Flat cable with 50-pin connectors
- 3-way jumper
- Medium sized flat blade screwdriver

OPTION INSTALLATION

INSTALLATION PROCEDURE

1. Remove the basic module top and bottom covers as described in the relevant sections.
2. Locate jumper block JU2 on the motherboard, remove jumper 5-12 and insert jumper 6-11.

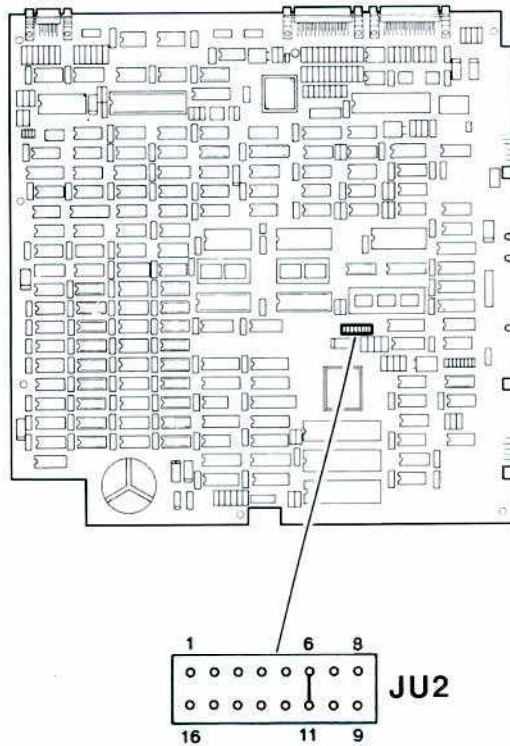


Fig. 3-68 Motherboard Jumpers JU2

3. Locate jumper block A and jumper W2 on the indigenous display controller board. Insert jumpers 4-5-6 and 2-3 on block A, and jumper 2-3 on jumper W2.

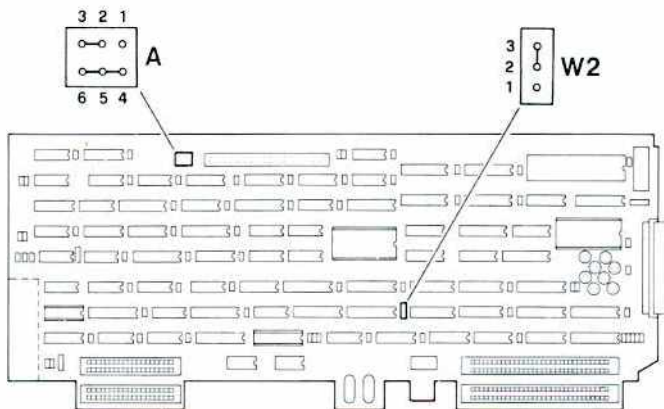


Fig. 3-69 Display Controller Jumpers

4. Ensure that the jumpers on the EGC board are connected correctly according to the table below:

JUMPER	POSITION	FUNCTION
A	present not present	Only one monitor connected to the system Two monitors connected to the system
C	C-1 C-2	For all PC systems For future applications
1G (or 7F)	1-2 2-3	For board installed in other systems For board installed in this system

OPTION INSTALLATION

5. If a colour display is connected to the EGC board, go on to step 7; if a monochrome display is connected, locate the +15 VDC power supply connector J7 on the top right-hand corner of the display controller board.

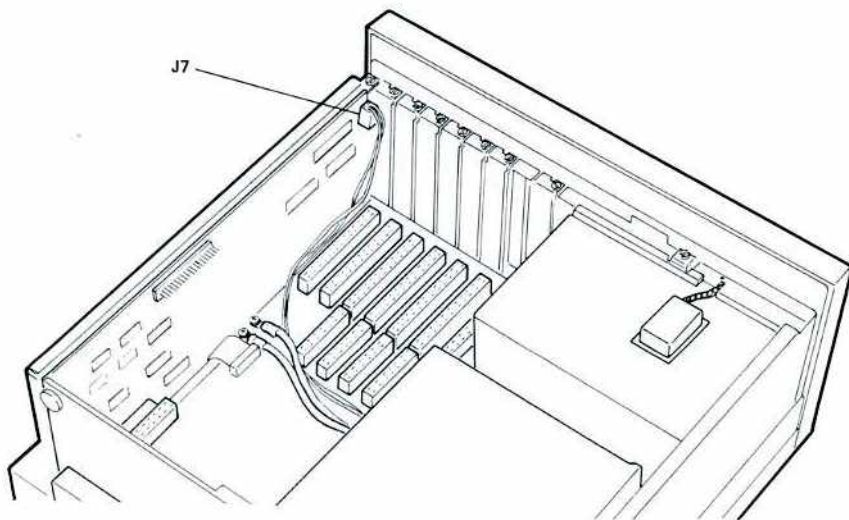


Fig. 3-70 Position of Connector J7

6. Unplug this connector from the display controller board and connect it to connector J4 of the EGC board.
-

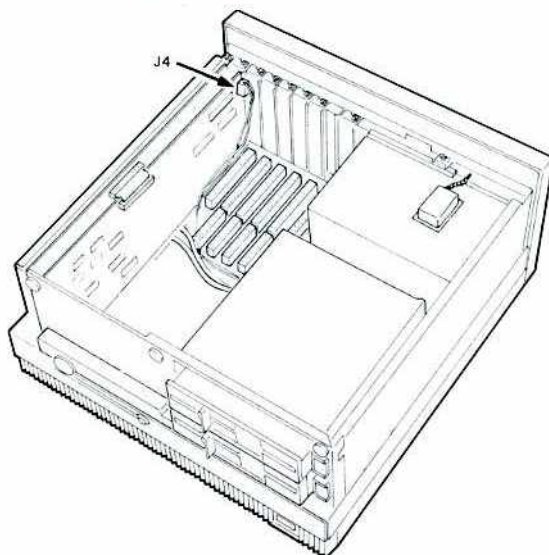


Fig. 3-71 Position of Connector J4

OPTION INSTALLATION

7. Identify the position in which the EGC board can be installed, insert it and secure it as described in the relevant sections.
 8. Connect one end of the flat cable supplied with the kit to connector J6 of the display controller board and the other end to connector J3 of the EGC board.
-

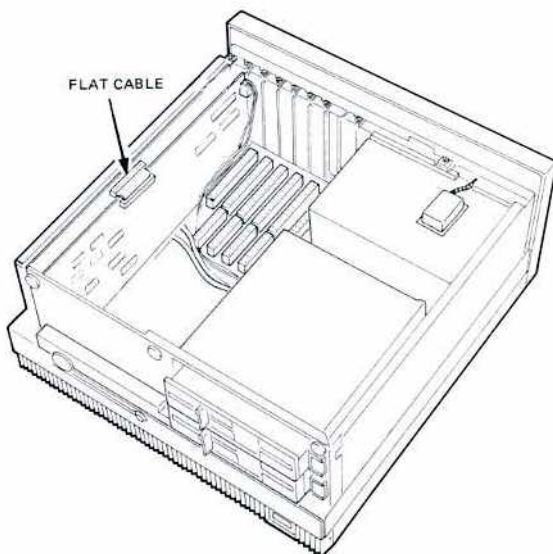


Fig. 3-72 Connecting the Flat Cable

9. Replace the basic module top and bottom covers as described in the relevant sections.
10. Recable the system as described in the relevant section by connecting the display signal cable to the EGC board connector protruding from the rear panel of the basic module.

INSTALLING THE MEMORY EXPANSION BOARD

This section describes how to install the memory expansion board. Read the instructions carefully to ensure a smooth and easy connection.

The Memory Expansion Board may be installed into a system with 512 KB of memory on the motherboard or into a system with 1 MB of memory on the motherboard. The following installation procedure describes the switch settings for both configurations but assumes that if other Memory Expansion boards are already installed in the system, they are configured to their full capacity (2 MB).

Note: the System Setup program must be run at the end of the installation procedure.

MATERIAL REQUIRED

- M28 PC System
- Memory expansion board
- Medium sized flat blade screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module top cover as described in the relevant section.
2. Set the switches on the board in accordance with the tables below (note that the setting shown is with reference to a memory expansion board with 512 KB of RAM; for boards with greater memory size, refer to the section "Upgrading Memory Expansion Board").

1	SW1		4
	2	3	
XX	ON	OFF	OFF

SW 2 defines the starting address of the memory expansion board. The setting of this switch depends on the system configuration.

The following table shows the switch 2 settings for the first, second and third memory expansion boards installed in a 512 KB system.

OPTION INSTALLATION

Board No.	SW2 SETTINGS							
	8	7	6	5	4	3	2	1
1	OFF	ON	ON	ON	OFF	ON	ON	ON
2	OFF	ON	ON	OFF	OFF	ON	ON	ON
3	OFF	ON	OFF	ON	OFF	ON	ON	ON

The table below show the switch 2 settings for the first, second and third memory expansion boards installed in a 1 MB system.

Board No.	SW2 SETTINGS							
	8	7	6	5	4	3	2	1
1	OFF	ON	ON	ON	OFF	ON	OFF	OFF
2	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
3	OFF	ON	OFF	ON	OFF	ON	OFF	OFF

where: ON = switch in ON position
 OFF = switch in OFF position
 XX = switch not used

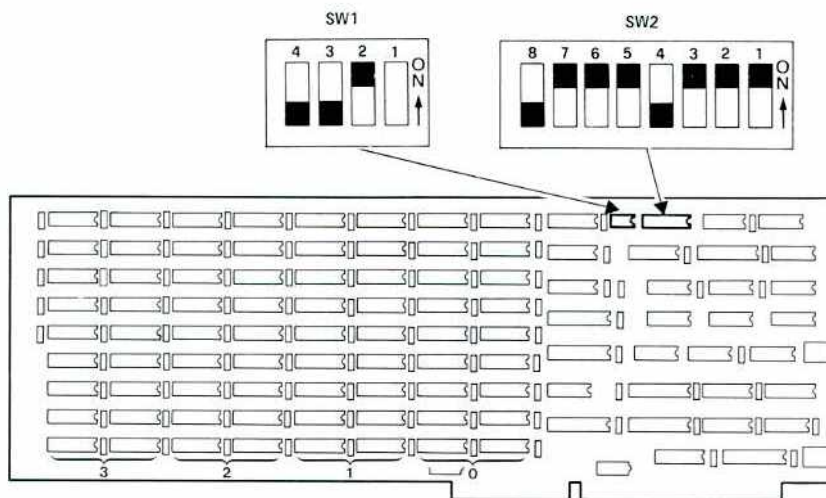


Fig. 3-73 Memory Expansion Board Switches

3. Identify the position in which the board can be installed, insert it and secure it as described in the relevant sections.
4. Replace the basic module top cover as described in the relevant sections.
5. Recable the system as described in the relevant section.

OPTION INSTALLATION

CONFIGURATIONS

This section describes the meaning of the various switches on the memory expansion board. For further information on their meaning, refer to the relevant manual.

SW1	POSITION	DESCRIPTION
1	---	Not used
2	OFF ON	Parity control disabled Parity control enabled
3 - 4	OFF - OFF	Banks 1, 2 and 3 disabled (board with 512 KB)
	ON - OFF	Banks 2 and 3 disabled (board with 1 MB)
	OFF - ON	Bank 3 (board with 1.5 MB)
	ON - ON	All banks enabled (board with 2 MB)

The first seven switches of SW2 establish the start address according to the following criteria:

- Switches 4, 5, 6 and 7 establish the start megabyte
- Switches 1, 2 and 3 establish the megabyte fraction.

This can be seen in detail in the table below:

SW2				START ADDRESS (megabyte)
4	5	6	7	
ON	ON	ON	ON	1 MB
OFF	ON	ON	ON	1 MB plus fraction
ON	OFF	ON	ON	2 MB plus fraction
OFF	OFF	ON	ON	3 MB plus fraction
ON	ON	OFF	ON	4 MB plus fraction
OFF	ON	OFF	ON	5 MB plus fraction
ON	OFF	OFF	ON	6 MB plus fraction
OFF	OFF	OFF	ON	7 MB plus fraction
ON	ON	ON	OFF	8 MB plus fraction
OFF	ON	ON	OFF	9 MB plus fraction
ON	OFF	ON	OFF	10 MB plus fraction
OFF	OFF	ON	OFF	11 MB plus fraction
ON	ON	OFF	OFF	12 MB plus fraction
OFF	ON	OFF	OFF	13 MB plus fraction
ON	OFF	OFF	OFF	14 MB plus fraction

1	SW2		START ADDRESS (fraction of megabyte)
	2	3	
ON	ON	ON	0.000 MB
OFF	ON	ON	0.128 MB
ON	OFF	ON	0.256 MB
OFF	OFF	ON	0.384 MB
ON	ON	OFF	0.512 MB
OFF	ON	OFF	0.640 MB
ON	OFF	OFF	0.768 MB
OFF	OFF	OFF	0.896 MB

Switch 8 of SW2 establishes the board operating mode; if it is set to OFF, "direct" operating mode is enabled; if it is set to ON, "split" operating mode is enabled.

OPTION INSTALLATION

UPGRADING MEMORY EXPANSION BOARD

This section describes the installation procedures to upgrade the memory on the memory expansion board. Read the instructions carefully to ensure a smooth and easy connection.

Note that the memory expansion board is upgraded in the normal way, that is, first bank 1, then bank 2 and lastly bank 3.

Note: the System Setup program must be run at the end of the installation procedure in order to define the correct contents of the CMOS-RAM. The correct memory size is automatically defined simply by calling the System Setup and then exiting by pressing the ESC key.

MATERIAL REQUIRED

- System with 1 MB of RAM on motherboard
- 1 or more memory expansion kits
- Medium sized flat blade screwdriver

INSTALLATION PROCEDURE

1. Remove the basic module top cover as described in the relevant section.
2. Remove the memory expansion board to be upgraded by loosening the mounting screw on the basic module rear panel.

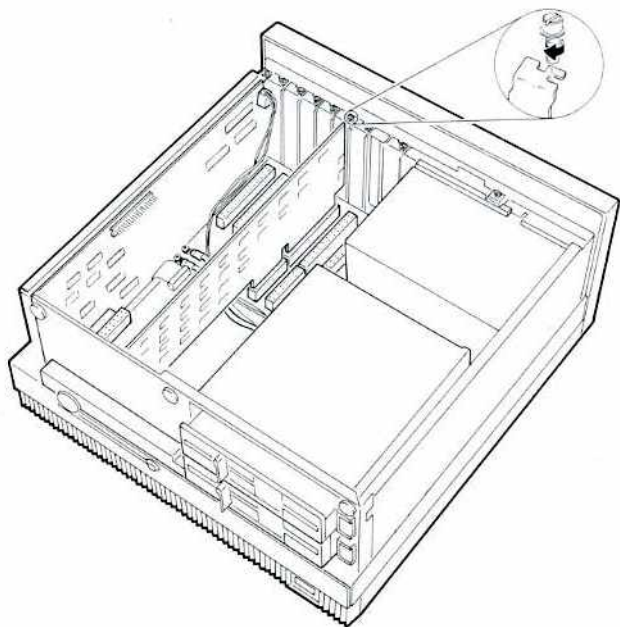


Fig. 3-74 Removing the Memory Expansion Board

OPTION INSTALLATION

3. Locate the first empty bank on the board.

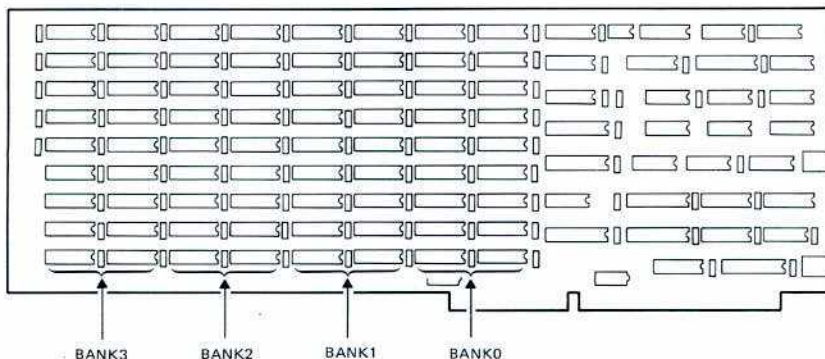


Fig. 3-75 Location of Banks on the Board

4. When installing the 256Kx1 memory chips in the sockets, ensure that pin 1 of the chip is located in the same direction as pin 1 of the other memory chips already installed in bank 0.

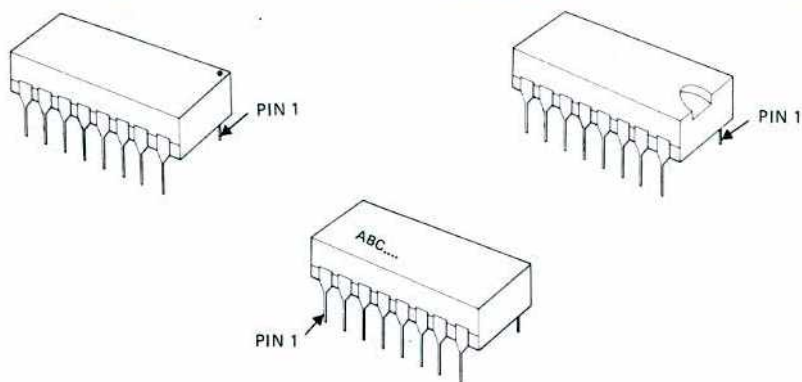


Fig. 3-76 Pin 1 Location on Various ICs

5. Align the RAM pins (A) with the socket (B) and gently insert the RAM chips into the socket.
-

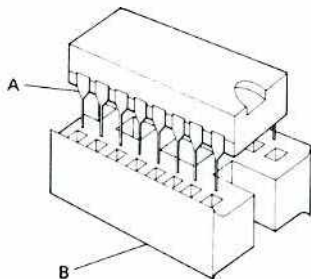


Fig. 3-77 Chip Insertion

6. Repeat step 5 for the remaining 17 sockets in the bank to be filled.
7. Repeat steps 3 to 6 for the other memory upgrading kits.

OPTION INSTALLATION

8. Set switches 3 and 4 of SW1 as shown in the table below according to the configuration of the upgraded board:

FINAL BOARD CONFIGURATION	SWITCH SETTINGS	
	3	4
1 MB	ON	OFF
1,5 MB	OFF	ON
2 MB	ON	ON

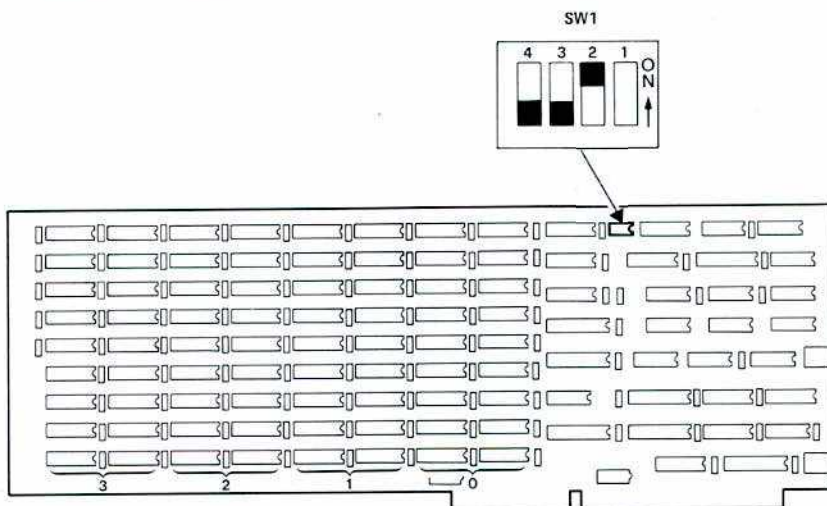


Fig. 3-78 Location of SW1

9. Reinsert the memory expansion board in its original slot by securing it to the rear panel with the screw removed in step 1.
-

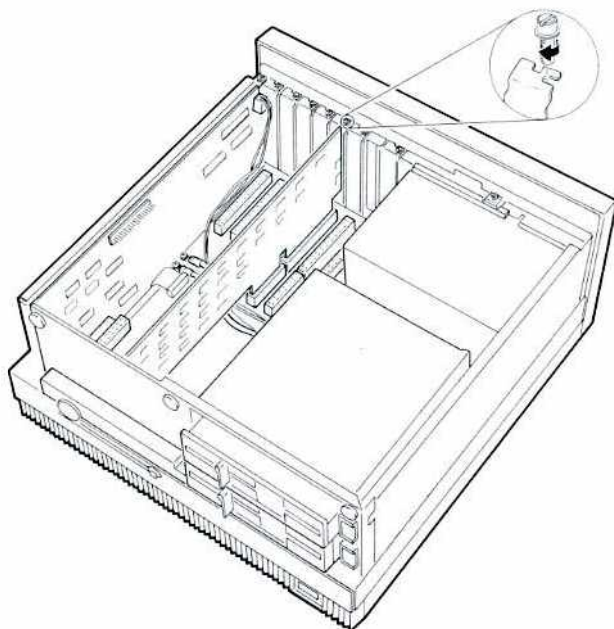


Fig. 3-79 Inserting the Board in the Basic Module

10. Replace the basic module top cover and reconnect the basic module as described in the relevant sections.

4. POWER-UP DIAGNOSTICS

CONTENTS

PAGE

4. POWER-UP DIAGNOSTICS

4-1	<u>INTRODUCTION</u>
4-1	<u>MAIN CHARACTERISTICS OF THE TESTS</u>
4-3	<u>REQUIREMENTS FOR CORRECT TEST EXECUTION</u>
4-4	<u>OPERATING PROCEDURES</u>
4-5	<u>FUNCTIONAL DESCRIPTION OF THE POWER-UP DIAGNOSTICS</u>
4-6	SHUTDOWN DIAGNOSTICS
4-6	PRIMITIVE DIAGNOSTICS
4-6	ADVANCED DIAGNOSTICS
4-6	CONFIGURATION DIAGNOSTICS
4-7	<u>DETAILED DESCRIPTION OF THE POWER-UP DIAGNOSTICS</u>
4-8	SHUTDOWN DIAGNOSTICS
4-11	SHUTDOWN DIAGNOSTICS FLOW CHART
4-12	PRIMITIVE DIAGNOSTICS
4-16	PRIMITIVE DIAGNOSTICS FLOW CHART
4-18	ADVANCED DIAGNOSTICS
4-30	ADVANCED DIAGNOSTICS FLOW CHART
4-35	CONFIGURATION DIAGNOSTICS
4-43	CONFIGURATION DIAGNOSTICS FLOW CHART
4-48	PRIMITIVE DIAGNOSTICS ERROR ROUTINE (PDER)
4-49	PDER FLOW CHART
4-50	ADVANCED DIAGNOSTICS ERROR HANDLING ROUTINE (ADER)

PAGE	
4-52	ADER FLOW CHARTS
4-54	BURNIN TEST COMPLETION ROUTINE (BTCR)
4-55	BTCR FLOW CHART
4-56	<u>SUMMARY OF MESSAGES</u>
4-56	MESSAGES DISPLAYED AT THE END OF SUCCESSFUL TESTS
4-57	ERROR MESSAGES
4-63	<u>HOW TO DETERMINE THE FAULTY MEMORY CHIP</u>
4-64	REFERENCE TABLE
4-68	<u>NO ERROR MESSAGES DISPLAYED</u>

INTRODUCTION

The power-up diagnostics are run each time the PC is switched on and when either a hardware reset (by pressing the reset button on the front panel of the basic module) or a software reset (by pressing keys CTRL, ALT and DEL simultaneously) is performed. These programs reside in the BIOS EPROMs and check the functionality of the various system modules in order to ensure a minimum operating level.

MAIN CHARACTERISTICS OF THE TESTS

The main characteristics of the power-up diagnostics are listed below:

- The tests are organized in steps, in such a way that each hardware component is tested before being used to test other hardware.
- Check points clearly indicate the completed steps.
- When each check point has completed successfully, a byte is sent to the parallel port and, for some check points, a message is also displayed on the video
- If an error occurs during the execution of a check point, a byte is sent to the parallel port and an error message is displayed on the video
- The errors are divided into two categories:
 1. Fatal errors
 2. Non-fatal errors

The first type of error affects the correct operation of the system, while with the second type of error the system usually continues to function correctly.

- The diagnostics automatically detect which of the three possible operating environments the system is using, and the diagnostics are accordingly different:
 - a) If the system is in an operating environment, the tests are run automatically without any operator intervention; if a fatal error occurs, the diagnostics stop and only continue when key F1 is pressed
 - b) If the system is in automated test environment, the diagnostics communicate directly with the black box connected, and all errors, except configuration errors, are considered fatal
 - c) If the system is in "burnin" environment, the diagnostics communicate with the burnin controller via the serial port, and all errors, except configuration errors, are considered fatal

- The CMOS-RAM is checked for bad RAM or a low battery condition
- The configuration of the system under test is checked to ensure that it agrees with the configuration contained in the CMOS-RAM; if there are discrepancies, the diagnostics warn the operator to run the System Setup program
- Faults are isolated to component or module level; faults on the motherboard identify the bad component, while faults relative to other boards or peripherals identify the bad module

REQUIREMENTS FOR CORRECT TEST EXECUTION

A minimum number of system components must be functional for the power-up diagnostics to execute. The following components in particular must function:

- The 82284 clock generator
- The 82288 bus controller
- A minimal subset of the 80286 instruction set
- The two BIOS EPROMs
- The address, data and control busses to the EPROMs.

The display controller must also be functional in 80x25 text mode, as well as the display or the parallel port, so that the results of the tests can be communicated.

If the display does not work, the servicing engineer should refer to the machine status shown by the group of LEDs located on the motherboard.

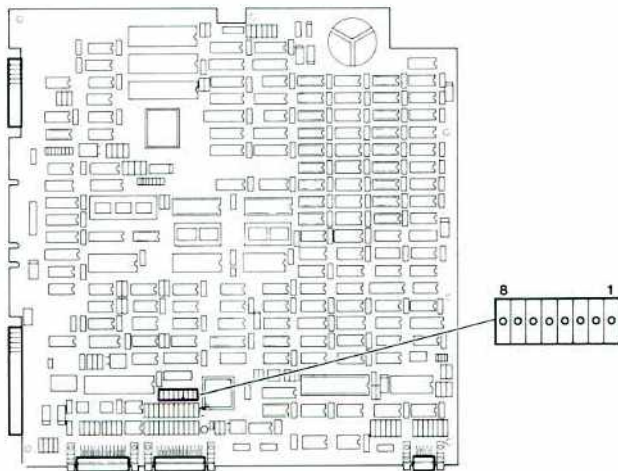


Fig. 4-1 Location of LEDs

OPERATING PROCEDURES

It is recommended to execute the diagnostic tests on power-up and the system tests every time the PC is serviced or an option is added to it. The power-up diagnostics run each time the system is powered up. The diagnostics take from 15 to 80 seconds to complete, depending on the amount of memory installed.

The following steps should be performed to run the power-up diagnostics:

1. Turn the brightness and control knobs on the display fully clockwise.
2. Set the basic module power switch to ON.

While the tests are running, messages of the type: "CPU(i80286) Pass" appear in the top left-hand corner of the screen.

Short beeps are emitted at the end of the tests, and the following message is displayed:

Primary boot-strap

If drive A does not contain a disk, or the inserted disk does not contain a valid bootstrap code and the hard disk does not contain a valid bootstrap code either, the following message is displayed:

Non-system disk or disk error
Replace disk and strike any key

and the system stops and waits until any key is pressed to continue the bootstrap procedure.

FUNCTIONAL DESCRIPTION OF THE POWER-UP DIAGNOSTICS

The power-up diagnostics can be divided into the following four main phases:

1. Shutdown diagnostics
2. Primitive diagnostics
3. Advanced diagnostics
4. Configuration diagnostics.

The errors detected during test execution are handled by special routines:

- The Primitive Diagnostic Error Routine (PDER)
- The Advanced Diagnostic Error Routines (ADER).

Another routine, called BPCR (Burnin Test Completion Routine) is used when the power-up diagnostics are run in burnin environment, whether an error is detected or the tests complete successfully.

The following sections give a brief description of the four main phases. For a more detailed description and for a description of the error handling routines, see the section entitled "DETAILED DESCRIPTION OF THE POWER-UP DIAGNOSTICS".

SHUTDOWN DIAGNOSTICS

The shutdown diagnostics are the first to run. The shutdown code is a special code contained in the EPROMs, which performs the transition from CPU virtual operating mode to real mode. This phase of the diagnostics is run first in order to minimize the time taken to enter real mode.

Any errors detected during this phase are handled by the PDER.

PRIMITIVE DIAGNOSTICS

The primitive diagnostics are run straight after the shutdown diagnostics, and rely on at least a minimal set of hardware components to be functional. The tests executed during this phase are all in-line tests; they do not use a RAM stack or any interrupts. The primitive diagnostics test and initialize the main hardware modules. At the end of these diagnostics, the display is initialized in 80x25 mode and a RAM stack is available.

The primitive diagnostics also use the PDER for error handling.

ADVANCED DIAGNOSTICS

The advanced diagnostics are run after the primitive diagnostics. These are not as restricted as the primitive diagnostics, in that both the display and the RAM stack have been initialized when they are run, and once these diagnostics have tested the interrupts, they can use them freely.

Errors detected during the advanced diagnostics are handled by the ADER.

CONFIGURATION DIAGNOSTICS

The main function of the configuration diagnostics is to verify that the hardware installed agrees with the hardware configuration stored in the CMOS-RAM. If there are any discrepancies, the user is prompted to execute the System Setup program.

The configuration diagnostics also use the ADER for the handling of any errors detected during execution.

DETAILED DESCRIPTION OF THE POWER-UP DIAGNOSTICS

The following sections describe the power-up diagnostics and the relative error handling routines in detail.

The descriptions are accompanied by flow charts to give a graphic description as well as a written one.

The sections relative to the description of the four main test phases also provide a table containing the messages displayed and the status of the LED connector inserted in the parallel port.

Note: In the following sections, the letter H after a value indicates that it is a hexadecimal value.

SHUTDOWN DIAGNOSTICS

The shutdown diagnostics are executed first to check whether there is a shutdown condition or not, and so whether to execute the relevant procedures.

At each system reset, whether this is due to a system power-up, because the reset button has been pressed, after a software reset or a shutdown, control passes to address F:FFF0. This address contains a jump instruction to a location containing a jump to the start of the power-up diagnostics.

Until the test to check for a shutdown condition has been performed, the relative shutdown code cannot assume anything about the state of the system. It cannot assume that the RAM has been tested, that the interrupts are working or that the display has been initialized. Thus, until it has been established that a shutdown situation exists, subroutines calls are avoided and any errors encountered are handled by the PDER.

The steps followed by the shutdown diagnostic test are set out below:

1. DUMMY CHECK POINT 0. Outputs value 40H to the parallel port and disables interrupts and parity errors.
2. START OF CHECK POINT 1. Executes a simple CPU flag test to check that they can be set at 1 and then at 0. Checks the conditional jump instructions.

If the test fails, the PDER is called with the following parameters:

- Message to display: CPU (i80286)
- Check point number: 1
- Type of error: fatal
- Other data to display: 1
- Step from which to continue the test: step 6 of the shutdown diagnostics.

3. It executes a simple test of the CPU ALU. This test checks the arithmetic and logical instructions AND, OR, EXOR, ADD, SUB and CMP, as well as the conditional jump instructions.

If the test fails, the PDER is called with the same parameters as the previous step, except for "Other data to display", which in this case is 2.

POWER-UP DIAGNOSTICS

4. It executes a simple pattern propagation test of all the 80286 registers which are compatible with the 8086, except for registers cs and ip.

If the test fails, the PDER is called with the same parameters as in step 1, except for "Other data to display", which in this case is 3.

5. END OF CHECK POINT 1. Outputs value 41H to the parallel port.
6. START OF CHECK POINT 2. Reads the keyboard controller status register and tests the shutdown bit. If this is at 0, it means that this is not a shutdown and the test skips to step 10, otherwise it goes on to step 7.
7. It sets up the system RAM stack, reads the contents of the CMOS-RAM shutdown byte and then clears it.
8. Checks the value of the shutdown byte. If this value is anything other than 2, 3, 4, 5, 9 or 0AH, it is considered undefined or illegal, and the PDER is called with the following parameters:

- Message to display: Illegal Shutdown
- Check point number: 2
- Type of error: non-fatal
- Other data to display: value of the shutdown byte
- Step from which to continue the test: step 1 of the primitive diagnostics

otherwise the test goes on to step 9.

9. Initializes both the 8259A interrupt controllers, unless the shutdown byte is 9, and executes the appropriate shutdown routine based on the value of the shutdown code found in the CMOS-RAM.
10. END OF CHECK POINT 2. Outputs value 42H to the parallel port.

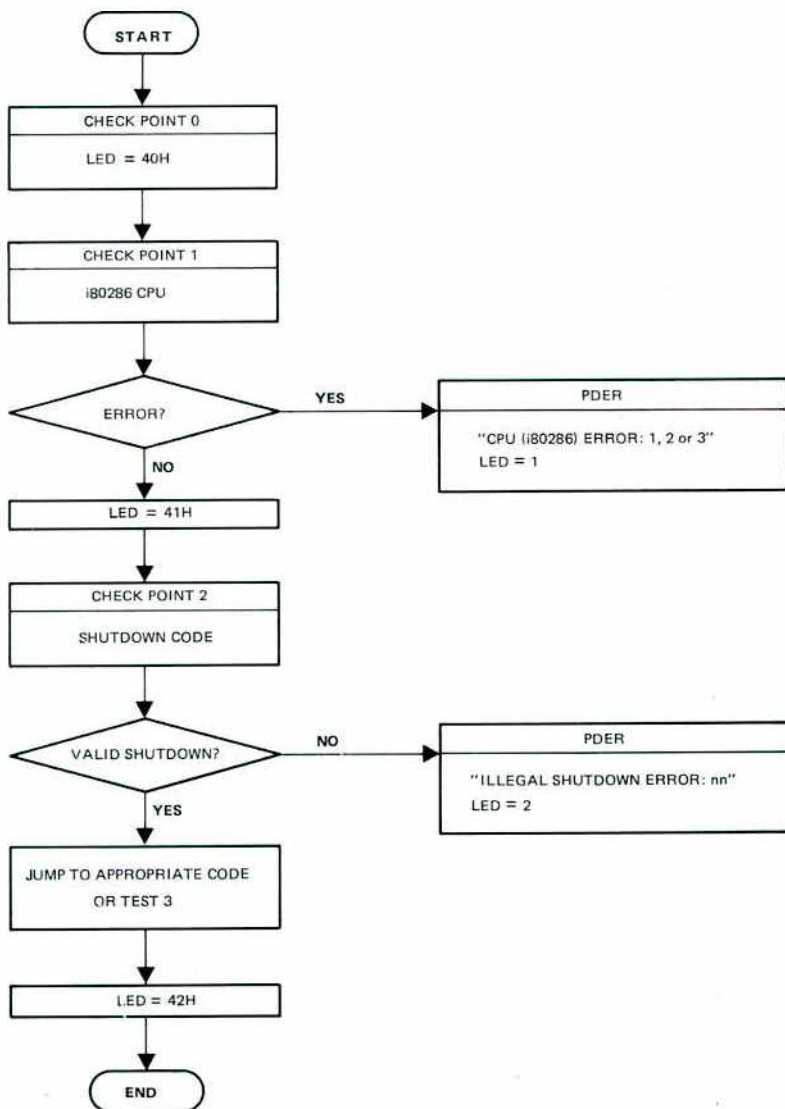
The table below gives the following information for each check point: the message displayed, the status of the LEDs located on the motherboard, and whether the check point completed without errors, if it failed or if it was blocked.

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDs 8 7 6 5 4 3 2 1
0	COMPLETED	—	0 1 0 0 0 0 0 0
	FAILED	—	—
	BLOCKED	—	—
1	COMPLETED	—	0 1 0 0 0 0 0 1
	FAILED	CPU (i80286) Error: 1 or CPU (i80286) Error: 2 or CPU (i80286) Error: 3	0 0 1 1 1 1 1 0
	BLOCKED	—	0 1 0 0 0 0 0 0
2	COMPLETED	—	0 1 0 0 0 0 1 0
	FAILED	Illegal Shutdown Error: nn	0 0 1 1 1 1 0 1
	BLOCKED	—	0 1 0 0 0 0 0 1

Note

0 = LED on
1 = LED off
nn = value of the shutdown code

SHUTDOWN DIAGNOSTICS FLOW CHART



PRIMITIVE DIAGNOSTICS

The primitive diagnostics test the essential parts of the hardware and initialize the main functions such as memory refresh, the RAM stack and the display controller.

As with the shutdown diagnostics, the primitive diagnostics cannot assume much about the state of the system, and so in this phase too, no subroutines calls are made, the RAM stack is not used and the interrupts are not enabled. The diagnostics also assume that the display is not initialized and no messages, except error messages, are displayed until the end of the diagnostics.

The steps performed by the primitive diagnostic test are shown below:

1. START OF CHECK POINT 3. Executes checksums on the motherboard EPROMs.

If the test fails, the PDER is called with the following parameters:

- Message to display: ROM Checksum
- Check point number: 3
- Type of error: fatal
- Other data to display: no other data
- Step from which to continue the test: step 3 of the primitive diagnostics

2. END OF CHECK POINT 3. Outputs value 43H to the parallel port.

3. START OF CHECK POINT 4. Tests the three 8254 timer channels and checks for not counting, counting too fast and counting too slowly.

If the test fails, the PDER is called with the following parameters:

- Message to display: Timer
- Check point number: 4
- Type of error: fatal
- Other data to display: number of the faulty timer channel
- Step from which to continue the test: step 5 of the primitive diagnostics

4. END OF CHECK POINT 4. Outputs value 44H to the parallel port.

5. START OF CHECK POINT 5. Starts the memory refresh and checks that this refresh is performed every 15.1 us. It resets the test byte in the RAM data area reserved for the BIOS ROM (address 40:0012H).

If the test fails, the PDER is called with the following parameters:

- Message to display: Memory Refresh
- Check point number: 5
- Type of error: fatal
- Other data to display: no other data
- Step from which to continue the test: step 7 of the primitive diagnostics

6. END OF CHECK POINT 5. Outputs value 45H to the parallel port.

7. START OF CHECK POINT 6. Issues a command to the keyboard controller to perform a self test and waits for this to complete.

If the test fails, the PDER is called with the following parameters:

- Message to display: Keyboard controller
- Check point number: 6
- Type of error: fatal
- Other data to display: 1 if the self test has detected an error, 2 if the self test timed out.
- Step from which to continue the test: step 9 of the primitive diagnostics

8. END OF CHECK POINT 6. Outputs value 46H to the parallel port.

9. START OF CHECK POINT 7. Checks if the reset was a software reset. If so, it skips to step 11, otherwise it tests the first 8 KB of RAM. This is done by writing the address and then the inverted address into each byte. After each block has been written it reads and compares the data.

This is not the real RAM test, but is only used to ensure the correct operation of the first 8 KB of RAM before the interrupt vector table is installed and a RAM stack initialized.

If the test fails, the PDER is called with the following parameters:

- Message to display: Memory
- Check point number: 7
- Type of error: fatal
- Other data to display: no other data
- Step from which to continue the test: step 11 of the primitive diagnostics

10. END OF CHECK POINT 7. Outputs value 47H to the parallel port.

11. Installs a dummy interrupt vector table and installs the display interrupt (int 10H). It sets up a RAM stack in the first 8 KB already tested and initializes the display controller in 80x25 text mode.

12. It displays the following message relative to the check points already completed:

Resident Diagnostic Rev X.XX

CPU (i80286)	Pass
ROM Checksum	Pass
Memory Refresh	Pass
Keyboard Controller	Pass

where X.XX corresponds to the ROM revision number present in the system.

It should be noted that this message appears even if errors have been detected in the course of the diagnostics performed up to this point and the diagnostics only continued after key F1 was pressed.

POWER-UP DIAGNOSTICS

The table below gives the following information for each check point: the message displayed, the status of the LEDs located on the motherboard, and whether the check point completed without errors, if it failed or if it was blocked.

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDs 8 7 6 5 4 3 2 1
3	COMPLETED	—	0 1 0 0 0 0 1 1
	FAILED	ROM Checksum Error	0 0 1 1 1 1 0 0
	BLOCKED	—	0 1 0 0 0 0 1 0
4	COMPLETED	—	0 1 0 0 0 1 0 0
	FAILED	Timer Error	0 0 1 1 1 0 1 1
	BLOCKED	—	0 1 0 0 0 0 1 1
5	COMPLETED	—	0 1 0 0 0 1 0 1
	FAILED	Memory Refresh Error	0 0 1 1 1 0 1 0
	BLOCKED	—	0 1 0 0 0 1 0 0
6	COMPLETED	—	0 1 0 0 0 1 1 0
	FAILED	Keyboard Controller Error: 1 or Keyboard Controller Error: 2	0 0 1 1 1 0 0 1
	BLOCKED	—	0 1 0 0 0 1 0 1
7	COMPLETED	Resident Diagnostic Rev X.XX CPU (i80286) Pass ROM Checksum Pass Memory Refresh Pass Keyboard Controller Pass	0 1 0 0 0 1 1 1
	FAILED	Memory Error	0 0 1 1 1 0 0 0
	BLOCKED	—	0 1 0 0 0 1 1 0

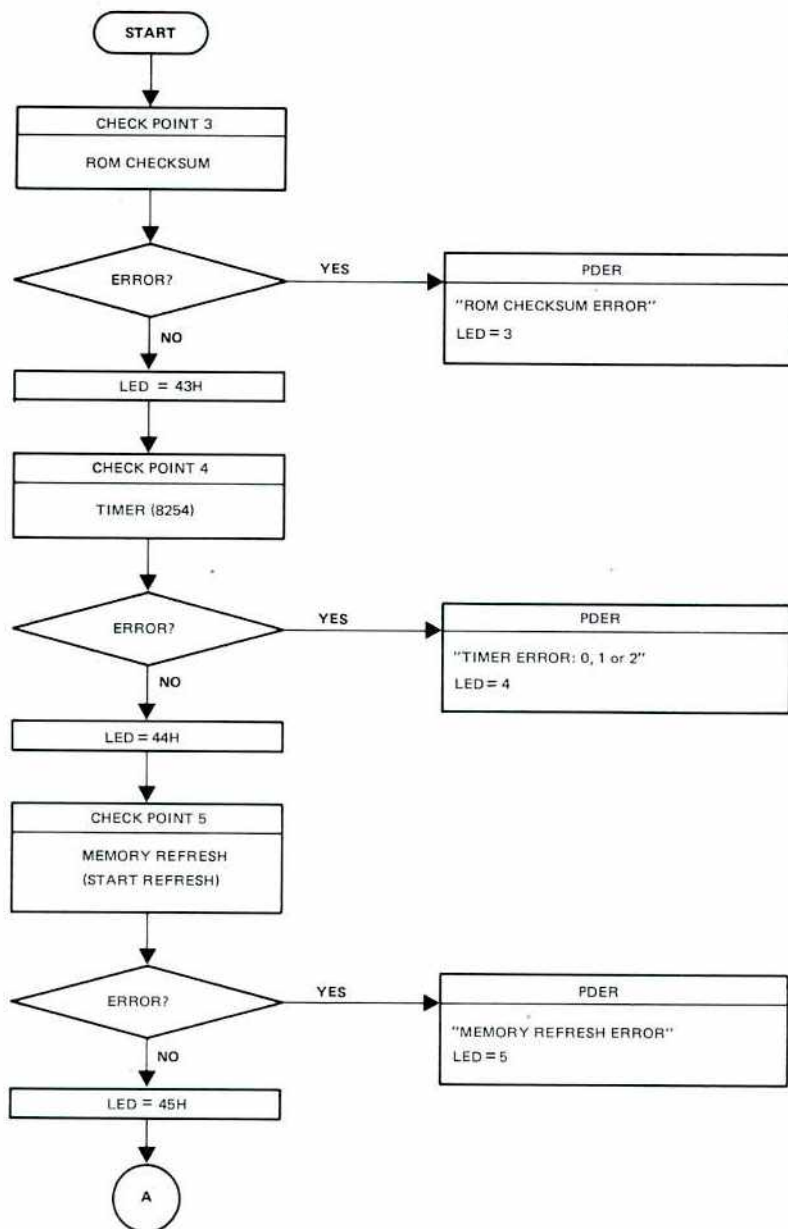
Note

0 = LED on

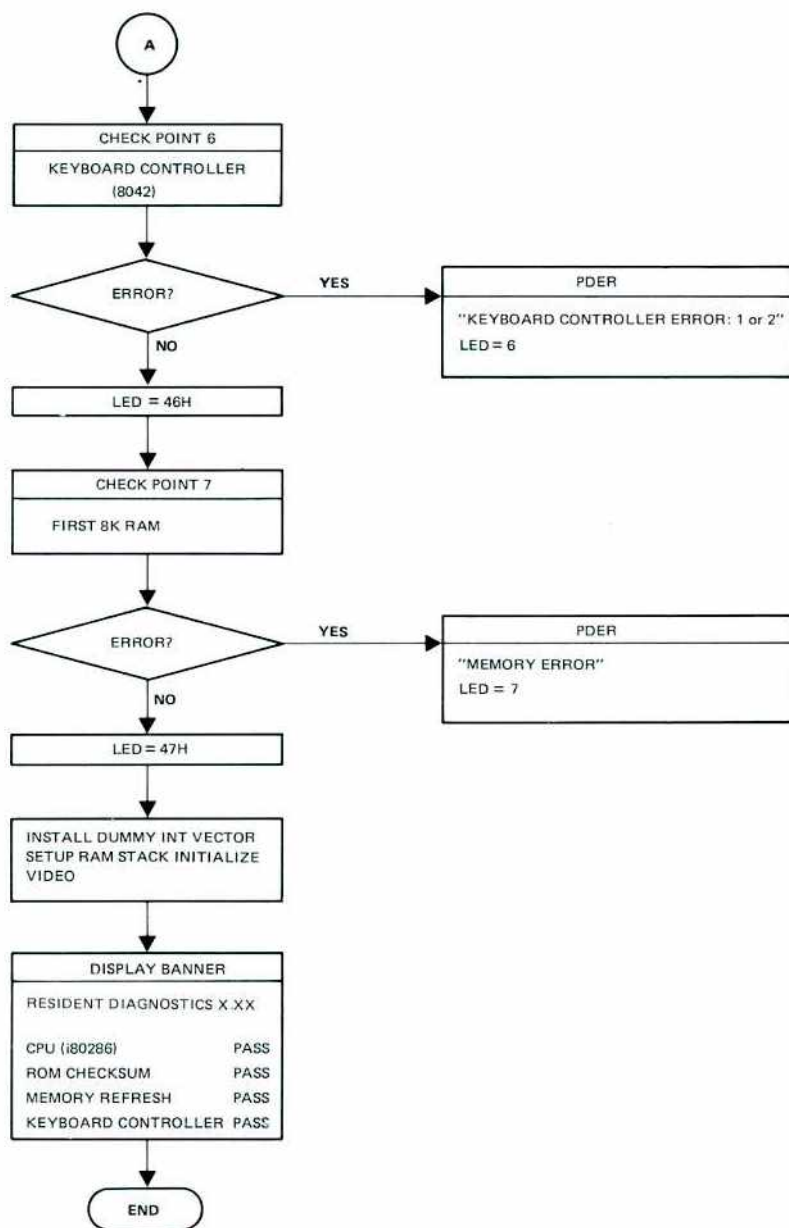
1 = LED off

X.XX = ROM revision number

PRIMITIVE DIAGNOSTICS FLOW CHART



POWER-UP DIAGNOSTICS



ADVANCED DIAGNOSTICS

The advanced diagnostics check a large part of the remaining hardware to ensure the correct use of the system.

The mini-floppy disk drives, the hard disk unit and the relative controller boards are not tested here, but by the configuration diagnostics. These diagnostics also test any optional ROMs in the system.

The advanced diagnostics assume that the memory refresh feature has been started up and that a RAM stack and the display controller have been initialized.

Errors are handled by the ADER or, in some cases, directly by the advanced diagnostics.

The steps performed by the advanced diagnostic test are shown below:

1. START OF CHECK POINT 8. Executes a simple test of the 80286 protected mode (a more complete test is executed in later steps). It also tests the CPU IDT and GDT registers and the LIDT/SIDT and LGDT/SGDT instructions.

If the test fails, the ADER is called with the following parameters:

- Message to display: Protected Mode
- Other data to display: 1
- Check point number: 8
- Type of error: fatal

2. END OF CHECK POINT 8. Outputs value 48H to the parallel port.

3. START OF CHECK POINT 9. Tests the CMOS-RAM shutdown byte by writing data to it and then clears it.

If the test fails, the ADER is called with the following parameters:

- Message to display: CMOS RAM
- Other data to display: 1
- Check point number: 9
- Type of error: fatal

4. END OF CHECK POINT 9. Outputs value 49H to the parallel port.

POWER-UP DIAGNOSTICS

5. START OF CHECK POINT 10. Executes a test of the CPU protected mode by entering the mode, reading the machine status word (MSW) to check that protected mode is activated, and then exiting.

If the test fails, the ADER is called with the following parameters:

- Message to display: Protected Mode
- Other data to display: 2
- Check point number: 10
- Type of error: fatal

6. END OF CHECK POINT 10. Outputs value 4AH to the parallel port.

7. START OF CHECK POINT 11. If the power-up diagnostics were started following a software reset, the test skips to step 11, otherwise it tests up to 640 KB of RAM. The test checks for the presence of each 128 KB block of memory until an error indicates the end of the memory blocks present in the system. For each block present the test writes the address and then the inverted address into each memory location. After each write, the contents of the memory location are read and compared.

Before the read and write test starts, the NMI on parity error must be enabled and a non-maskable interrupt handler must be installed in the interrupt vector table.

As each 128 KB block passes the presence test and the read/write test, the following message is displayed:

Base Memory xxx KB

where xxx indicates the total number of kilobytes of memory that have passed the test.

If the test detects a memory error, the following message is displayed:

```
Memory Error: Addr = s000:0000
               Wrote = wwwwww Read = rrrr
```

where:

- s000 is the memory segment
- 0000 is the segment offset
- wwwwww is the data written
- rrrr is the data read

If the test detects a parity error, the following message is displayed:

```
Parity Error: Addr = s000:0000
               Wrote = wwwwww Read = rrrr
```

where the parameters have the same values as above.

For any memory error the ADER is called with the following parameters:

- Check point number: 11
- Type of error: fatal

8. END OF CHECK POINT 11. Stores the total number of kilobytes found and outputs value 4BH to the parallel port.
9. START OF CHECK POINT 12. Executes the virtual memory test (above 1 MB). This test, similar to the test executed in step 7, also checks that the CPU works in virtual mode.

Errors and error messages are handled as described in step 7, except that the check point number in this case is 12.

During the execution of the test, the following message is displayed:

```
Testing Memory over 1 MB
```

The test does not display the 128 KB blocks as they pass the test, but the following message is displayed at the end of the test:

```
Expansion Memory      xxx KB
```

where xxx corresponds to the total number of kilobytes of memory which have passed the test.

10. END OF CHECK POINT 12. Stores the total number of kilobytes of virtual memory and displays the following message:

Total Memory xxx KB

where xxx is the total number of kilobytes of system memory
and outputs value 4CH to the parallel port.

11. START OF CHECK POINT 14. Installs a non-maskable interrupt handler in the interrupt vector table, disables all I/O and parity error checking, and checks for the presence of non-maskable interrupts.

If the test fails, the ADER is called with the following parameters:

- Message to display: NMI
- Other data to display: no data to display
- Check point number: 14
- Type of error: fatal

12. END OF CHECK POINT 14. Outputs value 4DH to the parallel port.

13. START OF CHECK POINT 15. Performs the parity circuit test with the NMI on parity error enabled and a non-maskable interrupt handler installed in the interrupt vector table.

If the test fails, the ADER is called with the following parameters:

- Message to display: Parity
- Other data to display: no data to display
- Check point number: 15
- Type of error: fatal

If the test completes without errors, the following message is displayed:

Parity Circuitry Pass

14. END OF CHECK POINT 15. Outputs value 4EH to the parallel port.

15. START OF CHECK POINT 16. Tests the first 8259A interrupt controller. It first tests the interrupt mask register, installs the test hardware interrupt vector and masks off all interrupts. Any interrupt occurring under these conditions is an error.

It then programs channel 0 of the timer to generate an interrupt and unmasks this interrupt. If the timer counts down and does not generate an interrupt, it is an error.

If the test fails, the ADER is called with the following parameters:

- Message to display: Interrupt Controller
- Other data to display:
 - . 1 if the timer does not generate an interrupt
 - . 2 if the timer does not count
 - . 3 if an interrupt occurs when masked
 - . 4 if the mask register test fails
- Check point number: 16
- Type of error: fatal

16. END OF CHECK POINT 16. Outputs value 50H to the parallel port.

17. START OF CHECK POINT 17. Tests the second 8259A interrupt controller. The test is similar to the previous one for the first interrupt controller, except that the timer interrupt is not generated.

If the test fails, the ADER is called with the following parameters:

- Message to display: Interrupt Controller
- Other data to display: 5 if an interrupt occurs when masked, 6 if the mask register test fails
- Check point number: 17
- Type of error: fatal

If the test completes without errors, it installs the interrupt service routine addresses in the interrupt vector table, unmasks all the interrupts and displays the following message:

Interrupt Controllers Pass

18. END OF CHECK POINT 17. Outputs value 51H to the parallel port.

POWER-UP DIAGNOSTICS

19. START OF CHECK POINT 18. Executes a marching bit pattern test on all the DMA page registers.

If the test fails, the ADER is called with the following parameters:

- Message to display: DMA Page Registers
- Other data to display: no data to display
- Check point number: 18
- Type of error: fatal

20. END OF CHECK POINT 18. Outputs value 52H to the parallel port.

21. START OF CHECK POINT 19. Tests the first DMA controller by testing all the write/read address registers and count registers. It also initializes each channel in the correct mode.

If the test fails, the ADER is called with the following parameters:

- Message to display: DMA Controller
- Other data to display: 1 if an error is verified in the register write/read test
- Check point number: 19
- Type of error: fatal

22. END OF CHECK POINT 19. Outputs value 53H to the parallel port.

23. START OF CHECK POINT 20. Tests the second DMA controller in the same way as the first controller.

If the test fails, the ADER is called with the following parameters:

- Message to display: DMA Controller
- Other data to display: 3 if an error is detected in the register write/read test
- Check point number: 20
- Type of error: fatal

If the test completes without errors, the following message is displayed:

DMA Controllers Pass

24. END OF CHECK POINT 20. Outputs value 54H to the parallel port.

25. START OF CHECK POINT 21. Performs a write/read test on the speaker port.

If the test fails, the ADER is called with the following parameters:

- Message to display: Speaker
- Other data to display: no data to display
- Check point number: 21
- Type of error: non-fatal

26. END OF CHECK POINT 21. Outputs value 55H to the parallel port.

27. START OF CHECK POINT 22. Tests the keyboard. Installs a keyboard interrupt handler in the interrupt vector table and unmask the keyboard interrupt.

It sends the keyboard self test command to the keyboard controller and waits enough time for the test to complete.

Checks the self test completion codes for an error condition.

Sets the keyboard input buffer in the RAM data area reserved for the BIOS ROM.

If the test fails, the ADER is called with the following parameters:

- Message to display: Keyboard
- Other data to display:
 - . 1 if the keyboard self test has completed with errors
 - . 2 if the self test has detected a stuck key
 - . 3 if there has been no keyboard interrupt
- Check point number: 22
- Type of error: fatal

28. If the test completes successfully, the following message is displayed:

Keyboard

Pass

29. END OF CHECK POINT 22. Outputs value 56H to the parallel port.

30. START OF CHECK POINT 23. Checks that the CMOS clock/calendar is keeping time.

If the test fails, the ADER is called with the following parameters:

- Message to display: Clock/Calendar
- Other data to display: no data to display
- Check point number: 23
- Type of error: non-fatal

If the test completes successfully, the following message is displayed:

Clock/Calendar	Pass
----------------	------

31. END OF CHECK POINT 23. Outputs value 57H to the parallel port.

32. START OF CHECK POINT 25. Executes another CPU test, checking the following features in particular:

- the special instructions LDT/SDT, LTR/STR, VERR/VERW, LAR/SLR, ARPL
- the PUSHA and POPA instructions
- CPU exception handling

This last test is executed in the following way:

- writes to a segment with extension 0 and waits until exception 13 interrupt is activated
- writes to a segment assigned for read-only and waits until exception 13 interrupt is activated
- checks the BOUND instruction by exceeding the allowed limits, and waits until exception 5 interrupt is activated.

If the test fails, the ADER is called with the following parameters:

- Message to display: Protected Mode
- Other data to display: 3 if an error occurred when the instructions were checked, 4 if an error occurred during exception handling
- Check point number: 25
- Type of error: fatal

If the test completes without errors, the following message is displayed:

CPU Protected Mode Pass

33. END OF CHECK POINT 25. Outputs value 59H to the parallel port.

POWER-UP DIAGNOSTICS

The table below gives the following information for each check point: the message displayed, the status of the LEDs located on the motherboard, and whether the check point completed without errors, if it failed or if it was blocked.

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDs 8 7 6 5 4 3 2 1
8	COMPLETED	—	0 1 0 0 1 0 0 0
	FAILED	Protected Mode Error: 1	0 0 1 1 0 1 1 1
	BLOCKED	—	0 1 0 0 0 1 1 1
9	COMPLETED	—	0 1 0 0 1 0 0 1
	FAILED	CMOS RAM Error: 1	0 0 1 1 0 1 1 0
	BLOCKED	—	0 1 0 0 1 0 0 0
10	COMPLETED	—	0 1 0 0 1 0 1 0
	FAILED	Protected Mode Error: 2	0 0 1 1 0 1 0 1
	BLOCKED	—	0 1 0 0 1 0 0 1
11	COMPLETED	Base Memory xxx KB	0 1 0 0 1 0 1 1
	FAILED	Memory Error: Addr = s000:0000 Wrote = wwww Read = rrrr or Parity Error: Addr = s000:0000 Wrote = wwww Read = rrrr	0 0 1 1 0 1 0 0
	BLOCKED	—	0 1 0 0 1 0 1 0
12	COMPLETED	Expansion Memory xxx KB	0 1 0 0 1 1 0 0
	FAILED	Memory Error: Addr = s000:0000 Wrote = wwww Read = rrrr or Parity Error: Addr = s000:0000 Wrote = wwww Read = rrrr	0 0 1 1 0 0 1 1
	BLOCKED	—	0 1 0 0 1 0 1 1

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDS 8 7 6 5 4 3 2 1
14	COMPLETED	————	0 1 0 0 1 1 1 0
	FAILED	NMI Error	0 0 1 1 0 0 0 1
	BLOCKED	————	0 1 0 0 1 1 0 1
15	COMPLETED	Parity Circuitry Pass	0 1 0 0 1 1 1 1
	FAILED	Parity Error	0 0 1 1 0 0 0 0
	BLOCKED	————	0 1 0 0 1 1 1 0
16	COMPLETED	————	0 1 0 1 0 0 0 0
	FAILED	Interrupt Controller Error: 1 or Interrupt Controller Error: 2 or Interrupt Controller Error: 3 or Interrupt Controller Error: 4	0 0 1 0 1 1 1 1
	BLOCKED	————	0 1 0 0 1 1 1 1
17	COMPLETED	Interrupt Controllers Pass	0 1 0 1 0 0 0 1
	FAILED	Interrupt Controller Error: 5 or Interrupt Controller Error: 6	0 0 1 0 1 1 1 0
	BLOCKED	————	0 1 0 1 0 0 0 0
18	COMPLETED	————	0 1 0 1 0 0 1 0
	FAILED	DMA Page Registers Error	0 0 1 0 1 1 0 1
	BLOCKED	————	0 1 0 1 0 0 0 1
19	COMPLETED	————	0 1 0 1 0 0 1 1
	FAILED	DMA Controller Error: 1	0 0 1 0 1 1 0 0
	BLOCKED	————	0 1 0 1 0 0 1 0
20	COMPLETED	DMA Controllers Pass	0 1 0 1 0 1 0 0
	FAILED	Dma Controller Error: 3	0 0 1 0 1 0 1 1
	BLOCKED	————	0 1 0 1 0 0 1 1

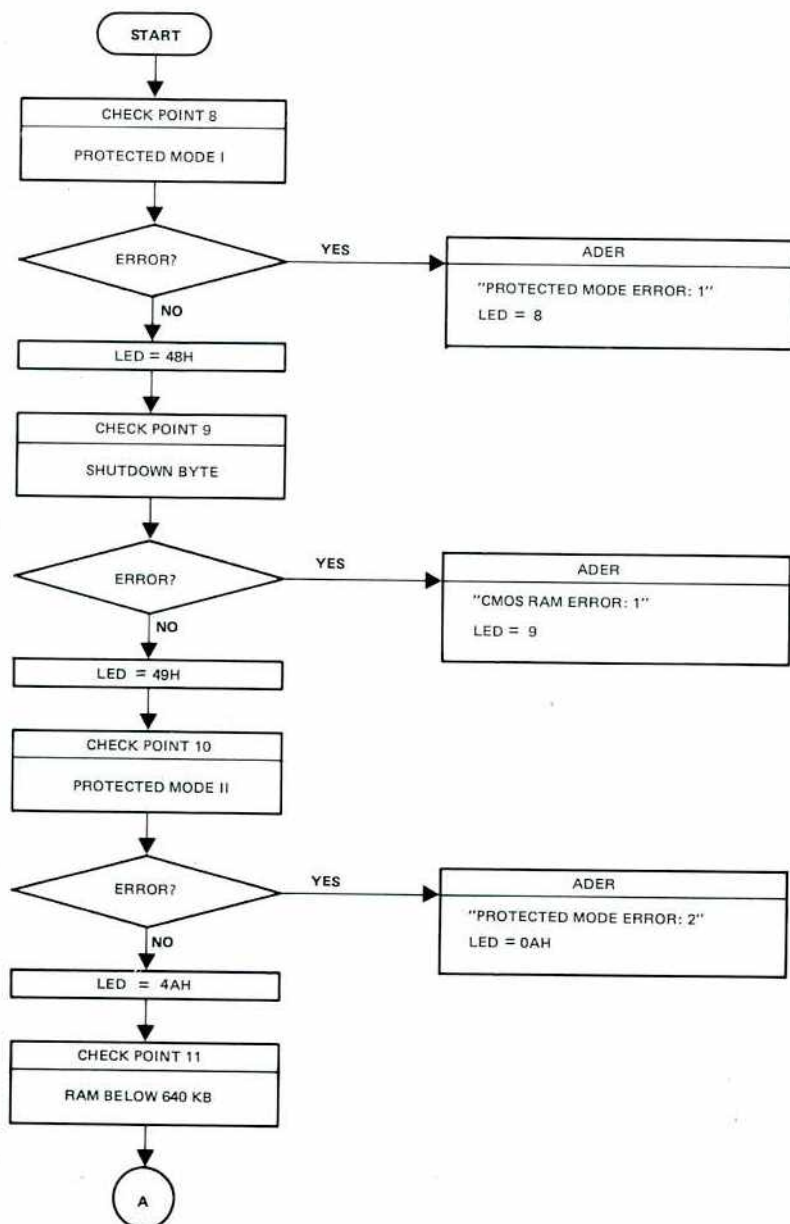
POWER-UP DIAGNOSTICS

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDS 8 7 6 5 4 3 2 1
21	COMPLETED	—	0 1 0 1 0 1 0 1
	FAILED	Speaker Error	0 0 1 0 1 0 1 0
	BLOCKED	—	0 1 0 1 0 1 0 0
22	COMPLETED	Keyboard Pass	0 1 0 1 0 1 1 0
	FAILED	Keyboard Error: 1 or Keyboard Error: 2 or Keyboard Error: 3	0 0 1 0 1 0 0 1
	BLOCKED	—	0 1 0 1 0 1 0 1
23	COMPLETED	Clock/Calendar Pass	0 1 0 1 0 1 1 1
	FAILED	Clock/Calendar Error	0 0 1 0 1 0 0 0
	BLOCKED	—	0 1 0 1 0 1 1 0
25	COMPLETED	CPU Protected Mode Pass	0 1 0 1 1 0 0 1
	FAILED	Protected Mode Error: 3 or Protected Mode Error: 4	0 0 1 0 0 1 1 0
	BLOCKED	—	0 1 0 1 1 0 0 0

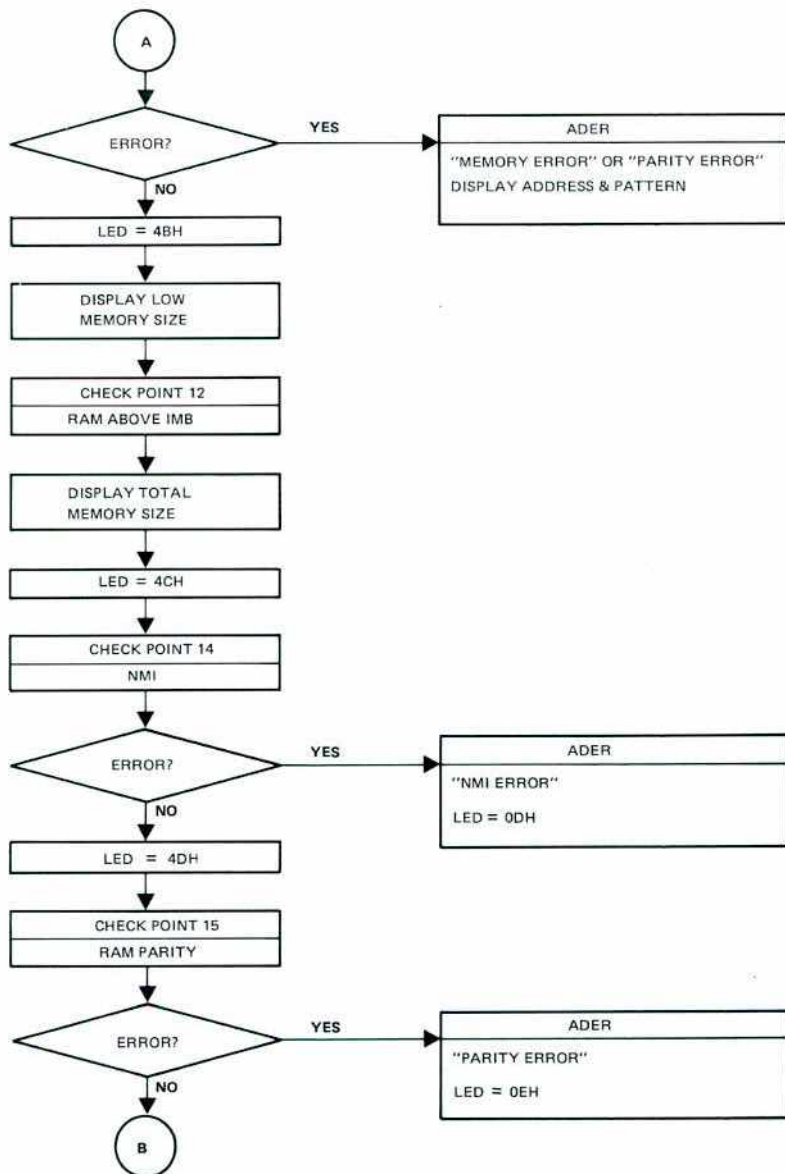
Note

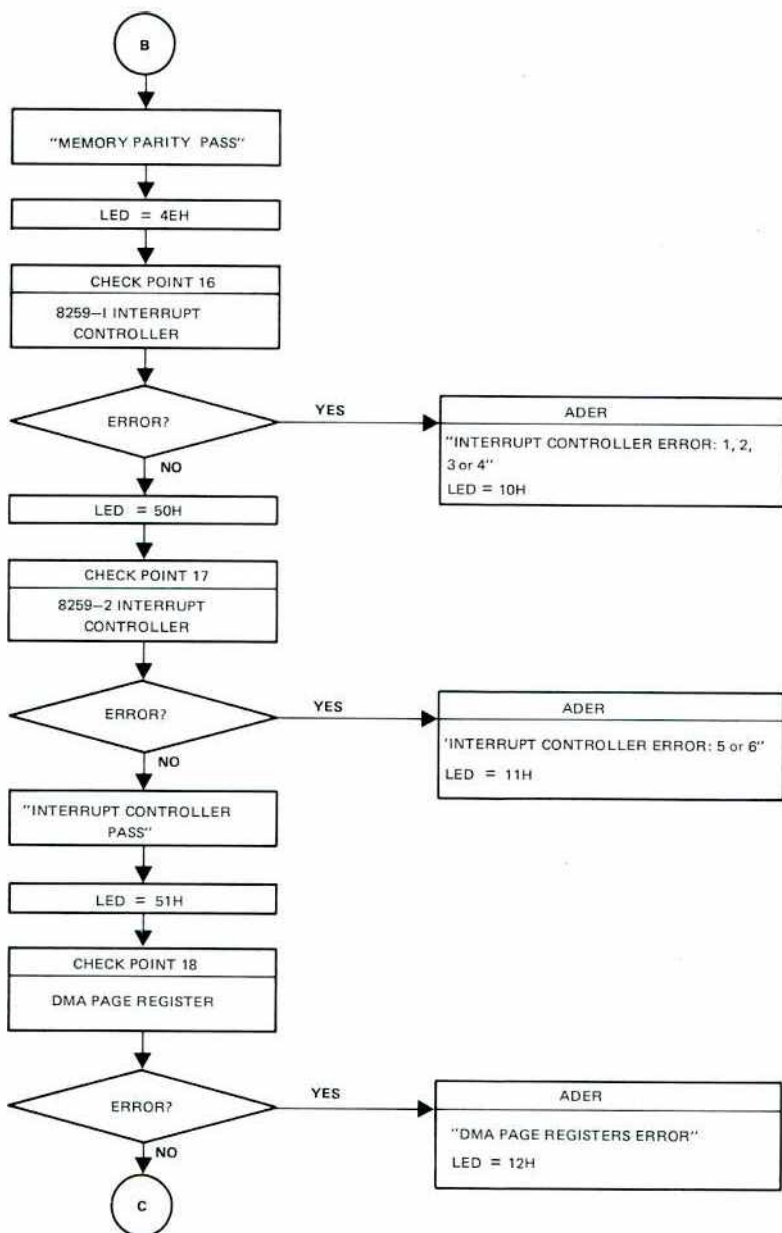
0 = LED on
 1 = LED off
 xxx = total number of KB
 s000 = segment of memory
 oooo = segment offset
 www = data written
 rrrr = data read

ADVANCED DIAGNOSTICS FLOW CHART

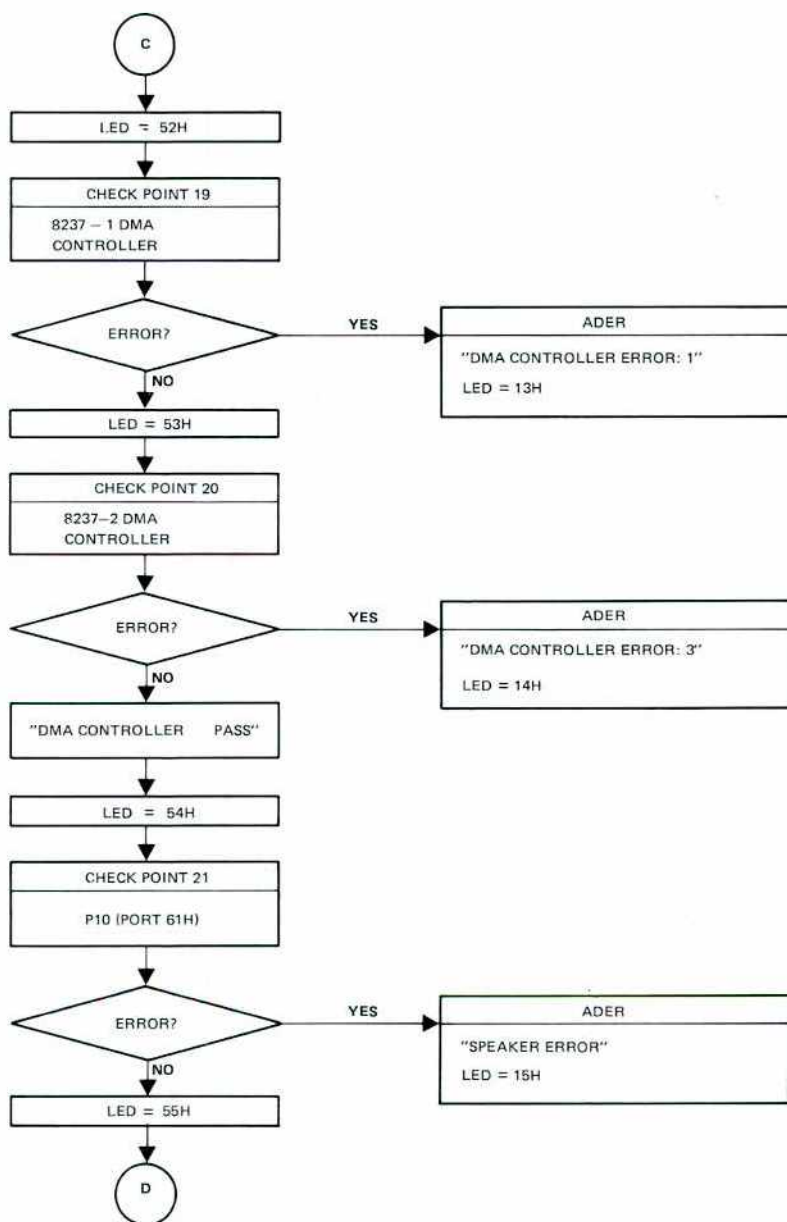


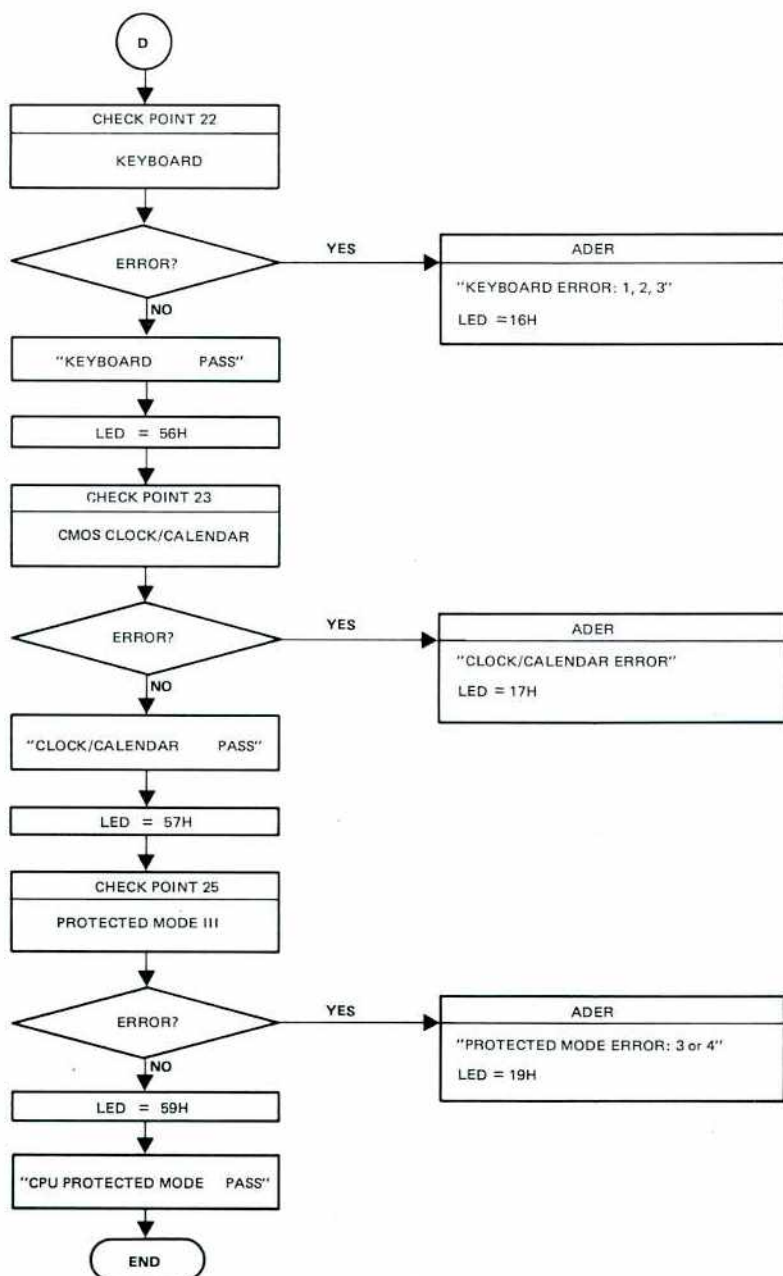
POWER-UP DIAGNOSTICS





POWER-UP DIAGNOSTICS





CONFIGURATION DIAGNOSTICS

The main aim of the configuration diagnostics is to determine the configuration of the system. For each device configured, the diagnostic test performs the following three steps:

- Updates the equipment flags in the RAM data area reserved for the BIOS ROM
- Initializes the devices for the contents of the ROM
- Checks the CMOS-RAM flags for discrepancies.

These diagnostics also test the mini-floppy disk drive, the hard disk unit and the relative controllers, and any optional ROMs present in the system.

The steps executed by the configuration diagnostic test are as listed below:

1. CHECK POINT 26. Tests the CMOS-RAM battery.

If the battery is low and the test is running in automated mode, the ADER is called with the following parameters:

- Message to display: CMOS RAM Battery
- Other data to display: no other data to display
- Check point number: 26
- Type of error: fatal

If the battery is low and the test is running in burnin or normal operating mode, the following message is displayed:

CMOS RAM Battery Low -- Run SETUP

and 1AH is written to RAM location 40:0012H.

If the battery is good, the test outputs value 5AH to the parallel port.

2. CHECK POINT 27. Executes a non-destructive test on the CMOS-RAM. The test consists in copying the contents of the CMOS-RAM to the system RAM, executing a pattern test and rewriting the contents of the CMOS-RAM previously stored.

If the test detects an error, the ADER is called with the following parameters:

- Message to display: CMOS RAM
- Other data to display: 2
- Check point number: 27
- Type of error: fatal

If the test completes without errors, the following message is displayed:

CMOS RAM Pass

and value 5BH is output to the parallel port.

3. CHECK POINT 28. Executes the CMOS-RAM checksum test by summing the bytes from locations 10H to 2DH and eliminating the overflow. The result should match the value of the two bytes at locations 2EH and 2FH.

If the test detects an error, the following message is displayed:

CMOS RAM Checksum Error -- Run SETUP

and value 1CH is written to RAM location 40:0012H.

At the end of the test value 5CH is written to the parallel port.

4. CHECK POINT 29. Finds and configures all the parallel ports in the system, particularly the ports at I/O addresses 3BCH, 378H and 278H. The search is performed by looking for a device connected to the ports in the following way:

- Writing the pattern AAH
- Reading the response
- Comparing the response with the data written.

For each port found it sets the port address in the parallel port address table and sets the printer timeout value in the RAM data area reserved for the BIOS ROM.

At the end of the test value 5DH is output to the parallel port.

POWER-UP DIAGNOSTICS

5. CHECK POINT 30. Finds and configures all the serial ports in the system. It particularly looks for the ports at I/O addresses 3FAH and 2FAH. The test consists of reading the port and checking for a UART; if present, the port is assumed to be a serial port.

For each port found it sets the port addresses in the serial port address table, sets the equipment flags for the number of serial ports and the timeout values in the RAM data area reserved for the BIOS ROM.

At the end of the test value 5EH is output to the parallel port.

6. CHECK POINT 31. Compares the memory size found in step 7 of the advanced diagnostics with the size stored in the CMOS-RAM.

If there is a discrepancy, the following message is displayed:

Memory Size Error -- Run SETUP

and value 1FH is written to RAM location 40:0012H.

At the end of the test value 5FH is output to the parallel port.

7. CHECK POINT 32. Compares the size of the virtual memory found in step 9 of the advanced diagnostics with the size stored in the CMOS-RAM.

If there is a discrepancy, the following message is displayed:

Virtual Memory Size Error -- Run SETUP

and value 20H is written to RAM location 40:0012H.

At the end of the test value 60H is output to the parallel port.

8. CHECK POINT 33. Tests for the presence of the 80287 numeric processor extension (NPX).

If the NPX is found but the CMOS-RAM configuration disagrees, or if the CMOS-RAM configuration indicates a numeric processor extension which is not detected, the following message is displayed:

80287 Configuration Error -- Run SETUP

and value 21H is written to RAM location 40:0012H.

If the NPX is found and this agrees with the CMOS-RAM configuration, the following message is displayed:

Math Processor (i80287) Pass

At the end of the test value 61H is output to the parallel port.

9. CHECK POINT 34. Checks for the presence of the game port at address 201H. If found, it sets the device bits in the ROM data area.

At the end of the test value 62H is output to the parallel port.

10. CHECK POINT 35. Checks that the key switch on the front panel of the basic module is turned to the unlocked position. If it is locked, the following message is displayed:

Turn Key to Unlocked Position

and the test waits until the switch is unlocked.

At the end of the test value 62H is output to the parallel port.

11. CHECK POINT 36. Checks for the presence of one or two hard disk units using the test drive ready command, and does any initialization required for hard disks.

If a single HDU is found, the following message is displayed:

Fixed Disks: 1 Present

If there are two HDUs, the following message is displayed:

Fixed Disks: 2 Present

If there is no HDU, the following message is displayed:

Fixed Disks: Not Present

In each case, the hard disk configuration is compared to the one stored in the CMOS-RAM. If there is a discrepancy, the following message is displayed:

Fixed Disk Configuration Error -- Run SETUP

and value 24H is written to RAM location 40:0012H.

At the end of the test value 63H is output to the parallel port.

12. CHECK POINT 37. Checks for the presence of optional ROMs, and whether they have the correct ID: AA55H. If an optional ROM is present, a checksum test is executed, and if this completes successfully, the ROM is called so that the EPROM int19H interrupt vector can be replaced by the ROM int19H.

POWER-UP DIAGNOSTICS

If an optional ROM is present and passes the checksum test, the following message is displayed:

Option ROM at s000:0000 Pass

where s000 is the paragraph and 0000 the offset where the ROM begins, and value 64H is output to the parallel port.

If an optional ROM is present but does not pass the checksum test, the following message is displayed:

Option ROM at s000:0000 Error

where the parameters have the same meaning as those shown in the previous message. The ADER is called with the following parameters:

- Check point number: 37
- Type of error: fatal

13. CHECK POINT 38. Checks for the presence of mini-floppy disk drives A and B via the floppy driver int 40H, and does any initialization required by the BIOS.

If a single drive is present, the following message is displayed:

Floppy Disks: 1 Present

If two drives are present, the following message is displayed:

Floppy Disks: 2 Present

If no drives are present, the following message is displayed:

Floppy Disks: Not Present

In each case, the configuration found is compared to the one stored in the CMOS-RAM. If there is a discrepancy, the following message is displayed:

Floppy Configuration Error -- Run SETUP

and value 26H is written to RAM location 40:0012H.

At the end of the test value 65H is output to the parallel port.

14. Executes int 19H to begin the bootstrap procedure. What happens at this point depends on the int 19H code which may be the system EPROM code or that of an optional ROM if there are any present.

The table below gives the following information for each check point: the message displayed, the status of the LEDs located on the motherboard, and whether the check point completed without errors, if it failed or if it was blocked.

CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDs 8 7 6 5 4 3 2 1
26	COMPLETED	—	0 1 0 1 1 0 1 0
	FAILED	CMOS RAM Battery Error	0 0 1 0 0 1 0 1
		or CMOS RAM Battery Low -- Run SETUP	0 1 0 1 1 0 0 1
	BLOCKED	—	0 1 0 1 1 0 0 1
27	COMPLETED	CMOS RAM Pass	0 1 0 1 1 0 1 1
	FAILED	CMOS RAM Error: 2	0 0 1 0 0 1 0 0
	BLOCKED	—	0 1 0 1 1 0 1 0
28	COMPLETED	—	0 1 0 1 1 1 0 0
	FAILED	CMOS RAM Checksum Error -- Run SETUP	0 1 0 1 1 0 1 1
	BLOCKED	—	0 1 0 1 1 0 1 1
29	COMPLETED	—	0 1 0 1 1 1 0 1
	FAILED	—	—
	BLOCKED	—	0 1 0 1 1 1 0 0
30	COMPLETED	—	0 1 0 1 1 1 1 0
	FAILED	—	—
	BLOCKED	—	0 1 0 1 1 1 0 1
31	COMPLETED	—	0 1 0 1 1 1 1 1
	FAILED	Memory Size Error -- Run SETUP	0 1 0 1 1 1 1 0
	BLOCKED	—	0 1 0 1 1 1 1 0

POWER-UP DIAGNOSTICS

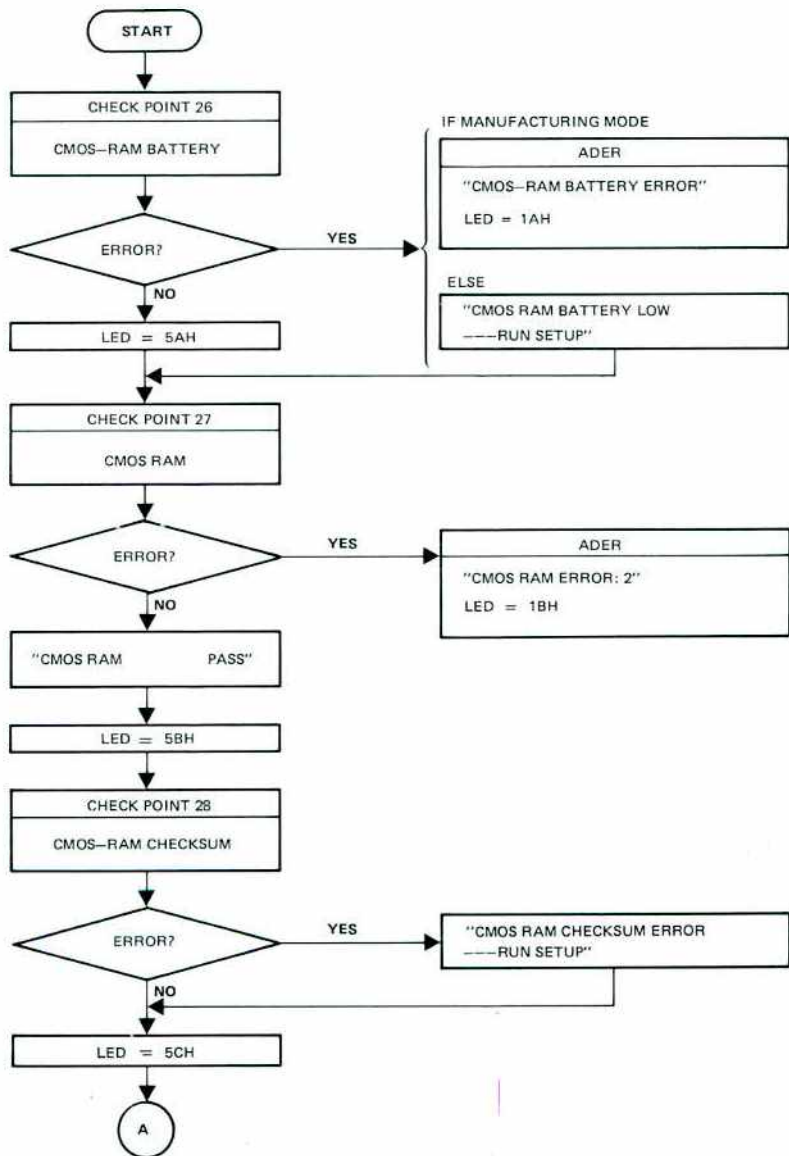
CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDS 8 7 6 5 4 3 2 1
32	COMPLETED	—	0 1 1 0 0 0 0 0
	FAILED	Virtual Memory Size Error -- Run SETUP	0 1 0 1 1 1 1 1
	BLOCKED	—	0 1 0 1 1 1 1 1
33	COMPLETED	Math Processor (i80287) Pass	0 1 1 0 0 0 0 1
	FAILED	80287 Configuration Error -- Run SETUP	0 1 1 0 0 0 0 0
	BLOCKED	—	0 1 1 0 0 0 0 0
34	COMPLETED	—	0 1 1 0 0 0 1 0
	FAILED	—	0 1 1 0 0 0 0 1
	BLOCKED	—	0 1 1 0 0 0 0 1
35	COMPLETED	—	0 1 1 0 0 0 1 0
	FAILED	Turn Key to Unlocked Position	0 1 1 0 0 0 1 0
	BLOCKED	—	0 1 1 0 0 0 1 0
36	COMPLETED	Fixed Disks: 1 Present or Fixed Disks: 2 Present or Fixed Disks: Not Present	0 1 1 0 0 0 1 1
	FAILED	Fixed Disk Configuration Error -- Run SETUP	0 1 1 0 0 0 1 0
	BLOCKED	—	0 1 1 0 0 0 1 0
37	COMPLETED	Option ROM at s000:0000 Pass	0 1 1 0 0 1 0 0
	FAILED	Option ROM at s000:0000 Error	0 0 0 1 1 0 1 0
	BLOCKED	—	0 1 1 0 0 0 1 1

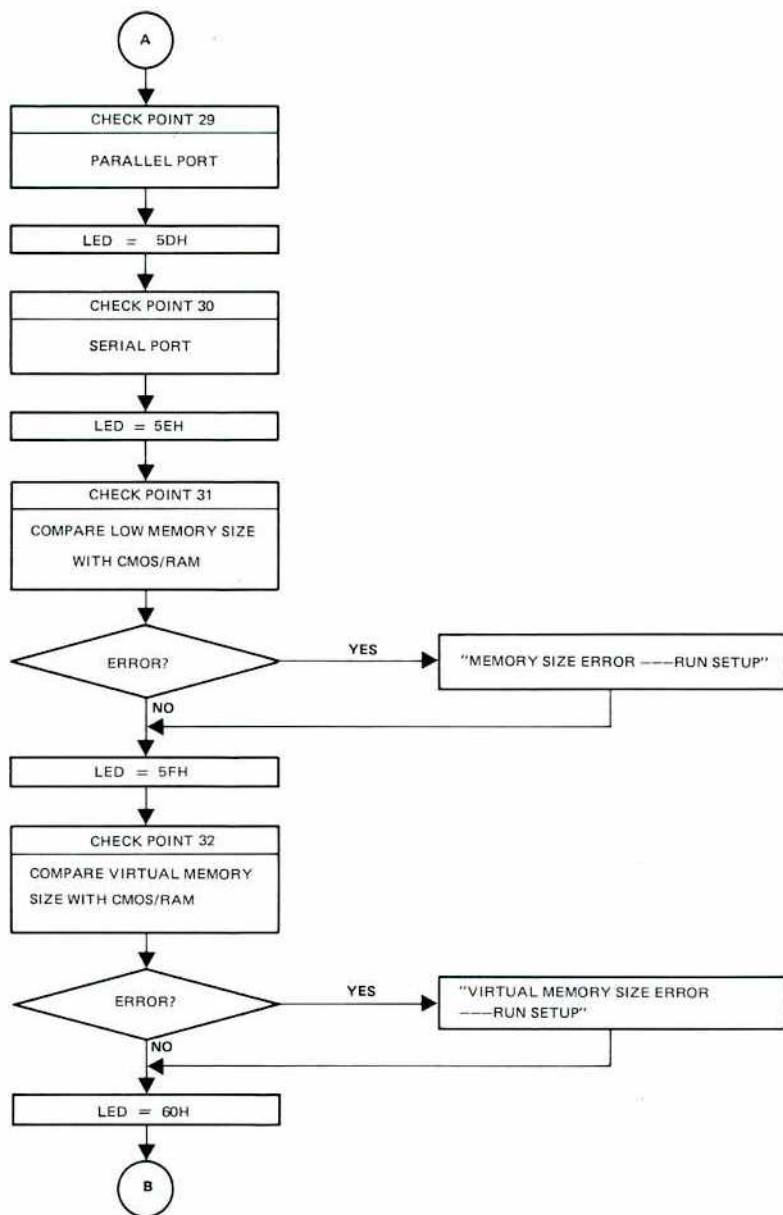
CHECK POINT	STATUS	MESSAGE DISPLAYED	STATUS OF LEDS 8 7 6 5 4 3 2 1
38	COMPLETED	Floppy Disks: 1 Present or Floppy Disks: 2 Present or Floppy Disks: Not Present	0 1 1 0 0 1 0 1
	FAILED	Floppy Configuration Error -- Run SETUP	0 1 1 0 0 1 0 0
	BLOCKED	—	0 1 1 0 0 1 0 0

Note

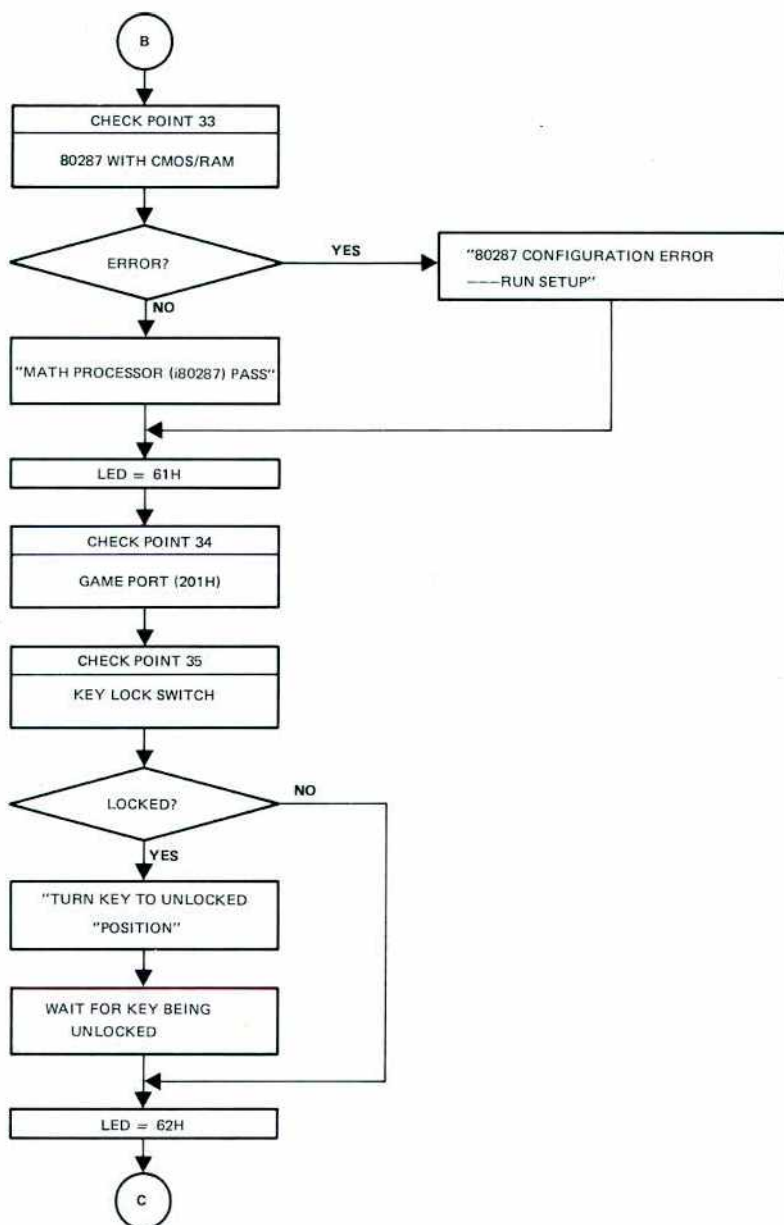
0 = LED on
 1 = LED off
 s000 = paragraph
 oooo = offset

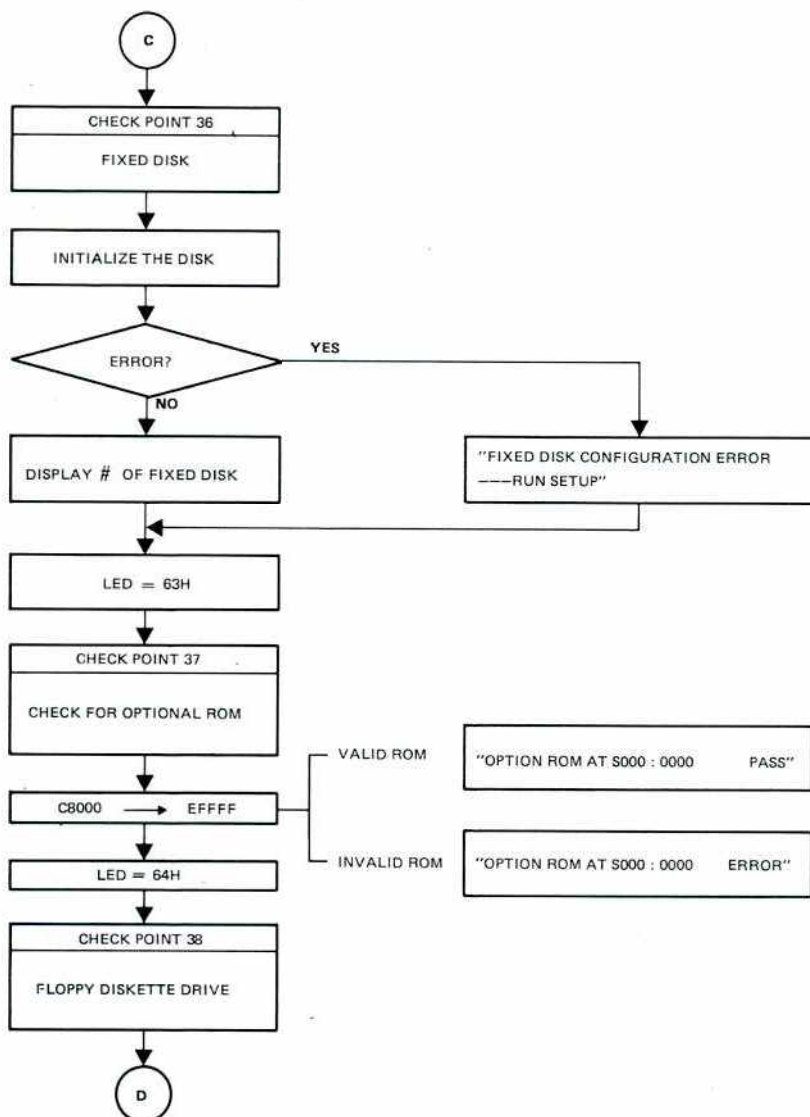
CONFIGURATION DIAGNOSTICS FLOW CHART



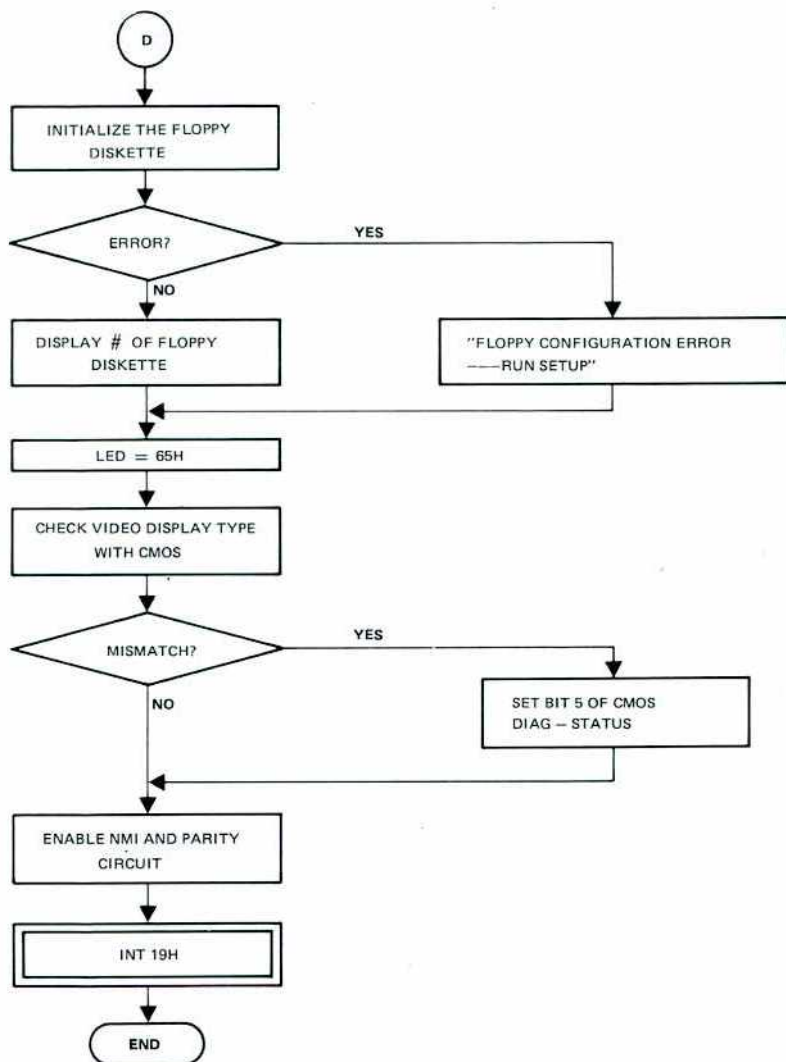


POWER-UP DIAGNOSTICS





POWER-UP DIAGNOSTICS



PRIMITIVE DIAGNOSTICS ERROR ROUTINE (PDER)

The PDER is executed each time an error is detected during the shutdown and primitive diagnostics.

The steps performed by the PDER are shown below:

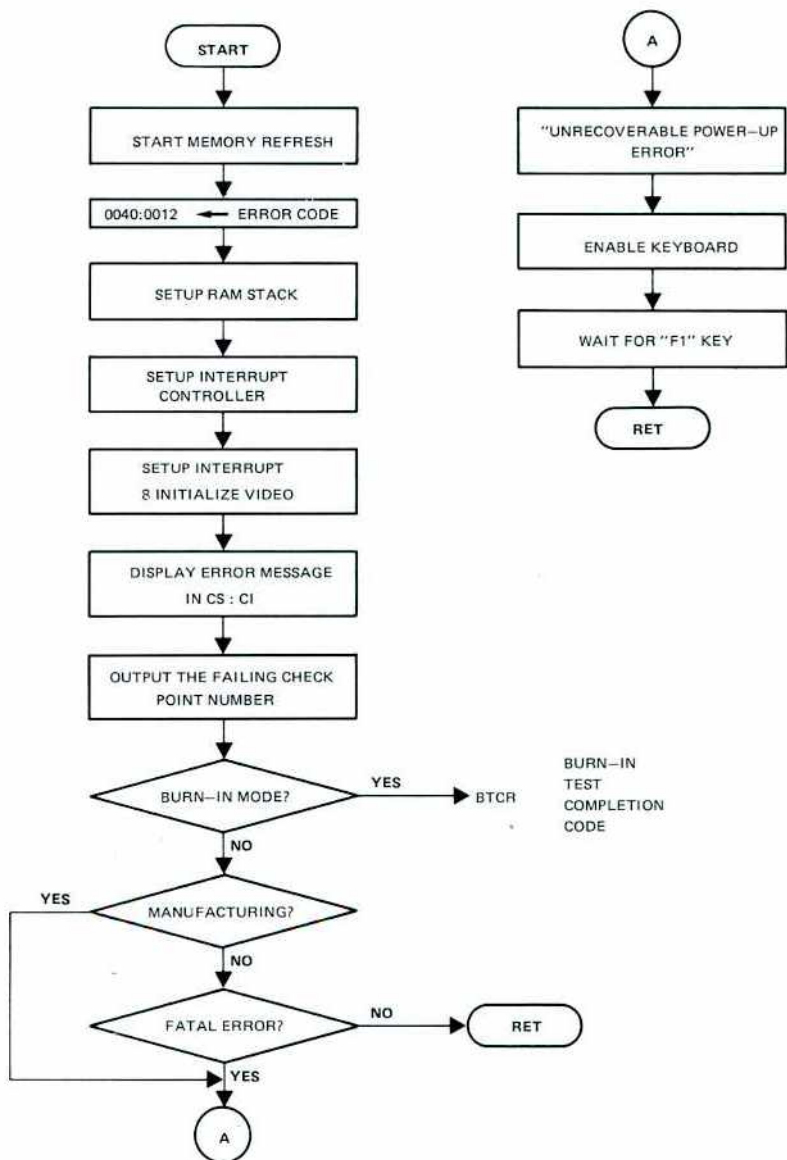
1. It starts the memory refresh so that a RAM stack can be allocated (even though the memory has not been tested) and, if the test is running in automated test mode, the number of the check point is written to location 40:0012 of the ROM.
2. Initializes the interrupt vector table and installs int 10H for display handling.
3. Initializes the display in 80x25 text mode.
4. Appends the word "Error" to the message displayed by the calling test and displays the whole message on the screen.
5. If there is other data to display, it adds the character ":" to the message, and then the additional data.
6. Displays an empty line.
7. Outputs to the parallel port the value obtained by executing an exclusive OR between the check point and the value 3FH.
8. If the error is a non-fatal error, the PDER returns to the calling test and continues from the step established by the test.
9. If the test is running in burnin environment, the BPCR is called.
10. If the error is a fatal error, an empty line is displayed, and then the message:

UNRECOVERABLE POWER-UP ERROR

11. Initializes and enables the keyboard and waits for key F1 to be pressed. When F1 is pressed, it returns to the calling test and continues from the step established by the test.
12. If the display is not working, a signal is emitted from the speaker.

POWER-UP DIAGNOSTICS

PDER FLOW CHART



ADVANCED DIAGNOSTICS ERROR HANDLING ROUTINE (ADER)

The advanced diagnostics error handling routine is divided into two subroutines, to provide greater flexibility:

- The advanced diagnostic error message routine (AEMR)
- The advanced diagnostic error handling routine (AEHR).

The first routine displays on the video, in standard format, the messages of any errors detected during the execution of the advanced and configuration diagnostics. The second routine handles all the other standard error detection functions.

Advanced Diagnostic Error Message Routine (AEMR)

The AEMR uses the following parameters passed by the calling test:

- Message to display
- Other data to display

The steps performed by the AEMR are shown below:

1. Appends the word "Error" to the message to display and displays the whole message on the screen.
2. If there is other data to display, it adds the character ":" to the message, and then the additional data.
3. Displays an empty line.
4. Returns to the calling test.

Advanced Diagnostic Error Handling Routine (AEHR)

The AEHR uses the following parameters passed by the calling test:

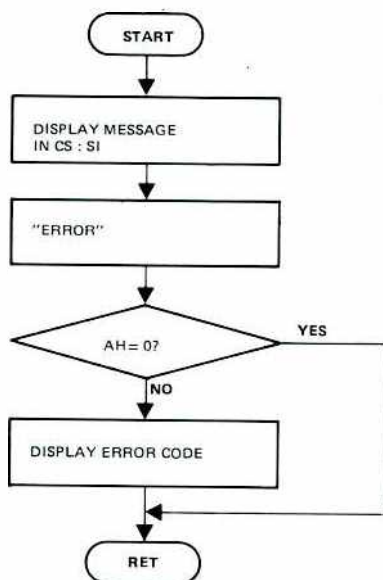
- Check point number
- Type of error

The steps performed by the AEHR are shown below:

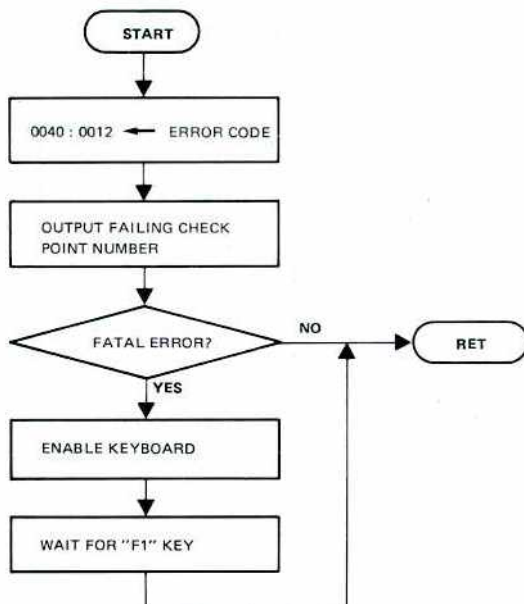
1. Updates the contents of the RAM location at address 40:0012 with the check point number.
2. Outputs to the parallel port the value obtained by executing an exclusive OR between the check point and the value 3FH.
3. If the error is a fatal error, it waits for key F1 to be pressed, and then returns to the calling test.
4. If the error is a non-fatal error, it returns to the calling test.

ADER FLOW CHARTS

Advanced Diagnostic Error Message Routine (AEMR)



Advanced Diagnostic Error Handling Routine (AEHR)



BURNIN TEST COMPLETION ROUTINE (BTCR)

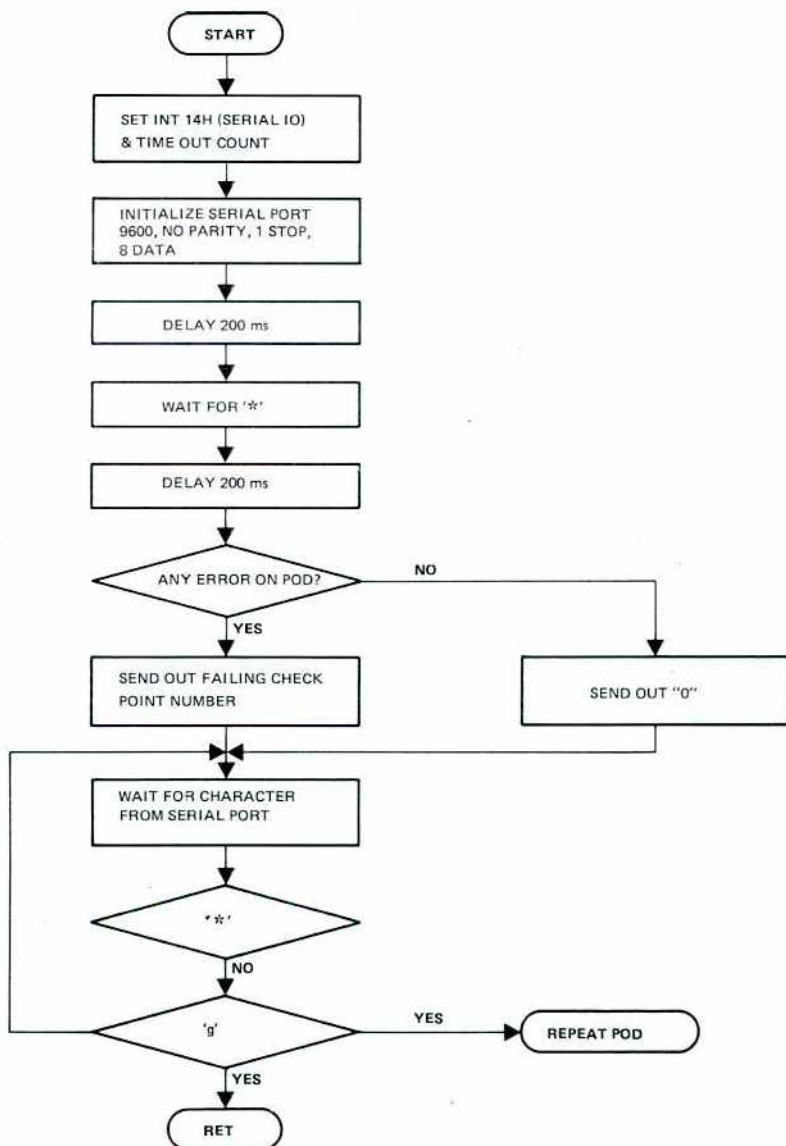
If the power-up diagnostics are executed in burnin environment, the BTCR is executed to communicate the test status to another computer, regardless of whether the diagnostics complete successfully or an error is detected. The other computer, called the burnin controller, communicates with the system via the serial port.

The steps executed by the BTCR are shown below:

1. It sets up the serial port (I/O address 3F8H) to communicate with the burnin controller. The operating parameters are established as follows:
 - 9600 baud
 - no parity
 - 8 bits per character
 - 1 stop bit.
2. Delays 200 ms.
3. Waits to receive a character "*" on the serial port and then sets the line into transmit operating mode. If a receive error or another character is received, it is ignored.
4. Delays 200 ms.
5. Sends the test completion code over the serial line. If the test has completed without errors, the code is 0 (30H). If the test has detected an error, the code is the failing check point number. For example, if the failing check point is 15 (decimal), the BTCR outputs a "1" character (31H) followed by a "5" character (35H) to the serial port.
6. Sets the serial line into receive operating mode and waits to receive a character "*" (2AH) or "g" (67H). If the character received is "*", it resets the CPU so that the diagnostic tests can be repeated. If the character received is "g", the BTCR continues with the bootstrap procedure. Any other character received is ignored.

POWER-UP DIAGNOSTICS

BTCR FLOW CHART



SUMMARY OF MESSAGES

MESSAGES DISPLAYED AT THE END OF SUCCESSFUL TESTS

If the power-up diagnostics complete without errors, the following set of messages is displayed. The messages preceded by an asterisk are only displayed if the relative module is found in the system:

```
Resident Diagnostics  Rev X.XX

CPU (i80286)           Pass
ROM Checksum           Pass
Memory Refresh         Pass
Keyboard Controller    Pass
Low Memory             xxx KB
* Virtual Memory       yyy KB
Total Memory           zzz KB
Memory Parity          Pass
DMA Controllers        Pass
Keyboard               Pass
Clock/Calendar         Pass
Protected Mode         Pass
CMOS RAM               Pass
* Math Processor (i80287) Pass
Fixed Disks:           1 Present
* Option ROM at s000:0000 Pass
Floppy Disks:          2 Present

Primary boot-strap
```

where:

- X.XX is the system ROM revision number
- xxx, yyy, zzz are the amount in kilobytes of memory
- s000 is the paragraph and 0000 is the offset of the start address of any optional ROMs in the system.

POWER-UP DIAGNOSTICS

ERROR MESSAGES

If errors are detected during the power-up diagnostics, error messages are displayed; these messages are shown in alphabetic order on the following pages. The following information is given for each error message: the actual message that appears on the display, the number of the check point in which the error was detected, the status of the LEDs located on the motherboard, and a brief description of the error message.

If an error occurs during the bootstrap procedure, the following message is displayed:

Non-system disk or disk error
Replace disk and strike any key

MESSAGE DISPLAYED	NO.	STATUS OF LEDS 8 7 6 5 4 3 2 1	DESCRIPTION
Clock/Calendar Error	23	0 0 1 0 1 0 0 0	The CMOS-RAM does not keep time correctly.
CMOS RAM Battery Error	26	0 0 1 0 0 1 0 1	The CMOS-RAM test executed in automated test mode found that the battery was low.
CMOS RAM Battery Low -- Run SETUP	26	0 1 0 1 1 0 0 1	The CMOS-RAM test executed in operating or burnin environment found that the battery was low.
CMOS RAM Checksum Error -- Run SETUP	28	0 1 0 1 1 0 1 1	The CMOS-RAM checksum test failed. This may mean that the CMOS-RAM has not been initialized, that the battery is low or that the software wrote into the CMOS-RAM without calculating the new checksum.
CMOS RAM Error: 1	9	0 0 1 1 0 1 1 0	The CMOS-RAM shutdown byte test has failed.
CMOS RAM Error: 2	27	0 0 1 0 0 1 0 0	The CMOS-RAM write/read test has failed.
CPU (i80286) Error: 1	1	0 0 1 1 1 1 1 0	The CPU failed the flag test.
CPU (i80286) Error: 2	1	0 0 1 1 1 1 1 0	The CPU failed the ALU test.
CPU (i80286) Error: 3	1	0 0 1 1 1 1 1 0	The CPU failed the registers test.
DMA Controller Error: 1	19	0 0 1 0 1 1 0 0	The first DMA controller failed the register write/read test.
DMA Controller Error: 3	20	0 0 1 0 1 0 1 1	The second DMA controller failed the register write/read test.

POWER-UP DIAGNOSTICS

MESSAGE DISPLAYED	NO.	STATUS OF LEDS	DESCRIPTION
		8 7 6 5 4 3 2 1	
DMA Page Registers Error	18	0 0 1 0 1 1 0 1	The DMA page register write/read test has failed.
Fixed Disk Configuration Error -- Run SETUP	36	0 1 1 0 0 0 1 0	The number of hard disk units found in the system does not agree with the configuration stored in the CMOS-RAM.
Floppy Configuration Error -- Run SETUP	38	0 1 1 0 0 1 0 0	The number of floppy disk drives found in the system does not agree with the configuration stored in the CMOS-RAM.
Illegal Shutdown Error: <code>	2	0 0 1 1 1 1 0 1	There is a shutdown condition, but the relative code is illegal or undefined.
Interrupt Controller Error: 1	16	0 0 1 0 1 1 1 1	No timer interrupt occurred when the first interrupt controller was tested.
Interrupt Controller Error: 2	16	0 0 1 0 1 1 1 1	Channel 0 of the timer failed to count when the first interrupt controller was tested.
Interrupt Controller Error: 3	16	0 0 1 0 1 1 1 1	A masked interrupt occurred when the first interrupt controller was tested.
Interrupt Controller Error: 4	16	0 0 1 0 1 1 1 1	The first interrupt controller failed the mask register test.
Interrupt Controller Error: 5	17	0 0 1 0 1 1 1 0	A masked interrupt occurred when the second interrupt controller was tested.
Interrupt Controller Error: 6	17	0 0 1 0 1 1 1 0	The second interrupt controller failed the mask register test.

MESSAGE DISPLAYED	NO.	STATUS OF LEDS 8 7 6 5 4 3 2 1	DESCRIPTION
Keyboard Controller Error: 1	6	0 0 1 1 1 0 0 1	The keyboard controller returned an error code at the end of the self test.
Keyboard Controller Error: 2	6	0 0 1 1 1 0 0 1	The keyboard controller timed out after a command to perform a self test.
Keyboard Error: 1	22	0 0 1 0 1 0 0 1	The keyboard returned an error code at the end of the self test.
Keyboard Error: 2	22	0 0 1 0 1 0 0 1	The keyboard returned a stuck key code at the end of the self test.
Keyboard Error: 3	22	0 0 1 0 1 0 0 1	The keyboard failed to generate an interrupt at the end of the self test.
Memory Error	7	0 0 1 1 1 0 0 0	An error was found in the first 8 KBs of system RAM.
Memory Error: Addr = s000:0000 Wrote = wwwwww Read = rrrrrr	11 12	0 0 1 1 0 1 0 0 0 0 1 1 0 0 1 1	A compare error was found during the RAM test.
Memory Refresh Error	5	0 0 1 1 1 0 1 0	Memory refresh did not occur every 15.1 us.
Memory Size Error -- Run SETUP	31	0 1 0 1 1 1 1 0	The actual memory size did not match the size stored in the CMOS-RAM.
NMI Error	14	0 0 1 1 0 0 0 1	A non-maskable interrupt was generated even with parity error checking disabled.
Option ROM at s000:0000 Error	37	0 0 0 1 1 0 1 0	The optional ROM at the given address failed a checksum test.

POWER-UP DIAGNOSTICS

MESSAGE DISPLAYED	NO.	STATUS OF LEDS	DESCRIPTION
		8 7 6 5 4 3 2 1	
Parity Error	15	0 0 1 1 0 0 0 0	A parity error was detected during the parity generator test.
Parity Error Addr = s000:0000 Wrote = wwwwww Read = rrrr	11 12	0 0 1 1 0 1 0 0 0 0 1 1 0 0 1 1	A parity error was detected during the memory test.
Protected Mode Error: 1	8	0 0 1 1 0 1 1 1	The CPU failed the test of the LIDT/SIDT and LGDT/SGDT instructions.
Protected Mode Error: 2	10	0 0 1 1 0 1 0 1	The CPU failed to enter virtual operating mode.
Protected Mode Error: 3	25	0 0 1 0 0 1 1 0	The CPU failed the test of the following instructions: LDT/SDT, LTR/STR, VERR/VERW, LAR/SLR, ARPL and POPA/PUSHA.
Protected Mode Error: 4	25	0 0 1 0 0 1 1 0	The CPU failed the exception handling test.
ROM Checksum Error	3	0 0 1 1 1 1 0 0	The resident ROM checksum test has failed.
Speaker Error	21	0 0 1 0 1 0 1 0	The speaker port test has failed.
Timer Error: <number>	4	0 0 1 1 1 0 1 1	One of the three timer channels does not count, or counts too fast or too slowly. The number of the faulty channel is displayed in the message.
Turn Key to Unlocked Position	35	0 1 1 0 0 0 1 0	The key switch on the front panel is in the locked position. The key must be turned to continue the test.

MESSAGE DISPLAYED	NO.	STATUS OF LEDS	DESCRIPTION
		8 7 6 5 4 3 2 1	
Virtual Memory Size Error -- Run SETUP	32	0 1 0 1 1 1 1 1	The size of the virtual memory found in the system does not match the size stored in the CMOS-RAM.
80287 Configuration Error -- Run SETUP	33	0 1 1 0 0 0 0 0	The 80287 NPX was not found in the system but was present in the CMOS-RAM configuration, or viceversa.

Note:

0 = LED on
 1 = LED off
 <code> = wrong shutdown code
 s000 = address segment
 oooo = segment offset
 wwwwww = data written
 rrrr = data read
 <number> = number of the faulty timer channel

If any errors detected during the diagnostics is fatal, the following message is also displayed:

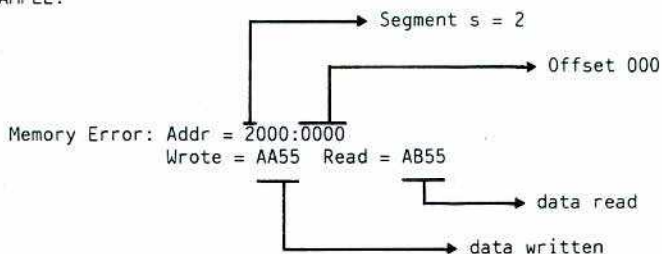
UNRECOVERABLE POWER-UP ERROR

HOW TO DETERMINE THE FAULTY MEMORY CHIP

If the diagnostics detect an error in the RAM, the faulty chip can be determined by analysing the relative error message.

The following example shows how to determine the faulty chip from the error message:

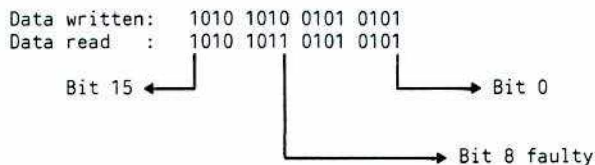
EXAMPLE:



i.e.:

- Error in the third 128 KB block (bank 0 of the motherboard)
- Data written: 1010 1010 0101 0101
- Data read: 1010 1011 0101 0101

By comparing the data written with the data read, it can be seen that the error is in bit 8: chip in position 8C.



REFERENCE TABLE

The tables on the following pages show the faulty chip determined from the values of s, of the faulty bit and of the system configuration.

s	Faulty Bit	Board	Bank	Faulty Chip (coordinates)	Notes
0 1 2 3	0	Motherboard	0	10C	----
0 1 2 3	1	Motherboard	0	10D	----
0 1 2 3	2	Motherboard	0	10E	----
0 1 2 3	3	Motherboard	0	10F	----
0 1 2 3	4	Motherboard	0	10G	----
0 1 2 3	5	Motherboard	0	10H	----
0 1 2 3	6	Motherboard	0	10J	----
0 1 2 3	7	Motherboard	0	10K	----

POWER-UP DIAGNOSTICS

s	Faulty Bit	Board	Bank	Faulty Chip (coordinates)	Notes
0 1 2 3	8	Motherboard	0	8C	----
0 1 2 3	9	Motherboard	0	8D	----
0 1 2 3	10	Motherboard	0	8E	----
0 1 2 3	11	Motherboard	0	8F	----
0 1 2 3	12	Motherboard	0	8G	----
0 1 2 3	13	Motherboard	0	8H	----
0 1 2 3	14	Motherboard	0	8J	----
0 1 2 3	15	Motherboard	0	8K	----

s	Faulty Bit	Board	Bank	Faulty Chip (coordinates)	Notes
4 8 9 10	0	Motherboard	1	9C	----
4 8 9 10	1	Motherboard	1	9D	----
4 8 9 10	2	Motherboard	1	9E	----
4 8 9 10	3	Motherboard	1	9F	----
4 8 9 10	4	Motherboard	1	9G	----
4 8 9 10	5	Motherboard	1	9H	----
4 8 9 10	6	Motherboard	1	9J	----
4 8 9 10	7	Motherboard	1	9K	----

POWER-UP DIAGNOSTICS

s	Faulty Bit	Board	Bank	Faulty Chip (coordinates)	Notes
4 8 9 10	8	Motherboard	1	7C	----
4 8 9 10	9	Motherboard	1	7D	----
4 8 9 10	10	Motherboard	1	7E	----
4 8 9 10	11	Motherboard	1	7F	----
4 8 9 10	12	Motherboard	1	7G	----
4 8 9 10	13	Motherboard	1	7H	----
4 8 9 10	14	Motherboard	1	7J	----
4 8 9 10	15	Motherboard	1	7K	----

NO ERROR MESSAGES DISPLAYED

If no messages appear on the display, the following procedures should be carried out:

1. Switch the power switch on the basic module and all external devices to OFF.
2. Disconnect all external devices except the display and keyboard from the basic module.
3. Turn the contrast and brightness controls fully anti-clockwise.
4. Ensure that all connectors and boards are securely plugged in.
5. Ensure that the basic module power cable is plugged into a functioning grounded wall outlet.
6. Set the basic module power switch to ON.

IF THERE IS STILL NO IMAGE ON THE DISPLAY CONSULT THE FOLLOWING TABLE:

ERROR INDICATION	POSSIBLE FAULT
Blank display, basic module LED OFF, HDU LED OFF, mini-floppy LED OFF, fan not working	Power supply
Blank display, LEDs (basic module, MFD, HDU) on, fan working	Display

5. MAINTENANCE

CONTENTS

PAGE

5. MAINTENANCE

5-1	<u>INTRODUCTION</u>
5-2	<u>SIGNAL ADJUSTMENTS</u>
5-2	POWER SUPPLY ADJUSTMENTS
5-3	MINI-FLOPPY DISK CONTROLLER BOARD VCO ADJUSTMENTS
5-10	<u>DISASSEMBLY AND ASSEMBLY OF MAIN MODULES</u>
5-11	REMOVING THE BASIC MODULE TOP COVER
5-13	REMOVING THE BOTTOM COVER
5-15	REMOVING THE REAR PANEL
5-16	REMountING THE TOP COVER
5-18	REMountING THE BOTTOM COVER
5-20	REMountING THE REAR PANEL
5-21	REPLACING THE POWER SUPPLY UNIT
5-23	REPLACING THE FAN
5-24	REPLACING THE MOTHERBOARD
5-26	REPLACING THE BUS EXPANSION BOARD
5-28	REPLACING THE DISPLAY CONTROLLER BOARD
5-31	REPLACING THE MINI-FLOPPY DISK DRIVE
5-33	REPLACING THE HARD DISK UNIT
5-36	REPLACING THE HARD DISK CONTROLLER BOARD
5-37	REPLACING THE MINI-FLOPPY DISK CONTROLLER BOARD
5-38	REPLACING THE BATTERY
5-39	REPLACING THE FRONT PANEL
5-42	REPLACING THE TAPE DRIVE

MAINTENANCE

INTRODUCTION

The solid state circuitry of the PC and the minimum number of moving parts render the system virtually free from maintenance problems. Preventive maintenance is therefore limited to cleaning, troubleshooting, and signal verification. Dust should be brushed from the active areas of the system, and care should be taken to ensure that foreign objects such as staples and pins do not fall into the keyboard.

This chapter deals with the adjustments performed on the power supply and the VCOs of the mini-floppy disk controller board. There are no adjustments to be carried out on the motherboard. For adjustments on the CRT display refer to the Video Display Unit General Service Manual, and for signal adjustments on the mini-floppy disk drive refer to the Mini-Floppy General Service Manual. A list of references is given in the preface of this manual.

This chapter also deals with the disassembly and assembly of the various modules.

SIGNAL ADJUSTMENTS

The adjustments described in this chapter refer to the power supply DC voltages and the two VCOs of 2.4 MHz and 4 MHz of the mini-floppy disk controller board. It is not necessary to perform any adjustments on the motherboard.

POWER SUPPLY ADJUSTMENTS

Tools required: voltmeter.

The power supply provides +5 VDC, -12 VDC, +15 VDC and +12 VDC voltages. Two suitable test points are provided on the power supply; one for the ground and the other for the +5 VDC. The only adjustment to be performed is on the +5V circuitry which in turn affects the other voltages. The adjustment is performed by means of the potentiometer located on the top of the power supply near the DC output connectors.

The voltmeter should be set up for Voltage DC range; the negative lead of the voltmeter is connected to point A, and the positive lead to point B. The voltmeter reading should be +5 Volts $\pm 5\%$; if it is not, rotate potentiometer C until the reading is +5 VDC $\pm 5\%$.

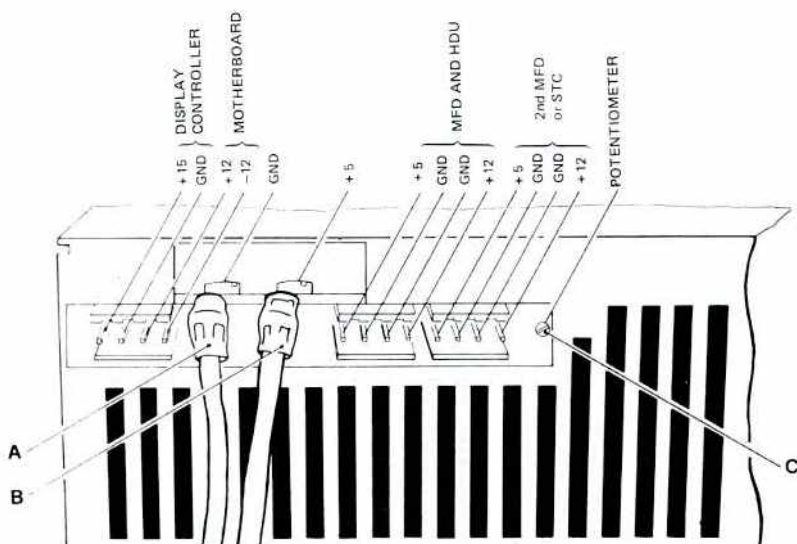


Fig. 5-1 Power Supply Test Points and Potentiometer

MAINTENANCE

MINI-FLOPPY DISK CONTROLLER BOARD VCO ADJUSTMENTS

This section describes the procedure to adjust the two VCOs on the mini-floppy disk controller board. In order to carry out this adjustment, the servicing engineer must have the equipment listed below and a connector to supply power to the board. This power connector is easily constructed with a female connector from a 62-pin printed circuit to which the following wires are soldered:

- A black wire to pin 1 (ground)
- A red wire to pin 5 (+5 VDC)
- A blue wire to pin 13 (-12 VDC)
- A green wire to pin 17 (+12 VDC)

These wires should be thick enough to support the following currents:

- +5 VDC power supply: 2.5 A
- -12 VDC power supply: 0.01 A
- +12 VDC power supply: 0.01 A

The wires do not need to be of any specific length, but they must be long enough to use with the board removed from the system and to connect the board to an external power supply unit.

Note: If the adjustment procedure does not bring about the required results, the controller board must be replaced.

MATERIAL REQUIRED

- Power supply unit capable of providing the following voltages and currents:
 - +5 VDC, $\pm 5\%$, 2.5 A
 - +12 VDC, $\pm 5\%$, 0.01 A
 - 12 VDC, $\pm 5\%$, 0.01 A
- Frequency meter able to measure frequencies up to 10 MHz with at least $\pm 1\%$ accuracy
- Non-metallic screwdriver

ADJUSTMENT PROCEDURE

1. Remove the mini-floppy disk controller board as described in the relevant section.
2. Insert the power supply plug in connector P1 of the board.

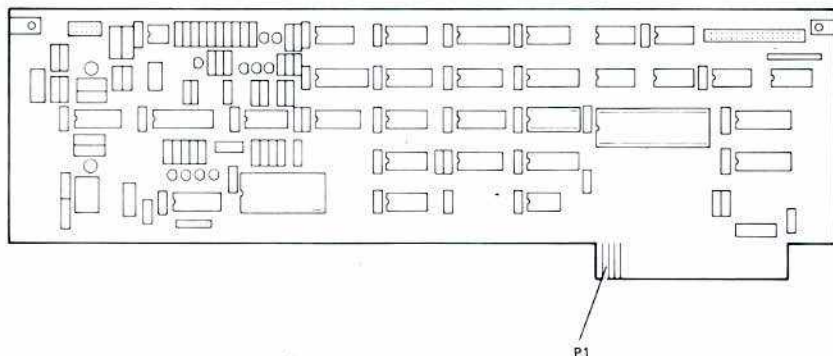


Fig. 5-2 Board Connector P1

3. Connect the wires protruding from the power supply connector to the power supply in the following way:
 - The black wire (ground) to ground
 - The red wire (+5 VDC) to the terminal which supplies the +5 VDC
 - The blue wire (-12 VDC) to the terminal which supplies the -12 VDC
 - The green wire (+12 VDC) to the terminal which supplies the +12 VDC

MAINTENANCE

4. Set jumpers J4 of the controller board in the following way:

- Pin 3-4 present
- Pin 5-6 not present
- Pin 7-8 not present
- Pin 9-10 not present

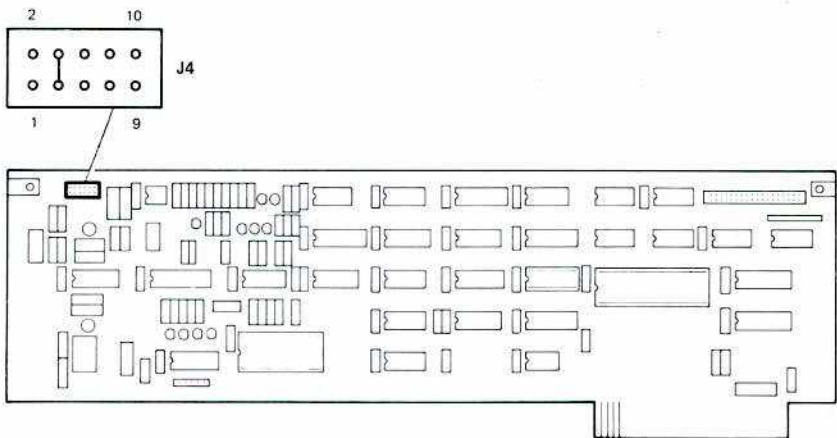


Fig. 5-3 Jumper J4

5. Connect the frequency meter to pin 1 of J4 of the controller board.
6. Switch the power supply and the frequency meter on.

7. Check that the frequency meter indicates a frequency of 2.4 MHz $\pm 5\%$; if it does not, turn capacitor C42 with the non-metallic screwdriver until the required reading is obtained.
-

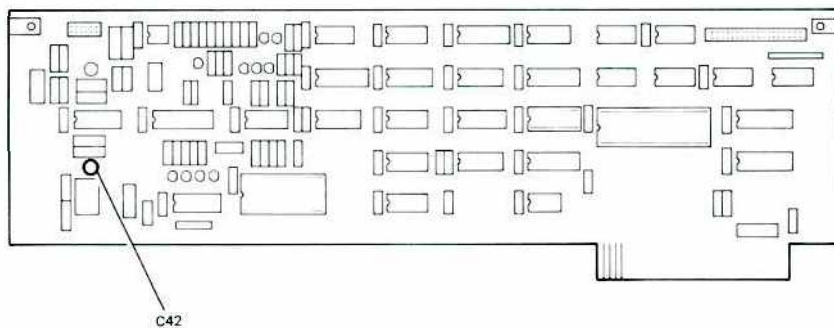


Fig. 5-4 Position of Capacitor C42

8. Switch the power supply and the frequency meter off.

MAINTENANCE

9. Set jumpers J4 of the controller board in the following way:

- Pin 3-4 not present
- Pin 5-6 not present
- Pin 7-8 present
- Pin 9-10 not present

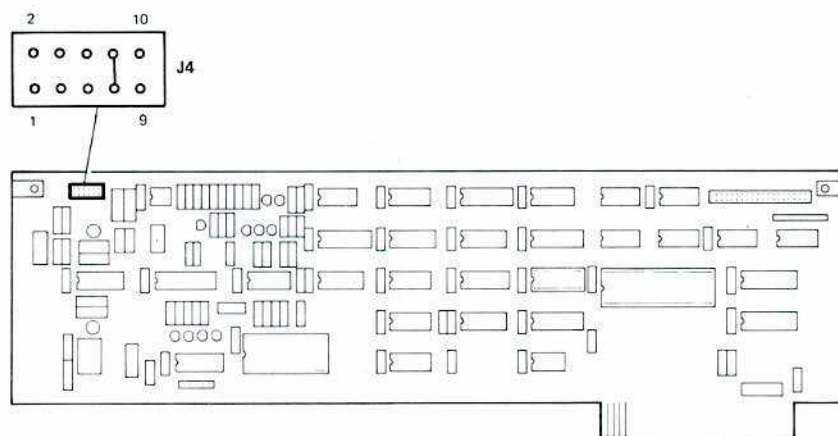


Fig. 5-5 Jumpers J4

10. Connect the frequency meter to pin 2 of J4 of the controller board.

11. Switch the power supply and the frequency meter on.

12. Check that the frequency meter indicates a frequency of 4 MHz $\pm 5\%$; if it does not, turn capacitor C51 with the non-metallic screwdriver until the required reading is obtained.

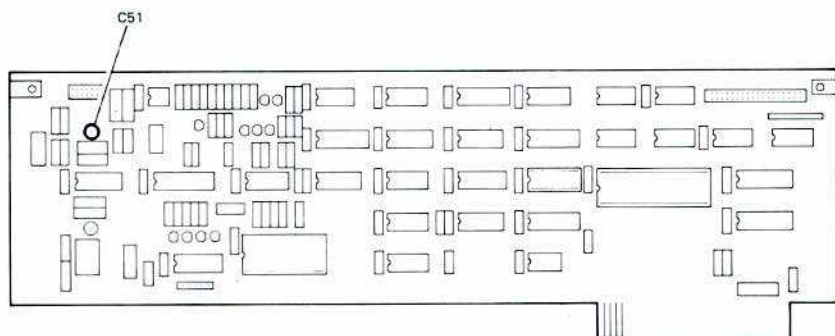


Fig. 5-6 Position of Capacitor C51

13. Switch the power supply and the frequency meter off.
14. Disconnect the frequency meter and the power supply connector from the controller board.

MAINTENANCE

15. Set jumpers J4 of the controller board for normal operation in the following way:

- Pin 1-2 not present
- Pin 3-4 not present
- Pin 5-6 present
- Pin 7-8 not present
- Pin 9-10 present

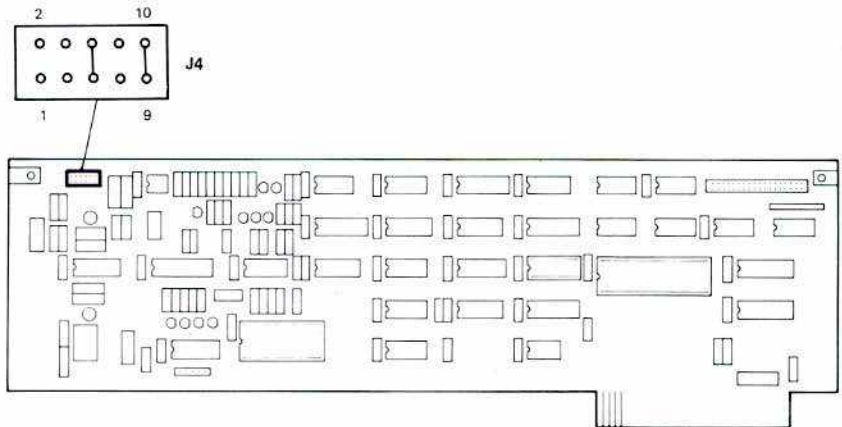


Fig. 5-7 Jumpers J4

16. Replace the mini-floppy disk controller board in the slot it occupied before in the basic module.
17. Reconnect the controller board for normal operation.
18. Replace the basic module top cover as described in the relevant section.
19. Recable the system.

DISASSEMBLY AND ASSEMBLY OF MAIN MODULES

BEFORE STARTING ANY DISASSEMBLY PROCEDURES MAKE SURE THAT THE SYSTEM IS SWITCHED OFF AND THE POWER CABLE IS DISCONNECTED.

This section contains procedures for the replacement of the following modules:

- Power Supply
- Fan
- Motherboard
- Display Controller Board
- Bus Expansion Board
- Mini-Floppy Disk Drive
- Hard Disk Unit
- Hard Disk Controller Board
- Mini-Floppy Disk Controller Board
- Battery
- Front Panel
- Tape Drive

REMOVING THE BASIC MODULE TOP COVER

The top cover of the basic module is removed in the following way:

1. Set the power switch on the basic module and on all external devices to OFF.
2. Unplug the basic module power cable from the wall outlet.
3. Disconnect all the cables connected to the basic module.
4. Remove the display and the other external devices from the basic module.
5. With a flat blade screwdriver, loosen the three top cover mounting screws located at the top of the basic module rear panel.

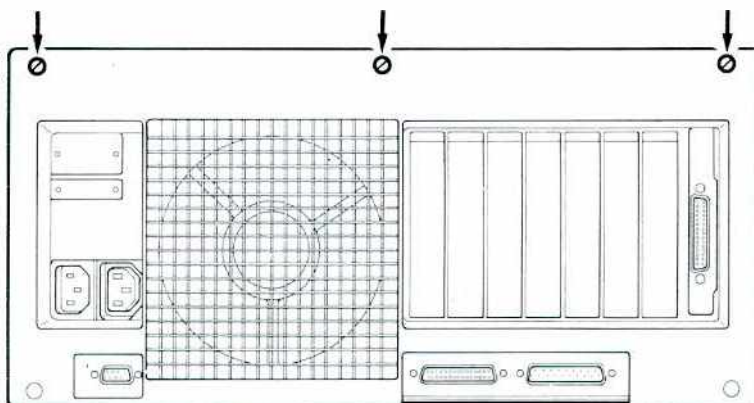


Fig. 5-8 Top Cover Mounting Screws

6. Remove the top cover by pushing it towards the front of the basic module and then lifting it out.
-

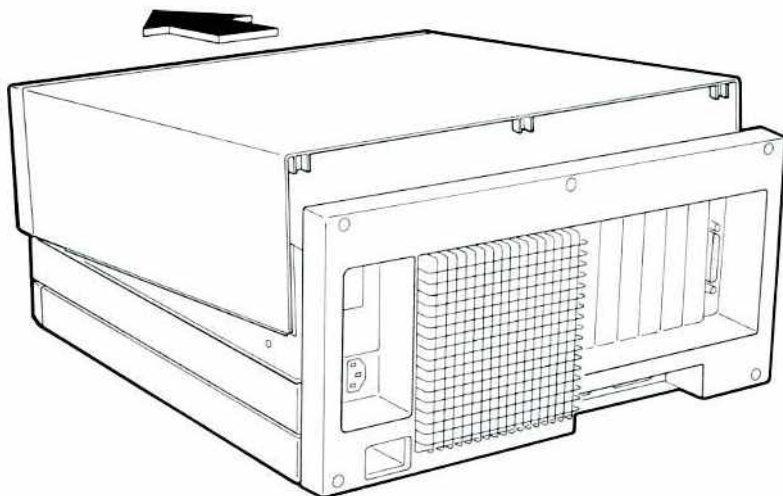


Fig. 5-9 Removing the Top Cover

MAINTENANCE

REMOVING THE BOTTOM COVER

The bottom cover of the basic module is removed in the following way:

1. Set the power switch on the basic module and on all external devices to OFF.
2. Unplug the basic module power cable from the wall outlet.
3. Disconnect all the cables connected to the basic module.
4. Remove the display and all other external devices from the basic module.
5. Turn the basic module upside down.
6. With a flat blade screwdriver, loosen the two bottom cover mounting screws located at the bottom of the basic module rear panel.

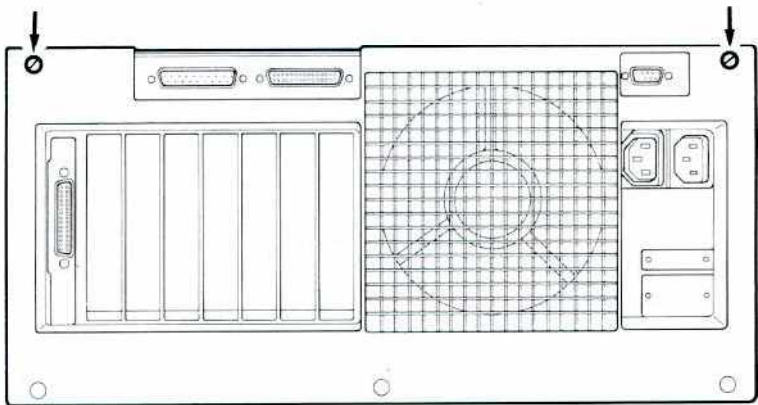


Fig. 5-10 Bottom Cover Mounting Screws

7. Remove the bottom cover by pushing it towards the front of the basic module and then lifting it out.

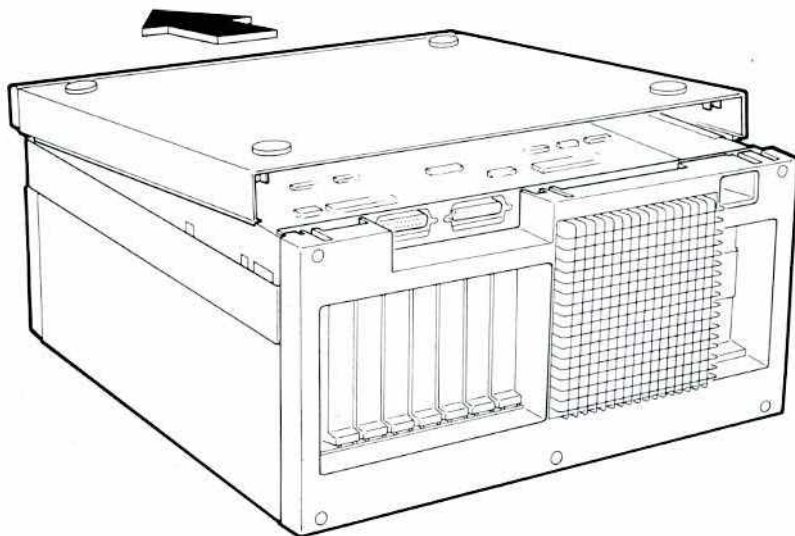


Fig. 5-11 Removing the Bottom Cover

MAINTENANCE

REMOVING THE REAR PANEL

The rear panel of the basic module is removed in the following way:

1. Remove the top and bottom covers of the basic module as described in the previous sections.
2. Loosen the two rear panel mounting screws and then remove the panel.

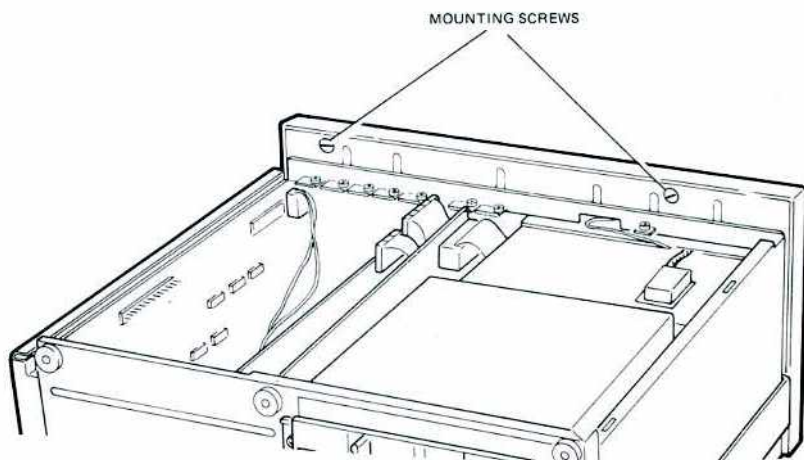


Fig. 5-12 Rear Panel Mounting Screws

REMountING THE TOP COVER

The top cover of the basic module is remounted in the following way:

1. Insert the top cover on the basic module and push it right up to the rear panel.

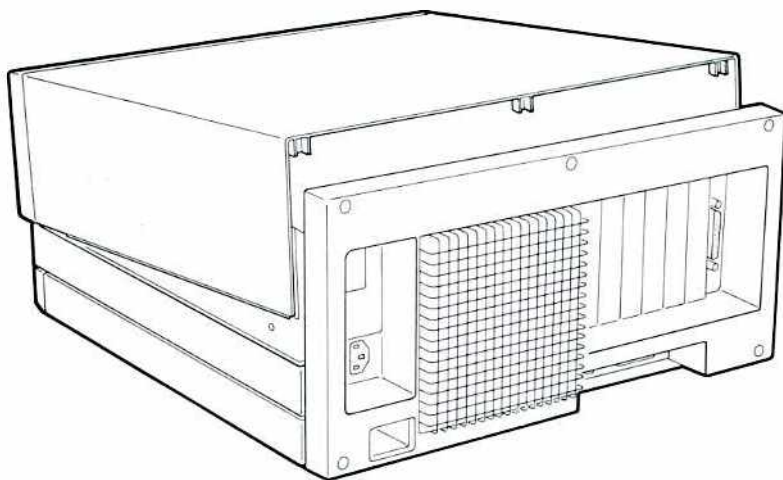


Fig. 5-13 Inserting the Top Cover

MAINTENANCE

2. With a flat blade screwdriver, tighten the three mounting screws located at the top of the basic module rear panel.

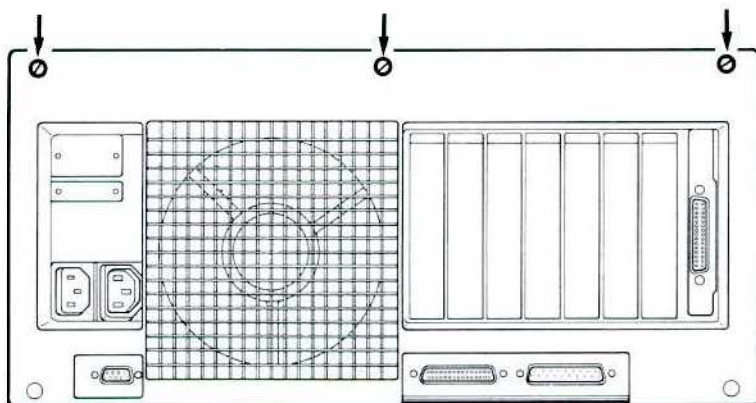


Fig. 5-14 Top Cover Mounting Screws

REMOUNTING THE BOTTOM COVER

The bottom cover of the basic module is remounted in the following way:

1. Turn the basic module upside down so that the electronic components on the motherboard can be seen.
2. Insert the bottom cover on the basic module and push it right up to the rear panel.

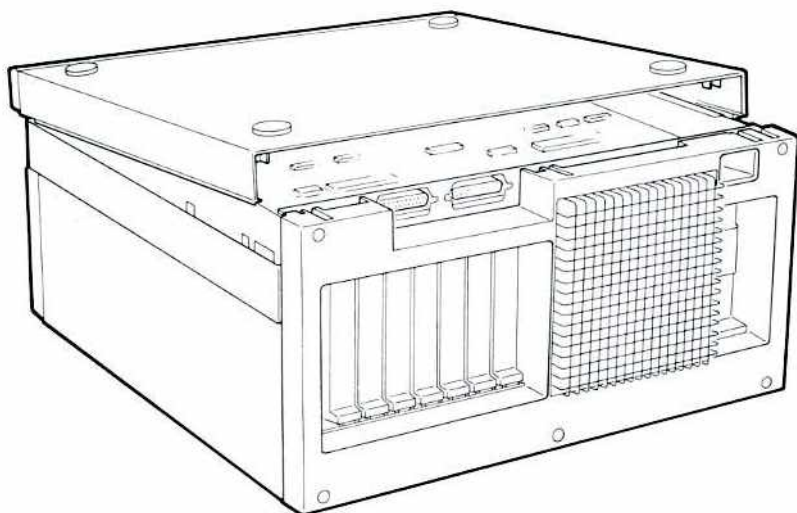


Fig. 5-15 Inserting the Bottom Cover

MAINTENANCE

3. With a flat blade screwdriver, tighten the two mounting screws located at the bottom of the basic module rear panel.

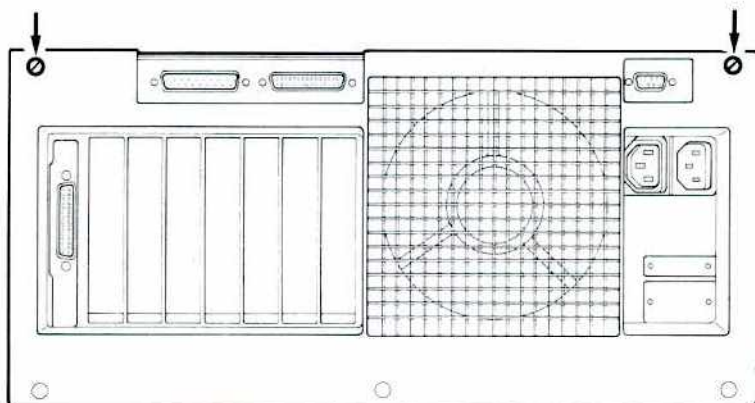


Fig. 5-16 Bottom Cover Mounting Screws

4. Return the basic module to its correct position.

REMountING THE REAR PANEL

The rear panel is remounted simply by placing it in position and tightening the two mounting screws.

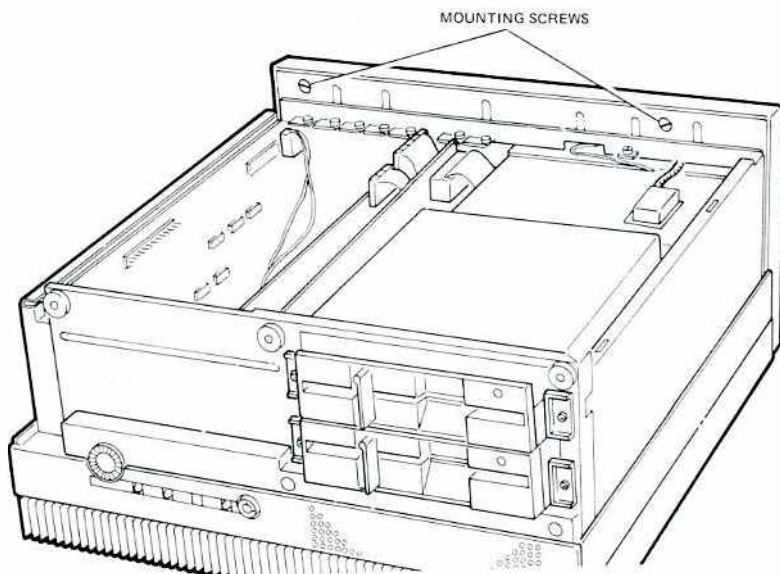


Fig. 5-17 Rear Panel Mounting Screws

REPLACING THE POWER SUPPLY UNIT

Removal Procedure

1. Remove the basic module top cover as described in the relevant section.
2. Remove the cover of the connector which carries the mains voltage to the power supply by loosening the mounting screw, and remove the connector.
3. Remove the power cables for the display controller, bus expansion board, hard disk unit and mini-floppy disk drives from the power supply.
4. Remove the +5V and GND cables from the power supply.
5. Remove the screws securing the power supply to the chassis.

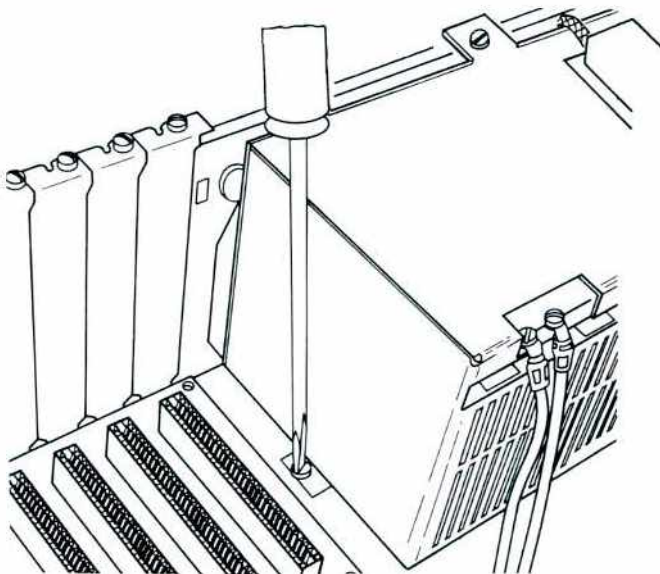


Fig. 5-18 Removing the Power Supply

6. Gently slide the power supply towards the bus expansion board until it can be raised from the chassis.
7. Remove the fan power connector from the back of the power supply.
8. Lift the power supply out of the basic module.

Reinstallation

Perform the removal procedure in reverse to reinstall the power supply.

MAINTENANCE

REPLACING THE FAN

Removal Procedure

1. Follow the instructions to remove the power supply.
2. Remove the basic module rear panel as described in the relevant section.
3. Use a pair of side cutters to cut the rubber inserts securing the fan to the chassis.
4. Remove the fan.
5. Disconnect the power supply cable from the fan.

Reinstallation

1. Connect the power supply cable to the fan.
2. Align the replacement fan with the holes in the chassis, making sure that the power connectors are at the top.
3. Slide the new rubber inserts through the holes until they protrude out of the rear of the fan.
4. Carefully pull the inserts through the fan until they are flush against the inside.
5. Follow the procedure to reinstall the power supply.

REPLACING THE MOTHERBOARD

CAUTION: WHENEVER THE MOTHERBOARD IS REPLACED, THE SYSTEM SETUP PROGRAM MUST BE RUN TO RESTORE THE CMOS-RAM CONTENTS.

Removal Procedure

1. Remove the basic module top and bottom covers as described in the relevant sections.
2. Remove the basic module rear panel as described in the relevant section; this gives access to the screws securing the serial and parallel connectors and the keyboard connector to the chassis.
3. Turn the basic module over and remove the front panel and bus expansion board cable connectors from the motherboard (see figure overleaf).
4. Remove the screws securing the serial and parallel connectors and the keyboard connector to the chassis (see figure overleaf).
5. Remove the screws securing the motherboard to the chassis.
6. Carefully remove the motherboard from the chassis, disconnecting it from the display controller board connectors.

Reinstallation

Perform the removal procedure in reverse to reinstall the motherboard.

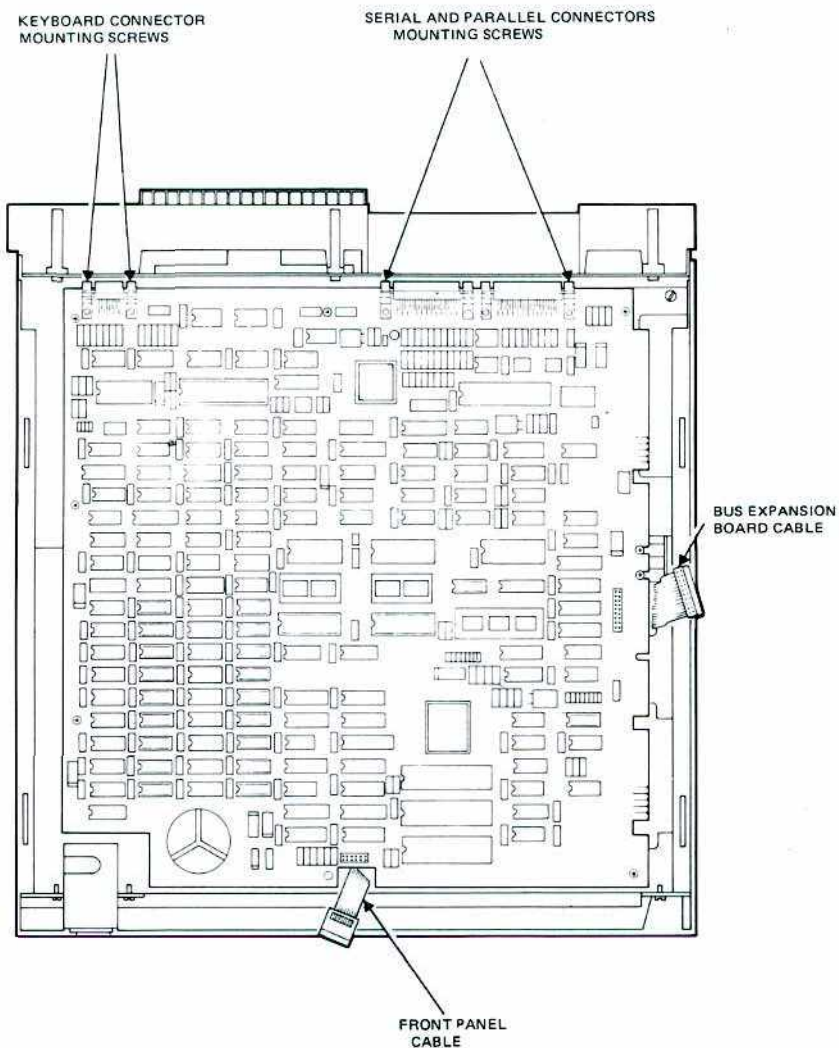


Fig. 5-19 Rear Panel and Bus Expansion Board Cables and Connector Mounting Screws

REPLACING THE DISPLAY CONTROLLER BOARD

Removal Procedure

1. Remove the basic module top and bottom covers as described in the relevant sections.
 2. Remove all the boards inserted in the bus expansion board by loosening the screws securing the retaining brackets to the rear panel of the basic module.
 3. Unplug the +15 VDC power cable from the display controller board.
 4. Remove the two screws securing the +5 VDC and GND terminals to the bus expansion board.
-

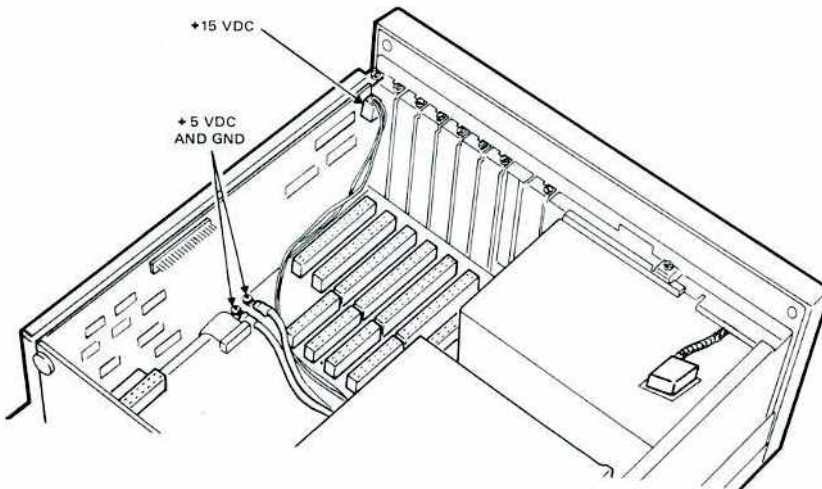


Fig. 5-21 Bus Expansion Board +5 VDC, GND and +15 VDC Terminal Connectors

5. Remove the +5 and GND power cables from the terminal connectors.

MAINTENANCE

6. Remove the basic module rear panel as described in the relevant section.
7. Remove the two screws securing the display controller retaining bracket to the chassis. One of the screws is at the top of the retaining bracket and the other is on the chassis under the display connector.
8. Remove the screws securing the left panel to the chassis.

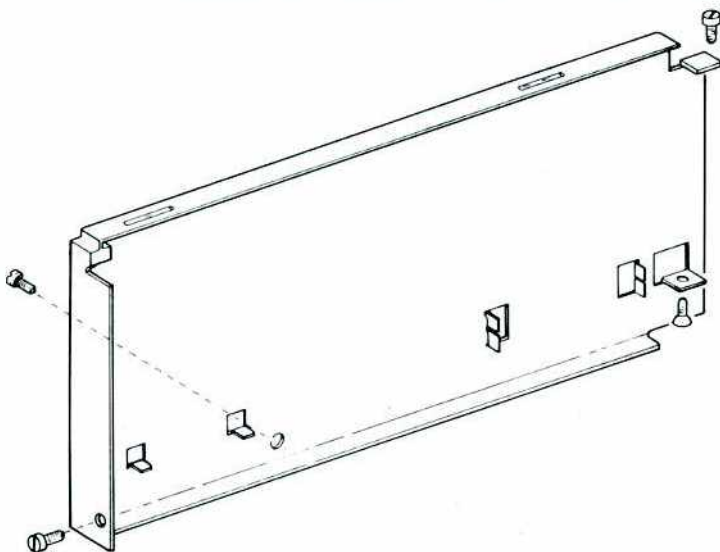


Fig. 5-22 Removing the Left Panel

9. Turn the basic module over and remove the two screws securing the +5 and GND terminals of the motherboard to the display controller.

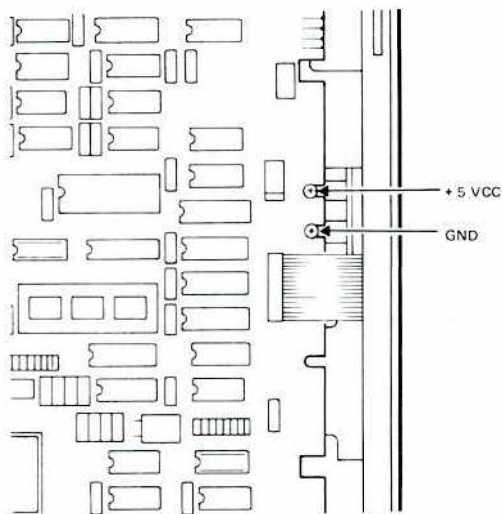


Fig. 5-23 Motherboard +5V and GND Terminal Connectors

10. Place the basic module on its side and gently lift the display controller connectors until they are separated from the bus expansion board and motherboard. Then remove the display controller from the basic module.

Reinstallation

Perform the removal procedure in reverse to reinstall the display controller board.

REPLACING THE MINI-FLOPPY DISK DRIVE

Removal Procedure

1. Remove the basic module top cover as described in the relevant section.
2. Remove the signal and power cables from the rear of the mini-floppy disk drive to be removed.

Note:

- Take note of how the numbers on the signal cable connectors correspond with the numbers on the connector at the rear of the drive
- If drive B is being removed, drive A must first be slightly pulled out so that the connectors can be reached easily.

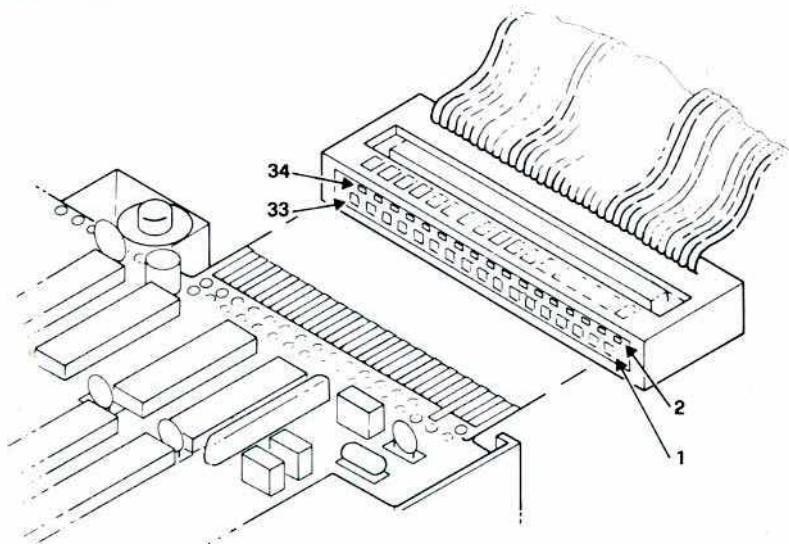


Fig. 5-24 MFD Signal Cable Connections

3. Remove from the front of the drive the screws securing the drive to the basic module chassis.
4. Carefully remove the drive from the basic module.

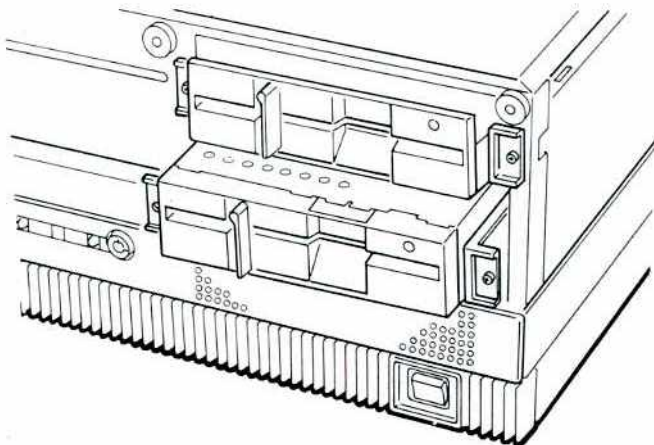


Fig. 5-25 Removing the Mini-Floppy Disk Drive

Reinstallation

Perform the removal procedure in reverse to reinstall the mini-floppy disk drive.

MAINTENANCE

REPLACING THE HARD DISK UNIT

Removal Procedure

1. Remove the basic module top and bottom covers as described in the relevant sections.
2. Loosen the three screws securing the front panel to the basic module and remove it carefully.

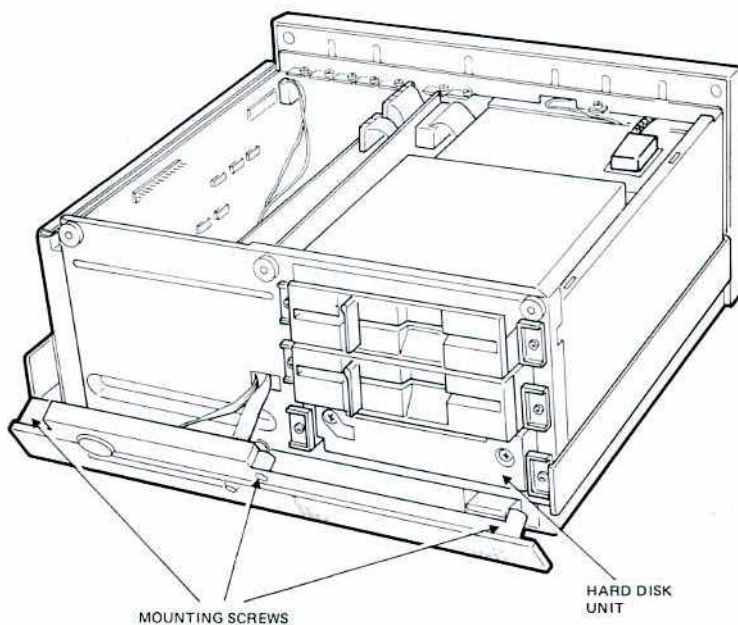


Fig. 5-26 Removing the Front Panel

3. Remove the signal and power cables from the rear of the drive.

Note:

- Take note of how the numbers on the signal cable connectors correspond with the numbers on the connectors at the rear of the hard disk unit
- For easy access to the connectors, it is advisable to pull out the two mini-floppy disk drives slightly.

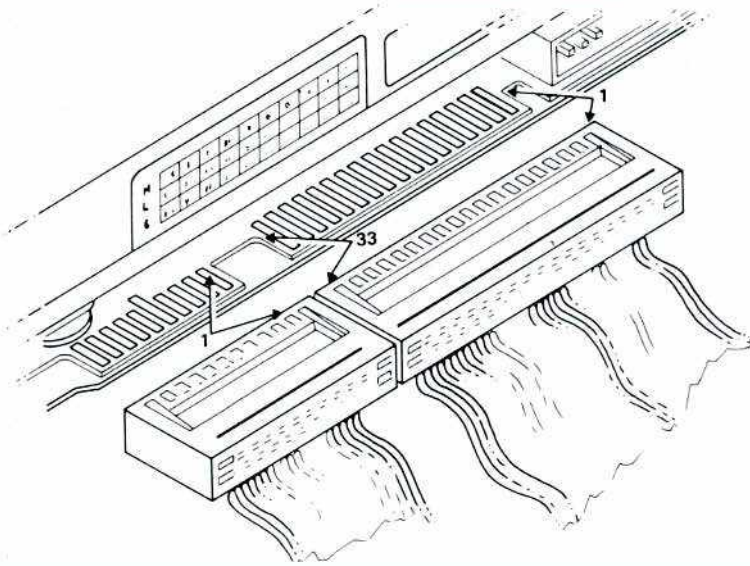


Fig. 5-27 HDU Cable Connection

MAINTENANCE

4. Loosen the screws securing the drive to the basic module and remove carefully.

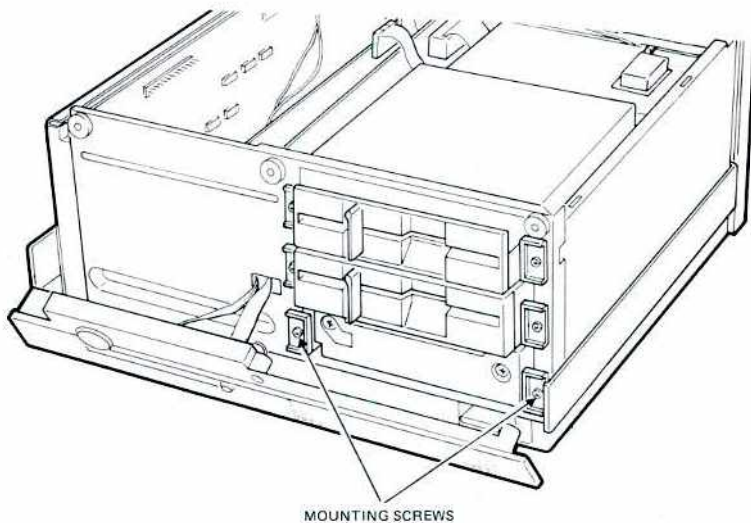


Fig. 5-28 Removing the Hard Disk Unit

Reinstallation

Perform the removal procedure in reverse to reinstall the hard disk unit.

REPLACING THE HARD DISK CONTROLLER BOARD

Removal Procedure

1. Remove the basic module top cover as described in the relevant section.
2. Disconnect the signal and power cables from the board.
3. Remove the power-up LED connector from the board, carefully noting the connector position.

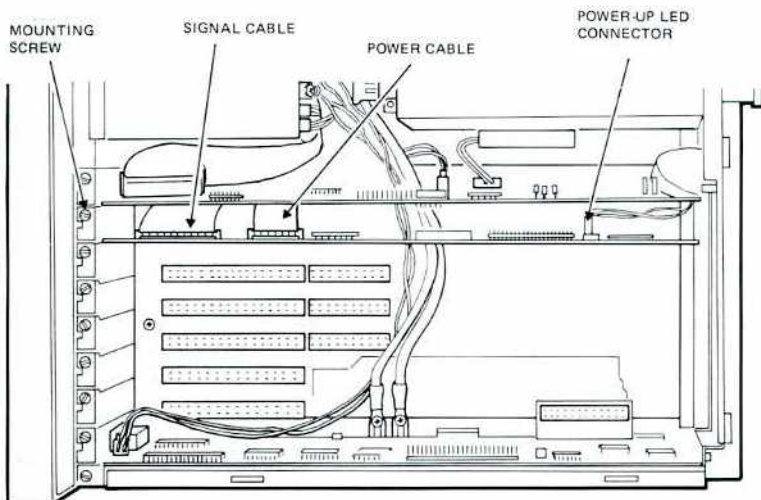


Fig. 5-29 LED Connector, Signal and Power Cables and Mounting Screw

4. Loosen the screw securing the retaining bracket to the rear panel of the basic module.
5. Remove the board from the bus expansion board.

Reinstallation

Perform the removal procedure in reverse to reinstall the hard disk controller board.

MAINTENANCE

REPLACING THE MINI-FLOPPY DISK CONTROLLER BOARD

Removal Procedure

1. Remove the basic module top cover as described in the relevant section.
2. Disconnect the signal cable from the board.

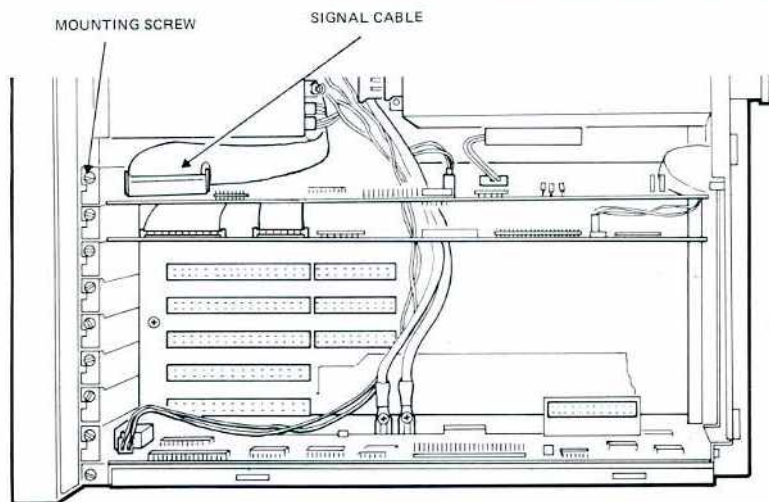


Fig. 5-30 Signal Cable and Mounting Screw

3. Remove the screw securing the retaining bracket to the rear panel of the basic module.
4. Remove the board from the bus expansion board.

Reinstallation

Perform the removal procedure in reverse to reinstall the mini-floppy disk controller board.

REPLACING THE BATTERY

CAUTION: WHENEVER THE BATTERY IS REPLACED, THE SYSTEM SETUP PROGRAM MUST BE RUN TO RESTORE THE CMOS-RAM CONTENTS.

Removal Procedure

1. Remove the basic module top cover as described in the relevant section.
2. Unplug the bipolar connector which connects the battery to the bus expansion board.
3. Remove the battery from the magnetic peripherals carrier.

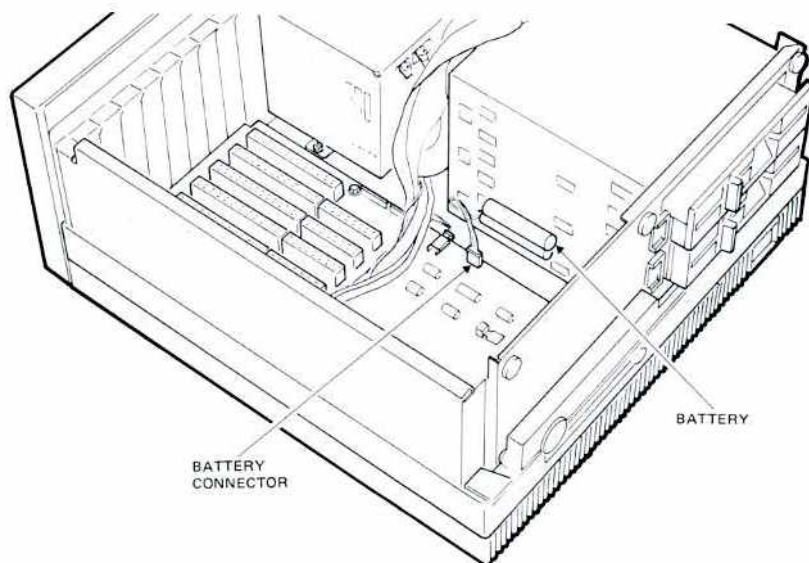


Fig. 5-31 Location of the Battery

Reinstallation

Perform the removal procedure in reverse to reinstall the battery.

REPLACING THE FRONT PANEL

Removal Procedure

1. Remove the basic module top and bottom covers as described in the relevant sections.
2. Turn the basic module upside down and remove the front panel cable connector from the motherboard.

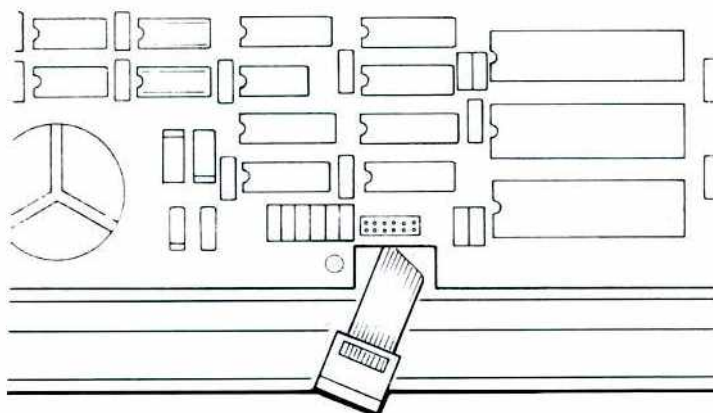


Fig. 5-32 Front Panel Cable

3. Loosen the three screws securing the front panel to the basic module and remove it carefully.
-

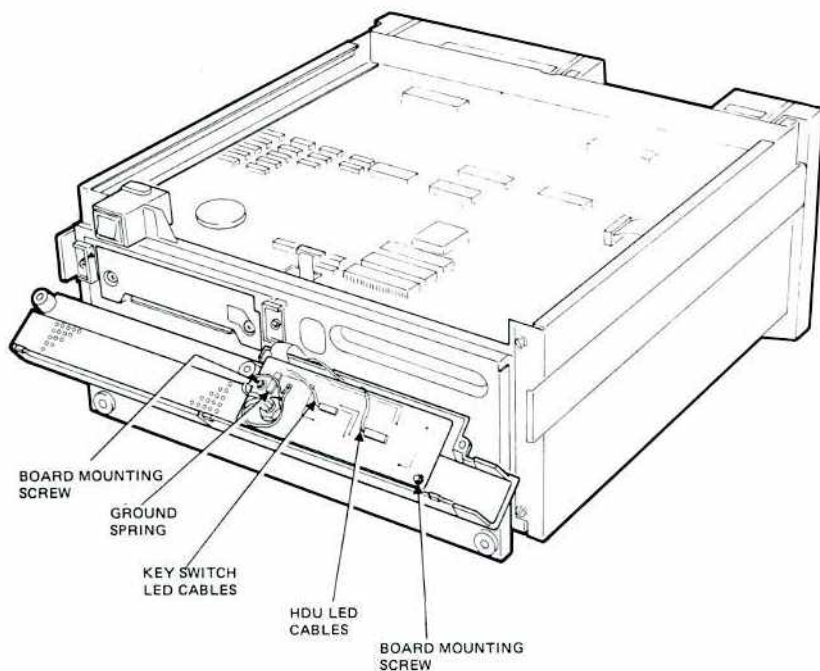


Fig. 5-33 Removing the Front Panel

4. Loosen the two screws securing the front panel board.

5. Disconnect all the cables leading to the board, noting carefully their original position (note that the flat cable connected to the motherboard cannot be removed, but should be pulled through the appropriate hole in the chassis).

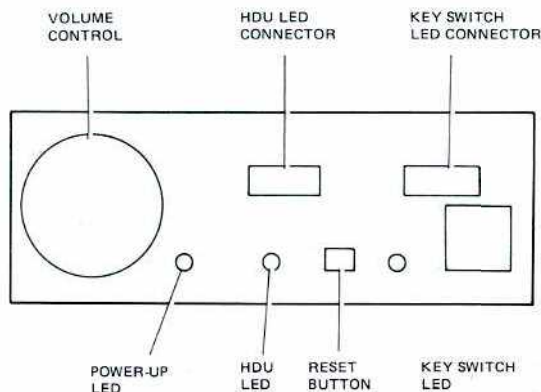


Fig. 5-34 Front Panel Board

6. Remove the front panel board by pressing the ground clip down.

Reinstallation

Perform the removal procedure in reverse to reinstall the front panel.

REPLACING THE TAPE DRIVE

Removal Procedure

1. Remove the basic module top cover as described in the relevant sections.
2. Remove the signal and power cables from the back of the tape drive.
Drive A should be pulled out slightly for easy access to the connectors.
3. Remove from the front part of the drive the screws securing the drive to the basic module chassis.
4. Carefully remove the drive from the basic module.

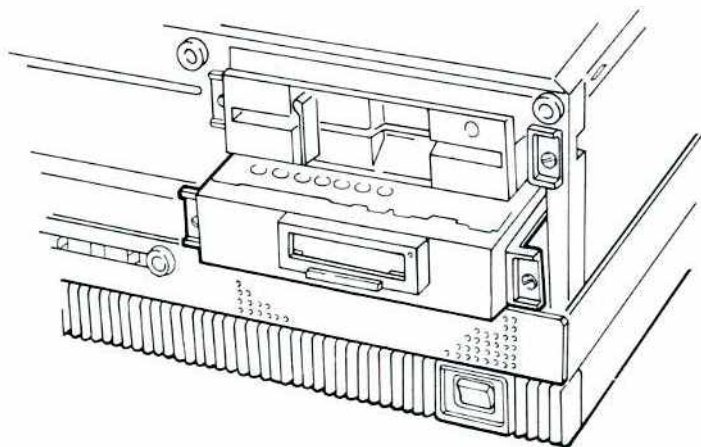


Fig. 5-35 Removing the Tape Drive

Reinstallation

Perform the removal procedure in reverse to reinstall the tape drive.

6. SOFTWARE OVERVIEW

CONTENTS

PAGE

6. SOFTWARE OVERVIEW

6-1	<u>DISK OPERATING SYSTEMS</u>
6-1	MS-DOS
6-1	XENIX
6-3	<u>USING MS-DOS</u>
6-4	KEYBOARD INSTALLATION AND NATIONAL VARIATIONS
6-5	CREATING AN AUTOEXEC.BAT FILE FOR KEYBOARD DRIVER AND FONT
6-6	HOW TO FORMAT ON DUAL-DRIVE VERSIONS
6-7	HOW TO FORMAT ON SINGLE-DRIVE VERSIONS
6-8	<u>FORMAT COMMAND</u>
6-10	<u>VOLUMES</u>
6-10	<u>FILES</u>
6-10	FILE NAMES
6-11	<u>DIRECTORIES</u>
6-12	LISTING VOLUMES
6-13	<u>FILE MANIPULATION</u>
6-13	COPYING FILES ON DUAL-DRIVE VERSIONS
6-14	DELETING A FILE ON DUAL-DRIVE VERSIONS
6-14	SOME SPECIAL FILES
6-14	THE INITIALIZATION FILE
6-15	<u>COPYING MINI-FLOPPY DISKS</u>
6-15	APPLICATION SOFTWARE MINI-FLOPPY DISKS

PAGE	
6-15	COPY-PROTECTION
6-15	MAKING BACKUPS
6-16	MAKING A BACKUP ON DUAL-DRIVE VERSIONS
6-17	MAKING BACKUPS ON A SINGLE-DRIVE VERSION
6-18	<u>OTHER MS-DOS FACILITIES</u>
6-22	<u>USING MS-DOS WITH THE HARD DISK</u>
6-22	INTRODUCTION
6-23	HOW TO SET UP THE HARD DISK FOR MS-DOS ONLY
6-25	HOW TO PARTITION THE HARD DISK
6-32	<u>ERROR MESSAGES</u>

SOFTWARE OVERVIEW

DISK OPERATING SYSTEMS

The Olivetti Personal Computer can operate with two different operating systems:

- MS-DOS
- UNIX/XENIX

Both operating systems carry out similar functions, but the manner in which these functions are attained are quite different. Both in effect give the PC a different personality.

An operating system can be defined as a group of programs which manage the computer's operation. A disk operating system can be defined as a group of programs that manage the transfer of data to and from a storage device such as a disk.

The two operating systems are briefly discussed in the following sections.

MS-DOS

MS-DOS was originally written by Seattle Computer Products in 1980. Later, Microsoft, Inc. acquired the exclusive marketing rights to this system, and renamed it MS-DOS. Subsequently, Lifeboat Associates began distributing the MS-DOS system under the name SB-86.

MS-DOS is a version of Microsoft's Xenix operating system. Xenix is, in turn, a version of the Unix operating system which was originally developed by Western Electric.

XENIX

The Xenix operating system is a multiuser timesharing system with hundreds of utilities. It forms the basis for a highly productive software development environment and a general-purpose applications system. The heart of the Xenix system is the Unix operating system developed at Bell Laboratories and licensed by Western Electric. The Unix system's design combines power, flexibility, and simplicity, and its vast array of software utilities greatly increase productivity. The figure overleaf shows the Xenix operating system's five-layer software structure. Xenix has a hierarchical structure, in which each of the five layers depends on the layers beneath it for its operation. The bottom two layers represent Unix version 7 and the remaining three layers are the refinements that combine to make the Xenix system.

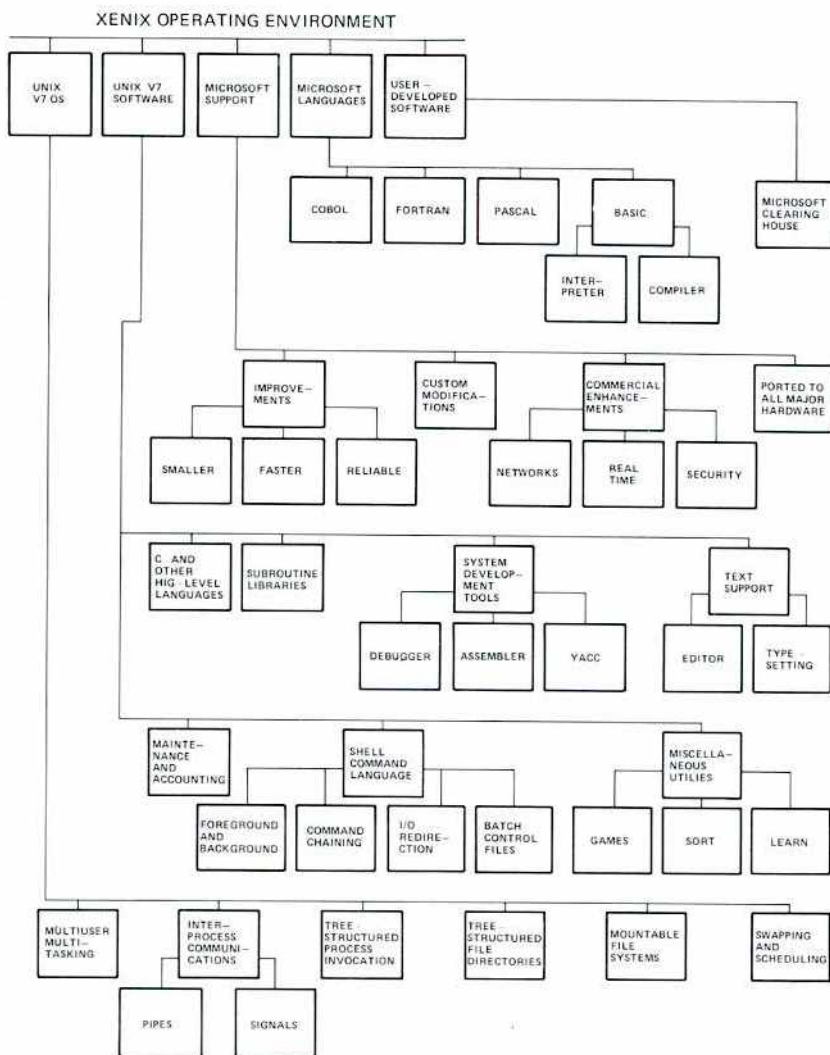


Fig. 6-1 Microsoft's XENIX operating system

SOFTWARE OVERVIEW

The Xenix system offers an ever-expanding variety of software, including data-base management, financial planning, communication, and networking packages.

By establishing a universal operating environment, complete with software tools to increase productivity, flexible design to widen applicability, and multiple microprocessor support to improve availability, Microsoft hopes that Xenix will become the preferred choice for software production and exchange.

USING MS-DOS

MS-DOS commands have their own format and syntax rules. Some MS-DOS commands are explained in this chapter without going into any detail.

The MS-DOS prompt:

A>_

indicates that MS-DOS is now ready to accept commands.

The A in the MS-DOS prompt is the drive identifier. Drive A is the upper disk drive, while drive B is the lower disk drive. Drive C is the hard disk unit.

KEYBOARD INSTALLATION AND NATIONAL VARIATIONS

The system is configured for use with the USA ASCII version of the keyboard. If the system keyboard is a different version and the MS-DOS operating system is used, the following procedure must be followed to define the keyboard to the system.

1. Refer to the following table to find the driver name corresponding to the national keyboard version

NATIONAL VERSION	DRIVER NAME
Danish	KEYBDA
French	KEYBFR
German	KEYBGR
Latin/Greek	GREEK
Italian	KEYBIT
Norwegian	KEYBNO
Portuguese	KEYBPO
Spanish (1)	KEYBSP
Spanish (2)	SPAIN1
Swedish/Finnish	KEYBFS
Swiss-French	KEYBSF
Swiss-German	KEYBSG
British	KEYBUK
Latin/Hebrew	KEYBHE

2. Remove the MS-DOS system disk and insert the mini-floppy disk labelled MS-DOS DEMO + KB DRIVERS into drive A.
3. Enter the driver name corresponding to the keyboard version.
4. If the keyboard is not Latin/Greek, Latin/Hebrew or Spanish (2), and graphics mode is to be used, an additional step is required. Key in one of the following when the A > prompt reappears:
 - NORDIC for Denmark or Norway
 - PORTUGAL for Portugal
 - GRAFTABL for all other national keyboards

The national version of the keyboard has now been defined. Unless the driver (and the font, if relevant) is loaded to an initialization AUTOEXEC.BAT file, this procedure must be performed each time the system is switched on or otherwise initialized. Follow the instructions overleaf to create such a file.

CREATING AN AUTOEXEC.BAT FILE FOR KEYBOARD DRIVER AND FONT

Ensure that the mini-floppy disk is NOT write protected and when the prompt

A>_

is displayed, enter:

copy con: autoexec.bat

and press <CR>.

If no font is required, enter the name of the required driver and press <CTRL Z> followed by <CR>.

If a font is required as well as the driver, press <CR> after the driver name, then enter the name of the font. Then press <CTRL Z> followed by <CR>.

The AUTOEXEC.BAT file is thus created and stored in the mini-floppy disk. Each time this disk is subsequently used, the file will be executed, and the keyboard version will automatically be made known to the system. To avoid accidental overwriting of the disk, it should be write protected, as described previously.

If a national keyboard driver is installed, the standard ASCII driver can be selected by pressing <CTRL ALT F1>. To return to the national keyboard driver press <CTRL ALT F2>.

HOW TO FORMAT ON DUAL-DRIVE VERSIONS

Enter:

format b:<CR>

A message similar to the following will be displayed:

**Insert new diskette for drive B:
and strike any key when ready**

Insert the mini-floppy disk to be formatted in the lower drive and strike any key.

The formatting process then begins and a message is displayed while the formatting process is taking place. This message gives information on the track number being formatted. The following message then appears:

Format another (Y/N)?

Enter <N>, and the MS-DOS prompt reappears.

HOW TO FORMAT ON SINGLE-DRIVE VERSIONS

Enter:

format <CR>

A message similar to the following will be displayed:

**Insert new diskette for drive A:
and strike any key when ready**

Remove the system disk and replace it with the mini-floppy disk to be formatted. Press <CR>.

The formatting process then begins and a message is displayed to indicate that the formatting process is executing. When formatting is finished, some information about the space on the disk appears and the following message is displayed:

Format another (Y/N)?

Remove the newly formatted mini-floppy disk and replace it with the system disk. Enter <N>, and the MS-DOS prompt re-appears.

FORMAT COMMAND

This command is used to format the disk in the specified or default drive to MS-DOS standards.

Syntax:

format (drive:) (/1) (/S) (/O) (/V) (/B) (/C)

where:

drive = the name of the drive that contains the disk. If the drive is not specified, the default drive is assumed.

() = optional parameters

The FORMAT utility must be run on any new mini-floppy disk to be used with MS-DOS. Any information on the disk is destroyed.

FORMAT places a bootstrap loader at the beginning of the mini-floppy disk, and a directory and file allocation table. It also checks for any bad sectors on the disk.

SOFTWARE OVERVIEW

Switch options available with the format command have the following effect:

SWITCH	MEANING
/1	Formats a mini-floppy disk single-sided. This facility is used to prepare 180 KB disks on a 360 KB drive (or 160 KB on a 320 KB drive if the /8 option is also specified).
/S	Copies the system files to the disk being formatted. These are: - IO.SYS - MSDOS.SYS - COMMAND.COM IO.SYS and MSDOS.SYS are hidden files and will not show in a directory listing (DIR command).
/O	Can only be used in conjunction with the /8 option to produce disks of compatible format to PC-DOS IBM release 1.1. Note: This option causes the FORMAT program to take significantly longer.
/V	Allows a name to be given to the mini-floppy disk. The format command issues a prompt that enables a name of up to 11 characters to be entered. This name will appear in subsequent directory listings (DIR command).
/8	Formats mini-floppy disks 8 blocks per track instead of the default 9 blocks per track. Disks formatted in this manner are compatible with previous MS-DOS releases.
/C	Formats disks logically rather than physically, that is, it deletes all data from the mini-floppy disk, but does not reformat the tracks. This option is used to format used MS-DOS disks the contents of which are no longer required.

VOLUMES

After a system directory has been created, the mini-floppy disk is often referred to as a volume. MS-DOS allows volumes to be named. For example, if all payroll information is to be kept on one disk and all stock control information on another, the volume names PAYROLL and STOCK could be used for the respective disk. A volume name is assigned when a mini-floppy disk is formatted, and it will then appear any time the system directory of the named volume is listed.

FILES

Information is stored on a volume in units called files. There are two basic types of file: program files and data files.

Program files (commonly called programs) may be executed to perform a particular task, such as printing out a set of pay-slips.

A data file is a collection of related items, such as a list of names and addresses.

Programs are created by the various programming languages supported by the PC, and data files can be created by executing a program. Files can also be created by using the MS-DOS line editor, **edlin**. For more detailed information on programming languages and the line editor, refer to the relevant manuals and the MS-DOS User Guide.

FILE NAMES

Each file is identified by its file name. A file name can comprise:

- One to eight characters
- One to eight characters, followed by a period (.) and a one to three character file name extension

Alphabetic characters within a file name can be entered in upper or lower case, but MS-DOS will translate any lowercase characters to uppercase.

A file name can be made up of any of the following characters:

A-Z	0-9	\$	&	#
%	'	(	)	-
@				!

DIRECTORIES

MS-DOS allows files to be grouped together in directories, and a volume can contain several directories. The primary directory on a volume is the system directory, and is called the "root". This is created by the FORMAT command, as described earlier in this chapter.

To access a file on this volume, the path from the root must be defined, for example:

command \PERSONNEL\PENSIONS

will direct an MS-DOS command to the file "PENSIONS" stored in the "PERSONNEL" directory. The first "\" symbol shows that the search is to start from the root, or system directory. The second "\" symbol is used to separate the directory name from the file name. The list of directories ending at a particular file is called a "path".

The use of directories means that files with identical file names can be stored on the same volume. A volume can, for example, contain two files called "PRODUCT", one stored in the "SALES" directory, the other in the "STOCK" directory. Each of the two "PRODUCT" files are accessed by different paths. The unique path must be specified to inform MS-DOS which "PRODUCT" file to access.

For a fuller description of directories and their use, refer to the MS-DOS User Guide.

LISTING VOLUMES

The names of directories and of files stored under the system directory can be displayed by using the DIR command. This command also provides information about the space occupied by each file and the space still available on the volume.

To see what is stored on the system disk, enter:

```
dir a:<CR>
```

A screen similar to the one illustrated below is displayed.

SORT	EXE	1216	8-22-83	2:06p
FIND	EXE	5796	8-22-83	2:06p
FC	EXE	2553	8-22-83	2:06p
MASM	EXE	77440	8-22-83	2:06p
CREF	EXE	13824	8-22-83	2:06p
MODE	EXE	13568	8-22-83	2:06p
FDISK	COM	13234	8-22-83	2:06p
BACKUP	COM	1437	8-22-83	2:06p
RESTORE	COM	1634	8-22-83	2:06p
UK	DAT	3072	8-22-83	2:06p
DENMARK	DAT	3072	8-22-83	2:06p
USA	DAT	3072	8-22-83	2:06p
ITALY	DAT	3072	8-22-83	2:06p
FRANCE	DAT	3072	8-22-83	2:06p
GERMANY	DAT	3072	8-22-83	2:06p
SPAIN	DAT	3072	8-22-83	2:06p
SWEDEN	DAT	3072	8-22-83	2:06p
PORTUGAL	DAT	3072	8-22-83	2:06p
NORWAY	DAT	3072	8-22-83	2:06p
SWFRENCH	DAT	3072	8-22-83	2:06p
SWGEMAN	DAT	3072	8-22-83	2:06p
36 Files(s)			21504 bytes free	

A>_

FILE MANIPULATION

File manipulation involves operations such as copying, deleting and renaming files. There are many reasons for wishing to manipulate files, for example to make a backup copy of a file, a copy of a file for distribution, or to delete files no longer wanted in order to obtain some free space.

For this reason, it would be helpful to carry out the short exercise that follows. It can only be carried out on dual-drive versions, but a similar procedure is used to copy files between mini-floppy disk and hard disk.

COPYING FILES ON DUAL-DRIVE VERSIONS

It can be seen from the system disk directory currently displayed that MS-DOS consists of several files. The file to be copied is called FC.EXE. Notice that on the directory the name appears as two words: FC and EXE separated by a space. The EXE is known as the file name extension. On the system directory listing, the file name extensions appear vertically aligned for ease of reading. However, file names appear in MS-DOS commands with the extension appended to the file name after a period. Thus, the file to be copied will be written as FC.EXE within the COPY command.

To copy the file, enter:

```
copy a:FC.EXE b:temp <CR>
```

The file is then copied onto the mini-floppy disk in the lower drive. The message:

```
1 File(s) copied
```

is displayed and the MS-DOS prompt appears. A new file name `temp` has been specified for the copy.

To look at the directory of the new disk, enter:

```
dir b:<CR>
```

A message similar to the following appears:

```
Volume in drive B: has no label
Directory of B:
TEMP 2533 8-22-83 208p
1 File(s) 309424 bytes free
```

The mini-floppy disk now contains the file called TEMP. This is an exact copy of FC.EXE from the system disk. The file occupies 2553 bytes of storage space.

DELETING A FILE ON DUAL-DRIVE VERSIONS

To delete this file from the mini-floppy disk, enter:

```
del b:temp<CR>
```

Look at the directory of the disk again, by entering:

```
dir b:<CR>
```

A message similar to the following appears:

File not Found

This means the mini-floppy disk is empty and the file **temp** has been removed. The 2553 characters that the file occupied are free again, for storing other information.

SOME SPECIAL FILES

Before ending this discussion on files, there are some important files the user should know about.

THE INITIALIZATION FILE

A special type of file called an initialization file can be created. If an initialization file containing MS-DOS commands is created, these will be executed automatically whenever MS-DOS is loaded.

The initialization file can be used to save performing repetitive tasks at the start of each work session. For example, it could be used to run a particular program every time the system is started up.

If an initialization file is created, it must be called AUTOEXEC.BAT. Whenever the MS-DOS is loaded, it looks for a file with this name. If it does not find one, the date and time messages appear as described earlier.

If the AUTOEXEC.BAT file is found, the date and time routines are bypassed and the commands in the file are executed. There are many special MS-DOS commands designed for use within the initialization file, for example:

- The REM command, which allows comments to be written
- The PAUSE command, which halts execution of the AUTOEXEC.BAT file so that the operator can indicate whether or not the file is to run to completion.

The commands that are available for AUTOEXEC.BAT can also be used within MS-DOS "batch files".

SOFTWARE OVERVIEW

Batch files can be used to perform repetitive processes. They are not executed automatically, only when requested via MS-DOS. For instance, if a customer file frequently has to be sorted into order of name and then a program has to be executed to print out the file, a batch file could be created to perform both operations. This would save having to type out all the commands individually every time the procedure was needed.

Detailed information on batch files and the AUTOEXEC.BAT file can be found in the **MS-DOS User Guide**.

COPYING MINI-FLOPPY DISKS

One task frequently performed is that of copying a mini-floppy disk. There are many reasons for doing this, one of the most obvious being to make a backup. This procedure will be described later on; the aim here is simply to make the user aware of a problem which may be encountered if an attempt is made to copy a disk containing application software.

APPLICATION SOFTWARE MINI-FLOPPY DISKS

Application software is supplied on a mini-floppy disk and provides a wide variety of packages: word processing, computerized spreadsheets, etc. The disks which contain this sort of package are sometimes copy-protected.

COPY-PROTECTION

Copy-protection varies from disk to disk. It may be possible, for example, to make a limited number of copies, or to copy a certain number of files from a mini-floppy disk.

As a general rule, before attempting to copy application software disks, refer to the associated documentation.

MAKING BACKUPS

It cannot be stressed too strongly how important it is to make a backup copy of mini-floppy disks containing important information. Many computer users make backup copies of modified files at the end of each working day.

There is already a mini-floppy disk which contains important information, the MS-DOS system disk. The following sections describe how to make a copy of the system disk.

MAKING A BACKUP ON DUAL-DRIVE VERSIONS

To copy from the MS-DOS system disk onto the mini-floppy disk used for file manipulation, enter:

```
diskcopy a: b:<CR>
```

A message similar to the following appears:

```
Insert source diskette into drive A:  
Insert destination diskette into drive B:  
Strike any key when ready
```

The source disk is the MS-DOS system disk which is already loaded in drive A. The destination disk is the mini-floppy disk used for file manipulation, which is already loaded in drive B. It should be noted that the copy operation will completely destroy anything that is on the destination disk. Since the destination disk in this case does not contain anything, proceed by entering <CR>.

The copy operation is then carried out and the message:

```
copying...
```

is displayed on the screen. When the copying is finished the following message is displayed:

```
Copy complete  
Copy another disk (Y/N) ?
```

Press <N> and the MS-DOS prompt will appear.

In this way a backup copy of the system disk has been made. The original can now be put in a safe place and work can proceed with the copy. Before using the copy, it should be labelled and write-protected. If the copy ever becomes unusable, another can be made from the original.

MAKING BACKUPS ON A SINGLE-DRIVE VERSION

To copy the system disk onto the mini-floppy disk formatted previously, enter:

diskcopy<CR>

A message similar to the following appears:

**Insert source diskette in drive A:
Strike any key when ready**

Press <CR>. MS-DOS then copies as much of the mini-floppy disk as possible into the PC memory. When it has done so, the following message appears:

**Insert destination diskette into drive A:
Strike any key when ready**

Remove the system disk and replace it with the formatted disk. Press <CR>. The part of the system disk that was stored in memory is written to the mini-floppy disk that was just loaded. When this has been done, the following message may appear:

**Insert source diskette in drive A:
Strike any key when ready**

This means that the PC did not have enough memory available to contain the entire contents of the system disk at once. Swap the disks again and press <CR>. The next part of the system disk will be copied into memory as before.

This swapping of disks continues until the entire system disk has been copied. It should be remembered that the source disk is the one being copied from, and the destination disk is the one being copied to.

The following message will eventually appear:

**Copy complete
Copy another disk (Y/N) ?**

Press <N>, and the MS-DOS prompt appears.

In this way a backup copy of the system disk has been made. The original can now be put in a safe place and work can proceed with the copy. Before using the copy, it should be labelled and write-protected. If the copy ever becomes unusable, another can be made from the original.

OTHER MS-DOS FACILITIES

The MS-DOS facilities discussed here are only a small portion of those available. A full description can be found in the **MS-DOS User Guide**. Some other useful facilities are listed briefly in the following table.

MS-DOS COMMAND	DESCRIPTION
break	Turns off and on the abort feature provided by <CTRL-C>.
backup	Backs up one or more files from the hard disk to the mini-floppy disks.
chdir	Changes the current directory and displays the name of the current directory.
chkdsk	Analyses a mini-floppy disk (or hard disk) and checks for consistency of data and for defective tracks.
cls	Clears the screen.
copy	Copies a file or concatenation of files to a file in the specified (or default) drive.
ctty	Enables the device from which commands are issued to be changed.
date	Displays the date known to the system, and enables this to be changed.
del	Deletes the specified file(s).
dir	Lists files in the current or specified directory.



SOFTWARE OVERVIEW

diskcopy	Copies the contents of a mini-floppy disk in one drive onto another disk.
echo	Turns the batch file echo feature off and on.
erase	Deletes the specified file(s).
exe2bin	Converts files from .exe format to binary format.
exit	Exits from the command processor COMMAND.COM and returns to an application program running previously.
fdisk	Partitions the hard disk.
find	Searches for a specified string of text in a file or files.
for	Allows iterative execution of MS-DOS commands.
format	Formats the disk in the specified or default drive to MS-DOS standards.
goto	Causes MS-DOS to jump to a specified position in a batch file.
if	Causes conditional execution of a command in batch processing.
graphics	Enables graphics currently displayed on the video to be printed when the <SHIFT-PRT SC> keys are pressed.

mkdir	Creates a new directory.
mode	This command enables the user to: 1) set the protocol for the RS 232-C port; 2) set the video display mode; 3) set the printing characteristics or redirect printer output to the RS 232-C communications port; 4) set the printer name.
more	Sends output to the terminal one screen page at a time.
path	Establishes a search command path.
pause	Suspends execution of the batch file in which it is contained.
print	Queues text files on a line printer while other MS-DOS commands are being used.
prompt	Changes the MS-DOS prompt.
recover	Recovers a file or an entire disk containing bad sectors.
ren	Renames the specified file.
restore	Restores one or more files from backup disks to a hard disk.
rmdir	Deletes a directory from a hierarchical directory structure.
set	Assigns a substitute string value to a string used in an application program or batch file.

SOFTWARE OVERVIEW

sort	Reads input and sorts it into an order.
type	Displays the contents of a specified file.
ver	Displays the MS-DOS version number.
vol	Displays the volume label of the disk in the specified or default drive.

Table 6-1 Other MS-DOS Commands

USING MS-DOS WITH THE HARD DISK

INTRODUCTION

There are several steps which must be taken before the hard disk can be used with MS-DOS.

If MS-DOS is the only operating system that will be used, the entire hard disk must be assigned to MS-DOS as described in the section "How to Set Up the Hard Disk for MS-DOS Only".

If other operating systems in addition to MS-DOS are to be used, then the hard disk must be divided into separate areas called partitions. One partition is required for each operating system, and each partition must be set up with the operating system that will use that partition. The operations relevant to MS-DOS are described in the section entitled "How to Partition the Hard Disk". For information on how to set up non-MS-DOS partitions refer to the appropriate operating system User Guide.

After setting up the hard disk for MS-DOS only, it may subsequently be necessary to use other operating systems. The hard disk will then have to be partitioned. Partitioning destroys the information held on the hard disk, and so the MS-DOS files on the hard disk must first be backed up using the BACKUP command. Then the hard disk can be partitioned for all the operating systems required, and the MS-DOS partition is restored using the RESTORE command. The BACKUP and RESTORE commands are described in the MS-DOS User Guide.

The MS-DOS command used to set up the hard disk is called the FDISK command. It uses a series of screen displays and prompts to guide the user through the operations step by step.

HOW TO SET UP THE HARD DISK FOR MS-DOS ONLY

1. Load MS-DOS from the mini-floppy disk in drive A and enter:

`fdisk`

The FDISK options menu will then appear on the display and will be similar to the following:

FDISK Options

Choose one of the following:

1. Create MS-DOS Partition
2. Change Active Partition
3. Delete MS-DOS Partition
4. Display Partition Information

Enter choice:

Press ESC to return to DOS

2. Enter:

`1`

Assuming the hard disk has not been set up already, a message similar to the following will be displayed:

Create MS-DOS Partition

No partition defined

Total disk space is ... cylinders

Do you wish to use the entire hard
disk for MS-DOS (Y/N).....?

If the hard disk has already been set up correctly, a different screen display will appear. In this case refer to the section entitled "How to Partition the Hard Disk".

3. Enter:

`<y>`

and the entire hard disk will be assigned to MS-DOS. A message similar to the following will be displayed:

You must now reboot MS-DOS

4. By pressing the "CTRL" "ALT" and "DEL" keys simultaneously, MS-DOS will be rebooted. At the same time it will recognize the hard disk as a valid drive and assign a drive letter (C) to it.
5. The hard disk must now be formatted so that MS-DOS can use it.

If MS-DOS is to be booted from the hard disk, be sure the hard disk partition is active (see the section entitled "How to Change the Active Partition", later in this chapter), then enter

`format c:/s`

If MS-DOS is not to be booted from hard disk it is sufficient to enter:

`format c:`

In either case the following prompt appears:

Press any key to begin formatting drive C:

6. Press any key and the message:

Formatting...

will be displayed. After several minutes the following message will appear:

Format complete

and if /s was entered in the command line the following message will also appear:

System transferred

This indicates that a copy of MS-DOS has been made on the hard disk. It will now be possible to boot from the hard disk.

7. If MS-DOS has been copied to the hard disk, it will probably be necessary to copy the MS-DOS external commands there as well. With the MS-DOS system disk still in drive A, enter:

`copy *.* ,c:`

HOW TO PARTITION THE HARD DISK

Each operating system that supports the hard disk has a command to set up the partition it will use.

The FDISK command enables the user to:

- Set up the MS-DOS partition to any size (within the capacity of the hard disk) and at any location on the hard disk
- Change the partition that will be active when the system is rebooted
- Delete the MS-DOS partition
- Display the hard disk partition map

To run the FDISK program enter:

fdisk

The FDISK options menu will be displayed as follows:

FDISK Options

Choose one of the following:

1. Create MS-DOS Partition
2. Change Active Partition
3. Delete MS-DOS Partition
4. Display Partition Data

Enter choice:

Proceed by entering the number of the selection required.

How to Create the MS-DOS Partition

1. Select option 1 from the FDISK options menu by entering:

1

2. If the hard disk has already been set up, proceed to step 5.
3. If the hard disk has not already been set up, the following prompt appears:

Create MS-DOS Partition

No partition defined

Total disk space is ... cylinders

Do you wish to use the entire hard disk
for MS-DOS.....?

4. Enter:

n

and a message similar to the following appears:

Maximum available space is xxxx
cylinders at cylinder xxxx.

This display shows the size and location of the largest number of contiguous cylinders available on the hard disk. As there is nothing on the hard disk, the number of contiguous cylinders available will be the same as the total hard disk space. Proceed to step 6.

5. If the hard disk has already been set up, a message similar to the following will appear:

Create MS-DOS Partition

Partition	Status	Type	Start	End	Size
1	N	non-MS-DOS	000	033	35
2	A	non-MS-DOS	035	089	35
3	N	non-MS-DOS	135	179	35

Total disk space is 180 cyls.

The current active partition is 2

Max avail space is 35 cyls at cyl 90.

The screen display shown above illustrates a typical partition map of a hard disk with three partitions.

The display shows for each partition:

- The status of the partition; that is, whether or not the operating system in that partition will be booted when the system is rebooted from the hard disk. If so, it is designated the active partition (indicated by "A"), while the other partitions are not active (indicated by "N").
- Whether the partition is MS-DOS or non-MS-DOS.
- The beginning and end of the partition in terms of the first and last cylinder numbers.
- The size of the partition.

The last two lines of the display show the capacity of the hard disk, the largest available space for another partition and the cylinder number at which this space starts.

6. FDISK gives the following prompt:

Enter partition size.....:

The default value is the maximum available space. Enter either "CR" alone to accept the default value, or enter the number of cylinders required, followed by "CR."

The following prompt will then be displayed:

Enter starting cylinder number...:

7. The default value for the starting cylinder number depends on the partition size which has just been specified. It is the first cylinder of the smallest space on the hard disk that is large enough for the partition. If this is where the MS-DOS partition is required, press "CR." Otherwise the number of the cylinder to be the first MS-DOS cylinder must be entered. The following prompt is then displayed:

Press RETURN to return to FDISK Option

8. Press "<CR>" to continue working with the FDISK command. Otherwise, with the system disk in drive A, press "CTRL" "ALT" and "DEL" simultaneously, and MS-DOS will be rebooted.

9. The MS-DOS partition must now be formatted so that MS-DOS can use it.

If MS-DOS is to be booted from the hard disk, ensure that the MS-DOS partition is active (see the section entitled "How to Change the Active Partition"), then enter:

```
format c:/s
```

If MS-DOS is not to be booted from the hard disk it is sufficient to enter:

```
format c:
```

In either case the following prompt appears:

Press any key to begin formatting drive C:

10. Press any key and the message:

Formatting...

appears. After several minutes the following message will be displayed:

Format complete

and if /s was entered in the command line the following message will also appear:

System transferred

This indicates that a copy of MS-DOS has been made on the hard disk.

If MS-DOS has been copied to the hard disk, it will probably be necessary to copy the MS-DOS external commands there as well. With the MS-DOS system disk still in drive A enter:

```
copy *.* ,c:
```

To make MS-DOS bootable from the hard disk the MS-DOS partition must be made active as described overleaf. If MS-DOS is not to be booted from the hard disk then there is no need to make the MS-DOS partition active.

How to Change the Active Partition

The active partition is the partition containing the operating system that will be loaded whenever the system is booted from the hard disk.

1. Select this option by entering

2

from the FDISK options menu. A message similar to the following will appear:

Change Active Partition

Partition	Status	Type	Start	End	Size
1	N	non-MS-DOS	000	044	45
2	A	non-MS-DOS	045	089	45
3	N	MS-DOS	090	134	45
4	N	non-MS-DOS	135	179	45

Total disk space is xxxx cylinders.
Enter the number of the partition you want
to make active.....:

2. Enter the partition number of the operating system which is to be made active. For example:

3

makes the operating system in partition 3 active. The operating system in partition 2 then becomes non-active.

3. Press "CR" to return to the FDISK menu, then enter 5 "CR" to return to MS-DOS.
4. To boot the operating system in the partition that has just been made active, remove the MS-DOS mini-floppy disk from the drive and press the "CTRL" "ALT" and "DEL" keys simultaneously.

How to Delete the MS-DOS Partition

CAUTION This option destroys the contents of the MS-DOS partition. A backup of the MS-DOS partition must be made using the BACKUP command before continuing.

1. To continue working with MS-DOS after deleting the MS-DOS partition, the MS-DOS system disk must be inserted. To continue working with a different operating system, either insert the system disk of that operating system in drive A, or make the hard disk partition of that operating system active before deleting the MS-DOS partition.
2. Enter:

3

from the FDISK options menu and a screen similar to the following will be displayed:

Delete DOS Partition

Partition	Status	Type	Start	End	Size
1	N	non-MS-DOS	000	044	45
2	A	non-MS-DOS	045	089	45
3	N	MS-DOS	090	134	45
4	N	non-MS-DOS	135	179	45

Total disk space is xxxx cylinders.

The current active partition is 2

Warning! All MS-DOS partition data
will be DESTROYED. Do you wish to
continue.....?

3. Press "CR" to cancel the operation, and the FDISK options menu will reappear. Conversely, to proceed with the deletion if all files have been backed up, enter:

y

The MS-DOS partition is deleted and the displayed partition map is updated.

4. Press the "CTRL" "ALT" and "DEL" keys simultaneously to carry on working either with an operating system booted from the mini-floppy disk in drive A or with the operating system contained in the hard disk partition that has just been made active.

How to Display the Hard Disk Partition Map

Enter:

4

from the FDISK options menu, and a hard disk partition map similar to the following will be displayed:

Display Partition Information

Partition	Status	Type	Start	End	Size
1	N	non-MS-DOS	000	044	45
2	A	non-MS-DOS	045	089	45
3	N	MS-DOS	090	134	45
4	N	non-MS-DOS	135	179	45

Total disk space is xxxx cylinders.

This screen shows a typical partition map of a hard disk with four partitions.

The display shows for each partition:

- The status of the partition; that is, whether or not that particular partition contains the operating system that will be booted when the system is rebooted from the hard disk. If so, it is designated the active partition (indicated by "A"), while the other partitions are not active (indicated by "N").
- Whether the partition is MS-DOS or non-MS-DOS.
- The beginning and end of the partition in terms of the first and last cylinder numbers.
- The size of the partition.

Press "CR" to return to the FDISK options menu.

ERROR MESSAGES

This section lists in alphabetical order the error messages which may be encountered when using MS-DOS.

ERROR MESSAGE	MEANING
Allocation error for file. size adjusted (CHKDSK)	An invalid sector number was found in the file allocation table. The file was truncated at the end of the last valid sector.
Ambiguous switch: z (LINK)	The characters specified by "z" do not uniquely identify a linker parameter. Use more characters from the parameter name.
Amount read less than size in header (EXE2BIN)	The file is smaller than indicated in its header. Recompile, or reassemble, and relink the program.
An internal failure has occurred (LINK)	An error has occurred in the linker program. Report the conditions under which the message appeared to your authorized dealer.
Attempt to access data outside of segment bounds, possibly bad object module (LINK)	An object file is invalid.

SOFTWARE OVERVIEW

Attempted write-protect violation	The mini-floppy disk being formatted cannot be written on because it is write-protected. The user is prompted to insert a new disk and press any key to restart formatting.
Aux I/O error (MS-DOS)	An input or output error occurred while trying to use the RS 232-C interface.
Bad call format error (device error)	A device driver was passed an incorrect length request header.
Bad command error (device error)	A device driver has issued an invalid command to the named device.
Bad command or file name (MS-DOS)	The command just entered is not a valid internal command, and a file called command-name.COM or command-name.EXE could not be found on the specified or default drive.
Bad numeric parameter (LINK)	The value specified with the /STACK parameter is not a valid numeric constant.
Bad or missing Command Interpreter (STARTUP)	The mini-floppy disk in drive A does not contain a copy of COMMAND.COM, or an error occurred while the disk was being loaded. If system reset fails to solve the problem, copy COMMAND.COM from a backup disk to the mini-floppy disk that failed.

Bad unit error (device error)	A device driver has been sent an invalid subunit number. Contact your dealer.
Batch file missing (MS-DOS)	The batch file that MS-DOS is processing has been deleted or renamed by one of the commands within it.
BF (DEBUG)	An invalid flag code setting was specified. Try the Register (RF) command again with the correct code.
BP	More than ten breakpoints were specified for the Go command. Try the Go (G) command again with ten or fewer breakpoints.
BR (DEBUG)	An invalid register name was specified. Try the Register (R) command again with the correct register name.
Cannot CHDIR to root Processing cannot continue (CHKDSK)	The disk being checked is faulty. Try restarting MS-DOS and RECOVER the disk.
Cannot do binary reads from a device (COPY)	An attempt has been made to use the /B switch with the name of a device. Place /A switch after the device name to do the copy in ASCII mode.

SOFTWARE OVERVIEW

Cannot edit .BAK file rename file (EDLIN)	.BAK files are considered to be backup files. A more up-to-date version of the file is therefore assumed to exist, hence the .BAK file cannot be edited.
Cannot find filespec Change diskette <hit any key> (LINK)	The linker could not find the specified object module on the drive. Insert the disk with the specified module on it and press any key.
Cannot find library lib-name Enter new drive letter	The linker could not find the specified library on the drive. Enter the letter for the drive the library is on.
Cannot nest response file (LINK)	@filespec was used within an automatic response file. Automatic response files cannot be nested.
Cannot open list file	The directory is full.
Cannot open overlay (LINK)	The directory is full.
Cannot open response file (LINK)	The automatic response file could not be found.
Data error (device error)	Data could not be read and/or written correctly because of a faulty disk.

DF (DEBUG)	Conflicting codes have been specified for a single flag. A flag can be changed only once for each Register (RF) command.
Disk error (device error)	An error has occurred reading from or writing to a disk.
Disk error writing FAT (CHKDSK)	An error occurred while CHKDSK was updating the file allocation table.
Disk full - file write not completed (EDLIN)	The disk in use does not have enough space to save all the file. Part of the file may have been saved on disk, but the portion that has not been saved is lost.
Drive not ready (PRINT)	If this message occurs when PRINT attempts a disk access, PRINT will keep trying until the drive is ready. Any other error causes the current file to be cancelled. An error message would be output on the printer in such a case.
Duplicate filename or file not found (REN)	Either an attempt has been made to rename a file with a file name that already exists in the directory, or the file to be renamed could not be found on the specified or default drive.
Entry error (EDLIN)	An EDLIN command has been entered incorrectly. Re-enter the command.

SOFTWARE OVERVIEW

ERROR: Dup record too complex (LINK)	There is a problem with an object module created from an assembler source program. A single DUP requires 1024 bytes before expansion. Debug the source program then rerun the linker.
ERROR: Fixup offset exceeds field width (LINK)	An assembly language instruction refers to an address with a short instruction instead of a long instruction. Edit the assembler source program and process it again.
Error in EXE/HEX file (DEBUG)	The EXE or HEX file contained invalid characters or records.
EXE/HEX file cannot be written (DEBUG)	The data would require a backwards conversion that DEBUG does not support.
File cannot be converted (EXE2BIN)	The input file specified does not have the correct format for conversion.
File cannot be copied into itself (COPY)	A request was made to COPY a file and place the copy (with the same name) in the same directory as the source file. Either change the name given to the copy or put it on another mini-floppy disk or directory.
File creation error (MS-DOS and commands)	An unsuccessful attempt was made to add a new file to the directory. Run CHKDSK to determine the cause of the error.

Filename is cross linked on cluster (CHKDSK)	Two files are cross linked. Make a copy of the file to be kept, and then delete both files that are cross linked.
Filename must be specified (EDLIN)	No file name was specified when EDLIN was started.
File not found (EDLIN)	The file named in the Transfer command does not exist.
File not found (MS-DOS and commands)	A file named in a command does not exist on the disk in the specified or default drive.
FIND: File not found <filename> (FIND)	The specified file does not exist on the drive.
FIND: Invalid number of parameters (FIND)	A string was not specified when issuing a FIND command.
FIND: Invalid parameter <option-name> (FIND)	An invalid parameter was specified in the find command.
FIND: Read error in <filename> (FIND)	An error occurred when FIND tried to read the file specified in the command.
FIND: Syntax error (FIND)	An illegal string was entered when the FIND command was issued.

SOFTWARE OVERVIEW

First cluster number is invalid, entry truncated (CHKDSK)	An invalid pointer to the data area has been found in the file named before this message. If /F was specified, the file is truncated to zero length.
Fixups needed-base segment (hex): (EXE2BIN)	The source (.EXE) file contained information indicating that a load segment is required for the file. Specify the absolute segment address at which the finished module is to be located.
Incompatible system size (SYS)	The hidden files IO.SYS and MSDOS.SYS do not take up the same amount of space on the destination disk as the new system will need.
Input file read error (LINK)	An invalid object file has been entered in the command line.
Insufficient disk space (MS-DOS and commands)	There is not enough free space on the mini-floppy disk.
Insufficient room in root directory Erase files in root and repeat CHKDSK (CHKDSK)	CHKDSK cannot create an entry in the root directory for saving lost chains as files (see message "X lost clusters found in Y chains - Convert lost chains to files (Y/N)?") because the root directory is full. Some files from the root directory should be copied to another disk, and CHKDSK reexecuted.

Insufficient space on disk (DEBUG)	A write command was issued to a disk that does not have enough free space to hold the data being written.
Invalid current directory Processing cannot continue (CHKDSK)	CHKDSK has found an error in the disk's current directory. Restart the system and rerun CHKDSK.
Invalid date (DATE)	An invalid date has been entered.
Invalid drive name or file (EDLIN)	An invalid drive or file name was specified when invoking EDLIN.
Invalid drive specification (MS-DOS and commands)	An invalid drive specifier was entered in a command line.
Invalid number of parameters (commands)	The wrong number of parameters was specified on the command line. Check the syntax of the command being used.
Invalid object module (LINK)	There is probably an invalid object file.
Invalid parameter (Commands)	The parameter entered for a command was incorrect. Check the syntax of the command being used.

Invalid subdirectory (CHKDSK)	The subdirectory contains invalid information. Rerun the CHKDSK command with the /V switch for further information.
Invalid time (TIME)	An invalid time or delimiter was entered. Hours/minutes, and minutes/seconds must be separated by a colon (:), while seconds/hundredths of seconds must be separated by a period (.).
Line too long (EDLIN)	During a Replace (R) command, the string given as the replacement caused the line to expand beyond the 253-character limit. The Replace command is ended abnormally. Split the long line into shorter lines, then reissue the Replace command.
List output is not assigned to a device (PRINT)	The list device specified is invalid. Subsequent attempts will return the same message until a valid device is specified.
Must specify destination number (EDLIN)	A destination line number was not specified for a Copy or Move command. Re-enter the command correctly.
No files match filespec (PRINT)	A filespec was given for files to add to the print queue, but no files match the specification. NOTE: if there are no files in the queue, no error message will appear.

Non DOS disk error (device error)	The file allocation table contains invalid information. The disk must be reformatted.
No paper error (device error)	The printer is either not switched on or is out of paper.
No room for system on destination disk (SYS)	There was not enough space on the destination disk for the IO.SYS and MS-DOS.SYS files.
No room in directory for file (EDLIN)	The directory of the specified disk is already full, or the specified disk drive or file name is illegal.
No room in disk directory (DEBUG)	The directory of the specified disk is already full.
Not enough room to merge the entire file (EDLIN)	There was not enough room in memory to enable a Transfer command to merge the entire contents of a file.
Not ready error (device error)	The named device is not available for the read/write operations required.
Out of environment space	An attempt has been made to access the PATH command via the GW-BASIC SHELL.
PRINT queue is empty (PRINT)	There are no files in the print queue.

PRINT queue is full (PRINT)	An attempt has been made to place more than ten files in the print queue.
Probable non-DOS disk Continue (Y/N)? (CHKDSK)	The disk in use is a non-MS-DOS disk. Indicate whether or not CHKDSK is to continue processing.
Program size or number of segments exceeds capacity of LINKER (LINK)	The load module is too large for the linker to process.
Read error in: filename (commands)	The command could not read the entire file.
Read fault error (device error)	MS-DOS cannot read the requested data from the named device.
Requested stack size exceeds 64K (LINK)	A stack size greater than 64 Kbytes has been specified.
Sector not found error (device error)	The sector containing the data cannot be found, usually due to a defective area on the disk.
Seek error (device error)	The disk drive cannot find the correct track on the disk.



Segment size exceeds 64K (LINK)	An attempt has been made to combine identically named segments resulting in a segment requirement of more than the addressing limit of 64 Kbytes.
Symbol defined more than once (LINK)	Two or more modules have defined the same symbol name.
Symbol table capacity exceeded (LINK)	Very many, and/or very long names were entered, exceeding the limit of approx. 25 Kbytes.
Too many external symbols in one module (LINK)	There are too many external symbols in one module. The limit is 256 external symbols per module.
Too many groups (LINK)	Too many groups are defined. The limit is 10.
Too many libraries specified (LINK)	Too many libraries have been named. The limit is 8.
Too many public symbols (LINK)	There are too many public symbols in one module. The limit is 1024.
Too many segments or classes (LINK)	There are too many segments or classes in the source files. The limit is 256 (segments and classes taken together).



SOFTWARE OVERVIEW

Unrecoverable error in directory Convert directory to file (Y/N)? (CHKDSK)	If <y> is pressed in response to this prompt, CHKDSK will convert the bad directory into a file. It can then be corrected or deleted.
Unresolved externals: list (LINK)	The external symbols listed have no defining module among the modules or library files specified.
Warning: no stack segment (LINK)	None of the object modules specified contains a statement allocating stack space, but the /STACK switch was entered.
Warning: Segment of absolute or unknown type (LINK)	There is a bad object module or an attempt has been made to link modules that the linker cannot handle, for example, an absolute object module.
Write error in TMP file (LINK)	No more disk space remains to expand the VM.TMP file.
Write error on Run file (LINK)	There is not enough disk space for the Run file.
Write fault error (device error)	MS-DOS cannot successfully write data from/to the named device.
Write protect error (device error)	An attempt has been made to write data to a disk that is write-protected.

X lost clusters found in y chains Convert lost chains to files (Y/N)?	CHKDSK has found lost clusters on the disk. If <y> is pressed in response to this prompt, CHKDSK will create an entry in the root directory and a file to resolve this problem (files created by CHKDSK are named FILEnnnnnn). CHKDSK will then display: X bytes disk space freed If N is pressed in response to this prompt, and the /F switch is not specified, CHKDSK frees the clusters and displays: X bytes disk space would be freed.
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Table 6-2 Error Messages

Pages marked * must be suppressed

FATAL MEN BANG

VOORAL BÛ VOL GRHEUSEM

LIEFOP SPAN-MS 5.08 VOLT DIGITAL.



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