Chapter 1
Hardware Overview

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Contents

Tables

Figures

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1.1 T2200SX Features

The Toshiba T2200SX is one of the lightest and most advanced portable computers available. Utilizing advanced Large Scale Integration (LSI) and Complimentary Metal-Oxide Semiconductor (CMOS) technology and high speed components, the T2200SX provides a minimum size, light weight, low power usage, and high reliability machine. The T2200SX also offers excellent display legibility, battery operation, and IBM PC/AT compatibility.

The T2200SX system unit consists of the following:

Microprocessor	An 80386SX-20 32-bit microprocessor, operating at either 20MHz or 10MHz. It is also capable of a 5MHz sleep mode.
Math co-processor	A built-in socket is provided for an 80387SX-20 math co-processor (NDP).
Memory	2MB of CMOS Random Access Memory (RAM) is provided as standard memory. This includes 640KB of conventional and 1408KB of extended memory that can be utilized as expanded memory compatible with the Lotus/ Intel/Microsoft Expanded Memory Specification (LIM-EMS). The standard memory is expandable by 2, 4, or 8MB increments to a maximum of 10MB.
Disk Storage	An internal 2.5" 40MB, 60MB, or 80MB Hard Disk Drive (HDD) provides an average access time of 19ms. A 3.5" Floppy Disk Drive (FDD) supports 2HD (1.44MB) as well as 2DD (720KB).
Display	A new larger surface area, high resolution, fully adjustable Liquid Crystal Display (LCD) composed of 640 horizontal and 480 vertical pixels displays 25 lines of standard text, 80 characters wide. The LCD displays 16 levels of gray and supports the High Resolution Graphics Subsystem (HRGS), including video graphics array (VGA) functions.
Keyboard	An 82/84-keyboard has full-sized keys, a numeric keypad overlay, cursor and page control. The keyboard supports software that uses the industry standard 101/102-key keyboard.
AC Adapter	The universal auto-sensing AC adapter supplies power to operate the T2200SX and recharge its batteries. It can operate from a range of 100 to 240 volts. Optional power cords support various countries' AC outlet configurations.

Batteries	There are three different batteries: a main battery, for system power; a sub-battery, for back-up power, and an RTC battery, which keeps the date and time and system configuration even when power is off.
Mouse Port	A PS/2 mouse connector is located on the right side of the computer.
Interface Ports	A parallel port, serial port, RGB port, numeric keypad port, and expansion bus connector are provided to allow the T2200SX to interface with a variety of optional equipment.

The T2200SX Personal Computer is shown in Figure 1-1 and the T2200SX system configuration is shown in Figure 1-2.

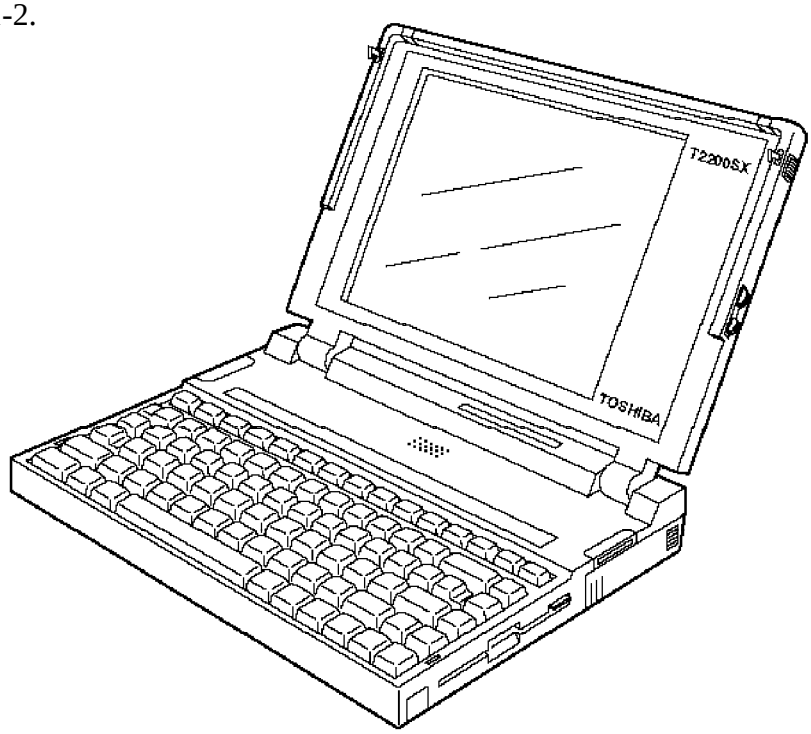

Figure 1-1 T2200SX personal computer

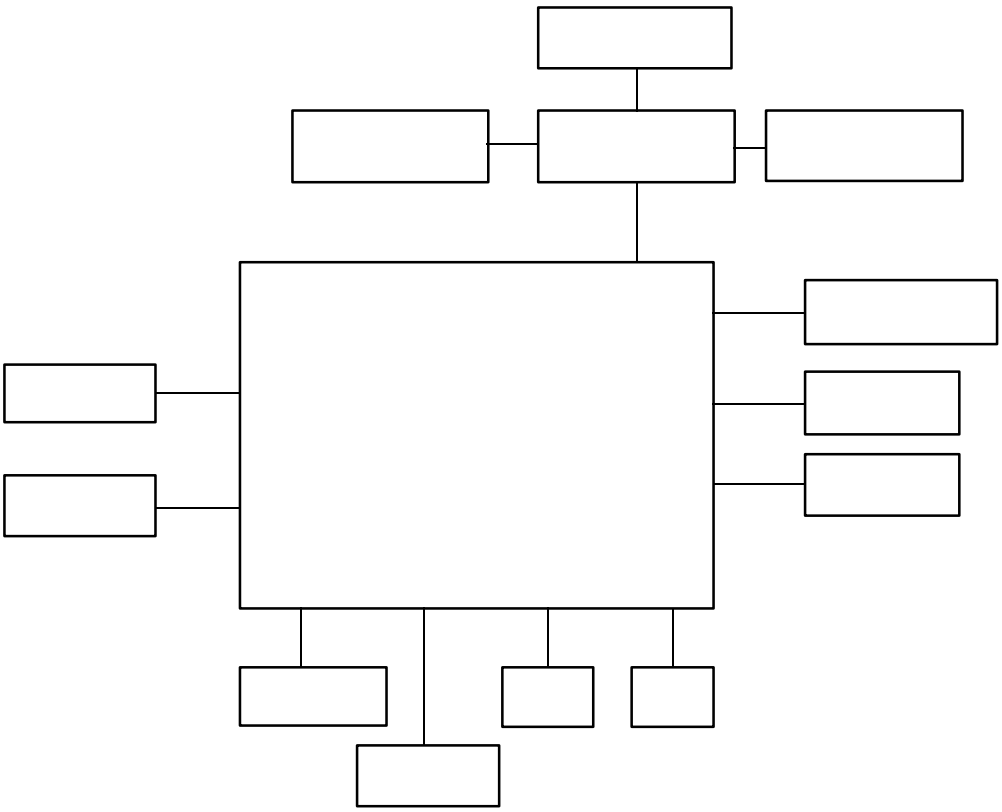

Figure 1-2 T2200SX system unit configuration

1.2 System Unit Block Diagram

Figure 1-3 is a block diagram of the T2200SX system unit.

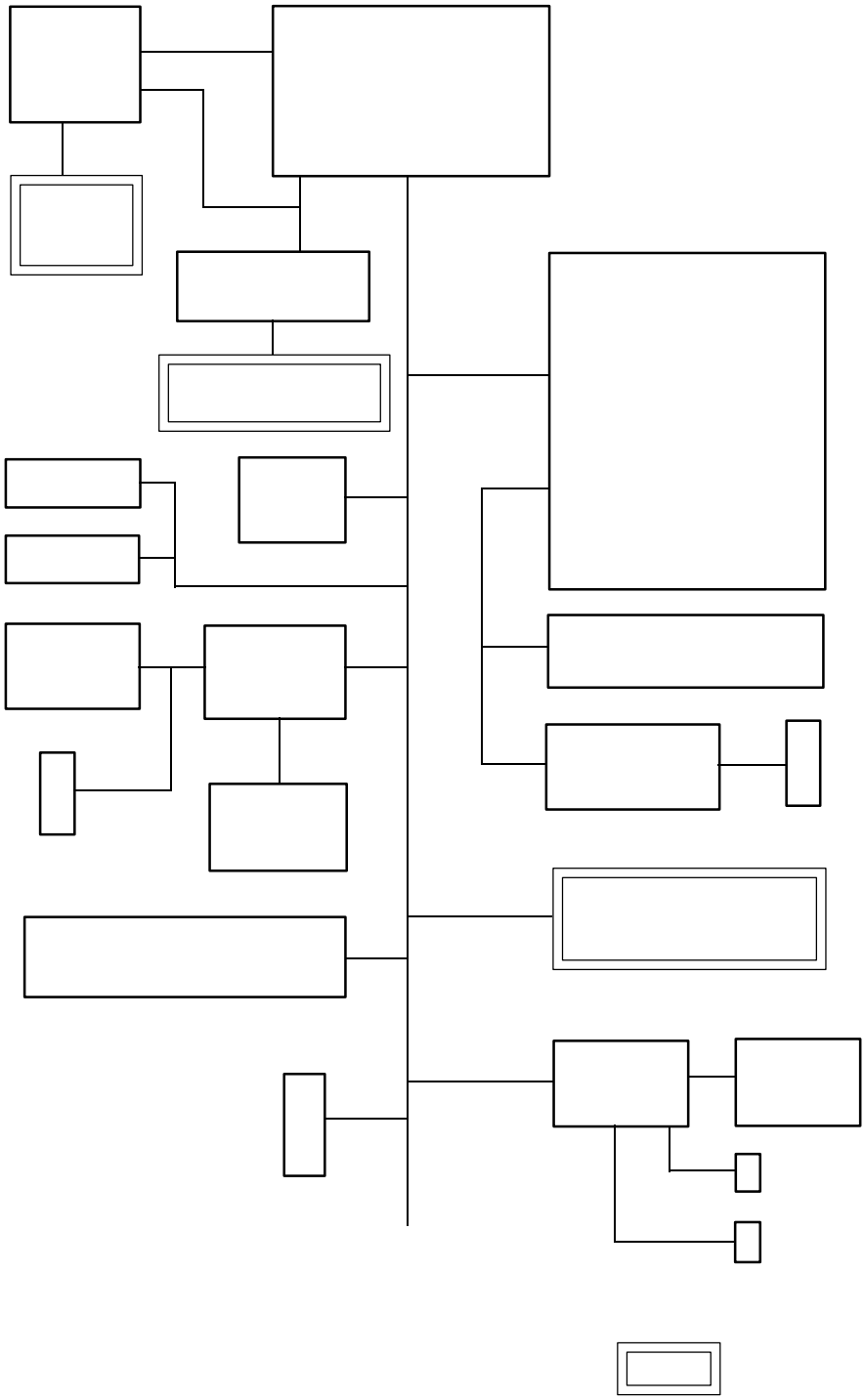

Figure 1-3 T2200SX block diagram

The system board in the T2200SX is composed of the following major components:

- ❑ Central Processing Unit (CPU): 80386SX-20
  The CPU is a 32-bit microprocessor operating at 20MHz (high) and 10MHz (low) clock speeds.

- ❑ Math coprocessor (NDP) socket for the 80387SX-20 (optional)

- ❑ Super Integration (SI): T9901

  The SI stores the following components:
  · Two Direct Memory Access Controllers (DMACs): 82C37A
  · Two Programmable Interrupt Controllers (PICs): 82C59A
  · One Programmable Interval Timer (PIT): 82C54
  · One Floppy Disk Controller (FDC): TC8565
  · One Serial Input/Output Controller (SIO): TC8570
  · One Variable Frequency Oscillator (VFO): TC8568
  · One I/O Controller

- ❑ Real Time Clock (RTC): 146818AF

  The RTC chip stores the date, time, and system configuration with power supplied from the RTC battery.

- ❑ Keyboard Controller (KBC): U37452

- ❑ Power Supply Controller (PSC): U47C440

- ❑ Memory:

  Standard RAM: 2MB
  Backup RAM: 32KB
  BIOS ROM: 128KB (96KB are used)
  BIOS ROM contains the Initial Reliability Test (IRT), the system's Basic Input/Output System (BIOS), and the video BIOS.
  Video RAM: 256KB
  Optional memory cards:
  The system can have up to 10MB of RAM by installing an optional memory card.

- ❑ System control gate array: GA-SCNT2 (208-pin)

- ❑ VGA display controller: PVGA1F (132-pin)

- Oscillators (OSC):

  40.0MHz OSC (X1) is used for the CPU.
  44.9MHz OSC (X2), 28.322MHz OSC (X3), and 25.175MHz OSC (X4) are used for the video.
  14.7456MHz OSC (X5) is used for the COM.
  14.31818MHz OSC (X6) is used for the KBC.
  32.768KHz OSC (X7) is used for the RTC.
  24MHz OSC (X8) is used for the FDC and VFO.

  See Appendix A for the location of the oscillators.

1.3 3.5-inch Floppy Disk Drive

The T2200SX 3.5-inch Floppy Disk Drive (FDD) is a thin, high performance, reliable drive that supports 720KB (formatted) 2DD and 1.44MB (formatted) 2HD 3.5-inch floppy disks.

The T2200SX FDD is shown in Figure 1-4 and its specifications are described in Table 1-1.

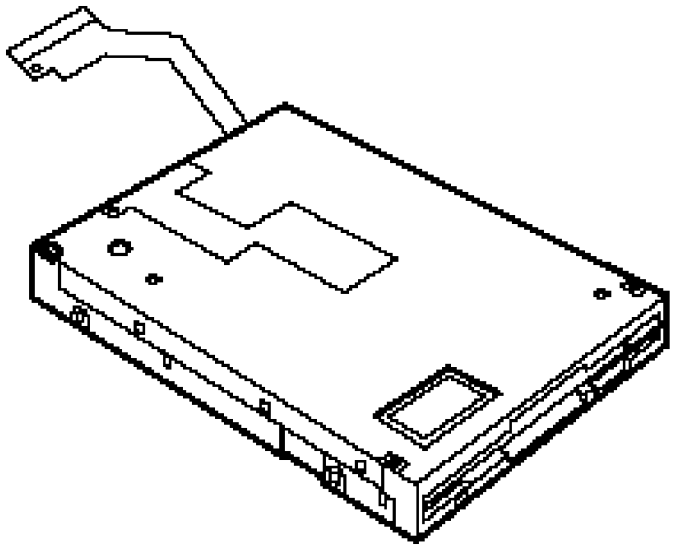

Figure 1-4 3.5-inch FDD

Table 1-1 3.5-inch FDD specifications

Item	2-Mbyte mode	1-Mbyte mode
Storage capacity (Kbyte)		
Unformatted	2,000	1,000
Formatted	1,440	720
Number of heads	2	2
Number of cylinders	80	80
Access time (ms)		
Track to track	3	3
Average	94	94
Head settling time	15	15
Recording track density (tpi)	135	135
Data transfer rate (Kbps)	500	250
Rotation speed (rpm)	300	300
Recording method	Modified Frequency Modulation (MFM)	

UPDATE

1.4 2.5-inch Hard Disk Drive

The 40MB, 60MB, or 80MB (unformatted) Hard Disk Drive (HDD) is a random access, nonvolatile storage device. It is equipped with non-removal 2.5-inch magnetic disks and mini-Winchester type magnetic heads.

The T2200SX HDD is shown in Figure 1-5. The HDD specifications are described in Table 1-2.

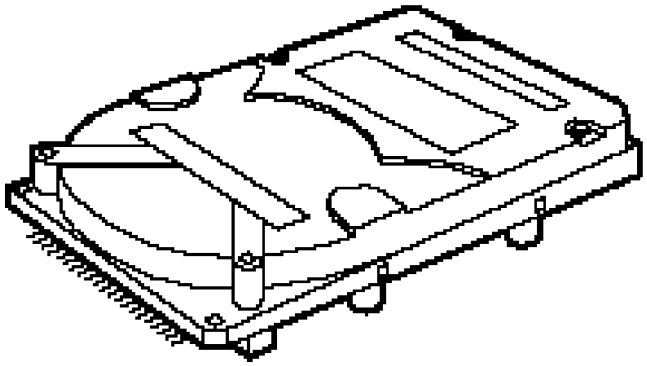

Figure 1-5 2.5-inch HDD

Table 1-2 2.5-inch HDD specifications

Item	40MB		60MB	80MB
	CP-2044	JD-E2850P	CP-2064	JD-E2085M
Storage capacity Formatted (Mbytes)	42.5	42.52	64.0	85.68
Number of disks	2	2	2	2
Data heads	4	3	4	4
Data surfaces	4	3	4	4
Tracks per surface	552	791(+2)	823	791(+2)
Tracks per drive	2,208	2,373(+6)	1,306	3,164
Sectors per track	38(+1)	35(+1)	38(+1)	35(+1)
Bytes per sector	512	512	512	512
Access time (ms) Track to track Average Maximum	 5 19 40	 9 25 47	 5 19 40	 9 25 47
Rotation speed (rpm)	3,486	3,109	3,444	3,118
Data transfer rate (bps) To/from media	12M	10M	12M	5M
Interleave	1:1	1:1	1:1	1:1
Recording method	2-7 RLL/ 1-7 RLL*	2-7 RLL*	2-7 RLL/ 1-7 RLL*	1-7 RLL

* Run Length Limited

1.5 Keyboard

The 82-key (USA) or 84-key (European) keyboard is mounted in the system unit. The keyboard is connected to the keyboard controller located on the system board through a 19-pin flat cable. The keyboard is shown in Figure 1-6.

See Appendix E for optional keyboard configurations.

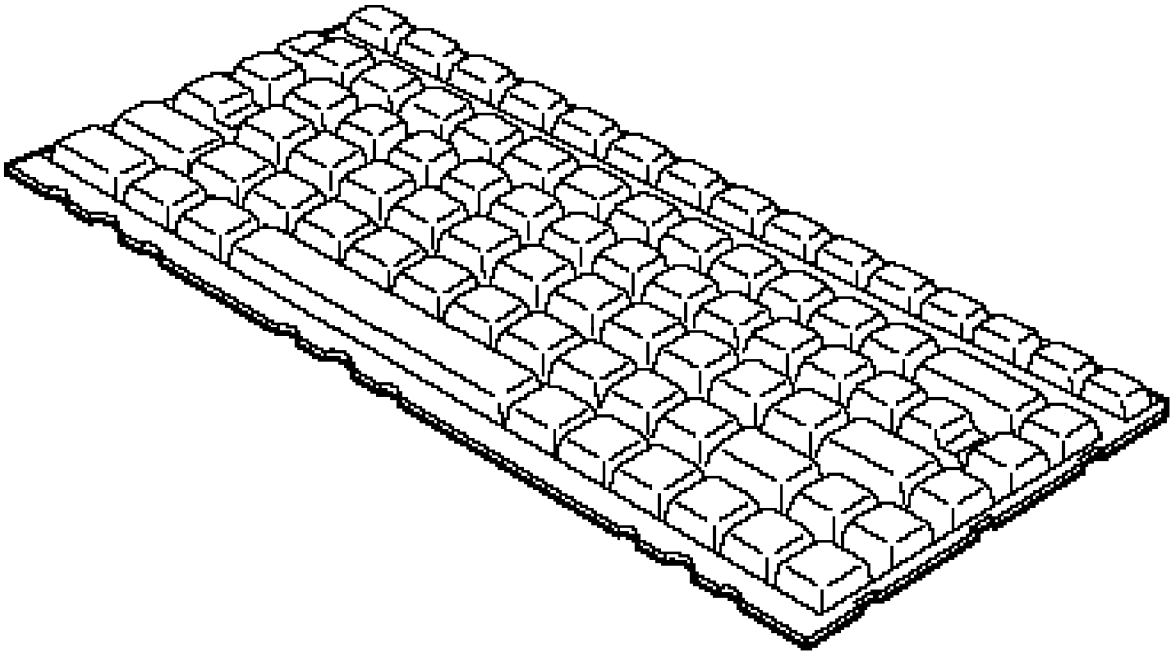

Figure 1-6 Keyboard

1.6 Sidelit Liquid Crystal Display

The sidelit Liquid Crystal Display (LCD) is composed of an LCD module, a Fluorescent Lamp (FL), and an FL inverter board.

1.6.1 LCD Module

The T2200SX sidelit LCD is illuminated from the side and supports 640x480 pixels with a High Resolution Graphics Subsystem (HRGS) and 16 levels of gray. The HRGS includes the functions of the Video Graphics Array (VGA).

The LCD receives vertical and horizontal synchronizing signals, 8-bit data signals (4-bit upper data signal, 4-bit lower data signal), and shift clock for data transmission from the PVGA1F video controller. All signals are CMOS-level compatible.

The sidelit LCD is shown in Figure 1-7 and its specifications are described in Table 1-3.

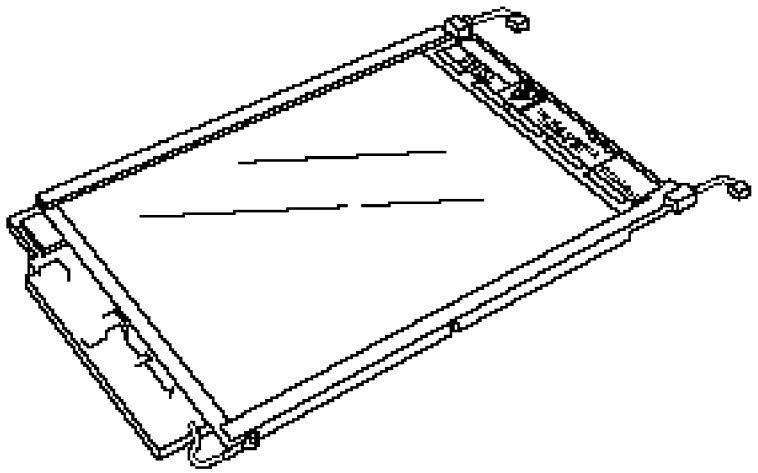

Figure 1-7 Sidelit LCD

Table 1-3 Sidelit LCD specifications

Item		Specifications
Number of dots	(dots)	640 x 480
Dot dimension	(mm)	0.24(W) x 0.24(H)
Dot pitch	(mm)	0.27(W) x 0.27(H)
Display area	(mm)	183.0(W) x 136.0(H)
Contrast		15:1 (typ.)
FL current	(mA)	4.0 - 6.0
FL frequency	(KHz)	35 - 43

1.6.2 FL Inverter Board

The FL inverter board supplies the high frequency current needed to illuminate the FL.

The specifications for the FL inverter board are described in Table 1-4.

Table 1-4 FL inverter board specifications

Item			Specifications
Input	Voltage	(VDC)	12 - 24
	Power	(W)	3.6 (Max.)
Output	Voltage	(VAC)	800 (Min.)
	Current	(mA)	5.5
	Frequency	(KHz)	39
	Bounds of current	(mA)	3.25 - 5.5

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Chapter 2
Operational Overview

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Contents

Tables

Figures

2.1 General

The T2200SX system board contains the following functional components:

- ❑ One Intel 80386SX-20 32-bit microprocessor

- ❑ One Intel 80387SX-20 math coprocessor socket

- ❑ 2MB of standard RAM
  - 2MB (Four 512Kx8-bit chips)
  - No parity bit
  - Access time 70ns

- ❑ BIOS ROM (640KB)
  - 128KB (One 64Kx16-bit chip)
  - 64KB in the ROM are used for SYSTEM BIOS
  - 32KB in the ROM are used for VGA BIOS
  - 32KB in the ROM are not used
  - Access time 85ns

- ❑ 32KB of back-up RAM

- ❑ 256KB of video RAM

- ❑ Optional memory
  - Maximum 8MB for a system total of 10MB
  - One expansion memory slot is available for 2, 4, or 8MB memory cards
  - No parity bit
  - Access time 70ns

- ❑ T9901 Super Integrations (SI)
  - This Super Integration (SI) includes the following components:
    - Two Direct Memory Access Controllers (DMACs): 82C37A
    - Two Programmable Interrupt Controllers (PICs): 82C59A
    - One Programmable Interval Timer (PIT): 82C54
    - One Floppy Disk Controller (FDC): TC8565
    - One Serial Input/Output Controller (SIO): TC8570
    - One Variable Frequency Oscillator (VFO): TC8568
    - One I/O Controller

- ❑ Video Controller
  - Paradise Video Graphics Array 1 (PVGA1)

- ❑ Gate Array
  - System Controller Gate Array (SYSCNT-GA)

- ❑ MC146818AF Real Time Clock (RTC)

- ❑ Keyboard Controller (KBC)

  The KBC controls the internal keyboard, numeric ten keypad port, and mouse port.

The block diagram of the T2200SX system unit is shown in Figure 2-1.

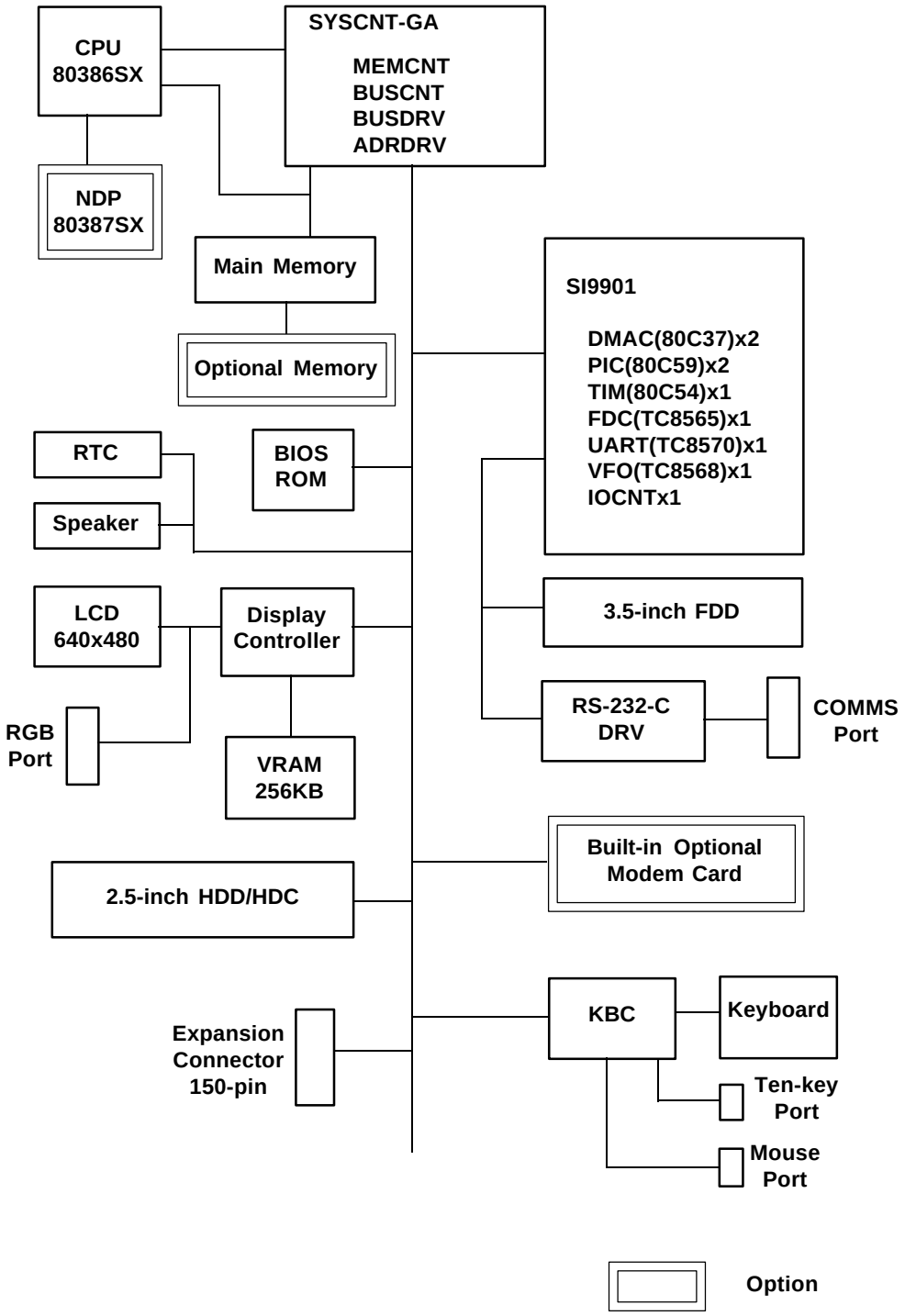

Figure 2-1 System unit block diagram

2.2 Processor

The T2200SX CPU is an Intel 80386SX-20 microprocessor. The 80386SX operates in both, real and protected modes. Real mode can only directly access 1MB of memory. The architecture is the same as the 8086, but allows access to the 32-bit register set of the 80386SX. The protected mode allows the 80386SX to increases the linear address space to access four gigabytes. This allows the virtual memory to run programs of almost unlimited size. Virtual Memory management is based on segmentation, four levels of protection, and an optional paging mechanism. For the details about the 80386SX hardware and its instruction set, refer to the *Intel 80386SX Hardware Reference Manual* and *Programmer's Reference Manual*.

2.2.1 Clock Mode

The 80386SX processor can operate at clock rates of 20MHz (high speed) and 10 MHz (low speed). To switch between the two rates, hold down the **Fn** key, and press the **PgDn** key to select slow speed; pressing the **Fn** and **PgUp** keys returns the processor to high speed. The slow speed may be required by some software packages.

2.2.2 Sleep Mode

The 80386SX processor sleep function is executed by the HALT command from the CPU. When the CPU executes the HALT command, the clock speed reduces to 5MHz to save power.

2.3 Memory

The T2200SX system memory contains 2MB of RAM. T2200SX working memory consists of four 512Kx8 bit dynamic RAM chips for system working memory. The refresh cycle is 15 microseconds.

The 80386SX supports both the real and protected mode operation. In the real mode, the first 640KB of the RAM are directly addressed by MS-DOS. In protected mode, the CPU can access the RAM above 1MB, called the extended memory. The extended memory can also be used as expanded memory by some software. Refer to the MS-DOS Manual for details about how to use extended and expanded memory.

The extended memory can be increased by an optional 2MB, 4MB, or 8MB to a system total of 10MB. The RAM above 640KB and below 1MB is “extra memory” and it can be mapped to the ‘100000’ address as extended memory.

The 640KB BIOS ROM contains the system BIOS, VGA BIOS, and IRT. The ROM data bus width is 8 bits. The system BIOS ROM from ‘FF0000’ to ‘FFFFFF’ is addressed only during CPU reset. The first CPU far jump operation releases the ROM from these addresses.

The RTC MC146818A has an internal 64KB of RAM which is backed up by the RTC battery power. This portion of RAM also stores the T2200SX’s setup information.

2.3.1 Real Mode Memory Map

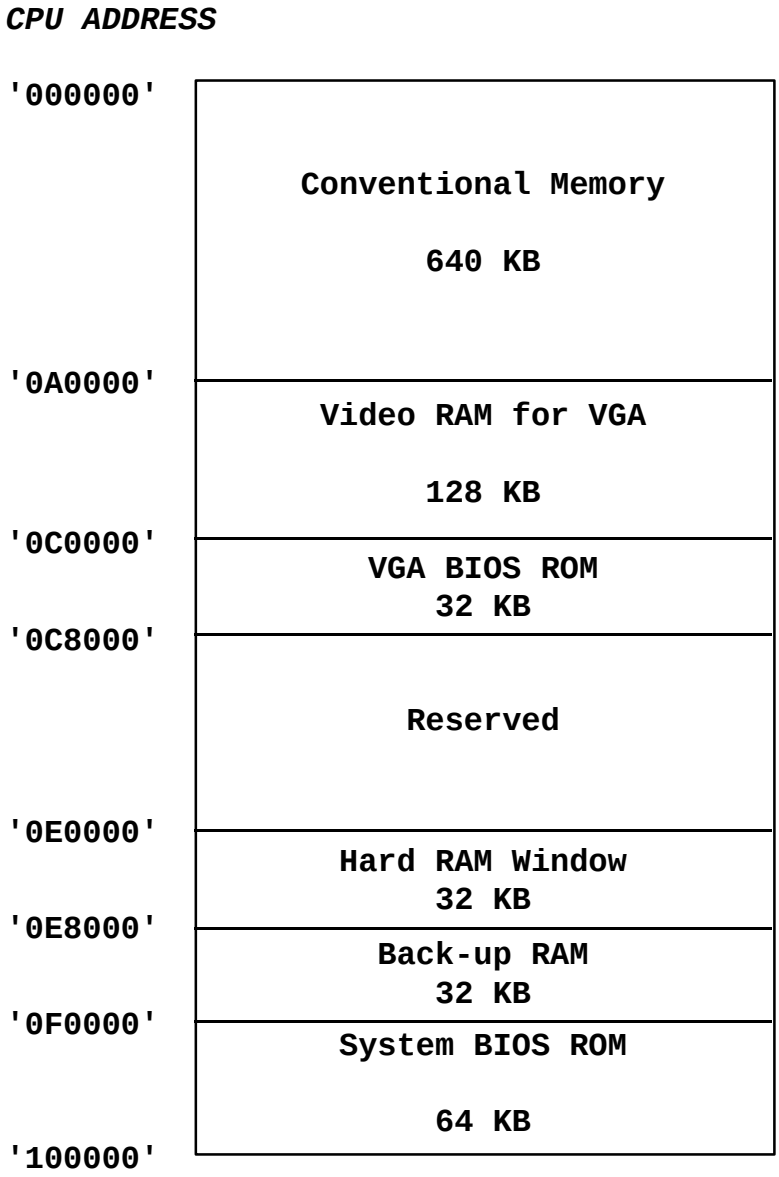

Figure 2-2 Real Mode Memory Map

2.3.2 Protected Mode Memory Map (Hard RAM = 0MB)

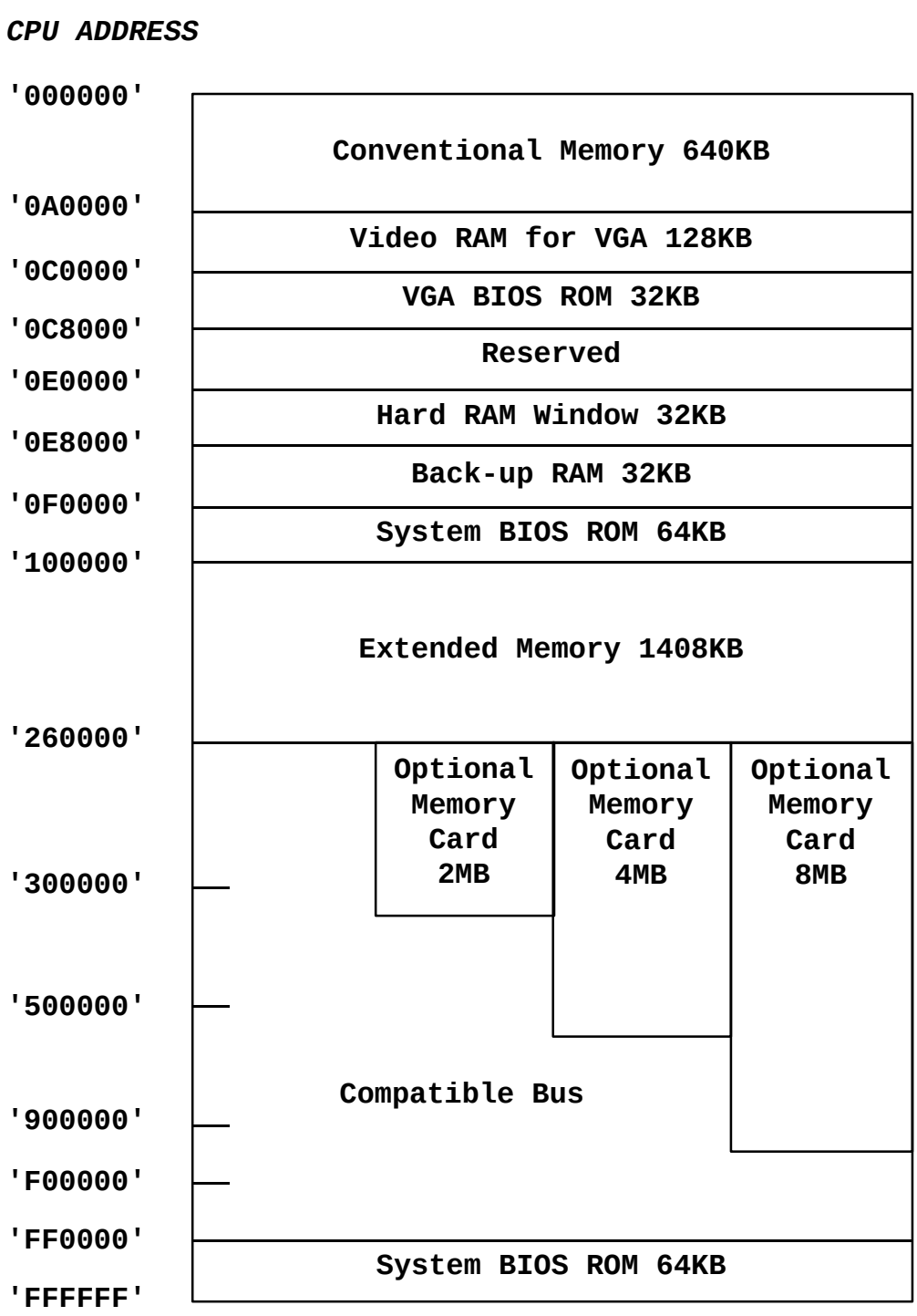

Figure 2-3 Protected Mode Memory Map

2.3.3 EMS Expanded Memory

The T2200SX does not support Expanded Memory at the hardware level. By using the 80386SX CPU function, which is the virtual 86 mode and paging system, the T2200SX can support Expanded Memory at the software level. The following software supports the T2200SX Expanded Memory:

EMM386
WINDOWS 386
QEMM386...
etc.

2.3.4 Extended Memory

The Extended Memory DRAM start address (base address) is assigned beyond the conventional memory size and Hard RAM size. Using a special register, extended memory is set in 64KB increments, except for the conventional memory and Hard RAM which are used for extended memory.

2.3.5 Hard RAM

Hard RAM is accessed through the 32KB Hard RAM window. Hard RAM is assigned from address '0E0000' to '0E7FFF.' Hard RAM can be selected from 128KB to a maximum of 8192KB in 64KB increments using the T2200SX Setup Program. The Hard RAM size is controlled by a special register.

2.3.6 DRAM Address Map

The following memory map indicates the address relationships of memory address and DRAM address.

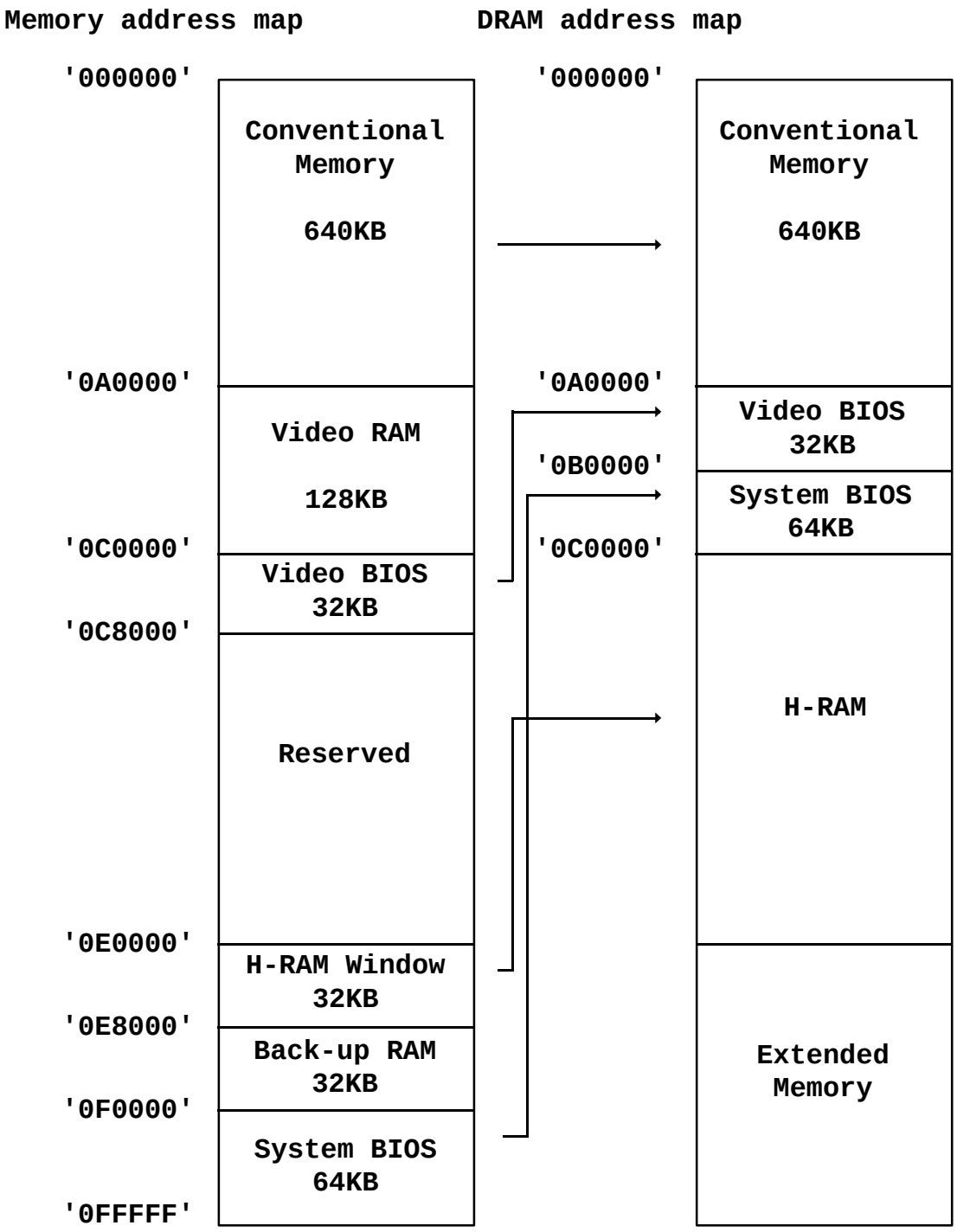

Figure 2-4 DRAM address map

2.4 Interrupts

The T2200SX supports one Non-Maskable Interrupt (NMI) and fifteen levels of maskable interrupts. Table 2-1 defines the interrupt assignments.

Table 2-1 Interrupt assignment

Interrupt	Level	Assigned to:
---	NMI	RAM Parity Error, I/O Channel Error
1	0	Timer
	1	Keyboard
	2	PIC 2 for level 8 to 15
	3	Secondary Communications (COM 2)
	4	Primary Communications (COM 1)
	5	PRT 2
	6	FDC
	7	PRT 1
2	8	RTC
	9	Software Redirect to INT '0A'
	10	Reserved
	11	Reserved
	12	PS/2 Mouse
	13	80387SX
	14	HDC
	15	Reserved

An I/O channel error occurs during one of the following situations:

1) An error coming from the Expansion port is detected.

2) An interrupt request from the intelligent power supply is detected.

The math co-processor (80387SX) generates an INT‘13’ interrupt by itself, and its interrupt handler executes INT‘02’, that is an NMI interrupt vector.

The RAM parity check is not used in this system. Therefore, when the I/O port ‘061’ bit-7 is read, this bit is always ‘0’.

The cause and control ports of the NMI are shown in Table 2-2.

Table 2-2 NMI

NMI	Mask *control	Check status
RAM Parity Error	P - '61' bit-2 (1 = Disable)	P - '61' bit-7 (1 = Enable)
I/O Channel Error	P - '61' bit-3 (1 = Disable)	P - '61' bit-6 (1 = Enable)

2.4.1 NMI Mask Register

An NMI is generated by an I/O channel error. An I/O channel error may occur in the expansion port or when a microprocessor of the intelligent power supply generates the error. System software can disable the NMI using the NMI mask register. This register is assigned to I/O port address '070.' The bit assignment of this register is as follows:

Bit							
7	6	5	4	3	2	1	0
MASK	---	---	---	---	---	---	---

Bit 7: Mask: A "0" enables the register to generate the NMI signal which is then sent to the Central Processor, while "1" disables the NMI signal. This bit will be set to "1" at system power on.

Bits 6 - 0: Reserved

2.4.2 PIC

There are two 82C59A equivalent Programmable Interrupt Controllers (PICs) contained in the SI T9901 to handle 15 levels of maskable interrupts. Programming these devices can mask each interrupt level on and off. STI and CLI instructions enable and disable all maskable interrupts.

2.5 Direct Memory Access

There are two 82C37A equivalent Direct Memory Access Controllers (DMACs) contained in the SI T9901. Direct Memory Access (DMA) operation allows high speed data transfers between memory and I/O devices without the processor's intervention. Seven DMA channels are defined in Table 2-3.

Table 2-3 DMA channel assignment

DMAC	Channel	Assigned to:
1	0	(Not used)
	1	(Reserved)
	2	FDD
	3	(Reserved)
2	4	Cascade for DMAC 1
	5	(Reserved)
	6	(Reserved)
	7	(Not used)

DMAC 1 contains channels 0 through 3. These channels transfer data as bytes (8 bits) between the I/Os and the T2200SX working memory in 64KB blocks.

DMAC 2 contains channels 4 through 7. Channel 4 is used to cascade channels 0 through 3 to the Central Processor. Channels 5 through 7 transfer data as words (16 bits) between the I/Os and working memory in 128KB blocks. Channels 5 through 7 cannot transfer data on odd byte boundaries.

2.6 Timer

An 82C54 equivalent Programmable Interval Timer (PIT) is also included in the SI T9901. The PIT has three timer/counter channels and its count clock is 1.19MHz. The timer/counters are used to generate the system timer clock, RAM refresh request, and speaker input. The time-of-day channel periodically generates the level-0 interrupt request to the central processor. The usage and I/O port assignments for the PIT are presented in Table 2-4 and Table 2-5.

Table 2-4 PIT channel usage

Channel	Use
0	System Timer
1	Dynamic RAM Refresh Request
2	Audio Signal for Speaker

Table 2-5 PIT I/O ports

Port	I/O	Description
'040'	I/O	Channel 0 Count Register
'041'	I/O	Channel 1 Count Register
'042'	I/O	Channel 2 Count Register
'043'	O	Control Word Register

2.7 Speaker

The Speaker is driven by a pulse shaped audio signal from channel 2 of the PIT Device. To sound the speaker, the program sets (1) to "1" in the +T2GT bit of the System Command to generate the audio signal. Number (2) is set to "1" in the +SPKD bit of the System Command Register which sends the audio signal to the Speaker.

By reading the System Status, and checking the +TC2O bit, the program can determine whether the PIT device in channel 2 generates an audio signal.

2.8 Real Time Clock

The MC146818A RTC Device is used as the calendar clock for the system. The RTC contains 64 bytes of CMOS memory, of which 14 bytes are used to keep track of the year, month, day, day of the week, hour, minutes, and seconds. The RTC battery is used for RTC back up power. 50 bytes of memory are used as non-volatile memory containing system configuration information.

2.8.1 RTC Address Map

The RTC address map is shown below.

Table 2-6 RTC address map

Address	Use
'00'	Seconds
'01'	Seconds Alarm
'02'	Minutes
'03'	Minutes Alarm
'04'	Hours
'05'	Hours Alarm
'06'	Day of Week
'07'	Date of Month
'08'	Month
'09'	Year
'0A'	Register A
'0B'	Register B
'0C'	Register C
'0D'	Register D
'0E' to '3F'	Configuration Information

2.9 Floppy Disk Controller

The TC8565 Floppy Disk Controller (FDC) is contained in the SI T9901. The FDC controls the internal 3.5-inch FDD and an external 5.25-inch FDD when one is connected to the system.

The FDC can control the following floppy disks:

- 3.5-inch 2HD, 1.44MB
- 3.5-inch 2DD, 720KB
- 5.25-inch 2D, 360KB
- 5.25-inch 2HD, 1.2MB

This controller uses DMA channel 2 for data transmission and generates a level-6 interrupt at the end of data transmissions. The interrupt also occurs when the FDC changes its status condition.

2.10 Printer Port

A printer port is provided at the rear of the System Unit. It is a 25-pin D-shell connector to connect a standard Centronics compatible parallel printer. This port can also be used as a general input/ output port for other devices as long as those devices have the same interface configuration as the printer.

2.11 Keyboard Controller

The T2200SX uses one microprocessor as the Keyboard Controller (KBC). The microprocessor consists of the keyboard controller, keyboard scan controller, and mouse controller.

2.11.1 Key Code Generation

The T2200SX keyboard has 82/84 keys on it, and when a key is pressed its corresponding key code is generated.

There are two sets of scan codes that the T2200SX supports: scan code set 1 and scan code set 2. There are two differences between these scan code sets. One is a byte code assigned to the key, and the other is a break code that is generated when a pressed key is released.

And, there are several modes of the keyboard, as listed below.

Table 2-7 Keyboard mode

NumLock	Overlay	Fn	Mode
OFF	OFF	OFF	Basic mode
OFF	OFF	ON	Temporary ten-key overlay (cur)
OFF	ON	OFF	Ten-key overlay (cursor cont)
OFF	ON	ON	Resetting overlay temporarily
ON	OFF	OFF	Basic mode
ON	OFF	ON	Temporary ten-key overlay (Num)
ON	ON	OFF	Ten-key overlay (Numeric pad)
ON	ON	ON	Resetting overlay temporarily

When **Fn** is pressed, an overlay LED is toggled.

The **Fn** key is used not only for a ten-key overlay operation, but also for system control operation and key expansions such as the right **Alt** key, right **Ctrl** key, and the ten-key **Enter** key. These combinations are active regardless of the mode.

Refer to Appendix D for a complete listing of the keyboard scan/character codes.

2.11.2 Mouse Control Command

The mouse control commands control the MOUSE port of the T2200SX.

The following table summarizes the mouse control commands.

Table 2-8 Mouse control commands

Code	Function
'A7'	Mouse Disable
'A8'	Mouse Enable
'A9'	Mouse Interface Test
'D3'	Virtual Mouse Interrupt
'D4'	Mouse Command Read

'A7' Mouse Interface Disable

This command disables the mouse data transfer from the mouse. It does not have parameter.

'A8' Mouse Interface Enable

This command enables the mouse data transfer from the mouse. It does not have parameter.

'A9' Mouse Interface Test

This command checks the MOUSE_CK signal line and MOUSE_D signal line for mouse transmission, then outputs the result of the test.

The following table shows the possible error statuses.

Table 2-9 Mouse interface test error statuses

Status	Description
00	No error
01	MOUSE_CK signal line error (Always "0")
02	MOUSE_CK signal line error (Always "1")
03	MOUSE_D signal line error (Always "0")
04	MOUSE_D signal line error (Always "1")

‘D3’ Virtual Mouse Interrupt

This command sends the transfer parameter as mouse data to the CPU.

‘D4’ Mouse Command Read

This command sends the transfer parameter from the CPU to mouse.

2.12 RS-232-C Port

The RS-232-C port is available at the rear of the system unit. This port supports the asynchronous communications with the RS-232-C like voltage interface, and is implemented with a 9-pin D-shell connector to attach a device having the RS-232-C like interface configuration and capabilities.

This port uses the Universal Asynchronous Receiver/Transmitter (UART) circuits in the Super Integration (SI) chip of the T2200SX. This UART is referred to as the Asynchronous Communication Element (ACE). ACEs are fully programmable and are capable of adding or removing start, stop, and/or parity bits to and from an external communication device, and can manage five-, six-, seven-, or eight-bit data with one, one and a half, or two stop-bit characters. It also allows communication operation from 50 to 9600 baud. The ACE device receives a 1.8432MHz clock signal derived from the 14.7456MHz crystal oscillator as the main timing reference.

The RS-232-C driver and receiver circuits convert the TTL-level signals to and from the RS-232-C level. At the RS-232-C level, the voltage between -3 and -15V is regarded as “marking” and between +3 and +15V is “spacing”. All other voltages are invalid. For a send or receive data signal, “marking” is used to denote “1” and “spacing” is “0”. For other control signals, “marking” is used to denote “OFF” and “spacing” is “ON”.

2.12.1 Data Format

The data format of the RS-232-C ports are as follows. The data bit first transferred (D0) is the least significant bit and the last (D7) is the most significant bit for 8-bit character data. The ACE device automatically inserts or examines the start, parity, and stop bits when the device is programmed to do so.

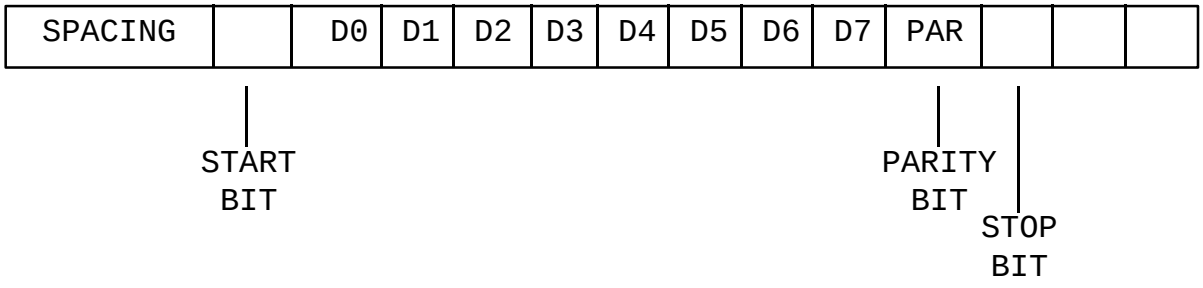

Figure 2-5 Start, parity, and stop bits

2.12.2 Input/Output Port

The RS-232-C ports are assigned to COM1 and COM2. I/O port addressing and interrupts used are shown below.

Table 2-10 RS-232-C ports and interrupts

COM number	Address	Interrupt level
COM1	3F8h - 3FFh	IRQ4
COM2	2F8h - 2FFh	IRQ3

The relationship between the RS-232-C ports and COM number is shown below.

Table 2-11 RS-232-C ports and COM number

Port	COM number
RS-232C	COM1 or COM2
Modem	COM1 or COM2

A COM port is used for an internal modem. When a modem is set to COM1, the RS-232-C port automatically becomes COM2.

2.12.3 25-pin Connector

This port connects an external RS-232-C device through a 9-pin D-shell connector, but the device may have a 25-pin RS-232-C connector to communicate with the port. In this case, an attachment to convert the 9-pin signal assignment into 25-pin becomes necessary. The following pin configurations are used to convert the 9-pin assignments to the 25-pin assignments.

Table 2-12 9-pin to 25-pin conversion

9-pin D-shell female connector	Description	25-pin D-shell male connector
1	Data Carrier Detect	8
2	Receive Data	3
3	Transmit Data	2
4	Data Terminal Ready	20
5	Ground	7
6	Data Set Ready	6
7	Request to Send	4
8	Clear to Send	5
9	Ring Indicator	22

2.13 Connectors

Appendix B contains the pin assignments for the connectors within the T2200SX.

Chapter 3
Troubleshooting Procedures

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Contents

Tables

Figures

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3.1 T2200SX Troubleshooting

The troubleshooting procedures described in this chapter are used to isolate defective Field Replaceable Units (FRUs). The FRUs covered are:

- ❑ Power supply board (PCB FSTPSx) (x = PCB revision number)
- ❑ System board (PCB FSTFGx) (x = PCB revision number)
- ❑ FDD
- ❑ HDD
- ❑ Keyboard
- ❑ Display

The Diagnostics Disk operations are described in Chapter 4 and detailed replacement procedures are given in Chapters 5 and 6.

The following items are necessary for implementing the troubleshooting procedures.

- ❑ T2200SX Diagnostics Disk
- ❑ Toshiba MS-DOS system disk
- ❑ 2DD or 2HD formatted work disk (for FDD testing)
- ❑ Cleaning disk kit (for FDD testing)
- ❑ Printer port LED
- ❑ RS-232-C wraparound connector
- ❑ Printer wraparound connector
- ❑ PS/2 mouse and driver software
- ❑ Phillips head screwdrivers (2mm, 3mm)
- ❑ Multimeter

3.2 Troubleshooting Flowchart

The flowchart in Figure 3-1 is used as a guide for determining which FRU is defective. Before performing the flowchart procedures, perform the following:

- ❑ Disconnect all optional equipment from the T2200SX.
- ❑ Remove any diskette in the FDD.

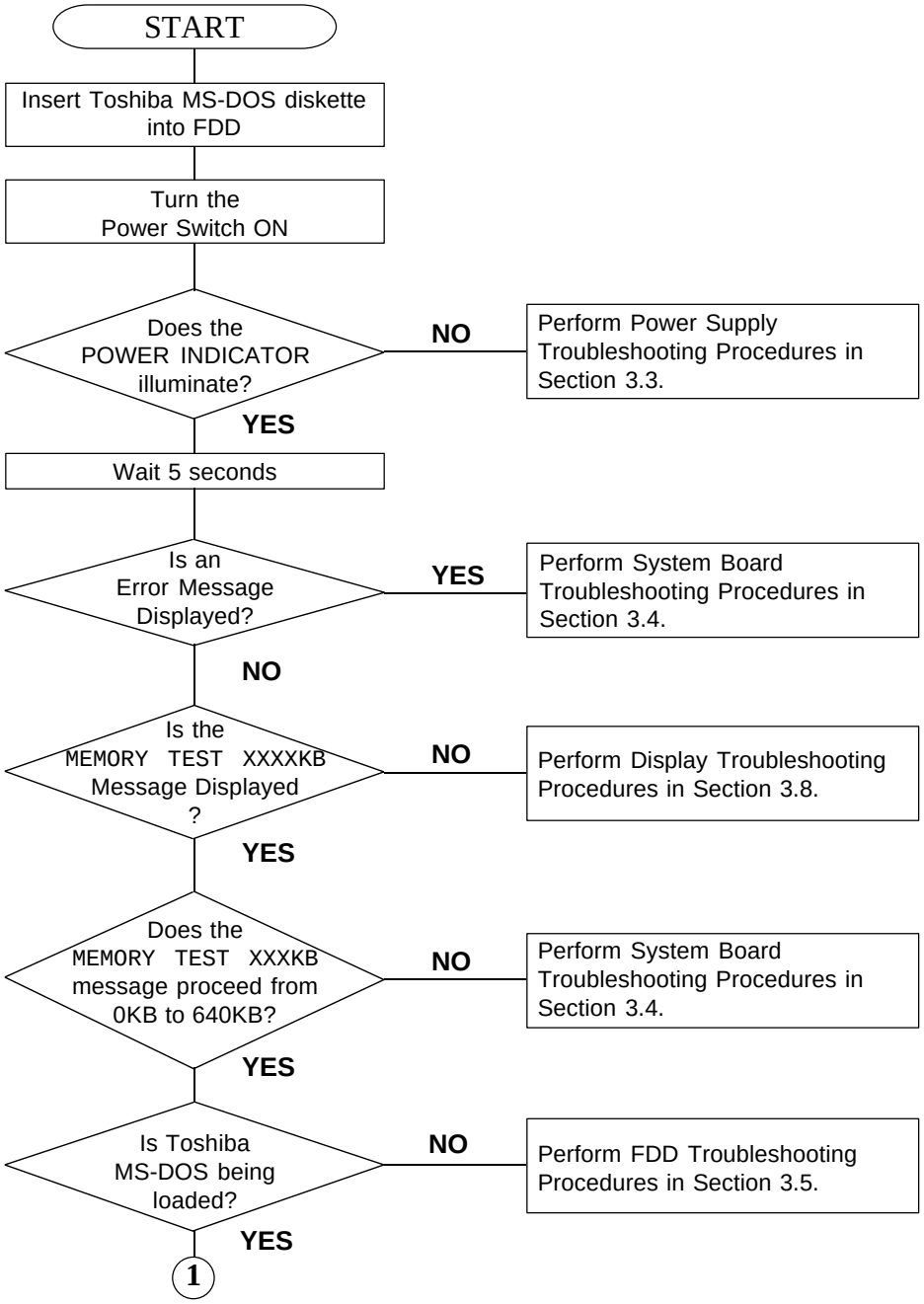


Figure 3-1 Troubleshooting flowchart

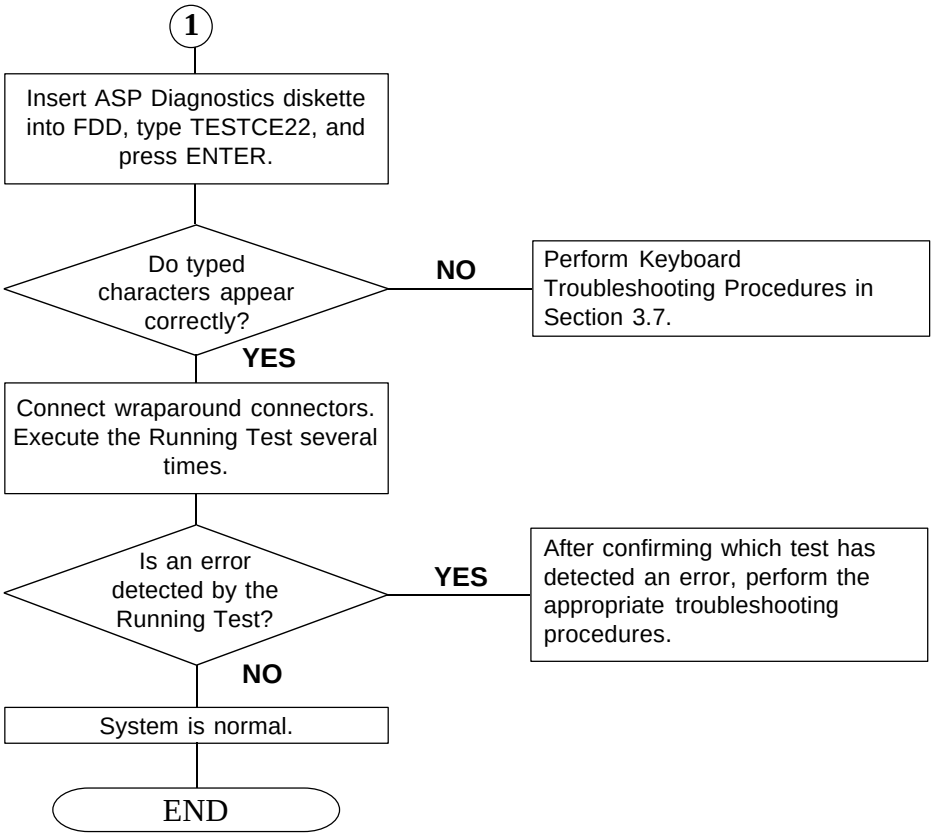


Figure 3-1 Troubleshooting flowchart (continued)

After confirming which diagnostic test detected an error(s), refer to the appropriate troubleshooting procedures as follows:

- ❑ If an error is detected on the system test, memory test, display test, ASYNC test, printer test, or real timer test, perform the system board troubleshooting procedures in Section 3.4.
- ❑ If an error is detected on the keyboard test, perform the keyboard troubleshooting procedures in Section 3.7.
- ❑ If an error is detected on the floppy disk test, perform the FDD troubleshooting procedures in Section 3.5.
- ❑ If an error is detected on the hard disk test, perform the HDD troubleshooting procedures in Section 3.6.

3.3 Power Supply Troubleshooting Procedures

This section describes how to determine if the power supply board is defective. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Charge Check

Procedure 2: Battery Indicator Check

Procedure 3: Connector Check

Procedure 1

Charge Check

When the AC adapter is connected and the power is off, the AC adapter charges the battery.

The LED indicator labeled **Battery** glows amber. If the AC adapter doesn't charge the battery, check the following items:

Check 1 Check that the AC adapter cable is firmly plugged into the **DC IN 18V** connector on the back of the computer.

Check 2 The AC adapter may be damaged. Replace it with a new AC adapter.

Check 3 Replace the battery pack with a new one. If the problem still exists, perform Proce-

dure 2.

Procedure 2

Battery Indicator Check

When the AC adapter is connected to a live wall outlet and the T2200SX, the LED indicator labeled **Battery** will light red. If the AC adapter's output voltage is abnormal or the power supply board is malfunctioning, the **Battery** indicator flashes red.

If the **Battery** indicator blinks red or does not glow when connecting the AC adapter to the computer, perform the following checks.

Check 1 Unplug the AC adapter from the wall outlet and the computer, then remove the battery pack.

Plug the AC adapter into the computer, and then into the wall outlet. Power on the computer.

If the problem still exists, perform Check 2.

Check 2 The AC adapter may be damaged. Replace it with a new AC adapter. If the problem still exists, perform Procedure 3.

Procedure 3

Connector Check

The power supply board is connected to other units by some cables. Any of these cables may be disconnected from the power supply board. Refer to Chapter 5 for instructions on how to disassemble the T2200SX and then perform the following check.

Check 1 Make sure that the following cables are connected to the power supply board correctly.

Battery Terminal connector	PJ1	Power Supply Board
	PJ2	Power Supply Board
System Board connector	PJ4	Power Supply Board
(This in a direct connection between the power supply board and the system board.)		
Sub Battery connector	PJ3	Power Supply Board

If any of these cables are disconnected, connect them. Test the computer again for

normal operation. If the problem still exists, refer to Procedure 4.

Procedure 4

System Board Replacement Check

The power supply board is connected to the system board. Power is supplied to the power supply board from the **DC IN 18V** plug located on the system board. The power supply board or the system board may be damaged. Refer to Chapter 5 for instructions on how to disassemble the T2200SX, and then perform the following checks.

Check 1 Replace the power supply board with a new one and restart the system. If the problem still exists, perform Check 2.

Check 2 Replace the system board with a new one. If the problem still exists, other units may

be damaged.

3.4 System Board Troubleshooting Procedures

This section describes how to determine if the system board is defective or not functioning properly. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Message Check

Procedure 2: Printer Port LED Check

Procedure 3: Test Program Execution

Procedure 4: LED Board and RTC Battery Check

Procedure 1

Message Check

1. Turn on the power.

2. If the system is loaded normally, refer to Procedure 3.

3. If the following message is displayed on the screen, press the **F1** key. Execute the setup operation. Detailed setup operation procedures are described in Chapter 4.

```
**** Error in CMOS.  Bad battery ****
Check system. Then press [F1] key.

**** Error in CMOS.  Bad check sum ****
Check system. Then press [F1] key.

**** Error in CMOS.  Bad configuration ****

**** Error in CMOS.  Bad memory size ****
Check system. Then press [F1] key.

**** Error in CMOS.  Bad HDD type ****
Check system. Then press [F1] key.

**** Error in CMOS.  Bad time function ****
Check system. Then press [F1] key.
```

4. If the following message is displayed on the screen, turn off the power. Wait five seconds or more, then turn on the power. If the following message is displayed again, go to the HDD Troubleshooting Procedures in Section 3.6.

```
Insert system disk in drive
```

```
Press any key when ready .....
```

5. If the following message is displayed on the screen, refer to Procedure 4.

```
CPU ERROR
SYSTEM ROM CHECK SUM ERROR
TIMER CH.2 OUT ERROR
PIT ERROR
MEMORY REFRESH ERROR
FIRST 64KB MEMORY ERROR
RTC ERROR
CRTC ERROR
VRAM ERROR
KBC ERROR
SYSTEM MEMORY ERROR
SYSTEM MEMORY PARITY ERROR
PROTECTED MODE ERROR
CPU EXCEPTION ERROR
EXTENDED MEMORY ERROR
EXTENDED MEMORY PARITY ERROR
EMS PAGE REGISTER ERROR
EXPANDED MEMORY ERROR
EXPANDED MEMORY PARITY ERROR
DMA PAGE REGISTER ERROR
DMAC #1 ERROR
DMAC #2 ERROR
PIC #1 ERROR
PIC #2 ERROR
KEYBOARD ERROR
KBC ERROR
HDC ERROR
HDD #0 ERROR
HDD #1 ERROR
NO FDD ERROR
FDC ERROR
TIMER INTERRUPT ERROR
RTC UPDATE ERROR
```

6. If none of the above messages are displayed and you have a printer port LED, go to Proce-

dure 2.

Procedure 2

Printer Port LED Check

1. Use the SETUP function in the Diagnostic Program to set the **External A-B-PRT** option to the **PRT** value and then turn off the power.

2. Plug the printer port LED into the **PRT/FDD** connector on the back of the unit.

3. While watching the printer port LED, turn on the power. The printer port LED will light when the power switch is turned on. See Appendix H for directions on how to connect and read the printer port LED.

4. Note the final LED status from left to right as you are facing the back of the computer.

5. If the final LED status matches any of the error status values in Table 3-1, refer to Procedure 4.

NOTE: *When reading the Printer Port LED error status, please be aware of the following information:*

- *Error Statuses 01h to 22h indicate which specific test has failed (i.e., Error Status 07h indicates a PIT function test error).*
- *Error Statuses 25h to FFh indicate test completion status (i.e., Error Status 30h indicates that the Extended memory test was completed successfully, however the following test, DMA page register, erred out).*

6. If the final LED status is FFh, go to Procedure 3.

Table 3-1 Printer port LED error statuses

Printer Port LED Indication		Error Status	Test Item	Message
A	B			
○○○○	○○○●	01h	Pre-init for warm start test	-
○○○○	○●○●	05h	PIT test	TIMER CH. 2 OUT ERROR PIT ERROR READ DATA = XXH WRITE DATA = XXH
○○○○	○●●○	06h	PIT Initialization	-
○○○○	○●●●	07h	PIT function test	MEMORY REFRESH ERROR
○○○○	●○●○	0Ah	First 64KB memory test	FIRST 64KB MEMORY ERROR
○○○○	●○●●	0Bh	System memory initialization	-
○○○○	●●○●	0Dh	Interrupt vector initialization	-
○○○●	○●○●	15h	RTC test	RTC ERROR READ DATA = XXH WRITE DATA = XXH
○○○●	○●○●	15h	CMOS RAM test	****Error in CMOS. Bad battery**** ****Error in CMOS. Bad check sum**** ****Error in CMOS. Bad configuration**** ****Error in CMOS. Bad memory size**** ****Error in CMOS. Bad HDD type**** ****Error in CMOS. Bad time function**** Check system. Then press [F1] key..
○○○●	○●●○	16h	RTC initialization	-
○○○●	●○○○	18h	PIC initialization	-
○○○●	●●●●	1Fh	Display initialization	CRTC ERROR VRAM ERROR READ DATA = XXXXXXXXH WRITE DATA = XXXXXXXXH
○○●○	○○●○	22h	KBC test	KBC ERROR
○○●○	○●○●	25h	System memory test	SYSTEM MEMORY ERROR ADDRESS = XXXXXXXXH READ DATA = XXXXXXXXH WRITE DATA = XXXXXXXXH
○○●●	○○○○	30h	Extended memory test	EXTENDED MEMORY ERROR ADDRESS = XXXXXXXXH READ DATA = XXXXXXXXH WRITE DATA = XXXXXXXXH EXTENDED MEMORY PARITY ERROR ADDRESS = XXXX0000H - XXXXFFFFH
○●○○	○○○○	40h	DMA page register test	DMA PAGE REGISTER ERROR READ DATA = XXXXXXXXH WRITE DATA = XXXXXXXXH

● = On
○ = Off

Table 3-1 Printer port LED error statuses (continued)

Printer Port LED Indication		Error Status	Test Item	Message
A	B			
○●○○	○○○●	41h	DMAC test	DMAC #1 ERROR READ DATA = XXXXH WRITE DATA = XXXXH
				DMAC #2 ERROR READ DATA = XXXXH WRITE DATA = XXXXH
○●○○	○○●○	42h	DMAC initialization	-
○●○○	●○●○	4Ah	PIC test	PIC #1 ERROR READ DATA = XXH WRITE DATA = XXH
				PIC #2 ERROR READ DATA = XXH WRITE DATA = XXH
○●○●	○●○○	54h	Keyboard test	KEYBOARD ERROR
○●○●	○●○●	55h	KBC initialization	KBC ERROR
○●○●	●○●○	5Ah	Mouse initialization	-
○●●○	○○○○	60h	HDD initialization	HDC ERROR
				HDD #0 ERROR
				HDD #1 ERROR
○●●○	○●○●	65h	FDD initialization	NO FDD ERROR
				FDD ERROR
○●●●	○○○○	70h	Printer test	-
●○○○	○○○○	80h	RS-232-C	-
●○○●	○○○○	90h	Timer initialization	TIMER INTERRUPT ERROR
				RTC UPDATE ERROR
●○●○	○○○○	A0h	NDP initialization	-
●○●○	○●●○	A6h	Expansion I/O ROM	-
●●●●	●●●●	FFh	Expansion system ROM	-

● = On
○ = Off

Procedure 3

Test Program Execution

The Diagnostic Program located on the Diagnostics Diskette has several tests for testing the T2200SX.

1. Perform the following tests from the Diagnostic Test Menu.

   - ❑ System test
   - ❑ Memory test
   - ❑ Keyboard test
   - ❑ Display test
   - ❑ Floppy disk test
   - ❑ Printer test
   - ❑ ASYNC test
   - ❑ Hard disk test
   - ❑ Real timer test

   Refer to Chapter 4 for detailed instructions about these tests, and then execute each test.

2. If an error is detected during the memory test, ASYNC test, or printer test, refer to Procedure 5.

3. If an error is detected during the floppy disk test, refer to the FDD Troubleshooting Procedures in Section 3.5.

4. If an error is detected during the hard disk test, refer to the HDD Troubleshooting Procedures in Section 3.6.

5. If an error is detected during the keyboard test, refer to the Keyboard Troubleshooting Procedures in Section 3.7.

6. If an error is detected during the display test, refer to the Display Troubleshooting Procedures in Section 3.8.

7. If an error is detected during the system test or real timer test, refer to Procedure 4.

Procedure 4

LED Board and RTC Battery Check

The LED board and the RTC battery are both connected to the system board. Either of these cables may be disconnected from the system board. Refer to Chapter 5 for instructions on how to disassemble the system unit and check the following cable connections.

RTC battery ——————— PJ2

LED board ——————— PJ11

If these cables are disconnected, connect them and restart the system. If the problem still exists, refer to Procedure 5.

Procedure 5

System Board Replacement

1. Replace the system board. Refer to Chapters 5 and 6 for instructions on how to remove and replace the system board.

2. If normal operation is restored after replacing the system board, the original system board is probably defective.

3. If normal operation is not restored, another FRU is probably defective. The defective unit must be isolated by continued testing and then replaced.

3.5 Floppy Disk Drive Troubleshooting Procedures

This section describes how to determine if the floppy disk drive is defective. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Message Check

Procedure 2: Format Check

Procedure 3: Test Program Check

Procedure 4: Connector Check

Procedure 1

Message Check

Prepare a Toshiba MS-DOS system disk and insert it into the FDD. Turn on the power. If Toshiba MS-DOS loading starts normally, refer to Procedure 2.

If the loading starts abnormally, the following message may appear on the screen. If the following message appears, refer to Procedure 4.

```
Place system disk in drive.
Press any key when ready.

Non-System disk or disk error
Replace and press any key when ready
```

Procedure 2

Format Check

Prepare a new floppy disk by formatting it using the Toshiba MS-DOS FORMAT command.

If the floppy disk does not format correctly, perform the following checks.

Check 1 Make sure the **FDD** indicator lights. If it does not light, refer to Procedure 4. If it lights, refer to Check 2.

Check 2 Make sure the Toshiba MS-DOS FORMAT command was used correctly.
When the media type is 2DD, use the FORMAT/3 command.
When the media type is 2HD, use the FORMAT command.

If the FORMAT command was used correctly, refer to Check 3.
If the FORMAT command was not used correctly, try again. If the problem still exists, refer to Check 3.

Check 3 Clean the read/write heads using the 3.5-inch FDD cleaning kit. If the problem still exists, refer to Procedure 3.

Procedure 3

Test Program Check

The FDD test program is stored on the T2200SX Diagnostics Disk. After loading Toshiba MS-DOS, run the Diagnostic Program (TESTCE22). Refer to Chapter 4 for detailed instructions about the FDD test.

Prepare a formatted floppy disk and then perform the FDD test. The error codes and statuses are described in Table 3-2.

If an error occurs, refer to Check 1.

Table 3-2 FDD error codes and statuses

Code	Status
01h	Bad command
02h	Address mark not found
03h	Write protected
04h	Record not found
06h	Media removed on dual attach card
08h	DMA overrun error
09h	DMA boundary error
10h	CRC error
20h	FDC error
40h	Seek error
60h	FDD not drive
80h	Time out error (Not ready)
EEh	Write buffer error

Check 1 If the **`Write protected`** message appears, disable the write protect tab on the floppy disk. If any other error message appears, refer to Check 2.

Check 2 Make sure the floppy disk is formatted correctly. If it is correct, refer to Procedure 4.

Procedure 4

Connector Check

The FDD is connected to the system board by the FDD cable. Disassemble the system unit and check the FDD. Refer to Chapter 5 for instructions on how to disassemble the system unit and then perform the following checks.

Check 1 Make sure the FDD cable is firmly connected to the system board at PJ14.

If this cable is disconnected, connect it to the system unit and refer back to Procedures 2 and 3. If the problem still exists, refer to Check 2.

Check 2 The FDD may be defective. Replace the FDD with a new one and refer back to Procedures 2 and 3. If the problem still exists, refer to Check 3.

Check 3 The system board may be causing the problem. Replace it with a new system board.

3.6 Hard Disk Drive Troubleshooting Procedures

This section describes how to determine if the hard disk drive is defective. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Message Check

Procedure 2: Partition Check

Procedure 3: Test Program Check

Procedure 4: Connector Check

> ***CAUTION:*** *The contents of the hard disk will be erased when the HDD Troubleshooting Procedures are executed. Before continuing, transfer the contents of the hard disk to floppy disks. This can be done with the Toshiba MS-DOS BACKUP command. Refer to the Toshiba MS-DOS manual for details.*

Procedure 1

Message Check

When the power switch is turned on, the following message may appear on the screen.

If the following message appears, refer to Procedure 4.

```
HDD #0 ERROR
```

After five seconds the following message will appear.

```
Insert system disk in drive
Press any key when ready.....
```

If the above message does not appear, refer to Procedure 2.

Procedure 2

Partition Check

Insert the Toshiba MS-DOS system disk and turn on the computer. Then perform the following checks.

Check 1 Type **C:** and press **Enter**. If you cannot change to drive C, go to Check 2. If you can change to drive C, go to Procedure 3.

Check 2 Type **FDISK** and press **Enter**. Choose Display Partition Information from the FDISK menu. If drive C is listed, go to Check 3. If drive C is not listed, return to the FDISK menu and choose to create a DOS partition on drive C. Then recheck the system. If the problem still exists, go to Procedure 3.

Check 3 If drive C is listed as active in the FDISK menu, go to Check 4. If drive C is not listed as active, return to the FDISK menu and choose to set the active partition for drive C. Then recheck the system. If the problem still exists, go to Procedure 3.

Check 4 Remove the system disk from the FDD and cold boot the computer. If the problem still exists, go to Procedure 3. Otherwise, the HDD is operating normally.

Procedure 3

Test Program Check

The HDD test program is stored on the T2200SX Diagnostics Disk. After loading Toshiba MS-DOS, run the Diagnostic Program (TESTCE22) and perform the HDD test. Refer to Chapter 4 for detailed instructions about the HDD test.

If an error is detected during the HDD testing, an error code and status will be displayed; refer to Procedure 4. The HDD error codes and statuses are described in Table 3-3. If an error code is not generated, the HDD is OK.

Table 3-3 HDD error codes and statuses

Code	Status
01h	Bad command
02h	Bad address mark
04h	Record not found
05h	HDC not reset
07h	Drive not initialize
09h	DMA boundary error
0Ah	Bad sector error
0Bh	Bad track error
10h	ECC error
11h	ECC recover enable
20h	HDC error
40h	Seek error
80h	Time out error
AAh	Drive not ready
BBh	Undefined
CCh	Write fault
E0h	Status error
F0h	Not sense error (HW. code = FF)

Procedure 4

Connector Check

The HDD is connected to the system board by the HDD flexible cable. Disassemble the system unit and check the HDD. Refer to Chapter 5 for instructions on how to disassemble the computer and then perform the following checks.

Check 1 Make sure the HDD flexible cable is firmly connected to the HDD.

HDD flexible cable ———————— HDD PJ5

If the cable is disconnected, firmly reconnect it and refer back to Procedures 2 and 3. If the problem still exists, refer to Check 2.

Check 2 The HDD may be damaged. Replace the HDD unit with a new one. If the error still occurs, refer to Check 3.

Check 3 The system board may be damaged. Replace the system board with a new one.

3.7 Keyboard Troubleshooting Procedures

This section describes how to determine if the keyboard is defective. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Test Program Check

Procedure 2: Connector Check

Procedure 1

Test Program Check

The keyboard test program is stored on the T2200SX Diagnostics Disk. After loading Toshiba MS-DOS, run the Diagnostic Program (TESTCE22) and perform the keyboard test. Refer to Chapter 4 for detailed instructions about the keyboard test.

If an error occurs, refer to Procedure 2.
If an error does not occur, the keyboard is operating properly.

Procedure 2

Connector Check

The keyboard is connected to the system board by a 19-pin flat cable. Disassemble the system unit and check the keyboard. Refer to Chapter 5 for instructions on how to disassemble the system unit and then perform the following checks.

Check 1 Make sure the following cable is firmly connected to the system board.

Keyboard cable ——————— System board PJ10

If this cable is not connected, connect it and refer back to Procedure 1. If the problem still exists, refer to Check 2.

Check 2 The keyboard or keyboard cable may be damaged. Replace the keyboard with a new one and refer back to Procedure 1. If the problem still exists, refer to Check 3.

Check 3 The keyboard controller on the system board may be damaged. Replace the system board with a new one.

3.8 Display Troubleshooting Procedures

This section describes how to determine if the display is defective. Start with Procedure 1 and continue with the other procedures as instructed. The procedures described in this section are:

Procedure 1: Brightness and Contrast Volume Check

Procedure 2: External Monitor Check

Procedure 3: Connector Check

Procedure 4: Replacement Check

Procedure 1

Brightness and Contrast Volume Check

The brightness and contrast dials are on the right side of the display unit. Use these dials to adjust the display screen to your satisfaction.

If only the brightness does not change, refer to Procedure 3.

If only the contrast does not change, refer to Procedure 3.

If both the brightness and contrast do not change, refer to Procedure 2.

Procedure 2

External Monitor Check

Connect an external monitor to the **RGB** port and reboot the computer. If the external monitor displays a video signal, the System Display Controller is operating and the internal LCD assembly is probably faulty. Go to Procedure 3.

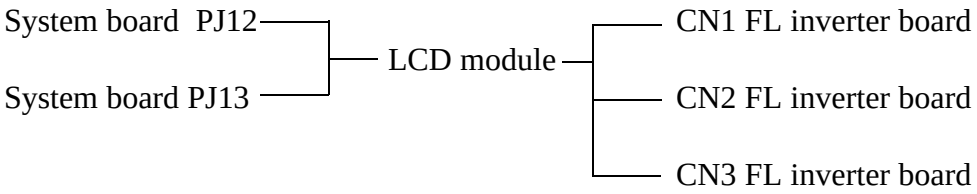
If the external monitor does not display a video signal, perform the Power Supply or System Board Troubleshooting Procedures in Section 3.3 or 3.4.

Procedure 3

Connector Check

The display unit has an LCD module and FL inverter board. The LCD module and FL inverter board are connected by three cables. The LCD module and system board are connected by two signal cables. Any of these cables may be disconnected from the system board or LCD module.

Disassemble the display unit and check these cables. Refer to Chapter 5 for instructions on how to disassemble the system unit.



If any of these cables are not connected, connect them and refer back to Procedures 1 and 2. If the problem still exists, refer to Procedure 4.

Procedure 4

Replacement Check

In this system unit the FL inverter board, LCD module, and system board are connected with the display circuits. Any of these units may be damaged. Refer to Chapter 5 for instructions on how to disassemble the system unit and then perform the following checks.

Check 1 Replace the FL inverter board with a new one and recheck the display. If the problem still exists, refer to Check 2.

Check 2 Replace the LCD module with a new one and recheck the display. If the problem still exists, refer to Check 3.

Check 3 The system board may be damaged. Replace the system board with a new one and recheck the display. If the problem still exists, refer to Check 4.

Check 4 The system board may be damaged. Replace the system board with a new one.

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Chapter 4
Tests and Diagnostics

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Contents

Tables

4.1 Introduction

This chapter explains how to use the T2200SX Diagnostic Program (TESTCE22) to test the functions of all the T2200SX hardware modules. This program is located on the T2200SX Diagnostics Diskette. The Diagnostic Program is composed of 18 programs divided into the Service Program Module (DIAGNOSTICS MENU) and the Test Program Module (DIAGNOSTIC TEST MENU).

The Service Program Module provides the following eight functions:

1. DIAGNOSTIC TEST
2. HARD DISK FORMAT
3. HEAD CLEANING
4. LOG UTILITIES
5. RUNNING TEST
6. FDD UTILITIES
7. SYSTEM CONFIGURATION
8. SETUP

The Test Program Module contains the following ten tests. These are all located within the Diagnostic Test function of the Service Program Module.

1. SYSTEM TEST
2. MEMORY TEST
3. KEYBOARD TEST
4. DISPLAY TEST
5. FLOPPY DISK TEST
6. PRINTER TEST
7. ASYNC TEST
8. HARD DISK TEST
9. REAL TIMER TEST
10. NDP TEST

To execute the T2200SX Diagnostic Program you will need the following:

- ❑ T2200SX Diagnostics Diskette
- ❑ Formatted work disk for the FDD test
- ❑ Cleaning disk kit to clean the FDD heads
- ❑ Printer wraparound connector for the printer wraparound test
- ❑ RS-232-C wraparound connector for the ASYNC wraparound test

The following sections detail the tests within the Diagnostic Test function of the Service Program Module. Refer to Sections 4.16 through 4.22 for detailed information on the remaining seven Service Program functions.

4.2 Using the T2200SX Diagnostic Program

To start the T2200SX Diagnostic Program, follow these steps:

1. Make sure the computer is loaded with **Toshiba** MS-DOS. Turn on the T2200SX and insert the T2200SX Diagnostics Diskette in the floppy disk drive.

2. Change to the A drive. Then type **TESTCE22** and press **Enter**.

3. The DIAGNOSTICS MENU will be displayed as shown below.

```
TOSHIBA personal computer T2200SX DIAGNOSTICS
version x.xx (c) copyright TOSHIBA Corp. 1991

DIAGNOSTICS MENU :

  1 - DIAGNOSTIC TEST
  2 - HARD DISK FORMAT
  3 -
  4 - HEAD CLEANING
  5 - LOG UTILITIES
  6 - RUNNING TEST
  7 - FDD UTILITIES
  8 - SYSTEM CONFIGURATION
  9 - EXIT TO MS-DOS
  0 - SETUP

PRESS [0] - [9] KEY
```

> ***NOTE:*** *To exit the Diagnostic Program Menu and return to MS-DOS, type **9** and press **Enter**. To exit any Subtest Menu, type **99** and press **Enter**. If a test is in progress, press **Ctrl** + **Break** to exit the test. If a test has not been executed, press **Ctrl** + **C** to return to the Subtest Menu.*

4. To execute the Diagnostic Test function from the DIAGNOSTICS MENU, type **1** and press **Enter**. The following DIAGNOSTIC TEST MENU will be displayed, listing the ten tests.

```
TOSHIBA personal computer T2200SX DIAGNOSTICS
version x.xx (c) copyright TOSHIBA Corp. 1990, 91

DIAGNOSTIC TEST MENU :

   1 - SYSTEM TEST
   2 - MEMORY TEST
   3 - KEYBOARD TEST
   4 - DISPLAY TEST
   5 - FLOPPY DISK TEST
   6 - PRINTER TEST
   7 - ASYNC TEST
   8 - HARD DISK TEST
   9 - REAL TIMER TEST
  10 - NDP TEST
  88 - FDD & HDD ERROR RETRY COUNT SET
  99 - EXIT TO DIAGNOSTICS MENU

PRESS [1] - [99] KEY
```

Diagnostic Tests 1 through 10 are discussed in Sections 4.4 through 4.13. Test menu option 88 sets the floppy disk drive and hard disk drive error retry count. Option 99 exits the DIAGNOSTIC TEST MENU and returns you to the DIAGNOSTICS MENU.

5. Enter the desired test number from the DIAGNOSTIC TEST MENU and press **Enter**. The following message will be displayed.

```
SYSTEM TEST                    XXXXXXX

                                 T2200SX DIAGNOSTIC TEST Vx.xx
                                 [Ctrl]+[Break] ; test end
                                 [Ctrl]+[C]     ; key stop
SUB-TEST  : XX
PASS COUNT: XXXXX    ERROR COUNT: XXXXX
WRITE DATA: XX       READ DATA  : XX
ADDRESS   : XXXXXX   STATUS     : XXX

SUB-TEST MENU :

01 - ROM checksum
02 - HW status
99 - Exit to DIAGNOSTIC TEST MENU

SELECT SUB-TEST NUMBER  ?
```

NOTE: *The message displayed by your T2200SX may be slightly different than the one shown above.*

6. Enter the desired subtest number from the subtest menu and press **Enter**. The following message will appear.

```
TEST LOOP (1:YES/2:NO) ?
```

Selecting **YES** increases the pass counter by one each time the test cycle ends and then re-starts the test cycle.

Selecting **NO** returns you to the subtest menu after the test is completed.

7. Type in **1** or **2** for the Test Loop and press **Enter**. The following message will appear.

```
ERROR STOP (1:YES/2:NO) ?
```

Selecting **YES** stops the test program when an error is found and displays the operation guide on the right side of the display screen as shown below.

```
ERROR STATUS NAME          [[ HALT OPERATION ]]

                               1: Test End
                               2: Continue
                               3: Retry
```

1: Terminates the test program execution and exits to the subtest menu.
2: Continues the test.
3: Restarts the test from the beginning of the test.

Selecting **NO** displays the error status, increases the error counter by one, and resumes the test.

8. Type in **1** or **2** for the Error stop and press **Enter** to execute the subtest chosen from the subtest menu. Table 4-1 in Section 4.3 lists the subtests available for each test on the DIAGNOSTIC TEST MENU.

Table 4-3 in Section 4.14 describes the error codes and error status for each error.

4.3 Subtest Names

Table 4-1 describes the subtest for each test program in the Test Program Module.

Table 4-1 Subtest names

Test No.	Test name	Subtest No.	Subtest name
1	SYSTEM	01	ROM checksum
		02	HW status
2	MEMORY	01	RAM constant data
		02	RAM address pattern data
		03	RAM refresh
		04	Protected mode
		05	Memory module
		06	Backup memory
		07	Hard-RAM
3	KEYBOARD	01	Pressed key display (82/84)
		02	Pressed key code display
4	DISPLAY	01	VRAM read/write
		02	Character attributes
		03	Character set
		04	80*25/30 Character display
		05	320*200 Graphics display
		06	640*200 Graphics display
		07	640*350/400/480 Graphics display
		08	Display page
		09	"H" pattern display/Border color
		10	LED/DAC pallet
5	FDD	01	Sequential read
		02	Sequential read/write
		03	Random address/data
		04	Write specified address
		05	Read specified address
6	PRINTER	01	Ripple pattern
		02	Function
		03	Wrap around
7	ASYNC	01	Wrap around (board)
		02	Board (#1) <=> board (#2)
		03	Point to point (send)
		04	Point to point (receive)
		05	Card modem loopback (1200BPS)
		06	Interrupt test

Table 4-1 Subtest names (continued)

Test No.	Test name	Subtest No.	Subtest name
8	HDD	01	Sequential read
		02	Address uniquence (uniqueness)
		03	Random address/data
		04	Cross talk & peek (peak) shift
		05	Write/read/compare (CE)
		06	Write specified address
		07	Read specified address
		08	ECC circuit
		09	Sequential write
		10	W-R-C specified address
9	REAL TIMER	01	Real time
		02	Backup memory
		03	Real time carry
10	NDP	01	NDP test

4.4 System Test

Subtest 01 ROM checksum

This test performs a ROM checksum test on the T2200SX's system board from address F0000h - FFFFFh (64KB).

Subtest 02 HW status

> ***NOTE:*** *When you select this subtest, be sure to select* ***no*** *for the Test Loop and Error Stop messages. Otherwise, you will need to cold boot the computer to terminate this subtest.*

This test reads and displays the T2200SX's hardware status as shown below.

```
             76543210
H/W status = 10001000

   Bit7 –              =
   Bit6 – CPU clock    = 20MHZ
   Bit5 – Notch signal = 2HD
   Bit4 – FDD type     = 2MB
   Bit3 –              =
   Bit2 – Drive A/B    = Ext. = B
   Bit1 – External FDD = OFF
   Bit0 – Internal FDD = 2HD
```

Once this information is displayed, press **Ctrl** + **C** to return to the SYSTEM TEST menu.

Table 4-2 describes the hardware bit status.

Table 4-2 Hardware bit status

Bit	H/W status	1	0
7	Reserved		-
6	CPU clock speed	10 MHz	20 MHz
5	Media type	2DD	2HD
4	FDD type	1 MB	2 MB
3	Reserved		-
2	Drive A/B	B	A
1	External FDD	ON	OFF
0	Internal FDD	2DD	2HD

4.5 Memory Test

Subtest 01 RAM constant data

This subtest writes constant data to conventional memory (0 to 640KB), then reads and compares it with the original data.

The constant data is FFFFh, AAAAh, 5555h, 0101h, and 0000h.

Subtest 02 RAM address pattern data

This subtest writes address pattern data created by eXclusive-ORing (XORing) the address segment and address offset to conventional memory (0 to 640KB), then reads and compares it with the original data.

Subtest 03 RAM refresh (real mode)

This subtest writes 256-byte units of constant data to conventional memory (0 to 640KB), then reads and compares it with the original data.

The constant data is AAAAh and 5555h.

There is a delay between the write and the read operations.

Subtest 04 Protected mode

This subtest writes constant data and address data to extended memory (addressed 100000h to the max.), then reads and compares it with the original data.

The constant data is FFh, AAh, 55h, and 00h.

Subtest 05 Memory module

> ***NOTE:*** *To execute the this subtest, an optional memory card must be installed in the T2200SX.*

This subtest is the same as Subtest 04; it is used for testing an optional memory card.

Memory module capacity is 2MB, 4MB, and 8MB.

After selecting Subtest 05, the following message will be displayed.

```
Extended memory size (1:1MB,2:2MB,3:4MB,4:8MB) ?
```

Select the number that corresponds to the memory card installed in the T2200SX.

Subtest 06 Backup memory

This subtest writes constant data to memory from address E8000h to EFFFFh, then reads and compares it with the original data.

The constant data is 00h, 55h, AAh, and FFh.

Subtest 07 Hard-RAM

> ***NOTE:*** *To execute this subtest, Hard-RAM must be set up on the system.*

This subtest writes word units of constant data to memory (address E0000h to E7FFFh), then reads and compares it with the original data.

The constant data is 00h, 55h, AAh, and FFh.

Also, this subtest executes the paging test on page data.

4.6 Keyboard Test

Subtest 01 Pressed key display (82/84)

> ***NOTE:*** *Make sure the* ***Num Lock*** *key is off. If the* ***Num Lock*** *key is on, this subtest cannot be executed.*

The keyboard layout, as shown below, is drawn on the display. When any key is pressed, the corresponding key on the screen is changed to the "*" (asterisk) character.

When a key is held down, the display will blink indicating that the auto-repeat function is enabled.

```
KEYBOARD TEST     IN PROGRESS     301000
```

```
[Print:Alt+SysReq , Pause:Ctrl+Break]
IF TEST OK, PRESS [DEL] THEN [ENTER] KEY
```

Subtest 02 Pressed key code display

When a key is pressed, the scan code, character code, and key top name are displayed on the screen in the format shown below.

The **Ins**, **Caps Lock**, **Num Lock**, **Scroll Lock**, **Alt**, **Ctrl**, **Left Shift**, and **Right Shift** keys are displayed in reverse video when pressed. The scan codes, character codes, and key top names are listed in Appendix D.

```
KEYBOARD TEST     IN PROGRESS     302000

           Scan code        =
           Character code   =
           Keytop           =
Ins Lock    Caps Lock    Num Lock    Scroll Lock
Alt         Ctrl         Left Shift  Right Shift
PRESS [ENTER] KEY
```

4.7 Display Test

Subtest 01 VRAM read/write

This subtest writes constant data and address data to video RAM (256KB), then reads the data written and compares it with the original data.

The constant data is FFFFh, AAAAh, 5555h, and 0000h.

Subtest 02 Character attributes (mode 1, 13h)

This subtest shows the following display modes and displays the foreground colors and intensified colors (16 colors or 16 levels of gray) using black, blue, red, magenta, green, cyan, yellow, and white from the color display.

Display Modes: Normal
Intensified
Reverse
Blinking

The display below appears on the screen when this subtest is executed.

```
CHARACTER ATTRIBUTES

  NEXT LINE SHOWS NORMAL DISPLAY.
     NNNNNNNNNNNNNNNNNNNNNNNNNNNN

  NEXT LINE SHOWS INTENSIFIED DISPLAY.
     IIIIIIIIIIIIIIIIIIIIIIIIIIII

  NEXT LINE SHOWS REVERSE DISPLAY.
     RRRRRRRRRRRRRRRRRRRRRRRRRRRR

  NEXT LINE SHOWS BLINKING DISPLAY
     BBBBBBBBBBBBBBBBBBBBBBBBBBBB
```

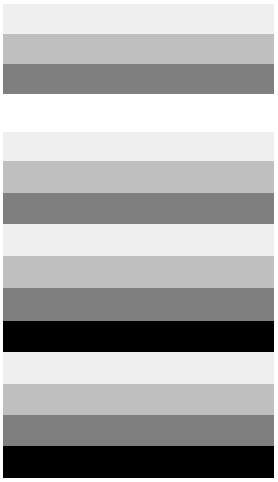
```
00 08 ; BLACK
01 09 ; BLUE
04 0C ; RED
05 0D ; MAGENTA
02 0A ; GREEN
03 0B ; CYAN
06 0E ; YELLOW
07 0F ; WHITE

PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

After pressing **Enter**, 16 colors or 16 levels of gray for mode 13h are displayed as shown below.

```
320*200 GRAPHICS DISPLAY [ 13 ]
```



```
BLACK
BLUE
GREEN
CYAN
RED
MAGENTA
BROWN
WHITE
GRAY
LIGHT     BLUE
LIGHT     GREEN
LIGHT     CYAN
LIGHT     RED
LIGHT     MAGENTA
YELLOW
INTENSE   WHITE

PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 03 Character set

In this subtest the character set (00h to FFh) is displayed in the 40x25 character mode as shown below.

```
CHARACTER SET IN 40*25
 ☺☻♥♦♣♠•◘○◙♂♀♪♫☼►◄↕‼¶§▬↨↑↓→←∟↔▲▼!"#$%&'
()*+,-./ 0123456789::<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvw
xyz{|}~⌂ÇüéâäàåçêëèïîìÄÅÉæÆôöòûùÿÖÜ¢£¥Pƒ
áíóúñÑªº¿⌐¬½¼¡«»░▒▓│┤╡╢╖╕╣║╗╝╜╛┐└┴┬├─┼╞╟
╚╔╩╦╠═╬╧╨╤╥╙╘╒╓╫╪┘┌█▄▌▐▀αßΓπΣσµτΦΘΩδ∞øε∩
≡±≥≤⌠⌡÷≈°∙·√ⁿ²■
```

```
PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 04 80x25 and 80x30 Character display (mode 12)

In this subtest, the character string is displayed shifting one character line by line in the 80x25 and 80x30 character mode as shown below.

```
80*XX CHARACTER DISPLAY
012345678901234567890123456789012345678901234567890123456789012345678901234567
  !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmn
“#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnop
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopq
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqr
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrs
‘()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrst
()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstu
)*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuv
*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvw
+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwx
,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxy
-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz
./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{
/0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}
123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}~
23456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}~•
3456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}~•Ç
456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}~•Çü
PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 05 320x200 Graphics display (mode 4, D)

This subtest displays the following two color sets for the color display in the 320x200 dots graphics mode 4 and D as shown below.

Color set 1: Green, Red, Yellow
Color set 2: Cyan, Magenta, White

```
320*200 GRAPHICS DISPLAY
COLOR SET X : [X]
```

GREEN RED YELLOW
CYAN MAGENTA WHITE

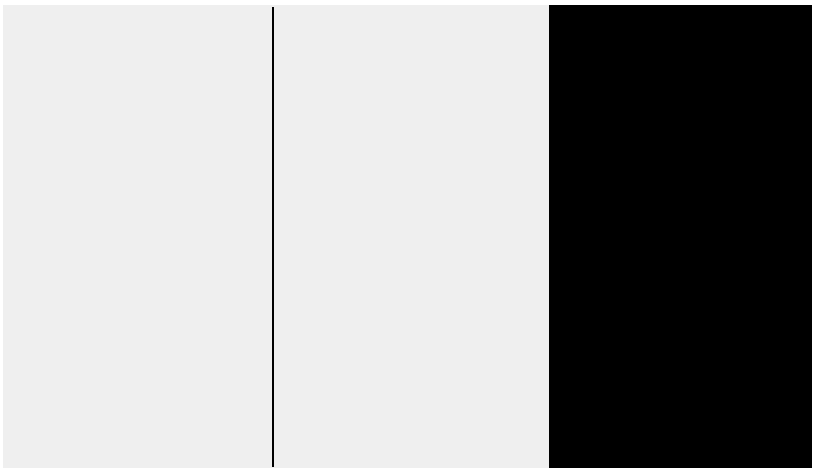
```
PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl + Break**.

Subtest 06 640x200 Graphics display (mode 6, E)

This subtest displays the even dots, odd dots, and all dots blocks in the 640x200 dots graphics mode 6 and E as shown below.

```
640*200 GRAPHICS DISPLAY : [X]
          EVEN DOTS     ODD DOTS     ALL DOTS
          DRIVEN        DRIVEN       DRIVEN
```



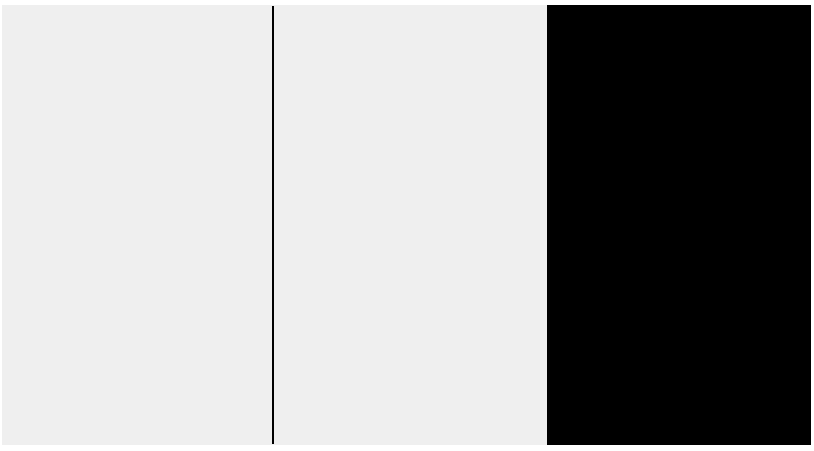
```
PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 07 640x350/400/480 Graphics display (mode 10, 74, 12)

This subtest displays the even dots, odd dots, and all dots blocks in the 640x350 and 640x480 dots graphics mode 10 and 12 as shown below.

```
640*XXX GRAPHICS DISPLAY : [XX]
          EVEN DOTS    ODD DOTS      ALL DOTS
          DRIVEN       DRIVEN        DRIVEN
```



```
PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 08 Display page

This subtest confirms that the pages can be changed in order from page 0 through page 7 in the 40x25 character mode.

```
DISPLAY PAGE 0

0000000000000000000000000000000000000000
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0                                      0
0000000000000000000000000000000000000000
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**. Once the subtest has displayed all seven pages, you will return to the DISPLAY TEST menu.

Subtest 09 "H" pattern display/border color

This subtest displays 2000 "H" characters on the entire screen as shown below.

```
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
```

If an external CRT display is attached, seven border colors and the following message will appear for selecting the CRT.

```
Setting the CRT (1:Yes/2:No)
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

Subtest 10 LED / DAC pallet

This subtest checks the LED Speed, Caps Lock, and Num Lock using key operations.

It also writes the 2Ah/15h data to 6 bits of 256x3 (RGB), then reads the written data and compares it with original data.

```
[ Speed/CRT/Caps/Num/Overlay LED test ]

  (1) Press [ Fn + Pgdn ] key !   ... Speed   (red)

  (2) Press [ Fn + Pgup ] key !   ... Speed   (green)

  (3) Press [ Caps Lock   ] key ! ... Caps    (on/off)

  (4) Press [ Num lock    ] key ! ... Num     (on/off)

  (5) Press [ Fn          ] key ! ... Overlay (on/off)

PRESS [ENTER] KEY
```

To exit this subtest and return to the DISPLAY TEST menu, press **Ctrl** + **Break**.

4.8 Floppy Disk Test

> ***CAUTION:*** *Before running the floppy disk test, prepare a formatted work disk. Remove the Diagnostics Disk and insert the work disk into the FDD. The contents of the floppy disk will be erased.*

OPERATION

1. When you select the floppy disk test from the DIAGNOSTIC TEST MENU, the following message will appear beneath the DIAGNOSTIC TEST MENU.

   ```
   Test drive number select (1:FDD#1,2:FDD#2,0:FDD1&2) ?
   ```

2. Select the drive number containing the floppy disk to be tested and press **Enter**. The following message will appear.

   ```
   Media in drive#x mode    (0:2DD,1:2D,2:2D-2HD/2DD,3:2HD) ?
   ```

3. Select the media type of the floppy disk to be tested and press **Enter**. The following message will appear.

   ```
   Test start track         (Enter:0/dd:00-79) ?
   ```

4. Select the start track number and press **Enter**. Simply pressing **Enter** sets the start track at zero. The FLOPPY DISK TEST menu will appear after you select the start track number.

5. The following message appears above the FLOPPY DISK TEST menu and during each subtest.

   ```
   FLOPPY DISK                                  XXXXXXX

   SUB-TEST   : XX
   PASS COUNT: XXXXX      ERROR COUNT: XXXXX
   WRITE DATA: XX         READ DATA  : XX
   ADDRESS    : XXXXXX    STATUS     : XXX
   ```

   The first three digits of the **ADDRESS** number are the cylinder number being tested, the fourth digit is the head number and the last two digits are the sector number.

   The first digit of the **STATUS** number is the drive number being tested and the last two digits are the error status code as explained in Table 4-3 on page 4-33.

CONTENTS

Subtest 01 Sequential read

This subtest performs the Cyclic Redundancy Check (CRC) with a continuous read operation of all the tracks on a floppy disk.

The tracks available for the CRC are:
Double-sided, double-density (2D): Tracks 0 to 39.
Double-sided, double-density, double-track (2DD) and Double-sided, high-density, double-track (2HD): Tracks 0 to 79.

The start track is specified when the Floppy Disk Test is selected from the DIAGNOSTIC TEST MENU.

Subtest 02 Sequential read/write

This subtest writes data to all tracks (as defined above) continuously, and then reads the data out and compares it with the original data.
(The data pattern B5ADADh is repeated.)

Subtest 03 Random address/data

This subtest writes random data to random addresses on all tracks defined in Subtest 01 and then reads the data out and compares it with the original data.

Subtest 04 Write specified address

This subtest writes the specified data to the specified track, head, and address. You can specify the test data, track number, and head number.

Subtest 05 Read specified address

This subtest reads the data from the specified track, head, and address. You can specify the track number and head number.

4.9 Printer Test

> ***CAUTION:*** *An IBM compatible printer must be connected to the system in order to execute Subtest 01 or 02. Make sure the setup option* ***External FDD/PRT*** *is set to* ***Printer****.*

OPERATION

When you select this test, the following message will appear.

```
channel#1 = XXXXh
channel#2 = XXXXh
channel#3 = XXXXh

Select the channel number (1-3) ?
```

The **XXXXh** data in the above message shows the printer I/O port address.

The T2200SX supports three printer channels. Select the printer channel number and press **Enter** to display the PRINTER TEST menu.

CONTENTS

Subtest 01 Ripple pattern

This subtest prints characters for codes 20h through 7Eh line by line while shifting one character to the right at the beginning of each new line.

```
  !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklm
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmn
"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnop
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopq
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqr
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrs
'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrst
()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstu
)*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuv
*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmnopqrstuvw
```

Subtest 02 Function

This subtest prints out the various print types shown below.

```
  PRINTER TEST
1. THIS LINES SHOWS NORMAL PRINT.
2.  THIS LINE SHOWS DOUBLE WIDTH PRINT.
3. THIS LINE SHOWS COMPRESSED PRINT.
4. THIS LINE SHOWS EMPHASIZED PRINT.
5. THIS LINE SHOWS DOUBLE STRIKE PRINT.
6. ALL CHARACTERS PRINT
 !"#$%&'()*+,./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmn
opqrstuvwxyz{|}~
```

Subtest 03 Wraparound

> ***NOTE:*** *To execute this subtest, a printer wraparound connector (C*D-4890004-A00) must be connected to the printer port. The printer wraparound connector wiring diagram is given in Appendix F.*

This subtest checks the data control and status lines through the printer wraparound connector.

Both the output mode and bi-directional mode are tested.

4.10 ASYNC Test

Subtests 01 through 04 requires the following data format:

Method:	Asynchronous
Speed:	9600 bps
Data:	8 bits and one parity bit (EVEN)
Stop bit:	One stop bit
Data pattern:	20h to 7Eh

Subtest 01 Wrap around (board)

> ***NOTE:*** *To execute this subtest, an RS-232-C wraparound connector (C*D-4890005-A00) must be connected to the RS-232-C port. The RS-232-C wraparound connector wiring diagram is given in Appendix F.*

This subtest checks the data send/receive function through the wraparound connector.

Subtest 02 Board (#1) <=> board (#2)

> ***NOTE:*** *To execute this subtest, an RS-232-C direct cable (9-pin to 9-pin) must be connected to channels 1 and 2. The RS-232-C direct cable wiring diagram is given in Appendix F.*

This subtest checks the data send/receive function through the RS-232-C direct cable.

Subtest 03 Point to point (send)

> ***NOTE:*** *To execute this subtest, two machines must be connected with an RS-232-C direct cable. One machine should be set as 'send' (Subtest 03) and the other set as 'receive' (Subtest 04). The wiring diagram for the RS-232-C direct cable is given in Appendix F.*

This subtest sends 20h through 7Eh data to the receive side, then receives the data back and compares it to the original data.

Subtest 04 Point to point (receive)

This subtest is used with Subtest 03 as described above.

This subtest receives the data from the send side, then returns the data.

Subtest 05 Card modem loopback (2400BPS)

> ***NOTE:*** *To execute this subtest, a card modem must be installed.*

This subtest sends the data from the RS-232-C direct cable to the built-in modem. The same data is then sent from the modem and compared to the original data.

Subtest 06 Interrupt test (IRQ 4, 3, and 5)

This subtest checks the Interrupt Request Levels (IRQ) 4, 3, and 5 from the send side.

4.11 Hard Disk Test

CAUTION: *The contents of the hard disk will be erased when Subtest 02, 03, 04, 06, 08, 09, or 10 is executed. Before running the test, transfer the contents of the hard disk to floppy disks. This can be done with the Toshiba MS-DOS BACKUP command. After the test, execute the Toshiba MS-DOS FDISK command, which will partition the hard disk drive. Then execute the Toshiba MS-DOS FORMAT command. Refer to the Toshiba MS-DOS manual for details.*

OPERATION

1. When you select the Hard Disk Test from the DIAGNOSTIC TEST MENU, the following message will appear.

   ```
   Test drive number select (1:HDD#1,2:HDD#2,0:HDD1&2) ?
   ```

2. Select the hard disk drive number to be tested and press **Enter**. The following message will appear.

   ```
   HDC F/W error retry      (1:yes,2:no) ?
   ```

3. This message is used to select the retry operation when the hard disk controller detects an error. Type in **1** or **2** and press **Enter**. The following message will appear.

   ```
   Data compare error dump  (1:no,2:yes) ?
   ```

4. This message is used to select the error dump operation when a data compare error is detected. Type in **1** or **2** and press **Enter**. The following message will appear.

   ```
   Detail status display    (1:no,2:yes) ?
   ```

5. This message is used to select whether or not the HDD status is displayed on the screen. The HDD status is described in Section 4.15. Type in **1** or **2** and press **Enter**. The HARD DISK TEST menu will appear.

6. During the hard disk test, the following message will appear.

```
HARD DISK TEST                        XXXXXXX

SUB-TEST   : XX
PASS COUNT: XXXXX      ERROR COUNT: XXXXX
WRITE DATA: XX         READ DATA   : XX
ADDRESS    : XXXXXX    STATUS      : XXX
```

The first three digits of the **ADDRESS** number are the cylinder number being tested, the fourth digit is the head number, and the last two digits are the sector number.

The first digit of the **STATUS** number is the drive number being tested and the last two digits are the error status code as explained in Table 4-3 on page 4-33.

CONTENTS

Subtest 01 Sequential read

The sequential read test is a sequential reading of all the tracks on the HDD starting at track 0. When all the tracks on the HDD have been read, the test starts at the maximum track and reads the tracks on the HDD sequentially back to track 0.

Subtest 02 Address uniquence (uniqueness)

The address uniqueness test writes unique address data to each sector, track by track, on the HDD. The data written to each sector is then read and compared with the original data. There are three ways in which the HDD can be read:

- Forward sequential
- Reverse sequential
- Random

Subtest 03 Random address/data

This subtest writes random data to random addresses (cylinder, head, and sector) on the HDD and then reads the written data back and compares it to the original data.

Subtest 04 Cross talk & peek (peak) shift

This subtest writes the eight types of worst pattern data (shown below) to a cylinder, then reads the data while moving from cylinder to cylinder.

Worst pattern data:
B5ADADh, 4A5252h, EB6DB6h, 149249h
63B63Bh, 9C49C4h, 2DB6DBh, D24924h

Subtest 05 Write/read/compare (CE)

This subtest writes the worst pattern data (B5ADADh) to the CE cylinder, and then reads the data out and compares it with the original data.

Subtest 06 Write specified address

This subtest writes specified data to a specified cylinder and head.

Subtest 07 Read specified address

This subtest reads data which has been written to a specified cylinder and head.

Subtest 08 ECC circuit

This subtest checks the Error Check and Correction (ECC) circuit functions of the specified cylinder and head.

Subtest 09 Sequential write

This subtest writes specified 2-byte data to all cylinders.

Subtest 10 W-R-C specified address

This subtest writes data to a specified cylinder and head, then reads and compares it with the original data.

4.12 Real Timer Test

Subtest 01 Real time

A new date and time can be inputted during the Real Time Subtest.

To execute the Real Time Subtest, follow these steps:

1. After the REAL TIMER TEST menu appears, select Subtest 01. The following message will appear displaying the current date and time.

```
Current date : xx-xx-xxxx
Current time : xx:xx:xx

Enter new date:

PRESS [ENTER] KEY TO EXIT TEST
```

2. If the current date is not correct, input the correct date at the prompt and press **Enter**. The following prompt will appear.

```
Enter new time :
```

3. If the current time is not correct, input the correct time (in military format) and press **Enter**. Press **Ctrl** + **Break** to return to the REAL TIMER TEST menu.

Subtest 02 Backup memory

This subtest perform the following checks of the backup memory.

- ❑ One bit of "on" data to addresses 01h through 80h.
- ❑ One bit of "off" data to addresses FEh through 7Fh.
- ❑ The data pattern AAh through 55h to 50 bytes of the RTC backup memory (addressed 0Eh through 3Fh).

Then the subtest reads and compares this data with the original data.

Subtest 03 Real time carry

> ***CAUTION:*** *When this test is executed, the current date and time are erased.*

This subtest checks if the real time clock correctly increments the date and time displayed (month, day, year, hour, minute, and second).

4.13 NDP Test

> ***NOTE:*** *To execute this test, a math co-processor (NDP) must be mounted on the system board.*

Subtest 01 NDP test

This subtest checks the control word, status word, bus, and addition and multiplication functions.

4.14 Error Codes and Error Status Names

Table 4-3 lists the error codes and error status names.

Table 4-3 Error codes and error status names

Device name	Error code	Error status name
(COMMON)	FF	Data Compare Error
SYSTEM	01	ROM Checksum Error
MEMORY	01	Parity Error
	02	Protected Mode Not Change
	14	Memory Read/Write Error
	15	RAM_ON_BIOS Unestablish
	19	BIOS Copy Error (System)
	1A	BIOS Copy Error (VGA)
	1B	H-RAM Mapping Error
	1C	H-RAM Read/Write Error
FDD	01	Bad Command
	02	Address Mark Not Found
	03	Write Protected
	04	Record Not Found
	06	Media Removed
	08	DMA Overrun Error
	09	DMA Boundary Error
	10	CRC Error
	20	FDC Error
	40	Seek Error
	60	FDD Not Drive
	80	Time Out Error
	EE	Write Buffer Error
PRINTER	01	Time Out
	08	Fault
	10	Select Line
	20	Out of Paper
	40	Power Off
	80	Busy Line

Table 4-3 Error codes and error status names (continued)

Device name	Error code	Error status name
ASYNC	01	DSR Off Time Out
	02	CTS Off Time Out
	04	RX-ENABLE Time Out
	08	TX-BUFFER Full Time Out
	10	Parity Error
	20	Framing Error
	40	Overrun Error
	80	Line Status Error
	88	Modem Status Error
	33	NO CARRIER (Card Modem)
	34	ERROR (Card Modem)
	36	NO DIAL TONE (Card Modem)
HDD	01	Bad Command Error
	02	Bad Address Error
	04	Record Not Found
	05	HDC Not Reset
	07	Drive Not Initialize
	09	DMA Boundary Error
	0A	Bad Sector Error
	0B	Bad Track Error
	10	ECC Error
	11	ECC Recover Enable
	20	HDC Error
	40	Seek Error
	80	Time Out Error
	AA	Drive Not Ready
	BB	Undefined
	CC	Write Fault
	E0	Status Error
	F0	Not Sense Error (FF)
NDP	01	No CO-PROCESSOR
	02	Control Word Error
	03	Status Word Error
	04	Bus Error
	05	Additional Error
	06	Multiple Error

4.15 Hard Disk Test Detail Status

When an error occurs in the Hard Disk Test, the following message is displayed.

```
HDC status = XXXXXXXX
```

Detailed information about the hard disk test error is displayed on the screen by an eight-digit number. The first four digits represent the HDC error status and the last four digits are not used.

The HDC error status is composed of 2 bytes; the first byte represents the contents of the HDC status register in hexadecimal form and the second byte represents the HDC error register.

The contents of the HDC status register are described in Tables 4-4 and 4-5.

Table 4-4 HDC status register contents

Bit	Name	Description
7	BSY (Busy)	"0"--HDC is busy. "1"--HDC is ready.
6	DRDY (Drive ready)	"0"--Hard disk drive is not ready to accept any command. "1"--Hard disk drive is ready.
5	DWF (Drive write fault)	"0"--DWF error is not detected. "1"--Write fault condition occurs.
4	DSC (Drive seek complete)	"0"--The hard disk drive heads are not settled over a track. "1"--The hard disk drive heads are settled over a track.
3	DRQ (Data request)	"0"--Drive is not ready to transfer data. "1"--Drive is ready for data transfer.
2	CORR (Corrected data)	"0"--Otherwise. "1"--Correctable data error is corrected.
1	IDX (Index)	"0"--Otherwise. "1"--Index is sensed.
0	ERR (Error)	"0"--Otherwise. "1"--The previous comand was terminated with some error.

Table 4-5 Error register contents

Bit	Name	Description
7	BBK (Bad block mark)	"0"--Otherwise. "1"--A bad block mark is detected.
6	UNC (Uncorrectable)	"0"--There is no uncorrectable data error. "1"--Uncorrectable data error has been detected.
5		Not used.
4	IDNF (Identification)	"0"--Otherwise. "1"--There was no ID field in the requested sector.
3		Not used.
2	ABRT (Abort)	"0"--Otherwise. "1"--Illegal command error or a drive status error occurs.
1	TK09 (Track 0)	"0"--The hard disk has found track 0 during a recalibrate command. "1"--The hard disk could not find track 0 during a recalibrate command.
0		Not used.

4.16 Hard Disk Format

This function executes a hard disk formatting command. There are two types of hard disk formatting:

- ❑ Physical formatting
- ❑ Logical formatting

This Hard Disk Format function physically formats the hard disk and executes the following Hard Disk formats and check:

1. All track FORMAT
2. Good track FORMAT
3. Bad track FORMAT
4. Bad track CHECK

> ***CAUTION:*** *The contents of the hard disk will be erased when this program is executed. Before executing the program, transfer the contents of the hard disk onto floppy disks. This can be done with the Toshiba MS-DOS BACKUP command. See the Toshiba MS-DOS manual for details.*

4.16.1 Function Description

1. All track FORMAT

   Physically formats all of the tracks on the hard disk as shown in Table 4-6 below.

> ***NOTE:*** *Before executing the All track FORMAT program, execute the Bad track CHECK program to display a list of bad tracks on the HDD.*

Table 4-6 Hard disk formatting sequence

Item	Description	
	40MB	60MB
Sector sequences	1	1
Cylinders	0 to 979	0 to 822
Heads	0 to 4	0 to 3
Sectors	1 to 17	1 to 38
Sector length (bps)	512	512

2. Good track FORMAT

   The Good track FORMAT program formats a specified cylinder and track as a good track. If the good track has been formatted as a bad track, use this program to change the track to a good track.

3. Bad track FORMAT

   The Bad track FORMAT program formats a specified cylinder and track as a bad track. If a bad track has been detected, use this program to label it as a bad track.

4. Bad track CHECK

   The Bad track CHECK program searches the hard disk for bad tracks by reading data to all of the tracks on the hard disk. A list of bad tracks is displayed when the program is completed. If an error other than a bad track is detected, the program is automatically terminated.

4.16.2 Operations

> ***CAUTION:*** *After physical formatting is finished, enter the Toshiba MS-DOS FDISK command which will partition the hard disk drive. Then execute the Toshiba MS-DOS FORMAT command. See the Toshiba MS-DOS manual for details.*

1. Select the HARD DISK FORMAT function from the DIAGNOSTICS MENU. The following prompt appears.

```
DIAGNOSTICS - HARD DISK FORMAT : Vx.xx

  1 - All track FORMAT
  2 - Good track FORMAT
  3 - Bad track FORMAT
  4 - Bad track CHECK
  9 - Exit to DIAGNOSTICS MENU

Press [NUMBER] key ?
```

2. All track FORMAT program

   (1) Selecting the All track FORMAT program displays the following message.

```
Drive number select (1:#1,2:#2) ?
```

   (2) Select a drive number and press **Enter**. The following message will appear.

```
Interleave number (1/1-8) ?
```

(3) Select an interleave number (usually **1**) and press **Enter**. The following message will be displayed.

```
Unlock Format select (1:no,2:yes) ?
```

(4) Select whether or not the HDD has an unlock format and press **Enter**. If the system unit contains a JVC HDD, select **yes**. If the system unit contains a Conner HDD, select **no**.

The following message will appear.

```
[ HDD TYPE ] : CYLINDER = xxxx
[ HDD TYPE ] : HEAD     = xx
[ HDD TYPE ] : SECTOR   = xx

[ WARNING : Current DISK data will be
          completely destroyed ]

Press [Bad track number (CCCCHH)] key ?
```

(5) Enter the cylinder and head number of all the bad tracks on the HDD and press **Enter**. The cylinder number is represented by **CCCC** and **HH** is the head number. If the HDD does not have any bad tracks, press **Enter**. The following message will appear and all the cylinders in the hard disk will be formatted and checked.

```
[[cylinder, head = xxxx xx]]
```

(6) After formatting the hard disk, execute the verify check program by pressing **Enter**. When the verify check program is completed, the following message will appear.

```
Format complete
```

(7) Press **Enter** to return to the HARD DISK FORMAT menu.

3. Good track FORMAT and Bad track FORMAT programs

(1) When the Good track FORMAT or Bad track FORMAT program is selected, the following message will appear.

```
Drive number select (1:#1,2:#2) ?
```

(2) Select a drive number and press **Enter**. The following message will appear.

```
Interleave number (1/1-8) ?
```

(3) Select an interleave number (usually **1**) and press **Enter**. The following message will appear.

```
[ HDD TYPE ] : CYLINDER = xxxx
[ HDD TYPE ] : HEAD     = xx
[ HDD TYPE ] : SECTOR   = xx
Press [Track number (CCCCHH) key ?
```

(4) Type the four digit track number and press **Enter**. The first three digits are the cylinder number and the last digit is the head number. This formats either good tracks or bad tracks as selected.

> ***NOTE:*** *This program can format only one track per operation. Repeat the operation as many times as necessary to format several good tracks or bad tracks.*

(5) After a track on the hard disk has been formatted, the following message will be displayed.

```
Format complete
```

(6) Press **Enter** to return to the HARD DISK FORMAT menu.

4. Bad track CHECK program

(1) When the Bad track CHECK program is selected, the following message will appear.

```
Drive number select (1:#1,2:#2) ?
```

(2) Select a drive number and press **Enter**. The following message will appear.

```
Interleave number (1/1-8) ?
```

(3) Select an interleave number (usually **1**) and press **Enter**. The following message is displayed, and the bad tracks on the hard disk are checked.

```
[ HDD TYPE ] : CYLINDER = xxxx
[ HDD TYPE ] : HEAD     = xx
[ HDD TYPE ] : SECTOR   = xx

          [[cylinder, head = xxxx xx]]
```

(4) After checking the bad tracks on the hard disk, the following message will appear.

```
Format complete
```

(5) Press **Enter** to return to the HARD DISK FORMAT menu.

4.17 Head Cleaning

4.17.1 Function Description

This function cleans the heads in the FDD by executing a series of head load/seek and read operations. A cleaning kit is necessary for cleaning the FDD heads.

4.17.2 Operations

1. Select the HEAD CLEANING function from the DIAGNOSTICS MENU and press **Enter**. The following prompt is displayed.

```
DIAGNOSTICS - FLOPPY DISK HEAD CLEANING : Vx.xx

Mount cleaning disk(s) on drive(s).
Press any key when ready.
```

2. Remove the Diagnostics Disk from the FDD. Insert the cleaning disk into the FDD and press **Enter**.

3. When the **`Cleaning start`** message appears, the FDD head cleaning has started.

4. The display automatically returns to the DIAGNOSTICS MENU when the function is completed.

4.18 Log Utilities

4.18.1 Function Description

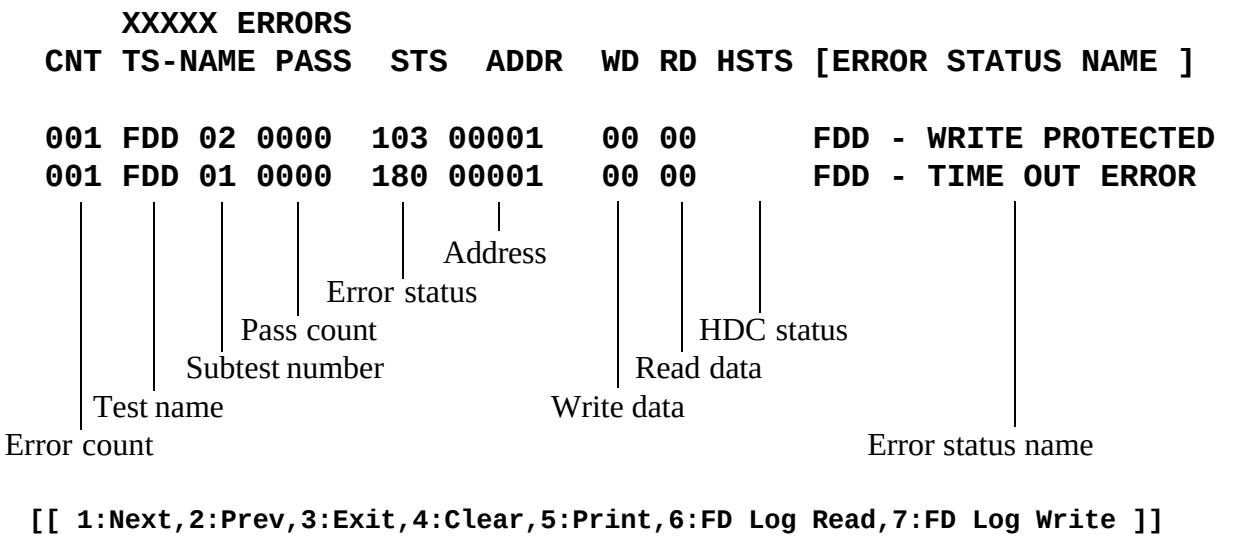
This function logs error information generated while a test is in progress and stores the results in RAM. If the POWER switch is turned off, the error information will be lost. The error information is displayed in the following order:

1. Error count (CNT)
2. Test name (TS-NAME)
3. Subtest number (TS-NAME)
4. Pass count (PASS)
5. Error status (STS)
6. FDD/HDD or memory address (ADDR)
7. Write data (WD)
8. Read data (RD)
9. HDC status (HSTS)
10. Error status name ([ERROR STATUS NAME])

This function can store data on a floppy disk or output the data to a printer.

4.18.2 Operations

1. Select the LOG UTILITIES function from the DIAGNOSTICS MENU and press **Enter**. The error information logged in RAM or on the floppy disk is displayed as shown below.



[[1:Next,2:Prev,3:Exit,4:Clear,5:Print,6:FD Log Read,7:FD Log Write]]

2. The error information displayed on the screen can be manipulated with the following number keys.

Number Key	Function
1	Scrolls the display to the next page.
2	Scrolls the display to the previous page.
3	Returns to the DIAGNOSTICS MENU.
4	Erases all error log information in RAM.
5	Outputs the error log information to a printer.
6	Reads the log information from a floppy disk.
7	Writes the log information to a floppy disk.

3. In the case of “error retry OK”, a capital **R** will be placed at the beginning of the error status. However, this is not added to the error count.

4.19 Running Test

4.19.1 Function Description

The Running Test function automatically executes the following tests in sequence.

1. System test (Subtest number 01)
2. Memory test (Subtest numbers 01, 02, 03, 04, 06, 07)
3. Display test (Subtest numbers 01 to 08)
4. FDD test (Subtest number 02)
5. Printer test (Subtest number 03)
6. ASYNC test (Subtest number 01)
7. HDD test (Subtest numbers 01, 05)

The system automatically detects the number of floppy disk drives connected to the T2200SX.

4.19.2 Operations

> ***CAUTION:*** *Do not forget to load a work disk. If a work disk is not loaded, an error will be generated during the FDD testing.*

1. Remove the Diagnostics Disk from the floppy disk drive and insert the work disk.

2. Select the RUNNING TEST function from the DIAGNOSTICS MENU and press **Enter**. The following message will be displayed.

   ```
   Printer wrap around test (Y/N) ?
   ```

   Selecting **Yes** executes the printer wraparound test. A printer wraparound connector must be connected to the printer connector on the back of the T2200SX to properly execute this test.

3. Type in **Y** or **N** and press **Enter**. The following message will appear.

   ```
   Async#1 wrap around test (Y/N) ?
   ```

   Selecting **Yes** executes the ASYNC wraparound test. An RS-232-C wraparound connector must be connected to the **COMMS** connector on the back of the T2200SX to properly execute this test.

4. Type in **Y** or **N** and press **Enter** to start the test.

5. This program is executed continuously. To terminate the program, press **Ctrl** + **Break**.

4.20 FDD Utilities

4.20.1 Function Description

The FDD Utilities function formats the FDD, copies floppy disks, and displays the dump list for both the FDD and HDD.

1. FORMAT

> ***CAUTION:*** *This program is only for testing a floppy disk drive. It is different from the Toshiba MS-DOS FORMAT command.*

This program can format a floppy disk (5.25-inch/3.5-inch) in the following formats:

- ❑ 2D: Double-sided, double-density, 48/67.5 TPI, MFM mode, 512 bytes, 9 sectors/ track.
- ❑ 2DD: Double-sided, double-density, double-track, 96/135 TPI, MFM mode, 512 bytes, 9 sectors/track.
- ❑ 2HD: Double-sided, high-density, double-track, 96/135 TPI, MFM mode, 512 bytes, 18 sectors/track.

2. COPY

This program copies a source floppy disk to a target floppy disk.

3. DUMP

This program displays the contents of a floppy disk (both 3.5-inch and 5.25-inch) and the designated sectors of the hard disk.

4.20.2 Operations

1. Select the FDD UTILITIES function from the DIAGNOSTICS MENU and press **Enter**. The following message will be displayed.

```
[ FDD UTILITIES ]

     1 : FORMAT
     2 : COPY
     3 : DUMP
     9 : EXIT TO DIAGNOSTICS MENU

PRESS [1] - [9] KEY
```

2. FORMAT program

   (1) Selecting FORMAT displays the following message.

```
DIAGNOSTICS - FLOPPY DISK FORMAT : Vx.xx
Drive number select (1=A:,2=B:) ?
```

   (2) Select a drive number and press **Enter** to display the following message.

```
Type select (0:2DD-2DD,1:2D1-2D,2:2D-2HD,3:2HD-2HD) ?
```

   (3) Select a media/drive type number and press **Enter**. A message similar to the one below will be displayed.

```
Warning : Disk data will be destroyed.

Insert work disk into drive A:
Press any key when ready.
```

   (4) Remove the Diagnostics Disk from the FDD, insert the work disk, and press any key.

   The following message will be displayed when the FDD format is executed.

```
[ FDD TYPE ] : TRACK  = xxx
[ FDD TYPE ] : HEAD   = x
[ FDD TYPE ] : SECTOR = xx

     Format start
                  [[track, head = xxx x]]
```

   After the floppy disk is formatted, the following message will appear.

```
Format complete
Another format (1:Yes/2:No) ?
```

   (5) If you type **1** and press **Enter**, the display will repeat the message in step (3) above. If you type **2**, the display returns to the DIAGNOSTICS MENU.

3. COPY program

(1) When COPY is selected, the following message appears.

```
FLOPPY DISK FORMAT & COPY : Vx.xx
Type select (0:2DD-2DD,1:2D-2D,2:2D -2HD,3:2HD-2HD) ?
```

(2) Select a media/drive type number and press **Enter**. A message similar to the one below will be displayed.

```
Insert source disk into drive A:
Press any key when ready.
```

(3) Remove the Diagnostics Disk from the FDD, insert the source disk, and press any key. The following message will appear and start the copying to memory.

```
[ FDD TYPE ] : TRACK  = xxx
[ FDD TYPE ] : HEAD   = x
[ FDD TYPE ] : SECTOR = xx

    Copy start

                    [[ track,head  =  xxx x ]]
```

(4) Remove the source disk from the FDD and insert the formatted work disk; press any key. The **[[track,head = xxx x]]** message will appear and start the copying to the target disk. When the amount of data is too large to be copied in one operation, the message in step (2) is displayed again.

After the floppy disk has been copied, the following message will appear.

```
Copy complete
Another copy (1:Yes/2:No) ?
```

(5) To copy another disk, type **1** and the message in step (1) will be displayed again. If you type **2**, the display returns to the DIAGNOSTICS MENU.

4. DUMP program

(1) When DUMP is selected, the following message appears.

```
DIAGNOSTICS - HARD DISK & FLOPPY DISK DUMP : Vx.xx
Format type select (0:2DD,1:2D,2:2HD,3:HDD) ?
```

(2) Select a format type number. Type in the number. If **3** is selected, the display will go to the message in step (5) below.

0: Displays a dump list for a floppy disk (2DD).
1: Displays a dump list for a floppy disk (2D).
2: Displays a dump list for a floppy disk (2HD).
3: Displays a dump list for a hard disk.

(3) If **0**, **1**, or **2** is selected, the following message will appear.

```
Select FDD number (1:A/2:B) ?
```

(4) Select an FDD drive number by typing in **1** or **2**. The following message will appear.

```
Insert source disk into drive A:
Press any key when ready.
```

(5) Remove the Diagnostics Disk from the FDD and insert a source disk. Press any key and the following message will appear.

```
— Max. address —-
   [Track ] = xxxx
   [ Head ] = xx
   [Sector] = xx

Track  number ??
```

(6) Type the track number and press **Enter**. The following message will appear.

```
Head number  ?
```

(7) Type the head number and press **Enter**. The following message will appear.

```
Sector number ??
```

(8) Type the sector number and press **Enter**. The specified dump list will be displayed.

(9) After a dump list is displayed on the screen, the following message will appear.

```
Press number key (1:up,2:down,3:end) ?
```

1: Displays the next sector dump.
2: Displays a previous sector dump.
3: Displays the following message.

```
Another dump (1:Yes/2:No) ?
```

If you type **1**, the display will return to the message shown after step (1) above. If you type **2**, the display will return to the DIAGNOSTICS MENU.

4.21 System Configuration

4.21.1 Function Description

The System Configuration function contains the following configuration information for the T2200SX.

- ❑ BIOS ROM version
- ❑ Base memory size
- ❑ Display mode
- ❑ Number of floppy disk drives
- ❑ Number of ASYNC ports
- ❑ Number of hard disk drives
- ❑ Number of printer ports
- ❑ Co-processor
- ❑ Extended memory size

4.21.2 Operations

Select the SYSTEM CONFIGURATION function from the DIAGNOSTICS MENU and press **Enter**. The following system configuration will be displayed.

```
SYSTEM CONFIGURATION :

     * - BIOS ROM VERSION = Vx.xx
     * - 640KB MEMORY
     * - COLOR/GRAPH(80 Column)
     * - 1 FLOPPY DISK DRIVE(S)
     * - 1 ASYNC ADAPTER
     * - 1 HARD DISK DRIVE(S)
     * - 1 PRINTER ADAPTER
     * - 0 MATH CO-PROCESSOR
     * - xxxxxKB EXTENDED MEMORY

PRESS [ENTER] KEY ?
```

Press **Enter** to return to the DIAGNOSTICS MENU.

4.22 SETUP

4.22.1 Function Description

This function displays the current system setup information as listed below:

1. Memory
   (1) Total memory size
   (2) Base memory size
   (3) Extended memory size
   (4) Hard RAM size
   (5) Shadow BIOS ROM

2. Display
   (1) Display Adapter
   (2) LCD display mode
   (3) LCD gray scale
   (4) LCD gray scale level

3. Hard Disk Capacity

4. Time and Date

5. COM/PRT/FDD
   (1) Serial port
   (2) Card modem
   (3) External FDD/PRT
   (4) Printer port type

6. POWER SAVE OPTIONS
   (1) CPU sleep mode
   (2) HDD auto off
   (3) Display auto off

7. OTHERS
   (1) Resume mode
   (2) Pop-up
   (3) Speaker
   (4) Battery alarm
   (5) Processing speed

4.22.2 Accessing the SETUP

Select the SETUP function from the DIAGNOSTICS MENU and press **Enter**. A display similar to the following will appear.

```
                              T2200SX SETUP
┌──────── MEMORY ─────────────────────┐ ┌──────── COM/PRT/FDD ──────────────┐
Total                =   2048KB       Serial Port         = COM1 (IRQ4/3F8H)
Base                 =    640KB
Extended             =   1280KB       Card Modem          = COM2 (IRQ3/2F8H)
Hard RAM             =      0KB
                                      External FDD/PRT    = Printer
Shadow BIOS ROM      = Enable (128KB) Printer Port Type   = Output
└─────────────────────────────────────┘ └───────────────────────────────────┘
┌──────── DISPLAY ────────────────────┐ ┌──────── POWER SAVE OPTIONS ───────┐
Display Adaptor      = VGA Compatible  CPU Sleep Mode      = Enable
LCD Display Mode     = Color           HDD Auto Off        = Disable
LCD Gray Scale                         Display Auto Off    = Disable
   = Normal:Semi-Bright,Intense:Bright
LCD Gray Scale Level = Normal 16 Levels
└─────────────────────────────────────┘ └──────── OTHERS ──────────────────┐
┌──────── HARD DISK ──────────────────┐ Resume Mode         = Boot
Capacity             = 60MB            Popup               = Enable
└─────────────────────────────────────┘ Speaker             = On
┌──────── TIME & DATE ────────────────┐ Battery Alarm       = On
07:54:24, Fri Nov 01, 1991             Processing Speed    = High
└─────────────────────────────────────┘ └───────────────────────────────────┘
```

This display is an example of the setup options available for the T2200SX. Notice that selecting the type of floppy disk drive is not an option. The T2200SX automatically determines what type of internal floppy disk drive is installed.

Press **Esc** if the setup options displayed accurately reflect your hardware configuration.

4.22.3 Changing SETUP Values

The SETUP values for the T2200SX can be changed automatically to their default settings or manually to user-defined settings.

Automatic Reset

Follow these steps to set all of the SETUP values to their default settings.

1. Press **Home** to reset all the SETUP values to their factory preset (default) values. The SETUP program calculates how much conventional and extended memory your T2200SX has, based on whether or not you have a memory expansion module (optional memory card) installed. SETUP stores the memory value it calculates in configuration memory along with the default values for the other options.

2. Confirm that the new SETUP values are correct. To change any option(s), go to the next section, **Manual Reset**.

3. If the new values are correct, refer to step 4 in the **Manual Reset** section.

Manual Reset

Follow these steps to change the SETUP option(s) manually.

> ***NOTE:*** *The cursor, shown as a reverse video bar, indicates which option is presently selected.*

1. Use the ←,→, ↑, and ↓ keys (or **Enter**) to move the cursor between the options.

2. When the option you want to change is highlighted, press either the **space bar** or **back-space** key to display the alternate values.

3. When you are finished making changes, press **End** to record the new values in the configuration memory.

4. The SETUP menu displays the following message.

   ```
   Save Settings And Reboot? (Y/N)
   ```

   Review your changes. If you need to make more alternations, press **N** and return to step 1 above.

5. If the new values are correct, press **Y** and the system will reboot.

4.22.4 SETUP Descriptions

This section explains the alternate values for each SETUP option.

1. Memory

   This group of options lets you configure the memory you install in the T2200SX.

   (1) Total
   This field displays the amount of memory installed and is automatically calculated by the computer.

   (2) Base
   This field displays the amount of base (conventional) memory, which is 640KB. This is automatically calculated by the computer and cannot be changed.

   (3) Extended
   This field displays the amount of extended memory the T2200SX has available. The amount of memory allocated to extended memory depends on the size of the Hard RAM.

(4) Hard RAM
Use this option to create a Hard RAM disk in the T2200SX's memory. When you press the **space bar** or **backspace** key, the size of memory allocated for Hard RAM increases and decreases. The amount of memory you can allocate for Hard RAM depends on the size of extended memory.

(5) Shadow BIOS ROM
Use this special feature of the T2200SX to copy BIOS functions from ROM to RAM for faster access while you're using the T2200SX. You must have at least 128KB of extended memory to select **Enable** for this option. Since the BIOS subroutines are accessed often, enabling this option significantly improves the T2200SX's operating speed.

Enable Copies BIOS from BIOS ROM to RAM.

Disable Accesses BIOS from BIOS ROM.

2. Display

This group of options helps you configure the T2200SX's display.

(1) Display adapter
Use this option to choose the display adapter.

VGA compatible Chooses the internal adapter for the VGA display. This is the default setting.

Not used Chooses an external adapter installed in the Desk Station IV.

(2) LCD Display Mode
Use this option to select whether the display will use the color or monochrome mode.

Color Selects the 80x25 text or 640x480 graphics modes. This option also affects a color monitor attached to the RGB port. This is the default setting.

Monochrome Selects the monochrome mode and simulates 64 levels of gray with the LCD's 16-level gray scale. This mode is also used when you attach a VGA monochrome monitor to the RGB port.

(3) LCD Gray Scale
This option specifies the relationship between the brightness levels for characters displayed in normal and intense display modes. A setting of **Bright** causes the T2200SX to use the maximum brightness level (gray scale level 15) to display characters. A setting of **Semi-Bright** uses a slightly lower brightness level (gray scale level 11).

The options are:

Normal:Semi-Bright,Intense:Bright (default)
Normal:Bright,Intense:Semi-Bright

If you're primarily using text-based programs as opposed to graphics software, you may find that choosing **Normal:Bright,Intense:Semi-Bright** makes the text easier to read.

(4) LCD Gray Scale Level

This option lets you switch between 8 and 16 levels of gray and normal and reverse video for screen text. This option also appears in the Pop-up Window.

Normal 16 Levels	Displays black text on a white background with 16 levels of gray. This is the default setting.
Reverse 16 Levels	Displays white text on a black background with 16 levels of gray.
Normal 8 Levels	Displays black text on a white background with 8 levels of gray.
Reverse 8 Levels	Displays white text on a black background with 8 levels of gray.

When you select a new LCD Gray Scale Level, any previous changes made using VCHAD (VGA Change Display program) are no longer valid.

3. Hard Disk

This section displays the size and type of hard disk installed in the T2200SX. Use either the **space bar** or **backspace** key to choose one of the two hard disk options.

Capacity = xxMB	Sets the hard disk to its standard setting. This is the default.
No Drive	Disables the hard disk. The T2200SX functions as if a hard disk is not installed.

4. Time & Date

Use either the **space bar** or **backspace** key to change the system date and time.

5. COMM/PRT/FDD

This option allows you to set the serial and parallel ports and the card modem.

(1) Serial Port
Use this option to assign a communications port name to the serial port (**COMMS**).

COM1 (IRQ4/3F8H)	Assigns COM1 to the serial port. This is the default setting.
COM2 (IRQ3/2F8H)	Assigns COM2 to the serial port.
Not Used	Disables the serial (**COMMS**) port.

(2) Card Modem
This option lets you assign a communications port name to the card modem slot.

COM1 (IRQ4/3F8H)	Assigns COM1 to the card modem slot.
COM2 (IRQ3/2F8H)	Assigns COM2 to the card modem slot. This is the default.
Not Used	Disables the card modem.

> ***NOTE:*** *You can assign a COM level only once. For example, the* ***Serial Port*** *and* ***Built-in Modem*** *cannot both be assigned to* ***COM1****.*

(3) External FDD/PRT
Use this option to assign the function of the **PRT/FDD** port.

Printer	Configures the port for output to a printer. This is the default setting.
FDD A	Configures the port for output and input with an external floppy disk drive and assigns the external drive as A. By default the internal drive becomes drive B.
FDD B	Configures the port for output and input with an external floppy disk drive and assigns the external drive as B. By default the internal drive remains drive A.

(4) Printer Port Type
When the **PRT/FDD** port is set for output to the Printer as opposed to the external floppy disk drive, this option lets you change the Printer port from output only (the default) to receive input as well as output. Do not change this setting if you're connecting the T2200SX to a printer. You would change this option only if you're

connecting the computer to a device that requires a bi-directional parallel signal.

Output Activates uni-directional operation.
This is the default setting.

Bi-Directional Activates bi-directional operation.

6. Power Save Options

Use these options to increase the amount of time you can operate the T2200SX with battery power.

(1) CPU Sleep Mode
Use this option to enable or disable the CPU sleep mode. This option also appears in the Pop-up Window.

When the AC adapter is connected to the computer and a wall outlet, this function is automatically disabled. If you use a non-Toshiba MS-DOS operating system, you must disable this option.

Enable Enables the CPU sleep mode. The computer will automatically shift to an operating speed of 5MHz when the processor is idle.
This is the default setting.

Disable Disables the CPU sleep mode.

(2) HDD Auto Off
Use this option to disable or set the duration of the HDD automatic power off function. This option also appears in the Pop-up Window.

When the AC adapter is connected to the computer and a wall outlet, this function is automatically disabled. If you use a non-Toshiba MS-DOS operating system, you must disable this option.

Disable Disables HDD automatic power off.
This is the default setting.

xxMin. Automatically turns off power to the HDD if it is not used for the specified duration. The duration **(xx)** can be set to 3, 5, 10, 15, 20, or 30 minutes.

(3) Display Auto Off
Use this option to disable or set the duration of the display automatic power off function. Setting this option conserves battery power because it causes the T2200SX to turn the sidelight off if you don't use the computer for the specified period of time. This option also appears in the Pop-up Window.

When the AC adapter is connected to the computer and a wall outlet, this function is automatically disabled. If you use a non-Toshiba MS-DOS operating system, you must disable this option.

Disable Disables the display automatic power off. This is the default setting.

xxMin. Automatically turns off power to the sidelit LCD panel if the computer is not used for the specified duration. Enabling this option will conserve battery power. The duration **(xx)** can be set to 1, 3, 5, 10, 15, 20, or 30 minutes.

Always OFF Turns off power to the sidelit LCD display's fluorescent lamp. This value is not displayed if the AC adapter is connected.

7. Others

Whether or not you need to configure the T2200SX with these options depends primarily on the type of software or peripherals you use.

(1) Resume Mode
This option enables and disables the AutoResume feature. You can also set this option using the Pop-up Window.

Boot Enables the boot mode by turning off the AutoResume feature. This is the default setting.

Resume Enables the AutoResume feature.

(2) Popup
Use this option to enable or disable the Pop-up window.

Enable Allows you to access the Pop-up window. This is the default setting.

Disable Disables the Pop-up window.

(3) Speaker
This option enables and disables the software usage of the system speaker. Setting this option to **Off** also disables the self-test alarm. All other system alarms are unaffected. This option appears in the Pop-up Window.

On Enables software usage of the system speaker. This is the default setting.

Off Disables software usage of the system speaker.

(4) Battery Alarm

This option enables and disables the battery alarm. The battery alarm sounds when the battery pack is low. This option also appears in the Pop-up Window.

`On` Enables the alarm.
This is the default.

`Off` Disables the alarm.

(5) Processing Speed

This option determines the operating speed of the processor. Unless your software runs better under a slower speed, leave this option at the **`Normal`** default setting.

`High` Selects the processor speed of 20MHz with optimized routines to maximize performance.

`Normal` Selects the 20MHz CPU speed.
This is the default setting.

`Low` Selects the low CPU speed of 10MHz.

Chapter 5
Disassembly Procedures

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Contents

Figures

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5.1 General

This chapter provides detailed procedures for disassembling the T2200SX to replace Field Replaceable Units (FRUs).

The following FRUs are covered in this section:

1. System board (PCB FSTFGx)
2. LED board (PCB FSTLEx)
3. Power supply board (PCB FSTPSx)
4. FL inverter board
5. Keyboard unit
6. Sub battery
7. RTC battery
8. Modem assembly
9. Cover assembly
10. Base assembly
11. Battery terminal assembly
12. LCD mask
13. LCD module
14. LCD cable
15. Speaker
16. HDD unit
17. FDD unit
18. Middle base assembly

x = Board revision number

Before You Begin

Review the procedures in this section before you begin disassembling the T2200SX. Familiarize yourself with the steps and remember the following points:

1. Do not disassemble the T2200SX unless it is operating abnormally.
2. Use only the correct and approved tools.
3. Make sure the working environment is free from the following elements whether you are using or storing the T2200SX:
   - ❑ dust and contaminates
   - ❑ static electricity
   - ❑ extreme heat, cold, and/or humidity
4. Make sure the FRU you are replacing is causing the abnormal operation by performing the necessary diagnostic tests described in Chapter 4 of this manual.
5. Do not perform any operations that are not necessary.
6. Follow the described procedures for disassembling and installing FRUs in the T2200SX.
7. After removing parts from the computer, place them in a safe place away from the computer so they are not damaged and do not interfere with your work.
8. You will remove and replace many screws when you disassemble the T2200SX. When you remove screws, make sure they are placed in a safe place and identified with the correct parts.
9. The T2200SX contains many sharp edges and corners. Be careful not to injure yourself.
10. After you have replaced an FRU, make sure the T2200SX is functioning properly by performing the appropriate diagnostic test on the FRU you have fixed or replaced.
11. Always exercise caution when removing tape to avoid damaging the system components.

Tools

You will need the following equipment to disassemble the T2200SX:

- ❑ (1) 2mm Phillips-head screwdriver to remove and replace screws.
- ❑ (1) 3mm Phillips-head screwdriver to remove and replace the HDD screws.
- ❑ Tweezers to lift out screws that you cannot easily grasp with your fingers.
- ❑ One System Board Support Block (85mm x 120mm x 300mm/3¼"h x 4¾"d x 12"w)
  This block must be composed of anti-static foam.
- ❑ One LCD Support Block (30mm x 200mm x 300mm/1¼"h x 8"d x 12"w)
  This block must be composed of anti-static foam.

5.2 Removing the Battery Pack

1. Turn off the power to the T2200SX and disconnect the power cord, AC adapter, and all external cables to the T2200SX.

2. Facing the right side of the computer, push up and hold the battery cover release lever as you slide the battery pack cover toward the back of the computer. Remove the battery pack cover to expose the battery pack (Figure 5-1).

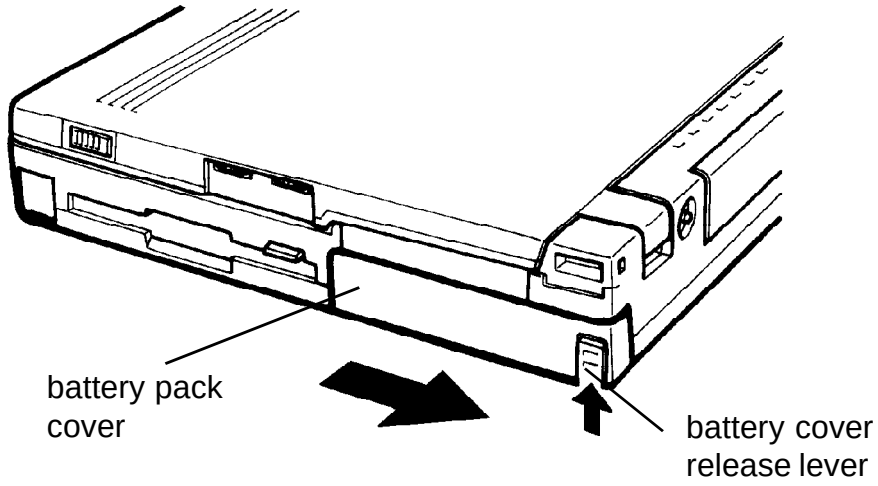


Figure 5-1 Removing the battery pack cover

3. Firmly grasp the battery pack pull tab and pull the battery pack out far enough so that you can grasp the battery pack. Then pull the battery out of the computer (Figure 5-2).

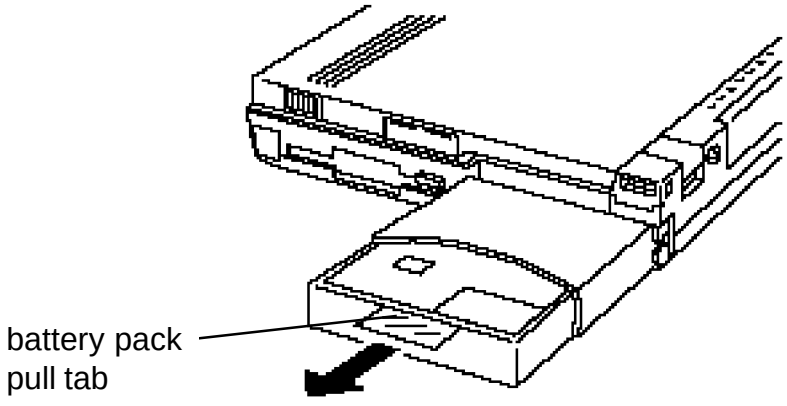


Figure 5-2 Removing the battery pack

5.3 Removing the Optional Memory Card and Card Modem

1. Turn off the power to the T2200SX and disconnect the power cord, AC adapter, and all external cables to the T2200SX. Then remove the battery pack as indicated in Section 5.2.

2. Open the display panel if it is closed.

3. Turn the computer so that the left side of the computer is facing you.

4. Lift the expansion memory slot cover to expose the memory card slot (Figure 5-3).

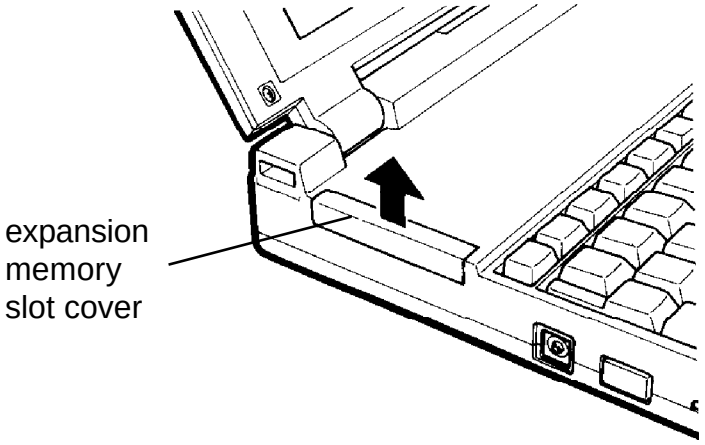


Figure 5-3 Removing the memory card slot cover

5. Pull the mylar pull tab until the optional memory card is released from its connector. Then remove the optional memory card (Figure 5-4).

> ***CAUTION:*** *Do not touch the connecting edge of the memory card. Debris or grease in the connector may cause memory access problems.*

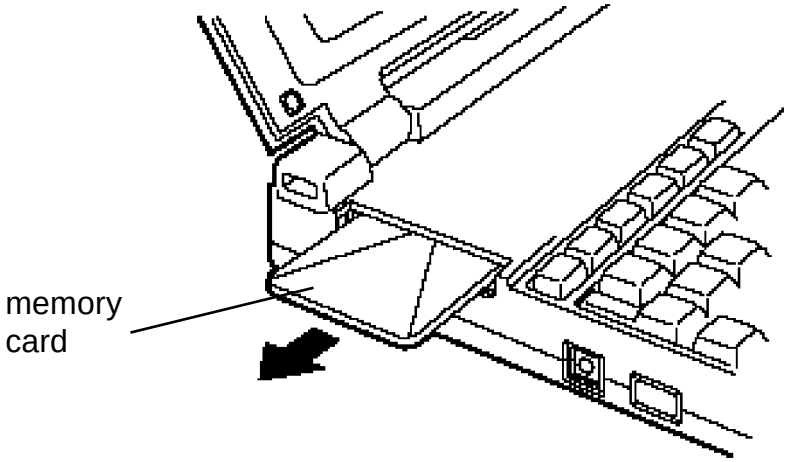


Figure 5-4 Removing the optional memory card

6. Turn the computer so that the right side is facing you.

7. Lift the card modem cover to expose the card modem slot.

8. Pull the tab until the card modem is released from its connector. Then remove the card modem.

> ***CAUTION:*** *Do not touch the connecting edge of the card modem. Debris or grease in the connector may cause modem access problems.*

5.4 Removing the LCD Module and FL Inverter Board

1. Remove the battery pack as indicated in Section 5.2.

2. Open the display panel. Then remove the two rubber cushions and the two plastic seals from the LCD mask. Then lay the LCD module back on the LCD support block to support the LCD module.

3. Remove the four (M2x4) screws securing the LCD mask. Then move the LCD module to its upright position.

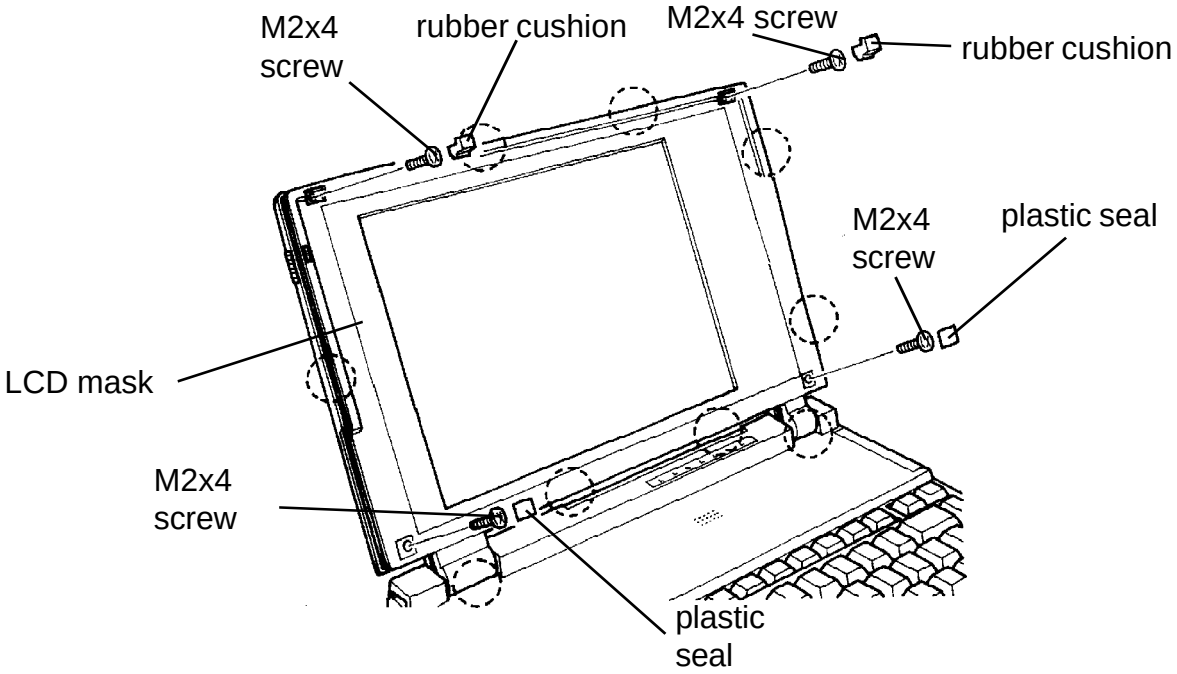


Figure 5-5 Removing the LCD rubber cushions, plastic seals, and screws

4. While holding the cover latches up, separate the LCD mask from the LCD cover starting with the two top corners of the LCD mask. Working from the top and then down the sides, release the top and side plastic lock latches on the LCD mask.

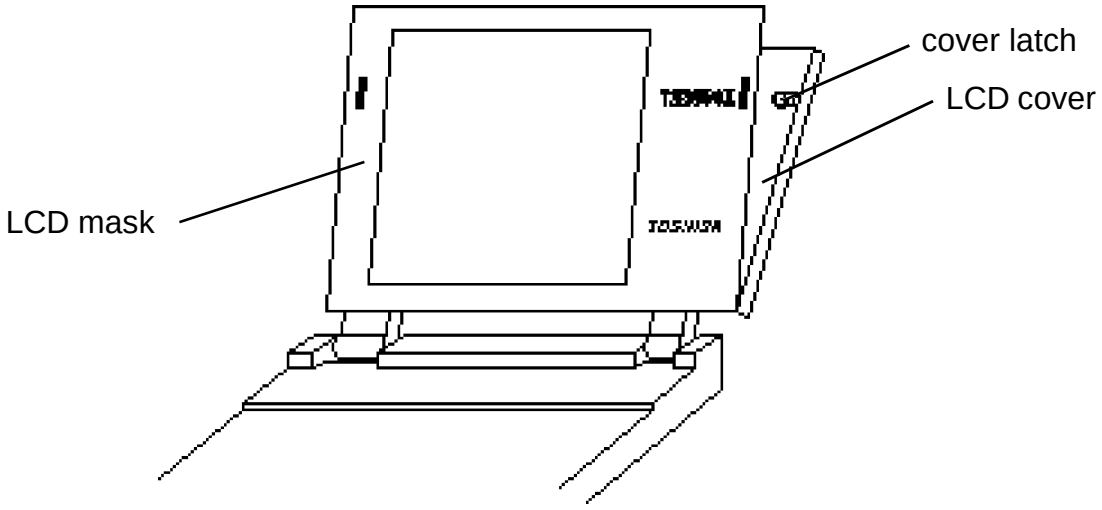


Figure 5-6 Releasing the LCD mask latches

5. Once again, lay the LCD module back on the LCD support block and press up on the bottom of the mask to release the bottom two latches.

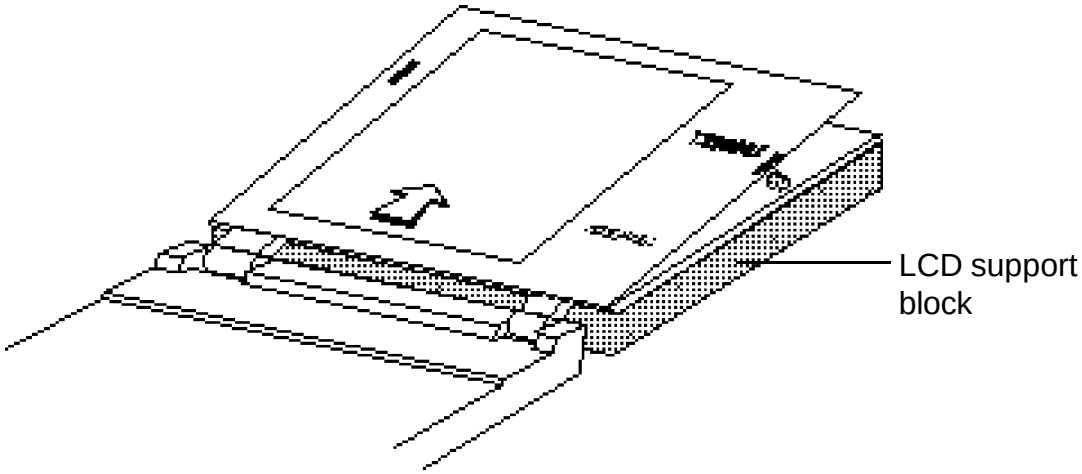


Figure 5-7 Releasing the bottom LCD mask latches

6. Rotate the LCD mask to the right and press up on the right hinge to release the lower right corner of the LCD mask.

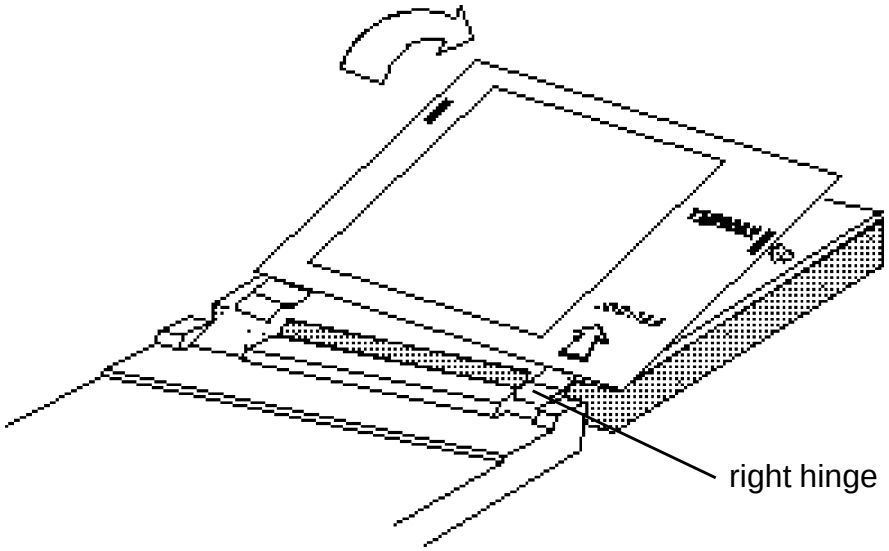


Figure 5-8 Removing the LCD mask

> ***WARNING:*** *DO NOT touch the LCD panel where the Warning label is affixed. Thin film transistors (TFTs) are located in this area and they can be easily damaged. Also, this area contains high voltage which can cause electric shock or damage to the system.*

7. Remove the two (M2x4) screws securing the FL inverter board. Rotate the FL inverter board toward the LCD module and disconnect the three cables from CN1, CN2, and CN3 on the FL inverter board. Then remove the FL inverter board (Figure 5-9).

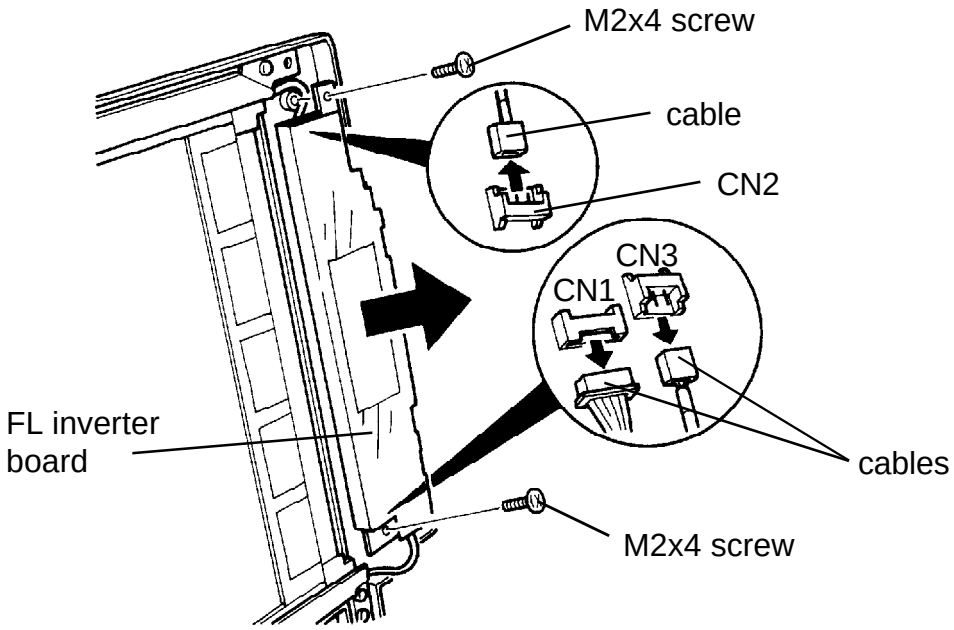


Figure 5-9 Removing the FL inverter board

8. Carefully lift the mylar shielding and tape which cover the connectors on the LCD module. Then disconnect the two display cables from CN1 and CN2 on the LCD module.

9. Remove the one (M2x4) screw from the top display support, one (M2.5x4) screw and one (M2.5x6 silver) screw from the bottom display support. Then remove the two display supports (Figure 5-10).

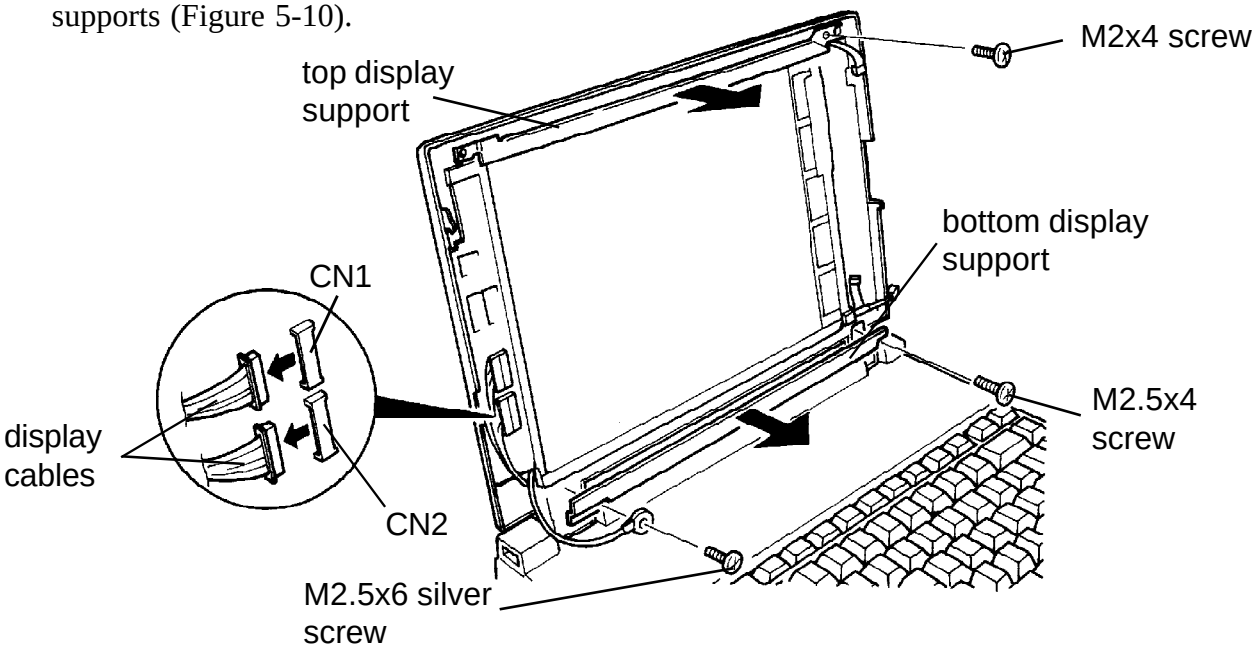


Figure 5-10 Removing the display supports

10. Remove the LCD module from the LCD cover and gently set it aside (Figure 5-11).

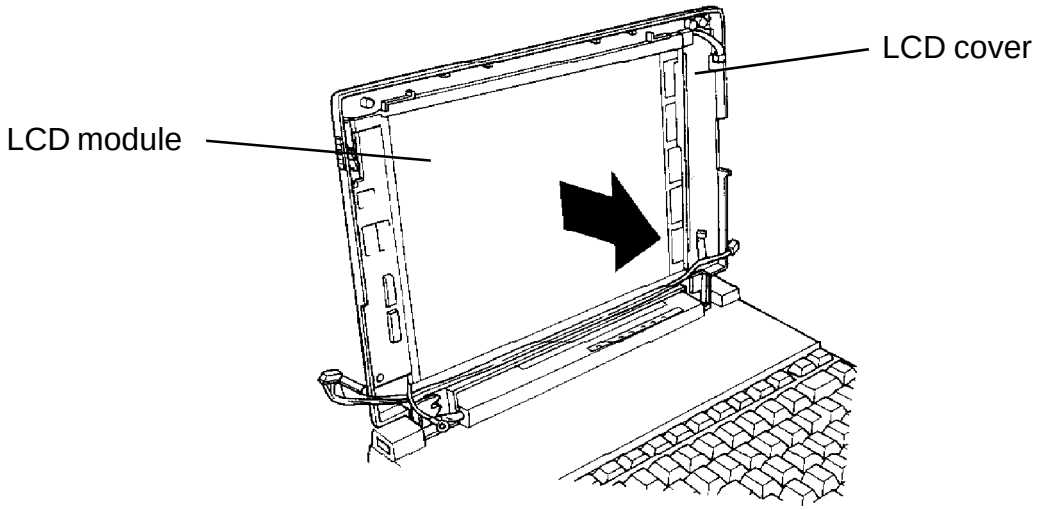


Figure 5-11 Removing the LCD module

11. Remove the two (M2.5x4) screws. Then lift and remove the LCD cover (Figure 5-12).

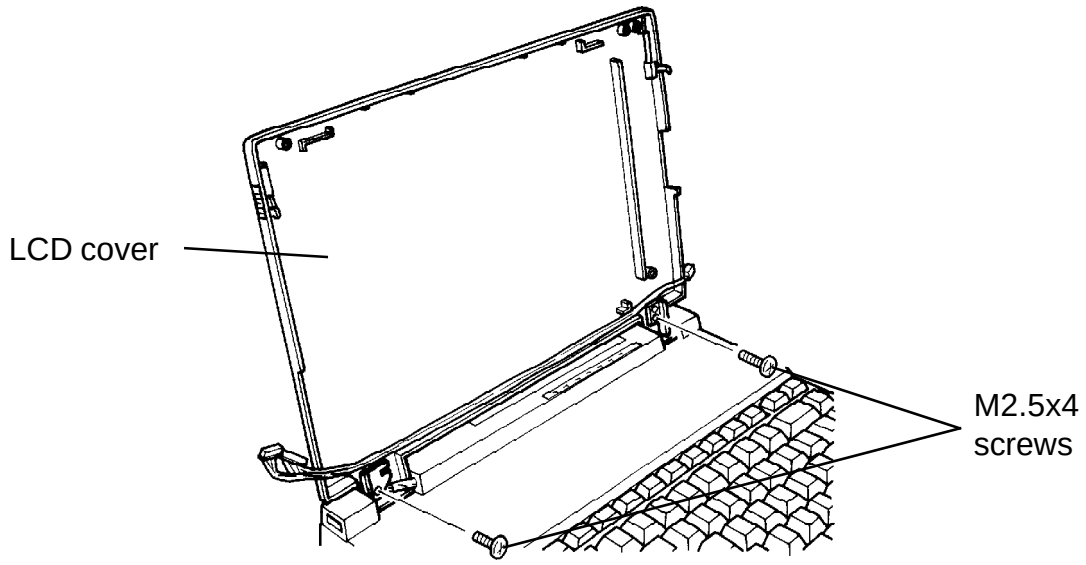


Figure 5-12 Removing the LCD cover

12. Place the LCD module onto the LCD support block and set the two in a safe place.

5.5 Removing the Sub Battery and Battery Terminal Assembly

1. Remove the battery pack, memory card and card modem as indicated in Sections 5.2 and 5.3.

2. Close the LCD display if it is open and remove the PS/2 mouse cover, the key pad connector cover, the EXP connector cover, and the I/O connector cover (Figure 5-13).

3. Turn the computer upside down with the rear of the computer facing you. While gently pressing down on the bottom cover, remove the ten (M2x5 silver) screws. Then remove the NDP (NPU) cover (Figure 5-13).

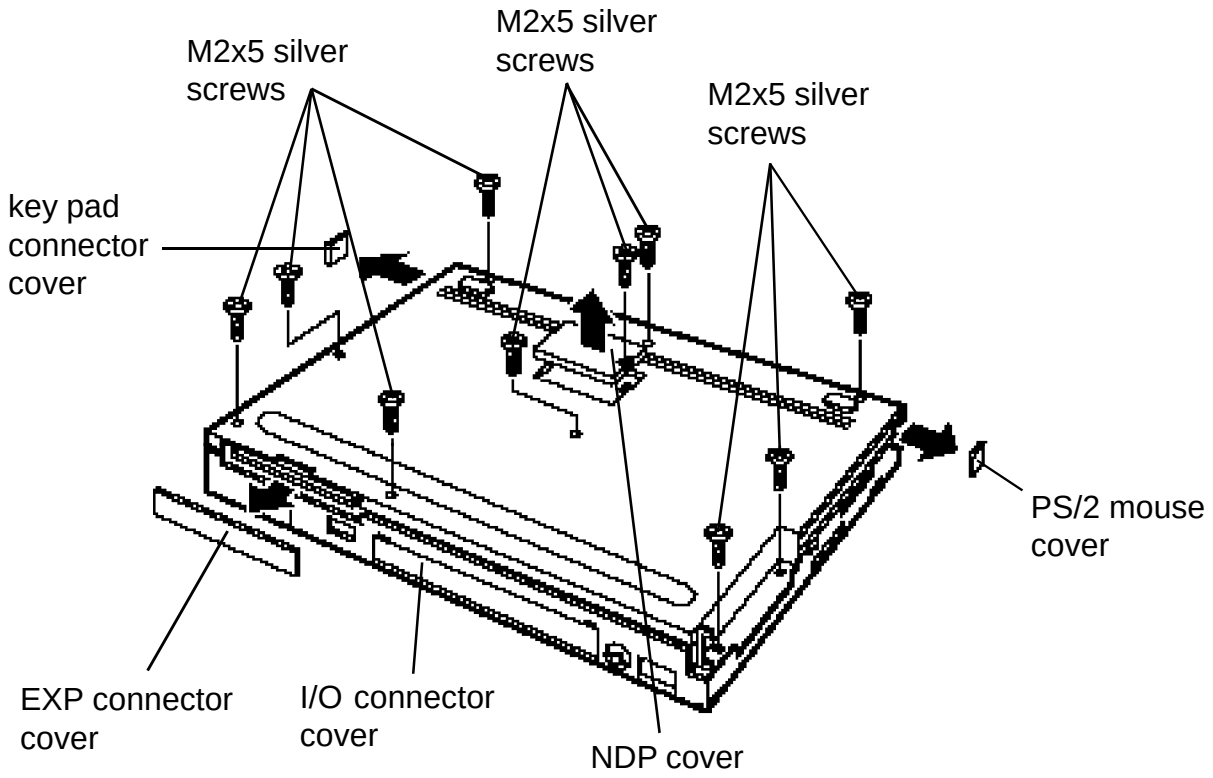
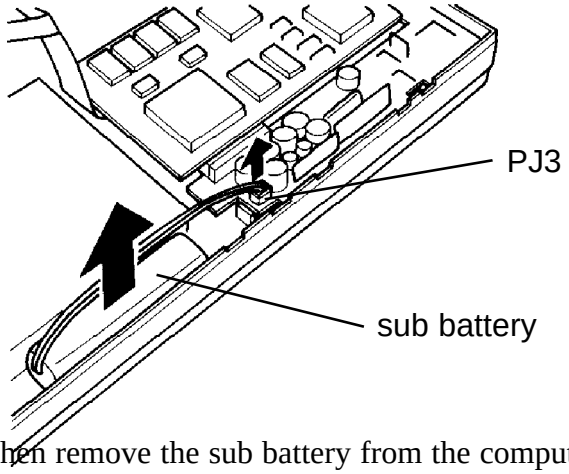


Figure 5-13 Removing the bottom cover screws

4. Separate the bottom cover from the computer.

5. Remove the tape securing the sub battery and its wires.

6. Press down on the power supply board while disconnecting the sub battery from PJ3 on the



power supply board. Then remove the sub battery from the computer (Figure 5-14).

Figure 5-14 Removing the sub battery

7. Carefully remove the tape securing the battery terminal assembly wires and the HDD cable.

8. Disconnect the battery terminal wires from PJ1 and PJ2 on the power supply board.

9. Gently lift the HDD cable at the drive connector and remove the two (M2x4) screws securing the battery terminal assembly to the middle base assembly.

10. Lift the edge of the battery terminal assembly closest to the outside edge of the computer and move the assembly so that it does not obstruct the HDD cable connector (Figure 5-15).

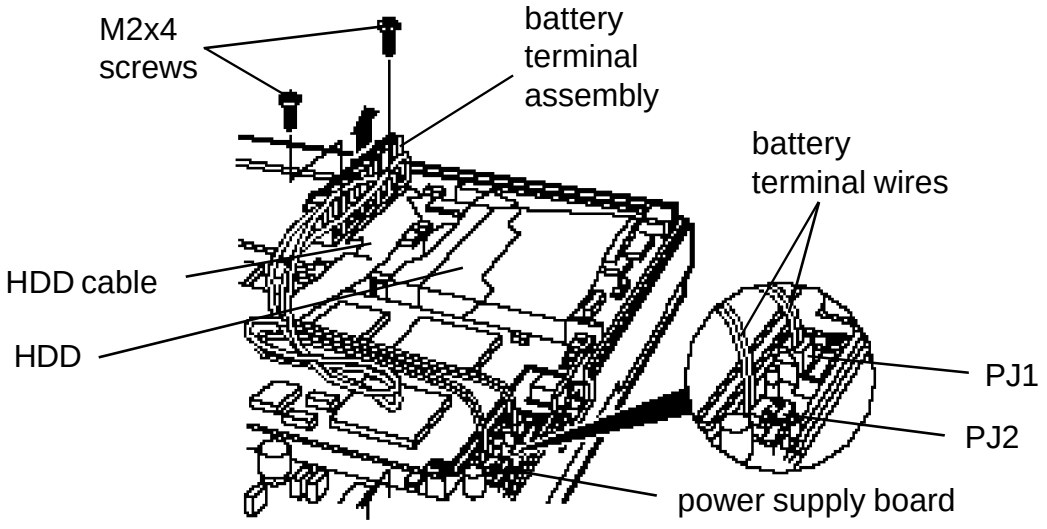


Figure 5-15 Removing the battery terminal assembly

11. Disconnect the HDD cable from the HDD. Then lift the HDD cable and remove the battery

terminal assembly from the computer.

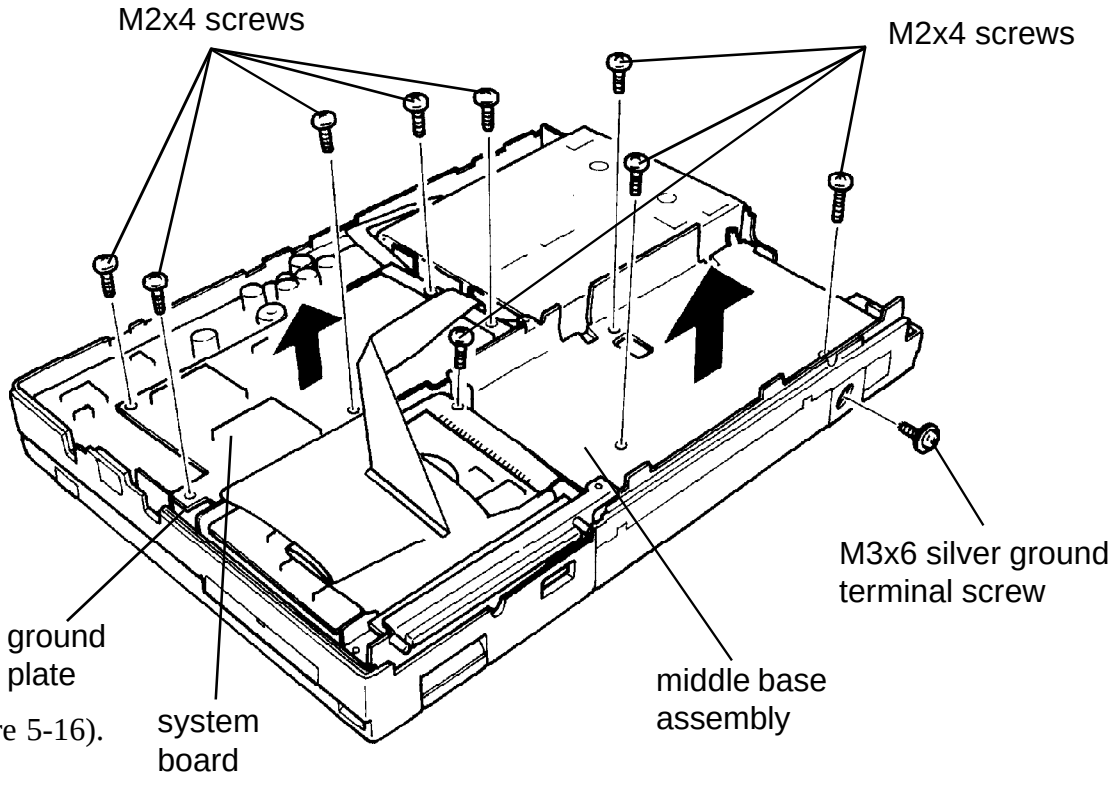
5.6 Removing the Hard Disk Drive

1. Remove the battery pack, memory card, card modem, and battery terminal assembly as indicated in Section 5.5.

> ***NOTE:*** *It is not necessary to disconnect and remove the sub battery as indicated in Step 5 of Section 5.5.*

2. Remove the four (M2x4) screws securing the middle base assembly and the five (M2x4) screws securing the top half of the system board. Remove the ground plate positioned under the middle base assembly and over the system board (Figure 5-16).

3. Remove the one (M3x6 silver) ground terminal screw from the back of the computer



(Figure 5-16).

Figure 5-16 Removing the system board and middle base assembly screws

4. Position the system board support block behind the computer.

> ***CAUTION:*** ***DO NOT*** *apply stress to the flexible portion of the system board assembly when working with the system board.*

5. Lift the middle base assembly away from the cover assembly by lifting up on the inside edge of the middle base assembly. Rest the middle base assembly on the system board support block.

6. Remove the two metal card puller assemblies from the middle base assembly (Figure 5-17).

7. Remove the two (M2x4) connector panel bracket screws and remove the two ground plates from the connector panel (Figure 5-17).

8. Remove the two (M2x4) EXP memory connector screws and the two (M2x4) card modem connector screws (Figure 5-17).

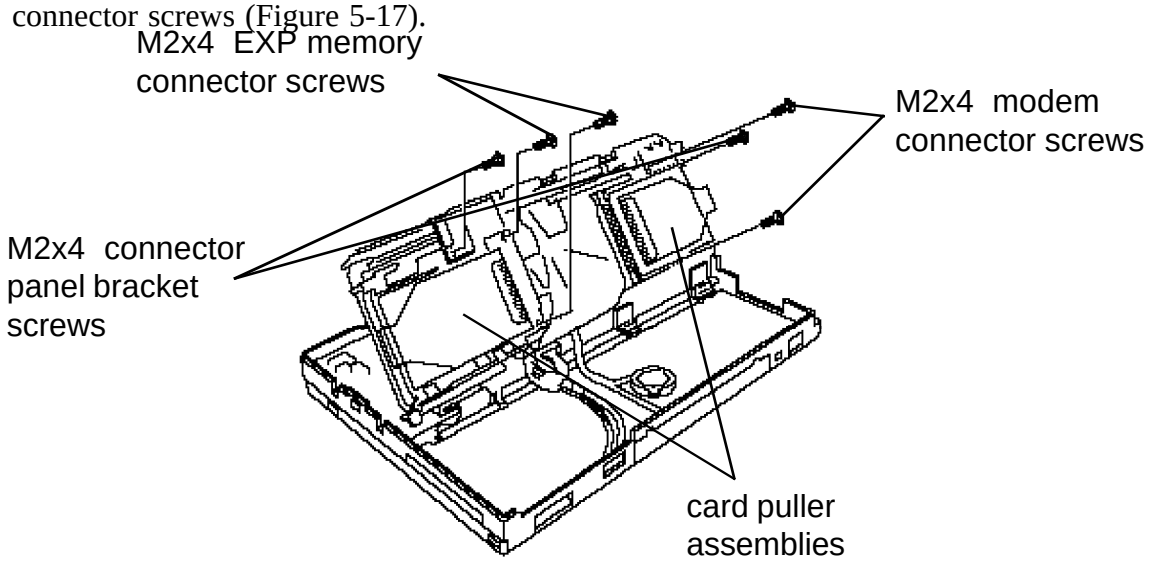
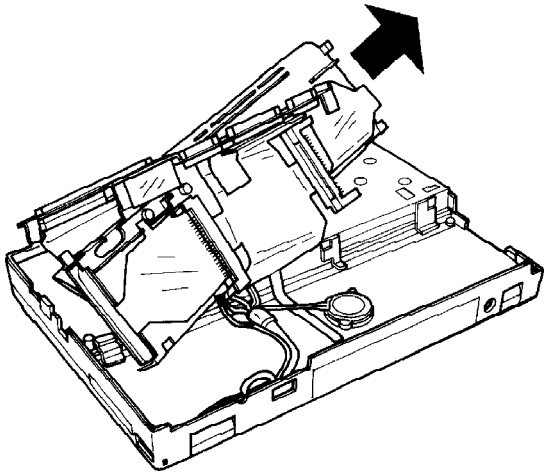


Figure 5-17 Removing the card modem and memory card connector screws

9. Dislodge the card modem and memory connectors from their respective screw posts.

10. Holding the system board in a vertical position, slide the middle base assembly to the right to release it from the connector panel bracket. Then swing the battery side of the middle base assembly away from the flexible cables and slide the middle base assembly out from



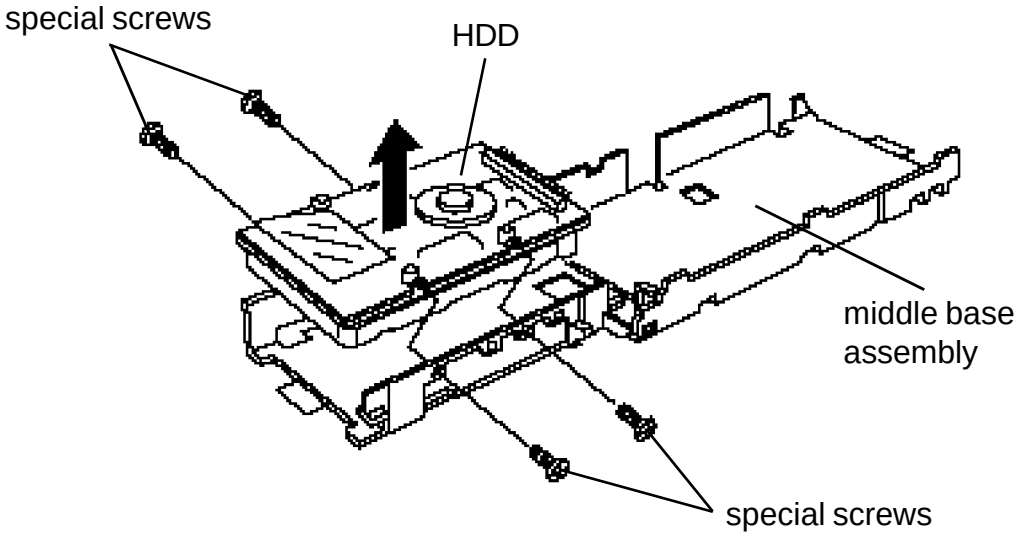
the flexible cables portion of the system board (Figure 5-18).

Figure 5-18 Removing the middle base assembly

11. Rest the system board assembly on the system board support block behind the computer to support the flexible cables and connector panel.

> ***CAUTION:*** *If stressed, the HDD cable can easily rip at the fold in the cable. Therefore, make sure the HDD cable rests in the same position on the support block as when the HDD is assembled in the computer.*

12. Remove the four special screws securing the HDD to the middle base assembly. Separate



the HDD from the assembly (Figure 5-19).

Figure 5-19 Removing the HDD from the middle base assembly

5.7 Removing the Floppy Disk Drive

1. Remove the battery pack, memory card, card modem, sub battery, and battery terminal assembly as indicated in Section 5.5.

2. Remove the four (M2x4) screws securing the middle base assembly and the five (M2x4) screws securing the top half of the system board. Remove the ground plate positioned under the middle base assembly and over the system board (Figure 5-20).

3. Remove the one (M3x6 silver) ground terminal screw from the back of the computer (Figure 5-20).

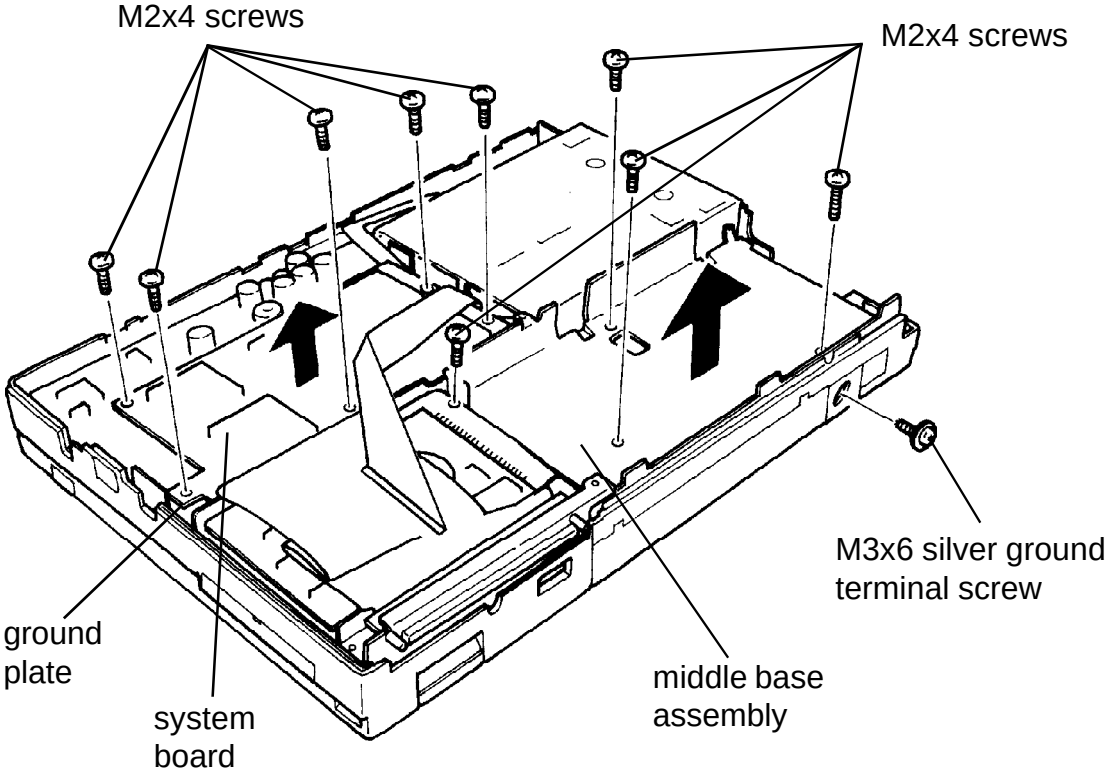


Figure 5-20 Removing the system board and middle base assembly screws

4. Remove the four (M2.5x4) screws securing the FDD (Figure 5-21).

5. Position the system board support block behind the computer.

> ***CAUTION: DO NOT*** *apply stress to the flexible portion of the system board assembly when working with the system board.*

6. Lift the middle base assembly away from the cover assembly by lifting up on the inside edge of the middle base assembly. Rest the middle base assembly on the system board support block.

7. Disconnect the FDD cable from the pressure plate connector PJ4 on the system board (Figure 5-21).

> ***CAUTION:*** *The FDD cable may catch on the system board components. Lift the cable up before disconnecting it from the connector.*

8. Lift the FDD and remove it from the keyboard base (Figure 5-21).

> ***CAUTION:*** *Be careful not to damage the mouse cable and the catch hook on the keyboard base as you remove the FDD.*

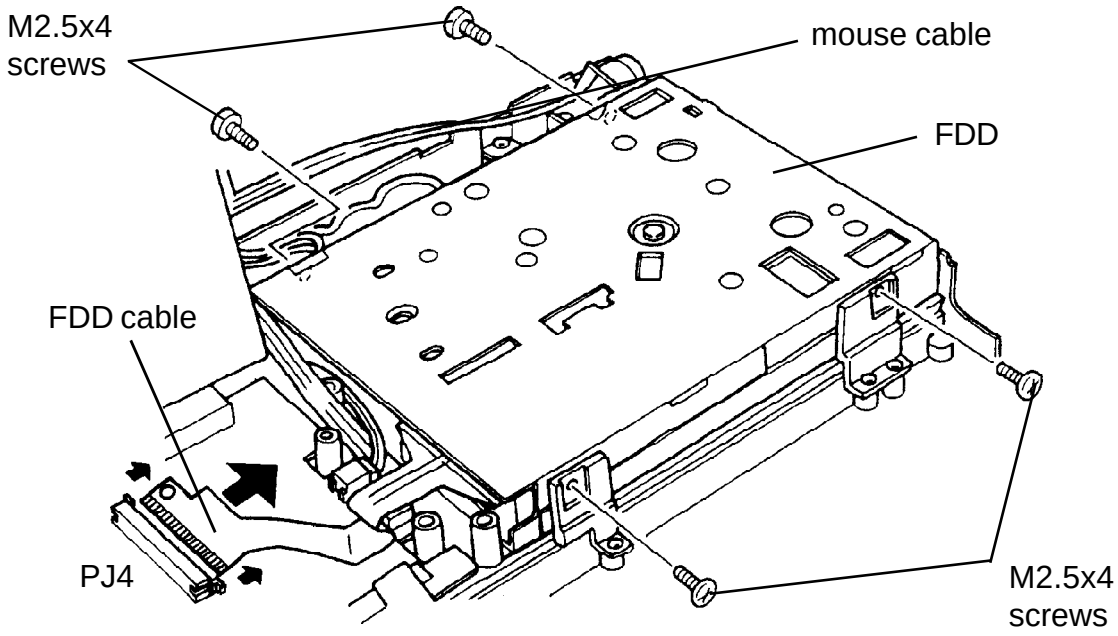


Figure 5-21 Removing the floppy disk drive

5.8 Removing the System Board, Power Supply Board, and Speaker

1. Remove the battery pack, memory card, card modem, sub battery, battery terminal assembly, and FDD as indicated in Section 5.7.

2. Disconnect the RTC battery cable from PJ2 on the system board and remove the RTC battery (Figure 5-22).

3. Disconnect the mouse cable from PJ19 and remove the mouse connector and cable from the computer (Figure 5-22).

4. Disconnect the following cables from the system board (Figure 5-22).

   Speaker cable from PJ8
   Keyboard cable from pressure plate connector PJ10
   LED cable from pressure plate connector PJ11
   LCD cables from PJ12 and PJ13
   Sensor harness (Panel close switch) cable from PJ15

> ***CAUTION:*** *When disconnecting the keyboard cable from pressure plate connector PJ10, be extremely careful removing the tape securing the keyboard cable.*

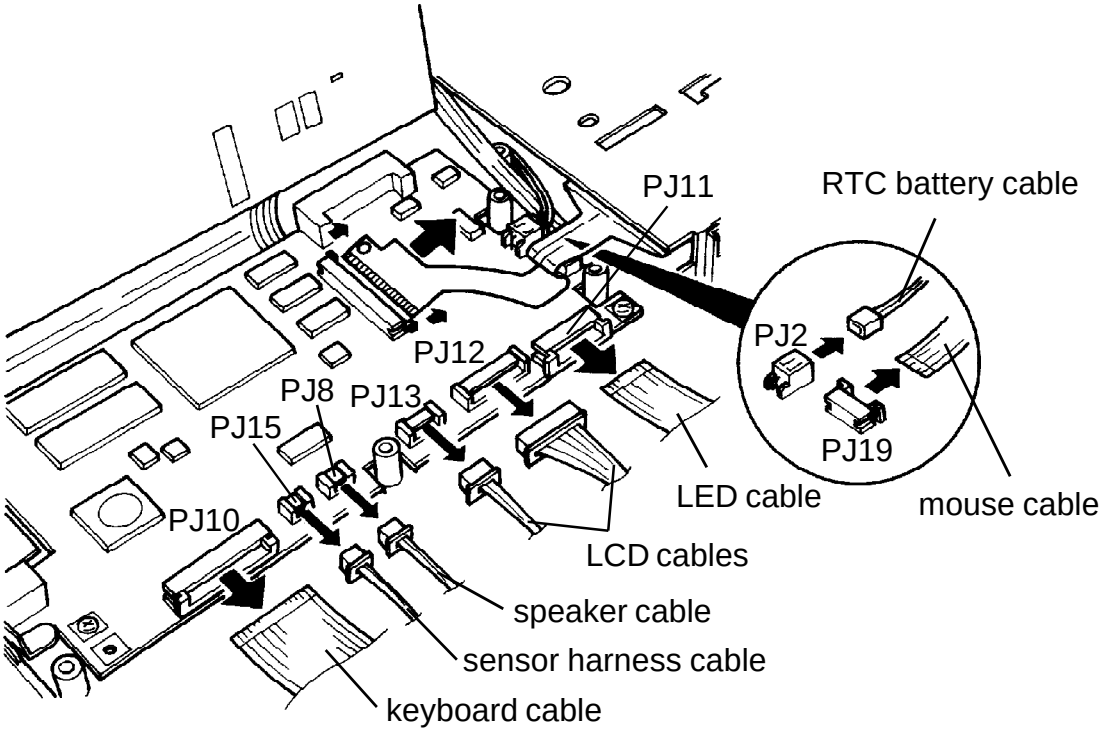


Figure 5-22 Disconnecting the cables from the system board

5. Remove the four (M2x4) screws securing the system board to the keyboard base (Figure 5-23).

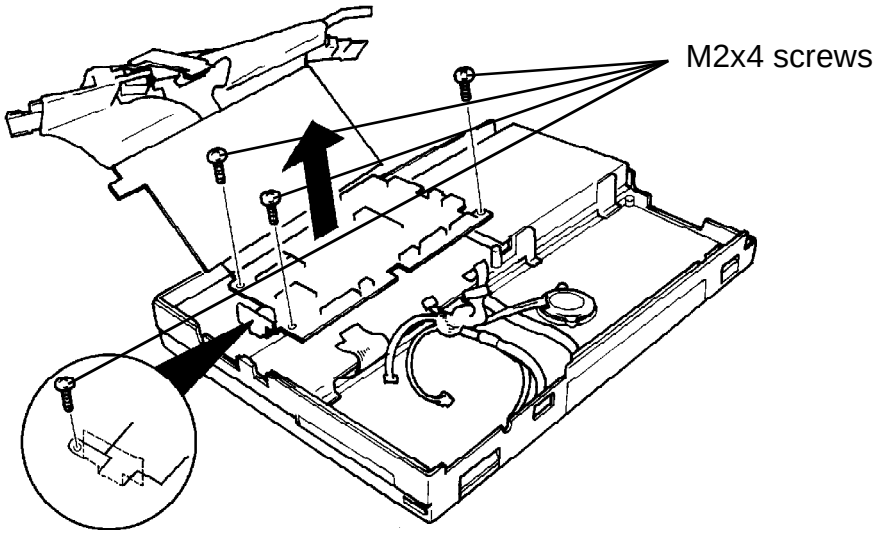


Figure 5-23 Removing the four system board screws

> ***CAUTION:*** *The system board must only be handled as follows:*
> *(1) Hold the system board vertically by the connector panel, or*
> *(2) Place one hand beneath the rigid portion of the system board and the other hand beneath the connector panel when handling the board horizontally.*

6. Lift and disconnect the system board from the power supply board at PJ4 on the power supply board. Then remove the system board from the computer.

> ***NOTE:*** *At this point, nothing is securing the power supply board. Therefore, the power supply board may lift up when you remove the system board.*

7. Remove the power supply board from the computer (Figure 5-24).

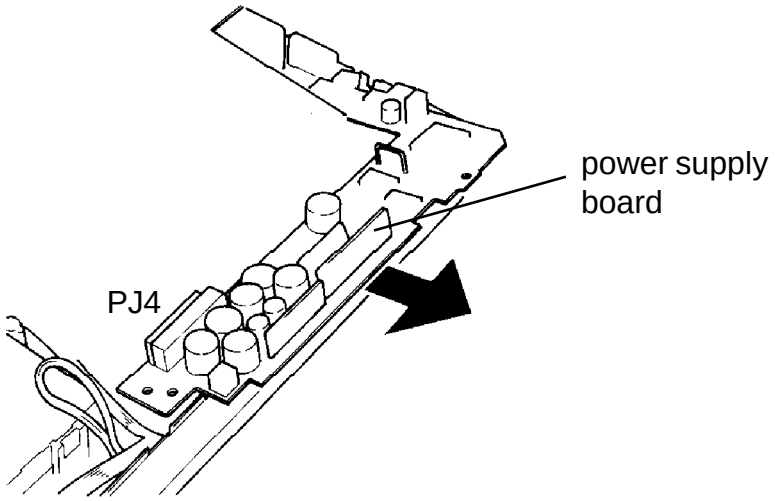


Figure 5-24 Removing the power supply board

8. Remove the two (M2x4) screws securing the speaker to the cover assembly and then lift the speaker assembly out of the computer (Figure 5-25).

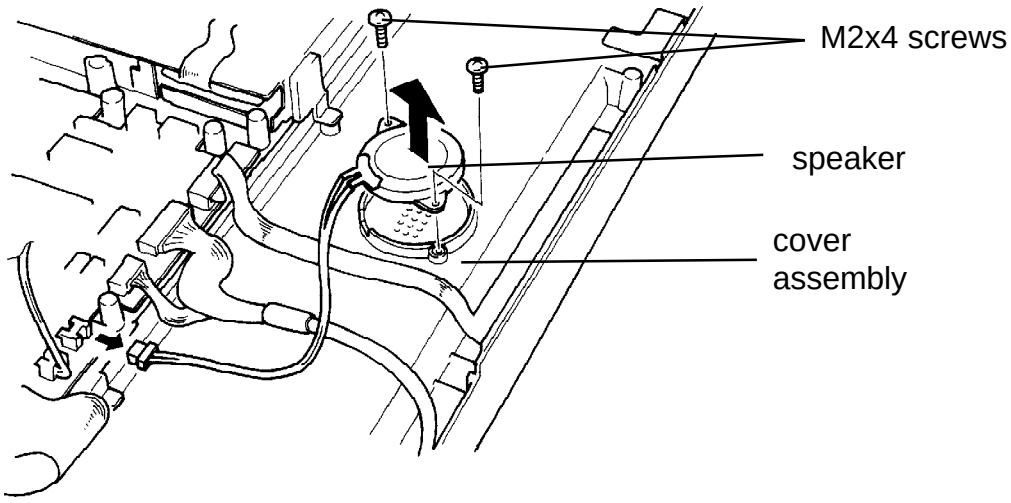


Figure 5-25 Removing the speaker

5.9 Removing the Keyboard

1. Remove the floppy disk drive, system board, and power supply board as indicated in Sections 5.7 and 5.8.

> ***NOTE:*** *It is not necessary to remove the speaker as indicated in Step 13 of Section 5.8.*

2. Remove the six (M2x4) screws securing the keyboard base to the cover assembly.

3. Remove the keyboard base from the computer (Figure 5-26). It may be necessary to separate the mylar shielding from the keyboard base and/or keyboard.

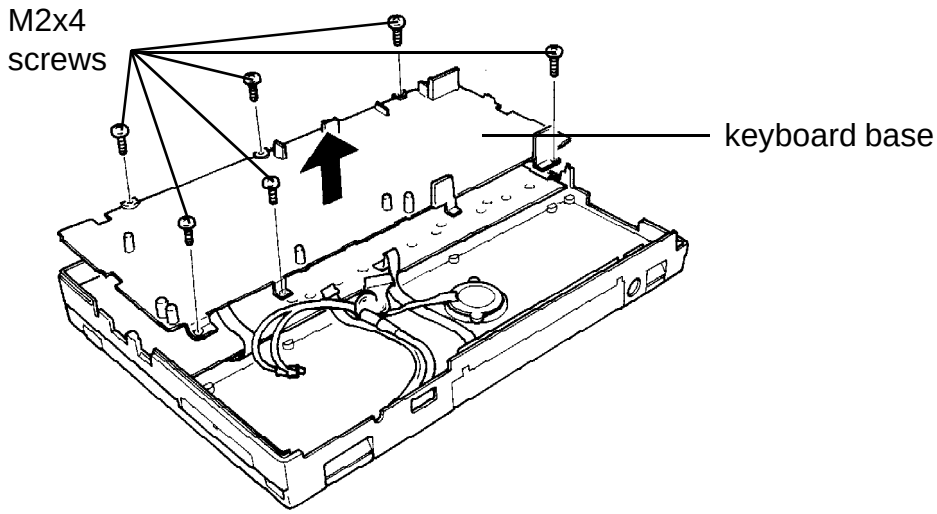


Figure 5-26 Removing the keyboard base

4. Release the two latches on the cover assembly and lift the keyboard assembly out of the computer (Figure 5-27).

> ***CAUTION:*** *Be careful not to apply too much pressure to the latches on the cover assembly.*

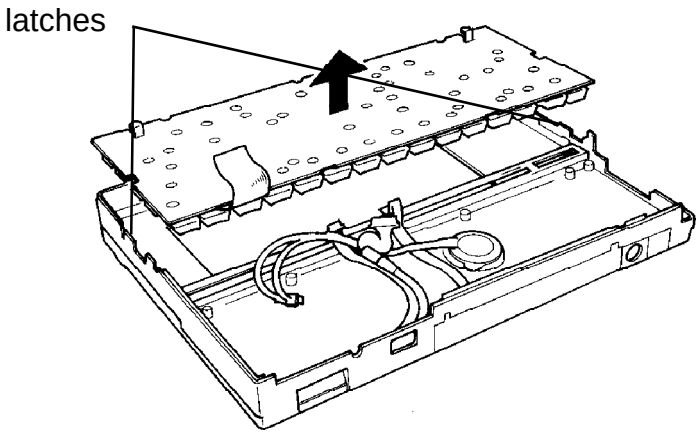


Figure 5-27 Removing the keyboard

5.10 Removing other Replaceable Parts

5.10.1 LCD Cable Harness

1. Remove the LCD module and FL inverter board as indicated in Section 5.4.

2. Remove the battery terminal assembly as indicated in Section 5.5.

> ***NOTE:*** *It is not necessary to disconnect and remove the sub battery as indicated in Step 5 of Section 5.5.*

3. Remove the four (M2x4) screws securing the middle base assembly and the five (M2x4) screws securing the top half of the system board. Remove the ground plate positioned under the middle base assembly and over the system board (see Figure 5-16).

4. Remove the one (M3x6 silver) ground terminal screw from the back of the computer (see Figure 5-16).

5. Position the system board support block behind the computer.

> ***CAUTION: DO NOT*** *apply stress to the flexible portion of the system board assembly when working with the system board.*

6. Lift the middle base assembly away from the cover assembly by lifting up on the inside edge of the middle base assembly. Rest the middle base assembly on the system board support block.

7. Remove the tape securing the LCD cable harness to the top cover.

8. Remove the one (M2x4) screw securing the left hinge cover and then remove the left hinge cover.

9. Disconnect the LCD cables from PJ12 and PJ13 on the system board.

10. Route the cable harness through the top cover to remove the LCD cable harness.

5.10.2 Sensor Harness

1. Remove the LCD module and FL inverter board as indicated in Section 5.4.

2. Remove the battery terminal assembly as indicated in Section 5.5.

> ***NOTE:*** *It is not necessary to disconnect and remove the sub battery as indicated in Step 5 of Section 5.5.*

3. Remove the four (M2x4) screws securing the middle base assembly and the five (M2x4) screws securing the top half of the system board. Remove the ground plate positioned under the middle base assembly and over the system board (see Figure 5-16).

4. Remove the one (M3x6 silver) ground terminal screw from the back of the computer (see Figure 5-16).

5. Position the system board support block behind the computer.

> ***CAUTION: DO NOT*** *apply stress to the flexible portion of the system board assembly when working with the system board.*

6. Lift the middle base assembly away from the cover assembly by lifting up on the inside edge of the middle base assembly. Rest the middle base assembly on the system board support block.

7. Disconnect the sensor harness cable from PJ15 on the system board.

8. Remove the one (M2x4) screw and then remove the left hinge cover.

9. Remove the two (M2x4) screws securing the sensor harness to the top cover.

10. Lift out the sensor harness.

5.10.3 LED Board

1. Remove the battery terminal assembly as indicated in Section 5.5.

> ***NOTE:*** *It is not necessary to disconnect and remove the sub battery as indicated in Step 5 of Section 5.5.*

2. Remove the four (M2x4) screws securing the middle base assembly and the five (M2x4) screws securing the top half of the system board. Remove the ground plate positioned under the middle base assembly and over the system board (see Figure 5-16).

3. Remove the one (M3x6 silver) ground terminal screw from the back of the computer (see Figure 5-16).

4. Position the system board support block behind the computer.

> ***CAUTION: DO NOT*** *apply stress to the flexible portion of the system board assembly when working with the system board.*

5. Lift the middle base assembly away from the cover assembly by lifting up on the inside edge of the middle base assembly. Rest the middle base assembly on the system board support block.

> ***CAUTION:*** *Thin film transistors (TFTs) are located throughout the LED Board. Only handle the board by its edges to avoid damaging the TFTs.*

6. Disconnect the LED cable from PJ11 on the system board.

7. Peel the LED board away from the top cover. An adhesive coating on the LED board is used to secure the LED board to the top cover.

Chapter 6
Reassembly Procedures

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Contents

Figures

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6.1 General

Due to the intricate nature of the T2200SX, this separate reassembly section has been provided to assist you in the correct and exact reassembly steps needed for the machine.

Before You Begin

Review the procedures in this chapter before you begin reassembling the T2200SX. Familiarize yourself with the necessary steps and keep the following points in mind:

1. For parts that are secured by more than one screw, start all the screws before tightening them.

2. Do not over-tighten the screws.

3. Make sure all cables and connectors are securely fastened.

4. Before securing parts, make sure there are no cables that will be pinched or otherwise damaged.

5. Make sure all latches and pressure plates are locked into place.

6. Be sure to use the correct screws to secure the various parts. Screw sizes are listed in the corresponding figures.

7. Make sure you replace all the screws that were removed during disassembly.

8. Remember to replace all tape removed during disassembly.

After installing an FRU in the T2200SX, confirm that the FRU and the T2200SX are functioning properly before returning the unit.

Tools

You will need the following equipment to reassemble the T2200SX:

- ❑ (1) M 2.5 Phillips-head screwdriver to replace screws.
- ❑ (1) M 3 Phillips-head screwdriver to replace the HDD screws.
- ❑ Tweezers to place screws that you cannot easily position with your fingers.
- ❑ One System Board Support Block (85mm x 120mm x 300mm/3¼"h x 4¾" d x 12"w)
- ❑ One LCD Support Block (30mm x 200mm x 300mm/1¼"h x 8"d x 12"w)

6.2 Installing the Sensor Harness and LCD Cable Harness

> ***CAUTION:*** *Be careful not to damage the microswitch located on the sensor harness.*

1. Place the sensor harness in position and secure it with the two (M2x4) screws at the top.

2. Route the LCD cable harness through the top cover. The end with the two connectors and ferrite core should be positioned inside the top cover.

3. Place the left hinge cover over the LCD cable harness. Make sure the sensor harness wires are not beneath the hinge cover. Secure the left hinge cover with the one (M2x4) screw.

4. Position the ferrite core on the LCD cable harness between the two protruding areas on the top cover. Secure the LCD cable harness by replacing the tape over the ferrite core.

5. Route the sensor harness wires alongside the LCD cable harness and replace the three pieces of tape.

6.3 Installing the Keyboard

1. Place the keyboard into the computer (Figure 6-1). Make sure all cables are clear from being pinched between the keyboard and the top cover.

2. Align the keyboard to the four guide pins on the top cover and make sure the keyboard is secured by the two latches on the top cover.

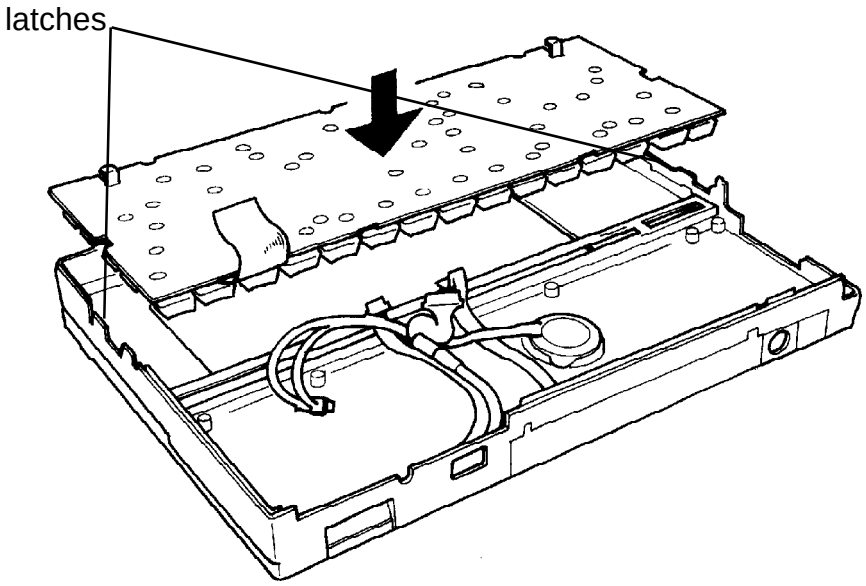


Figure 6-1 Installing the keyboard

3. Insert the keyboard base into the computer and reposition the mylar shielding. The secure the base with the six (M2x4) screws (Figure 6-2).

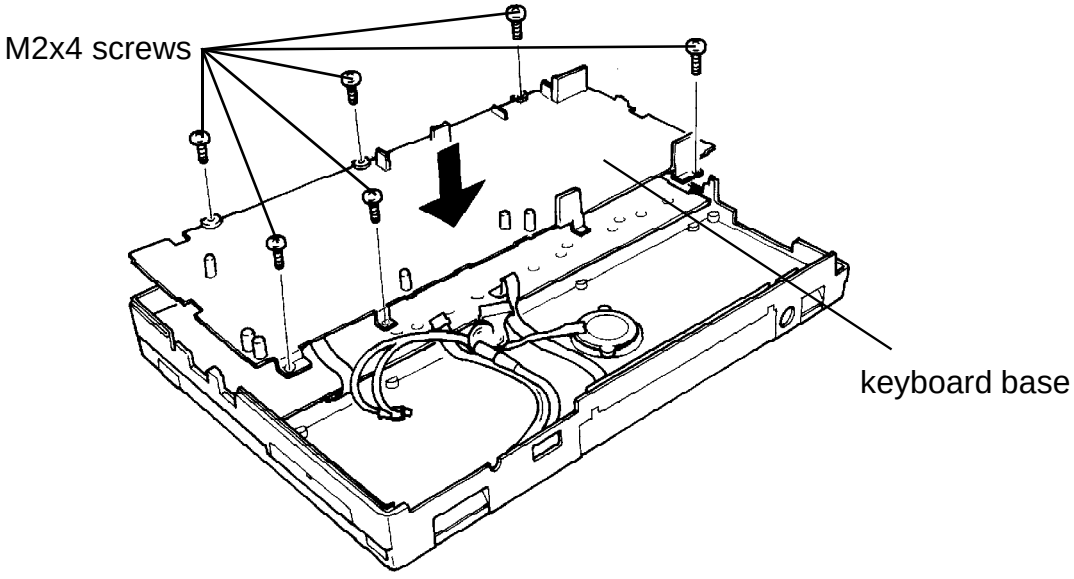


Figure 6-2 Securing the keyboard base

6.4 Installing the Speaker and LED Board

1. Replace the speaker, silver side down, into the computer and secure it with the two (M2x4) screws (Figure 6-3).

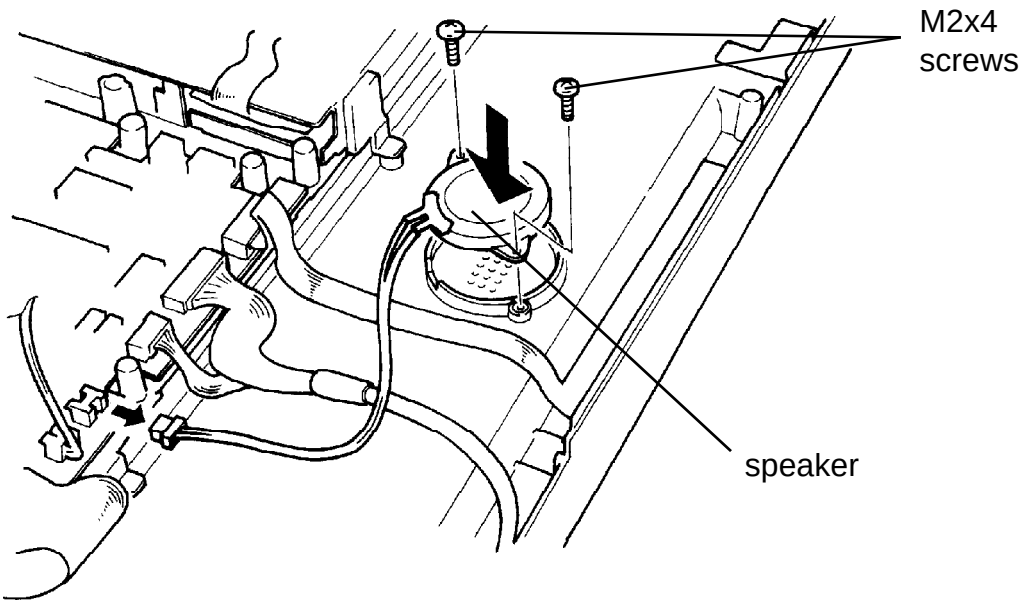


Figure 6-3 Securing the speaker

2. Peel the protective covering from the new LED board.

3. Place the LED board in position by aligning it with the guide pins. Then lightly press the board into position.

> ***CAUTION:*** *Thin film transistors (TFTs) are located throughout the LED board. Only handle the board by its edges to avoid damaging the TFTs.*

4. Route the LED cable under the speaker cable.

5. Connect the LED cable to PJ11 on the system board. Make sure the pressure plate connector is locked.

6. Secure all the cables and wires with tape.

6.5 Installing the System Board and Power Supply Board

1. Lay the rigid portion of the system board into position in the computer. Make sure the guide pins are aligned and that the flexible portion of the system board is resting on the system board support block.

2. Route the RTC battery cable under the RTC battery and away from any screw holes as you place the battery on the ledge provided at the back of the keyboard base.

3. Route the PS/2 mouse cable on top of the connector and on top of the RTC battery as you place the mouse connector into the slot on the side of the computer. Make sure the cable is clear of all screw holes.

4. Remove the system board support block and fold the flexible portion of the system board into position in the computer.

5. Slightly lift the system board and firmly connect it to the power supply board at PJ9 on the power supply board (Figure 6-4).

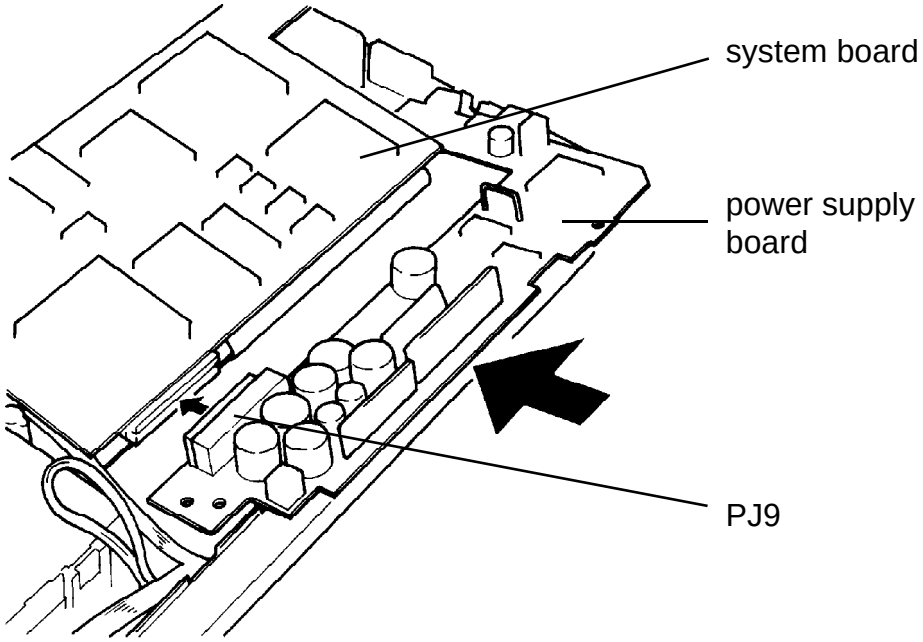


Figure 6-4 Positioning the power supply board

6. Insert the joined boards into the computer. Make sure the boards are aligned with the guide pins and that the metal tab on the system board is over the power supply board.

7. Install the one (M2x4) screw that secures the system board and power supply board to the computer (Figure 6-5).

8. Place the flexible portion of the system board onto the system board support block.

9. Reinstall the remaining three (M2x4) screws, making sure the system board is in the correct position before firmly securing the screws (Figure 6-5).

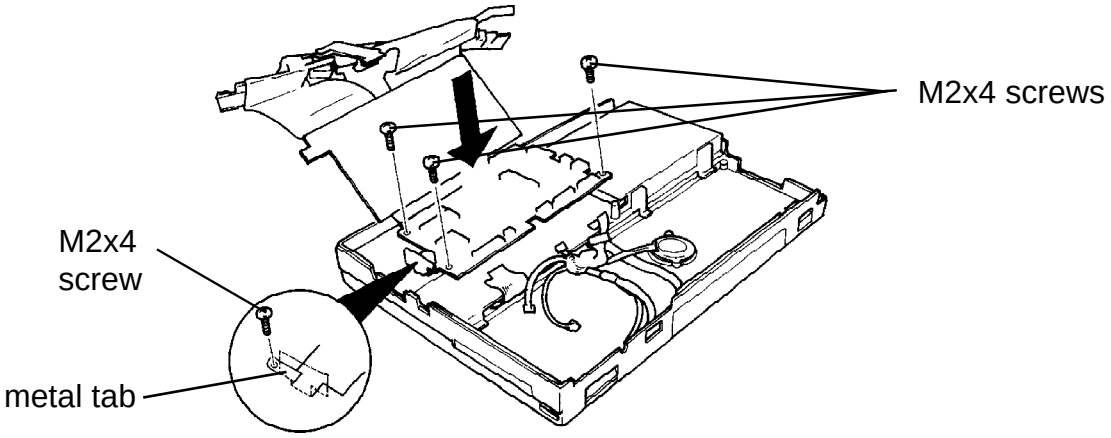


Figure 6-5 Securing the system board

10. Reconnect the following cables to the system board (Figure 6-6).

Keyboard cable to pressure plate connector PJ10
Speaker cable to PJ8
Sensor harness (Panel close switch) cable to PJ15
LCD cables to PJ12 and PJ13
LED cable to pressure plate connector PJ11
RTC battery cable to PJ2
PS/2 mouse cable to pressure plate connector PJ19
FDD cable to PJ4

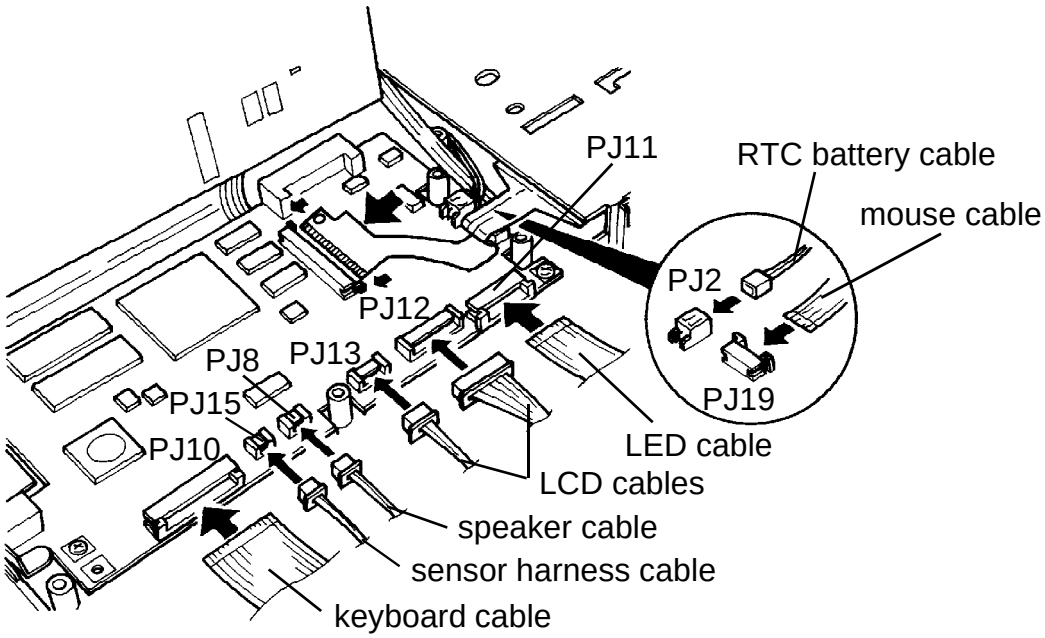


Figure 6-6 Connecting the system board cables

> ***CAUTION:*** *Route all cables so they will not be damaged when the middle base assembly is installed.*

6.6 Installing the Floppy Disk Drive

1. Place the FDD into position on the keyboard base. Make sure the FDD is underneath the catch hook on the keyboard base.

2. Secure the FDD to the keyboard base with the four (M2.5x4) screws (Figure 6-7).

> ***NOTE:*** *Be sure to use only M2.5x4 screws for securing the FDD. Any other screw size will permanently damage the FDD.*

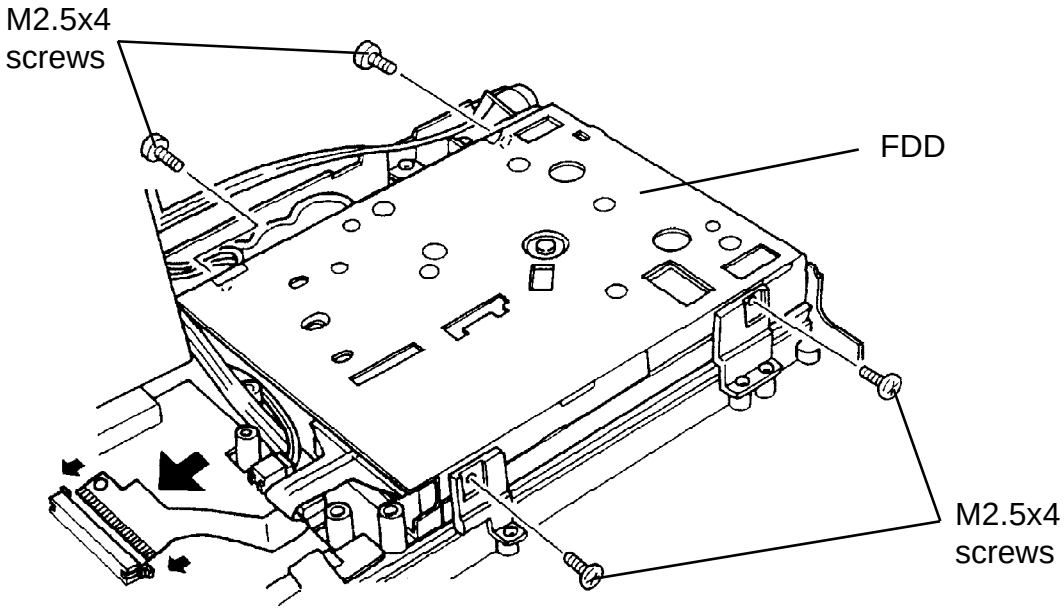


Figure 6-7 Securing the four FDD screws

3. Reconnect the FDD cable to PJ4 on the system board.

6.7 Installing the Hard Disk Drive

1. Place the HDD in the middle base assembly with the disk label facing down.

2. Insert, but do not completely tighten, the four special screws used to secure the HDD to the middle base assembly (Figure 6-8). Then tighten each screw evenly.

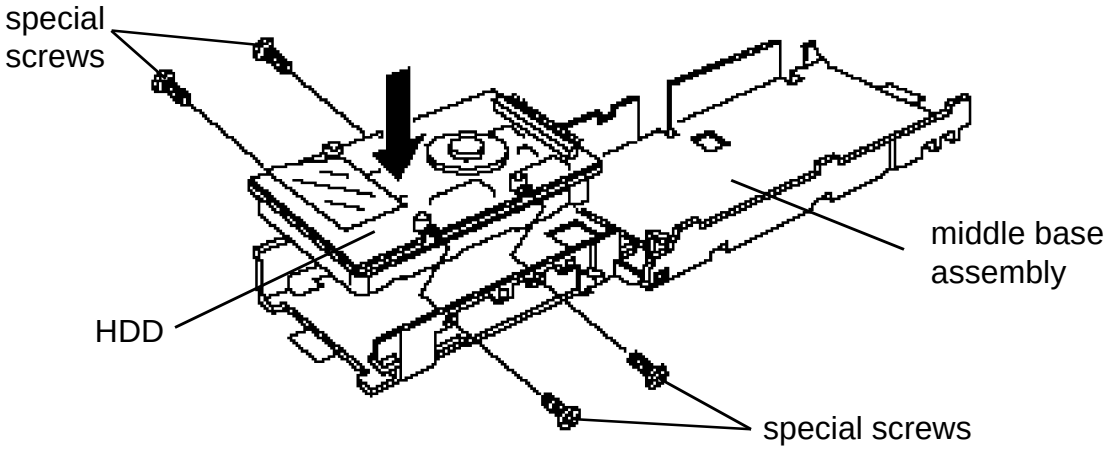


Figure 6-8 Securing the HDD to the middle base assembly

3. While vertically holding both the middle base assembly and system board, carefully feed the middle base assembly through the flexible cable portion of the system board, leading with the HDD unit from right to left (Figure 6-9).

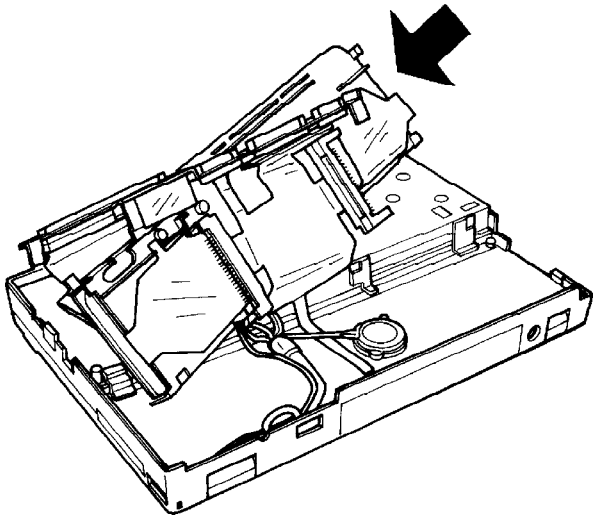


Figure 6-9 Routing the middle base assembly

4. Turn the middle base assembly over onto the system board support block. The connector panel bracket should be positioned in the groove along the back of the middle base assembly.

5. Install the two (M2x4) screws for the **EXP** memory connector and the two (M2x4) screws for the card modem connector (Figure 6-10).

6. Position the two ground plates on the connector panel bracket and then install the two (M2x4) screws for the connector panel bracket (Figure 6-10).

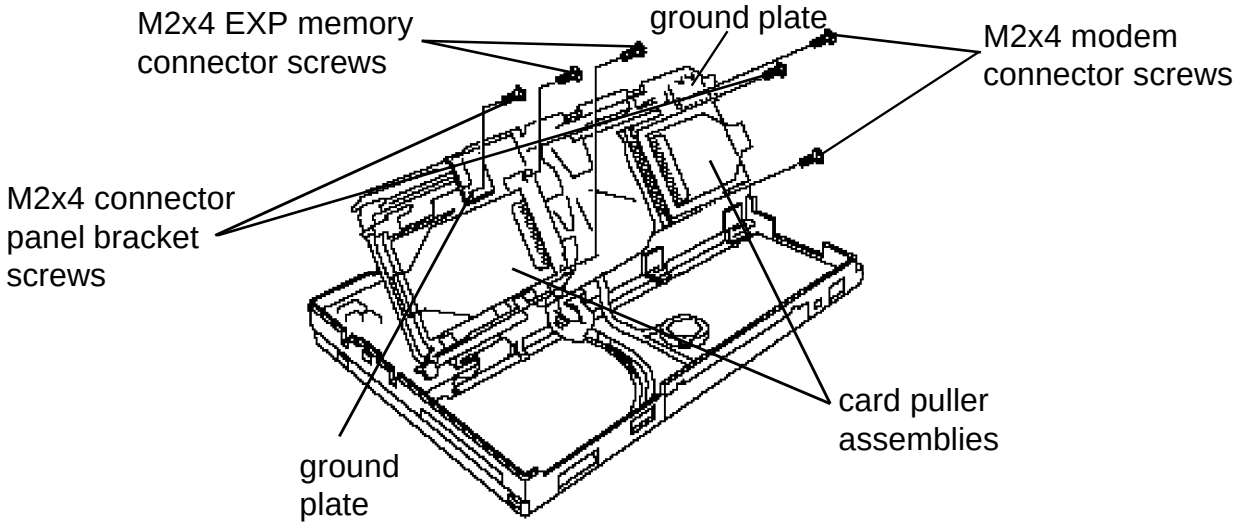


Figure 6-10 Installing the connector panel screws and ground plates

7. Install the metal card puller assemblies for the card modem and memory card.

8. Turn the middle base assembly over and place it into the computer.

9. Place the connector panel edge into the computer. Guide the mylar pull tab for the memory card through its slot on the top cover.

10. Install the ground plate over the system board, but under the middle base assembly.

11. Install the five (M2x4) screws to secure the system board (Figure 6-11).

12. Install the four (M2x4) screws to secure the middle base assembly (Figure 6-11).

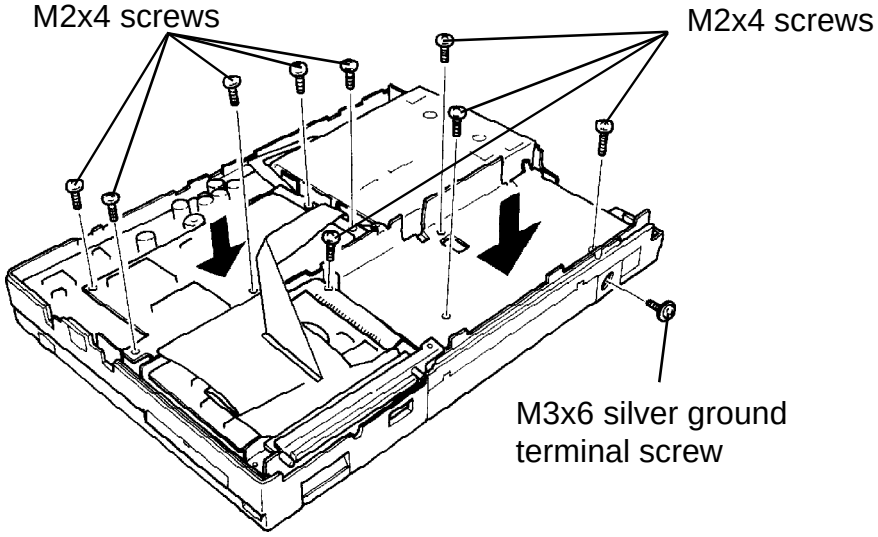


Figure 6-11 Installing the system board and middle base assembly screws

13. Replace the one (M3x6 silver) ground terminal screw at the back of the computer.

6.8 Installing the Sub Battery and Battery Terminal Assembly

1. Place the sub battery and its wires underneath the PS/2 mouse cable.

2. Reconnect the sub battery wires to PJ3 on the power supply board.

3. Secure the sub battery inside the computer with tape.

4. Lift the HDD cable and route the battery terminal assembly wires through the slot in the middle base assembly.

5. Connect the HDD cable to the HDD.

6. Insert the edge of the battery terminal assembly closest to the system board first.

7. Press the battery terminal assembly in place.

8. Insert the two (M2x4) screws to secure the battery terminal assembly to the middle base assembly (Figure 6-12).

9. Connect the battery terminal assembly wires to PJ1 and PJ2 on the power supply board.

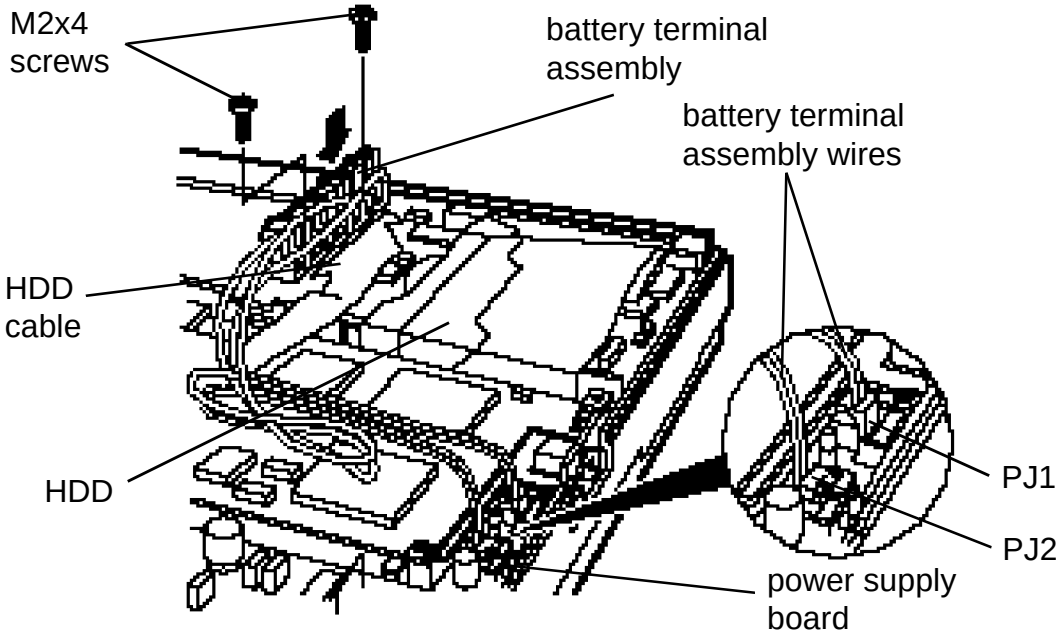


Figure 6-12 Installing the battery terminal assembly

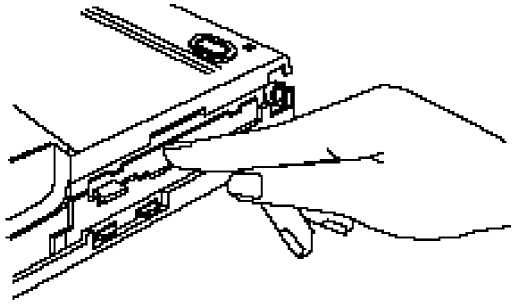
10. Route the wires along the edge of the middle base assembly and secure the wires with tape.

11. Secure the HDD cable with tape.

6.9 Installing the Bottom Cover

1. Set the bottom cover on the base assembly but DO NOT press the bottom cover into position.

2. Gently press the FDD door inward with your finger as you press the bottom cover to the base



assembly (Figure 6-13).

Figure 6-13 Installing the bottom cover

3. While pressing down on the bottom cover, insert the nine (M2x5 silver) screws to secure the bottom cover to the base assembly (Figure 6-14).

4. Place the NDP cover into position on the bottom cover. Insert the one (M2x5 silver) screw to secure the NDP cover to the bottom cover.

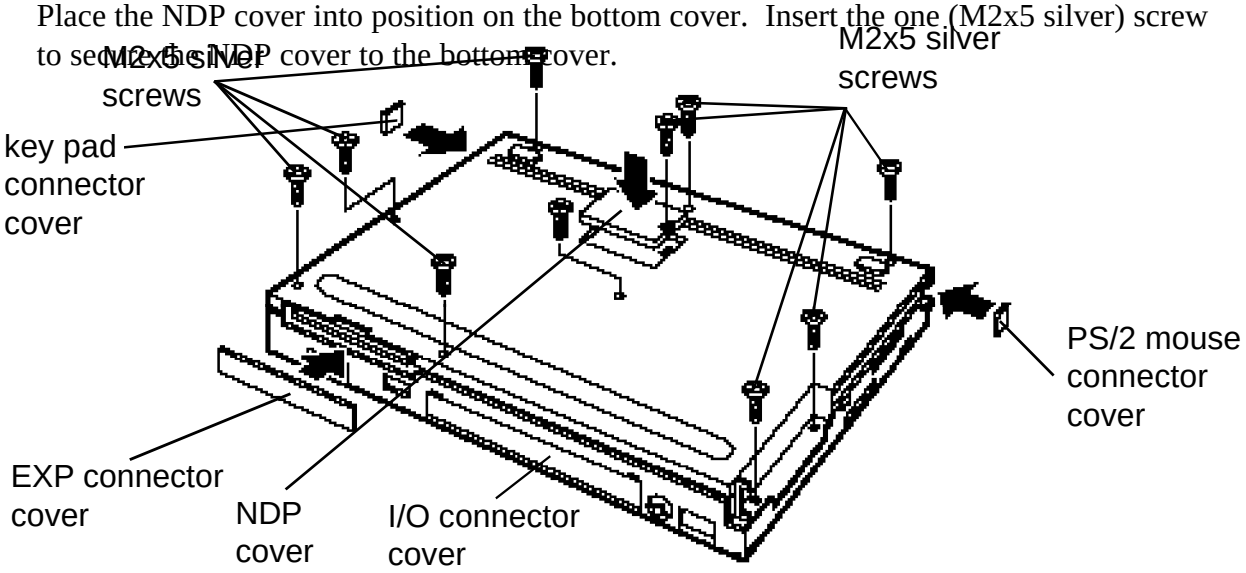


Figure 6-14 Installing the bottom cover screws

5. Turn the computer right side up with the front facing you.

6. Install the I/O connector cover, **EXP** connector cover, key pad connector cover, and PS/2 mouse connector cover.

CAUTION: *Make sure the PS/2 mouse connector cover is installed with the two hooked protrusions facing downward.*

6.10 Installing the FL Inverter Board and LCD Module

1. Place the LCD support block behind the computer. Then set the LCD cover on the LCD support block.

CAUTION: *Before proceeding make sure the display cables are not being pinched by the left hinge of the LCD cover.*

2. At the lower left corner of the LCD cover, route the larger display cable between the two screw posts on the LCD cover.

3. Rotate the two hinges toward the LCD cover and align the screw holes.

4. Install the two (M2.5x4) screws into the lower screw holes to secure the LCD cover to the hinges (Figure 6-15).

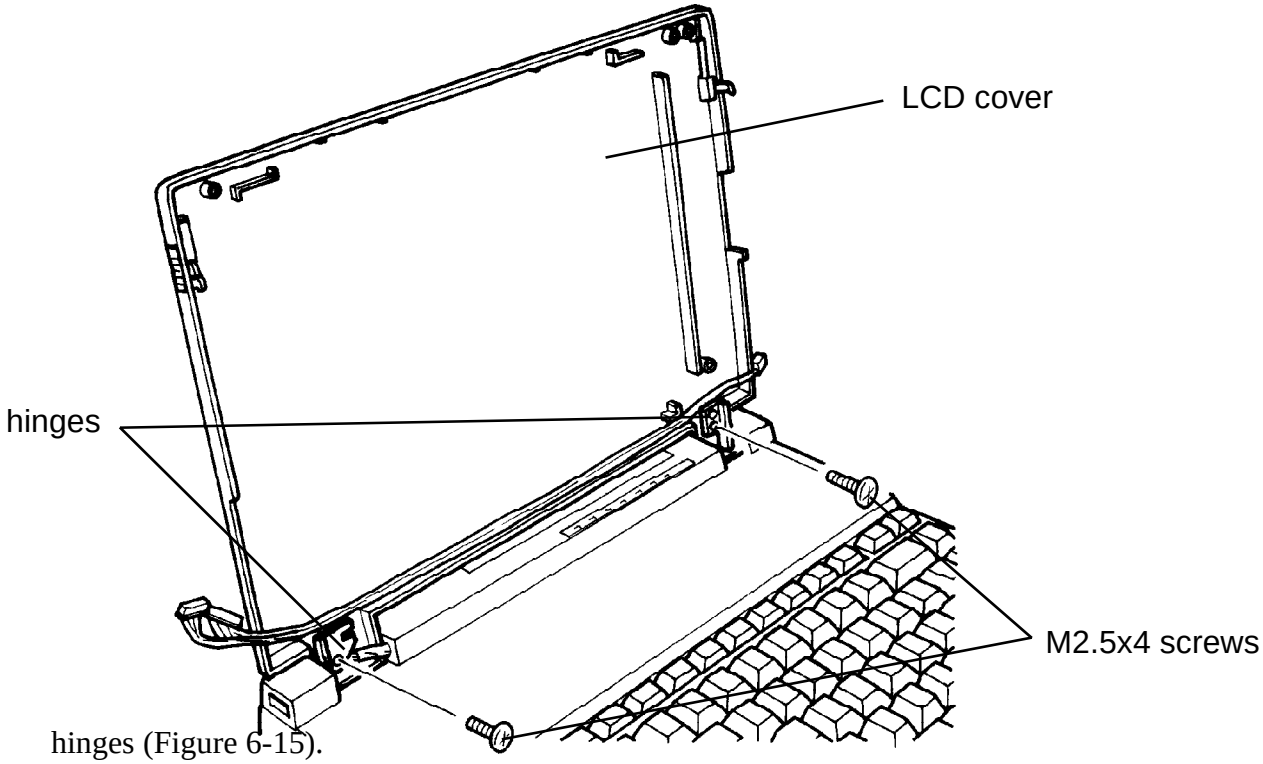


Figure 6-15 Installing the LCD cover

CAUTION: *The LCD module must only be handled by its edges. NEVER touch the edge containing the CAUTION label or you may permanently damage the module.*

5. Place the LCD module in the LCD cover. Align the lower left corner of the LCD module

with the guide pin on the LCD cover.

6. Connect the two display signal cables to CN1 and CN2 on the left side of the LCD module.

CAUTION: *Be extremely careful not to damage any components on the LCD module.*

7. Route the FL inverter board power cable along the bottom of the LCD module and then position this cable under the white FL lamp cable located at the lower right corner of the LCD module.

8. Turn the FL inverter board so that the back is facing you and then connect the three FL inverter cables to CN1, CN2, and CN3 on the FL inverter board (Figure 6-16).

9. Rotate the FL inverter board to the right and place it into the LCD cover. Align the bottom of the FL inverter board with the guide pin on the LCD cover.

10. Install the two (M2x4) screws to secure the FL inverter board to the LCD cover (Figure 6-16).

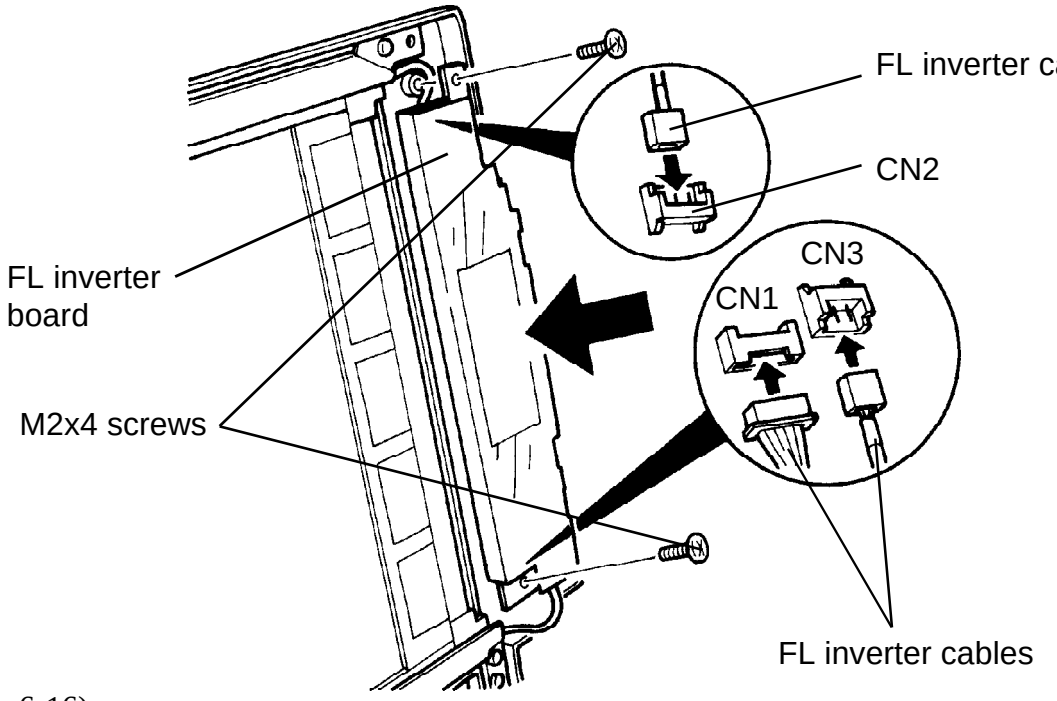


Figure 6-16 Installing the FL inverter board

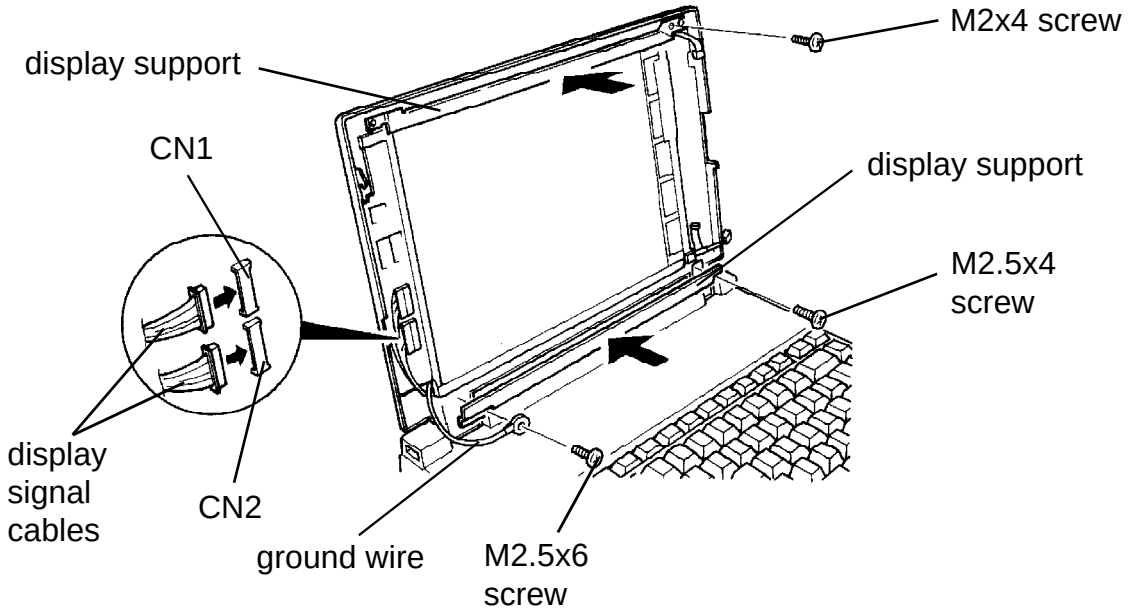
11. Install the two display supports. Then replace the one (M2.5x6 silver) screw to secure the ground wire and the one (M2.5x4) screw to secure the right corner of the lower display support (Figure 6-17).

CAUTION: *The lower display support should house the black FL inverter board power cable. Make sure this cable is not pinched by the display support before replacing the*

screws.

12. Insert the one (M2x4) screw to secure the upper display support to the LCD cover (Figure 6-17).

> ***NOTE:*** *There two screw holes in the right corner of the upper display support. The M2x4 screw is inserted into the inside screw hole. The remaining screw hole is used for*



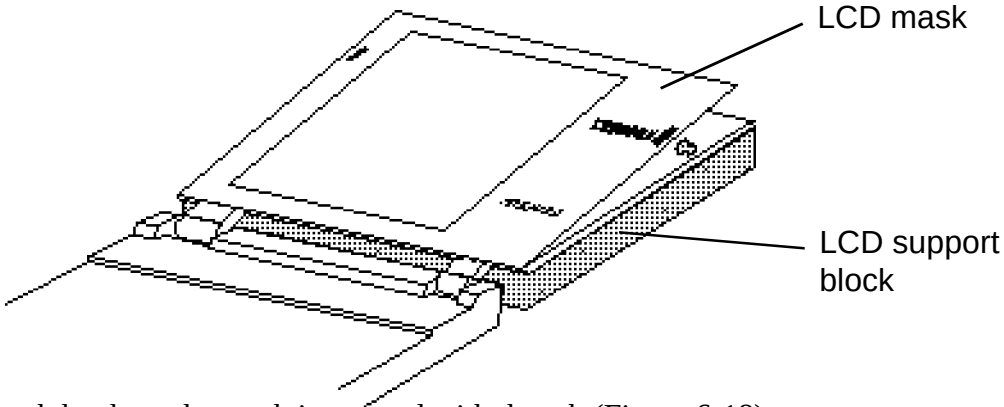
securing the LCD mask to the LCD cover.

Figure 6-17 Installing the display supports and screws

13. Reposition the mylar shielding and secure the display signal cables located on the left side of the LCD module with tape.

14. Lay the LCD module back on the LCD support block (Figure 6-18).

15. Slide the bottom right corner of the LCD mask into position over the right hinge, making

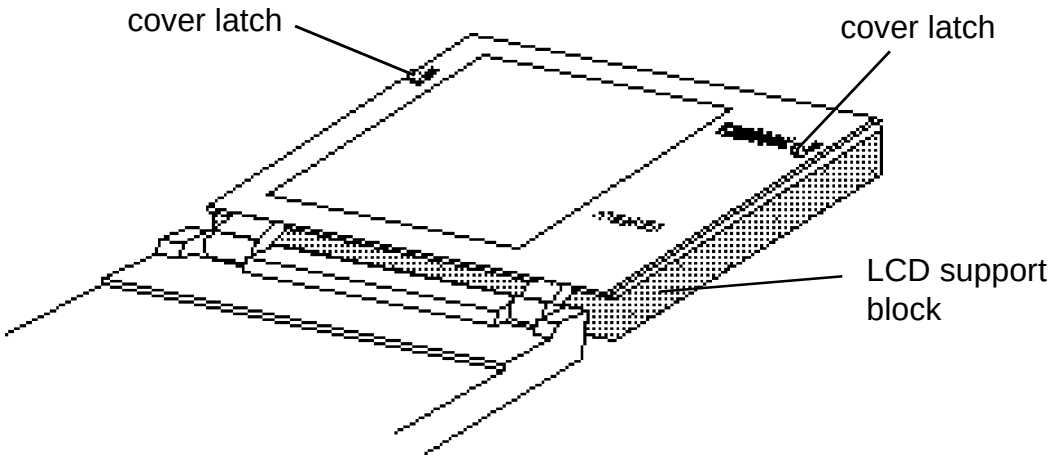


sure that the catch hook on the mask is secured with the tab (Figure 6-18).

Figure 6-18 Placing the LCD mask over the right hinge

16. Position the bottom left corner over the left hinge. Then press on the hinge to secure the LCD mask to the hinge.

17. Secure the latches by moving clockwise around the mask, starting with the left side of the



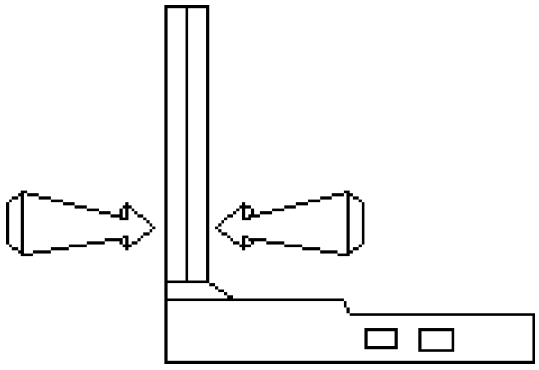
mask. If necessary, move the cover latches to position the LCD mask (Figure 6-19).

Figure 6-19 Securing the latches on the LCD mask

18. Reposition the LCD module in its upright position at a 90° angle to the computer

.

19. Using both hands, press the LCD mask and top cover at the same time to individually secure

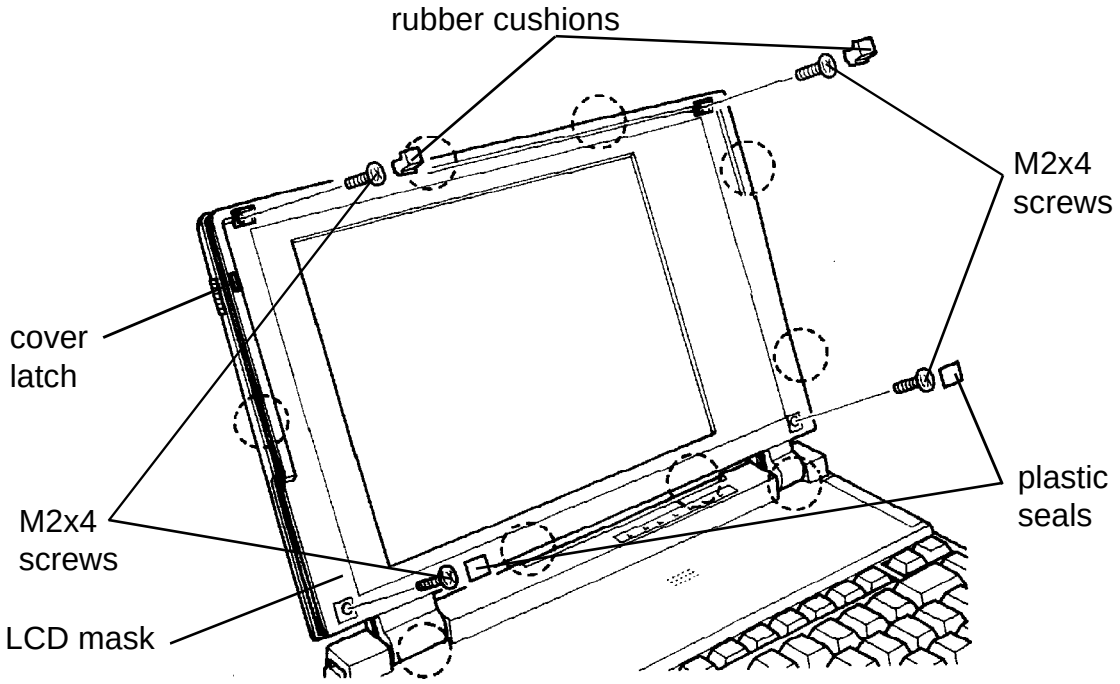


Left side view

each of the two latches at the bottom of the LCD mask (Figure 6-20).

Figure 6-20 Securing the bottom latches

20. Install the four (M2x4) screws to secure the LCD mask (Figure 6-21).



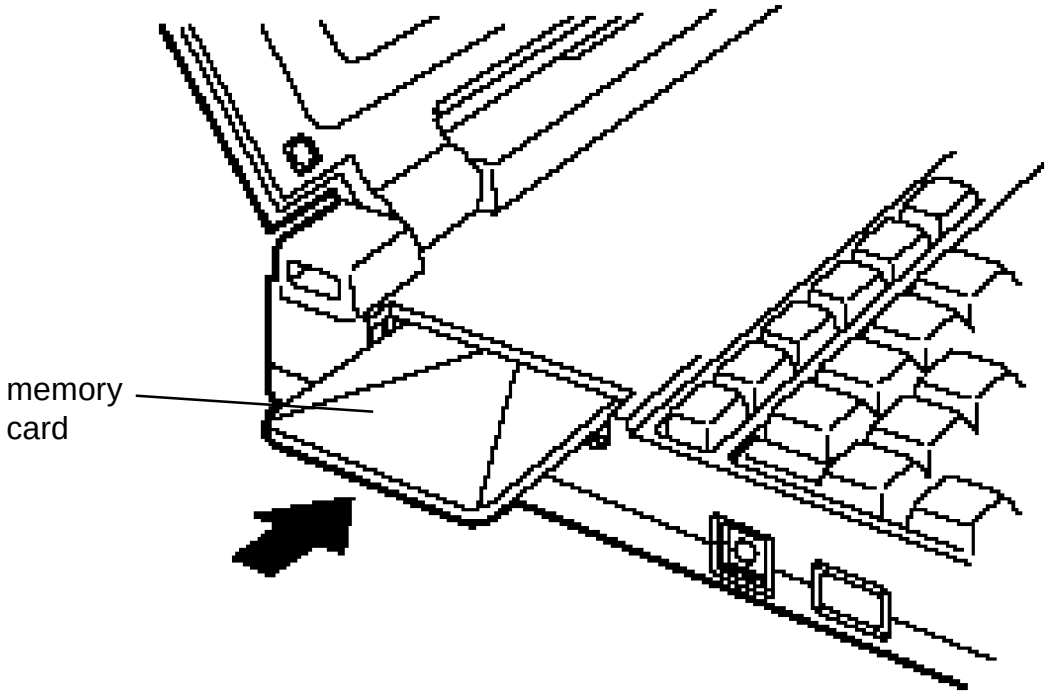
21. Insert the two rubber cushions and the two plastic seals on the LCD mask (Figure 6-21).

Figure 6-21 Installing the LCD mask

6.11 Installing the Optional Memory Card and Card Modem

1. Turn the memory card upside down so that the word “insert” and an arrow pointing toward the connecting edge are face up.

2. Carefully slide the memory card into the narrow slot and push gently to ensure a firm



connection (Figure 6-22). DO NOT force the memory card into place.

Figure 6-22 Inserting the optional memory card

3. Slide the mylar pull tab into place.

4. Replace the **EXP** memory slot cover; its latches should snap into place.

5. Turn the card modem upside down so that the word “insert” and an arrow pointing toward the connecting edge are face up.

6. Carefully slide the card modem into the narrow slot and push gently to ensure a firm connection. DO NOT force the card modem into place.

7. Slide the mylar pull tab into place.

8. Replace the modem slot cover; its latches should snap into place.

6.12 Installing the Battery Pack

1. Make sure the Toshiba logo and pull tab are facing up on the battery pack.

> ***CAUTION:*** *Damage can occur to the computer if the battery pack is placed in the battery well upside down.*

2. Slide the battery pack into the battery slot until it stops (Figure 6-23).

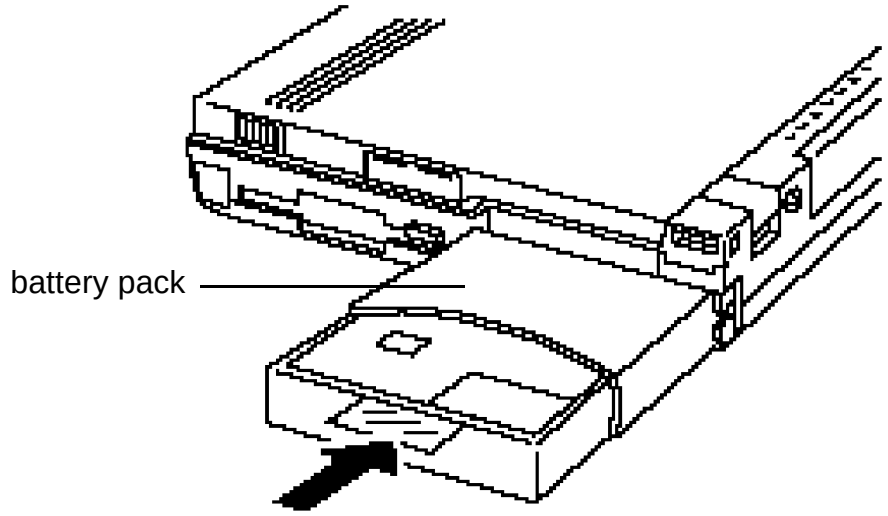


Figure 6-23 Inserting the battery pack

3. Place the battery pack cover in place and secure its latch (Figure 6-24).

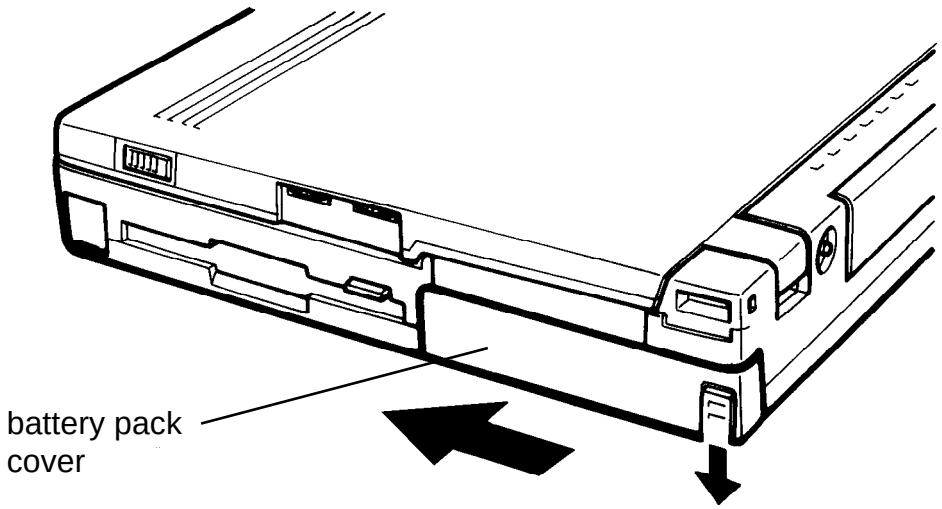


Figure 6-24 Installing the battery pack cover

Appendices

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Contents

Figures

Tables

Appendix A System Board Layout

A.1 System Board FSTFGx (ICs)

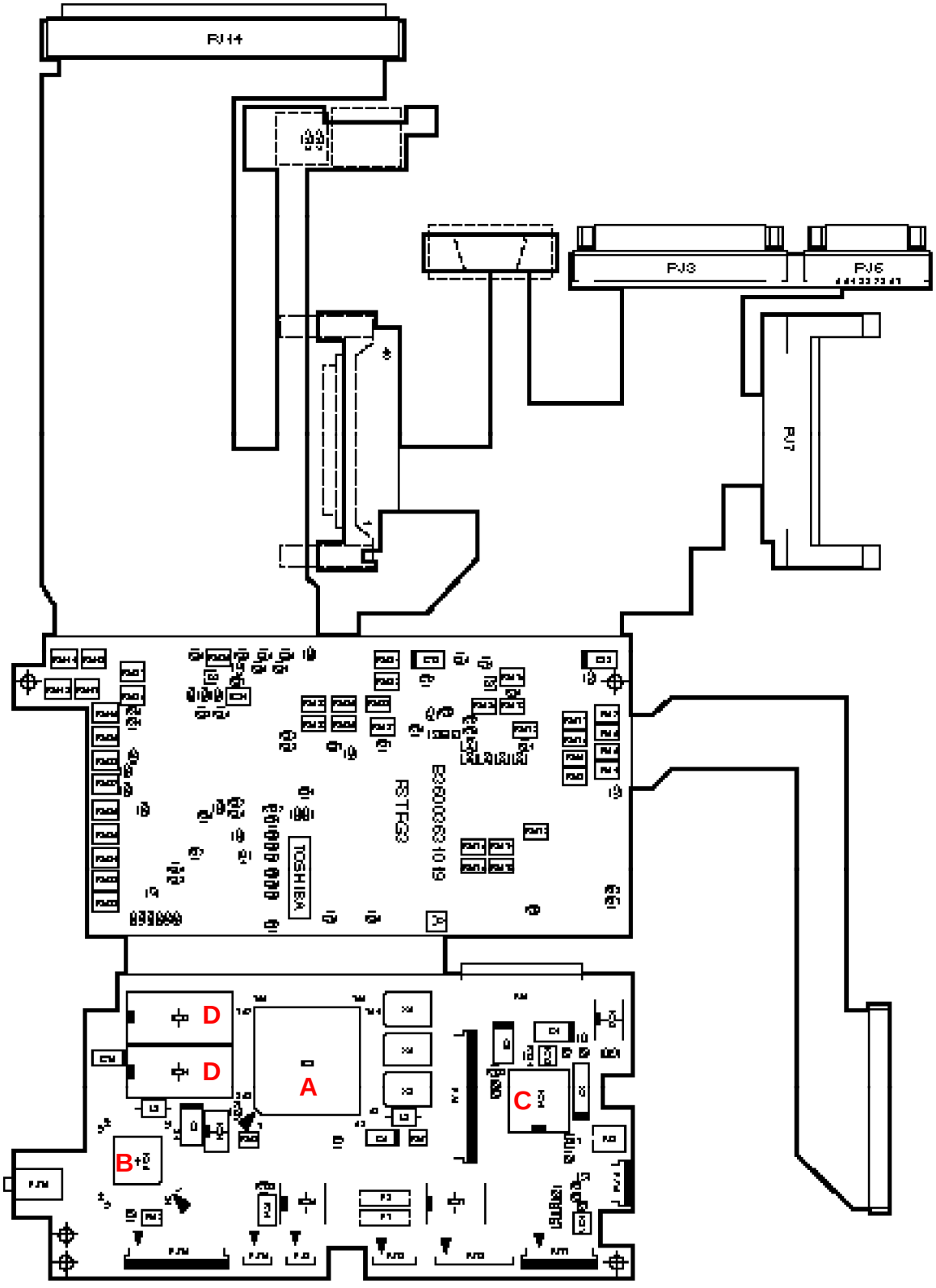

Figure A-1 System board FSTFGx (ICs) (front)

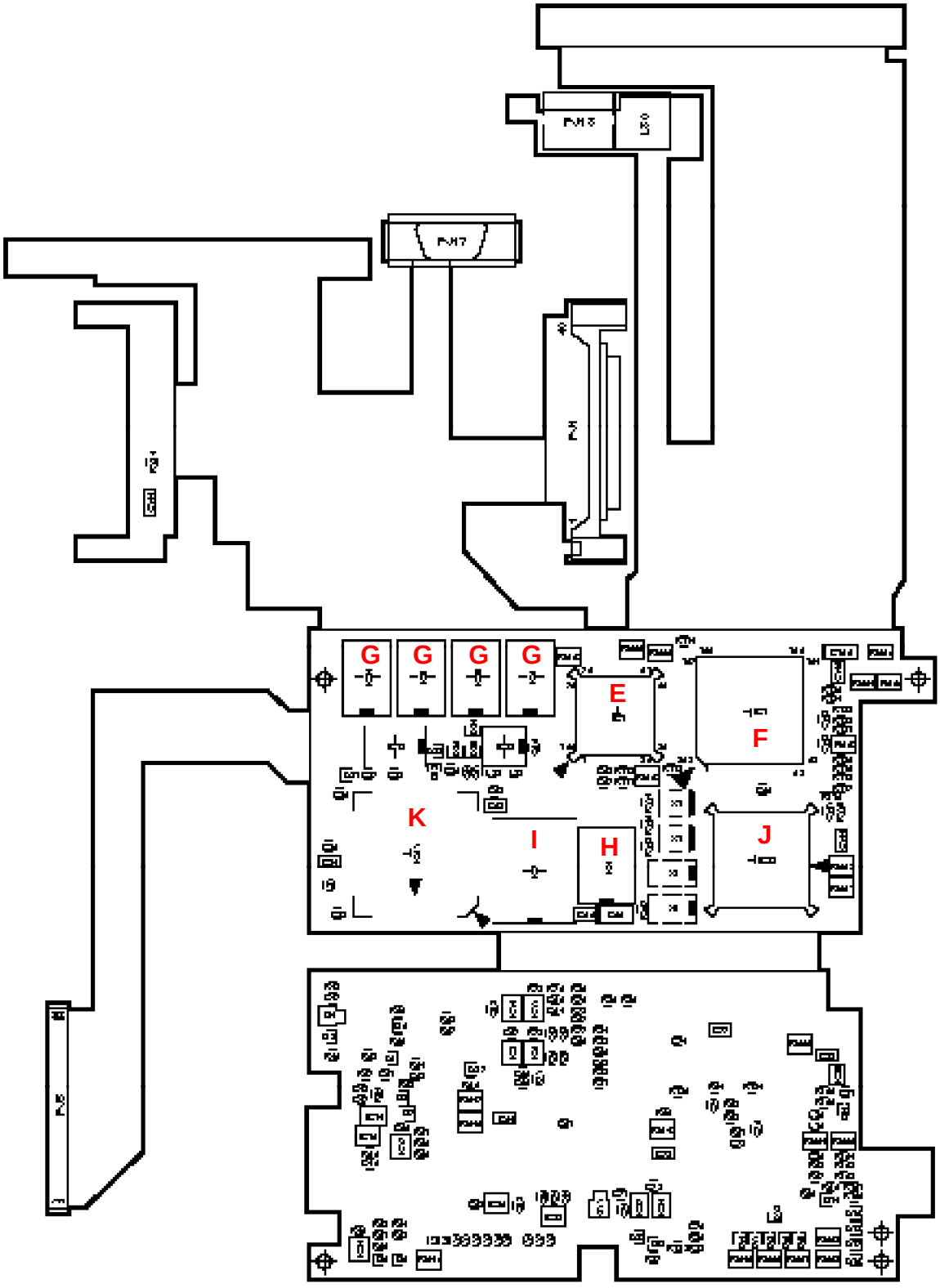

Figure A-2 System board FSTFGx (ICs) (back)

Table A-1 ICs on the system board FSTFGx

Callout	Number	Name
(A)	IC3	SI: SI Super Integration (T9901)
(B)	IC6	Real Time Clock (RTC)
(C)	IC19	KBC: Keyboard Controller (M37452M4)
(D)	IC23, 24	Video RAM
(E)	IC1	CPU: Central Processing Unit (80386SX-20)
(F)	IC2	System Controller Gate Array
(G)	IC4, 5, 35, 36	System RAM
(H)	IC6	Backup RAM
(I)	IC7	BIOS ROM
(J)	IC22	PVGA1F
(K)	IC41	Math Co-processor Socket (80397SX-20)

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A.2 System Board FSTFGx (Connectors)

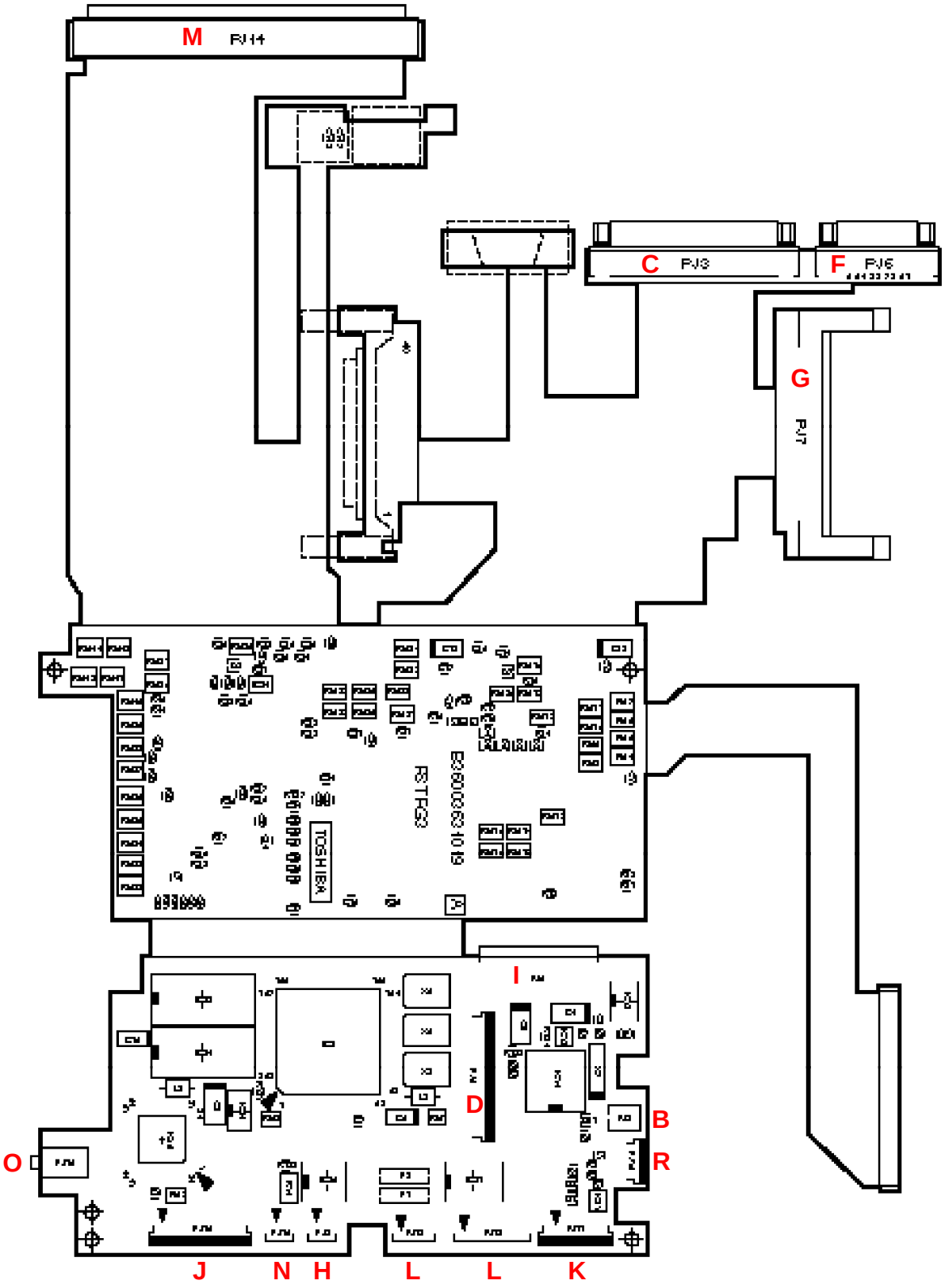

Figure A-3 System board FSTFGx (connectors) (front)

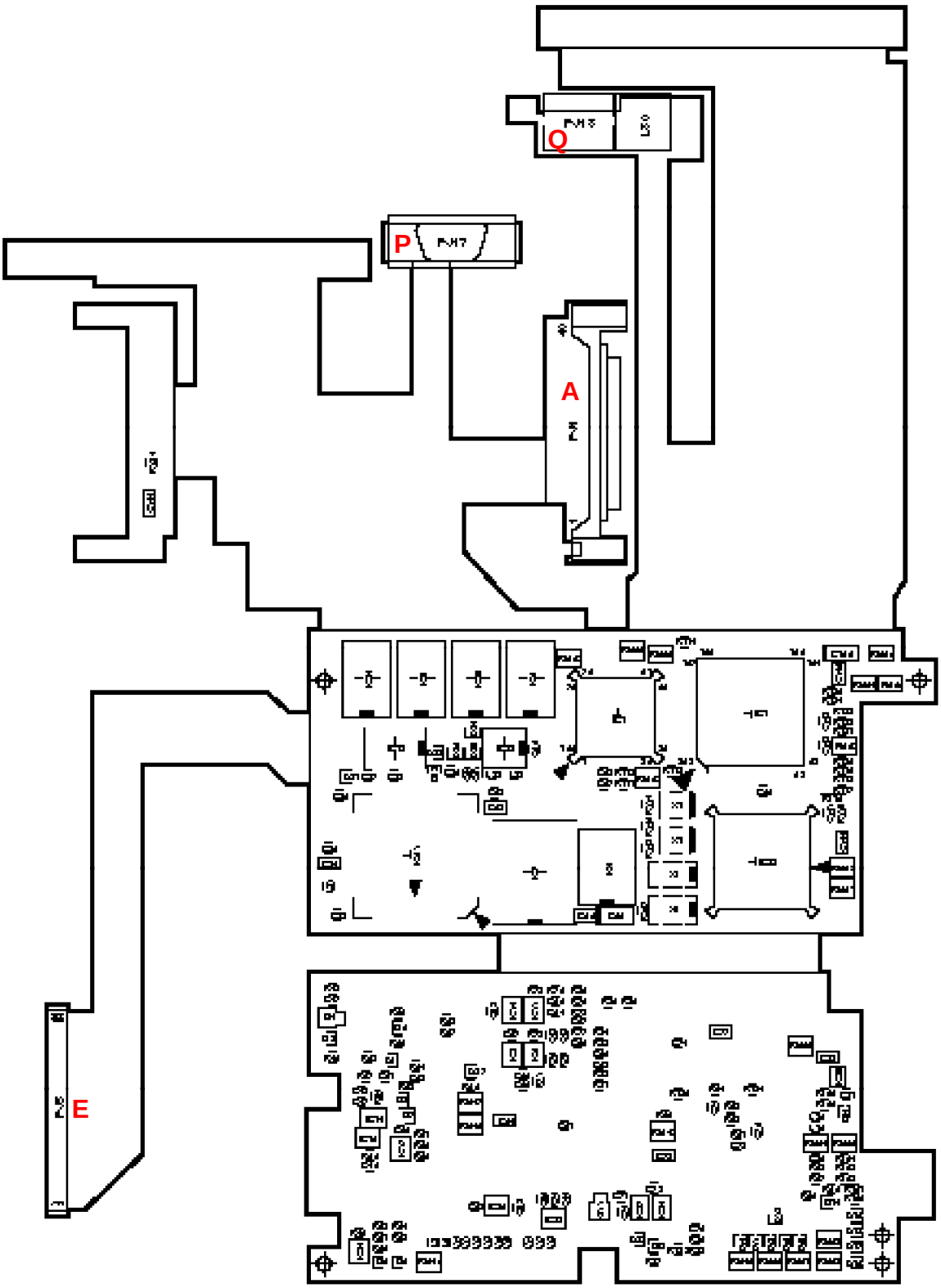

Figure A-4 System board FSTFGx (connectors) (back)

Table A-2 Connectors on the system board FSTFGx

Callout	Number	Name
(A)	PJ1	EXP MEM Connector
(B)	PJ2	RTC Battery Connector
(C)	PJ3	PRT/FDD (Ext) Connector
(D)	PJ4	FDD Connector
(E)	PJ5	HDD Connector
(F)	PJ6	Asynchronous Connector
(G)	PJ7	Card Modem Connector
(H)	PJ8	Speaker Connector
(I)	PJ9	Power Supply Connector
(J)	PJ10	Keyboard Connector
(K)	PJ11	LED Connector
(L)	PJ12, 13	LCD Connectors
(M)	PJ14	Expansion Connector
(N)	PJ15	Tenkey Pad Connector
(O)	PJ16	Numeric Keypad Connector
(P)	PJ17	CRT Connector
(Q)	PJ18	DC IN 18V Connector
(R)	PJ19	PS/2 Mouse Connector

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A.3 System Board FSTFGx (OSCs)

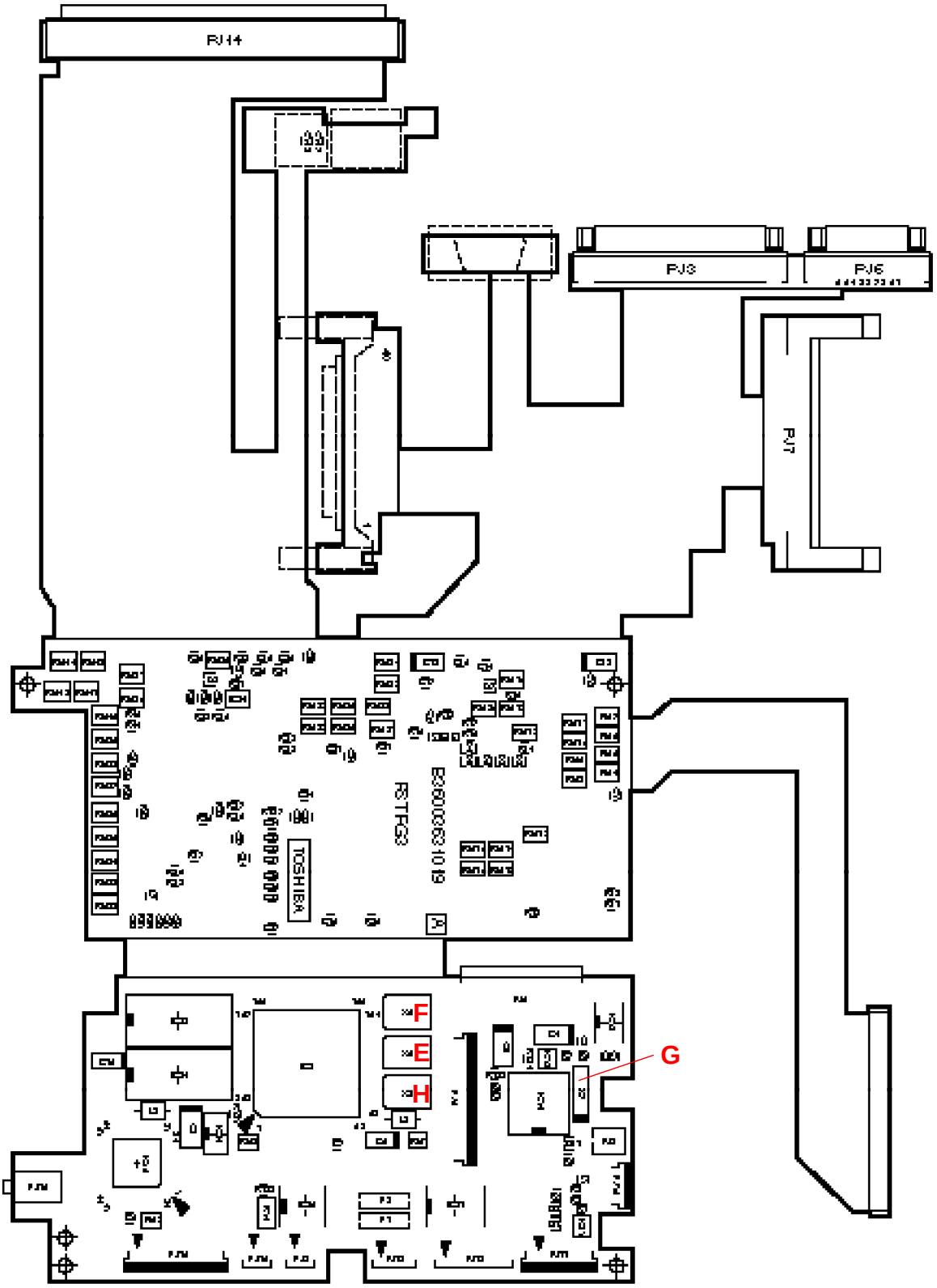


Figure A-5 System board FSTFGx (OSCs) (front)

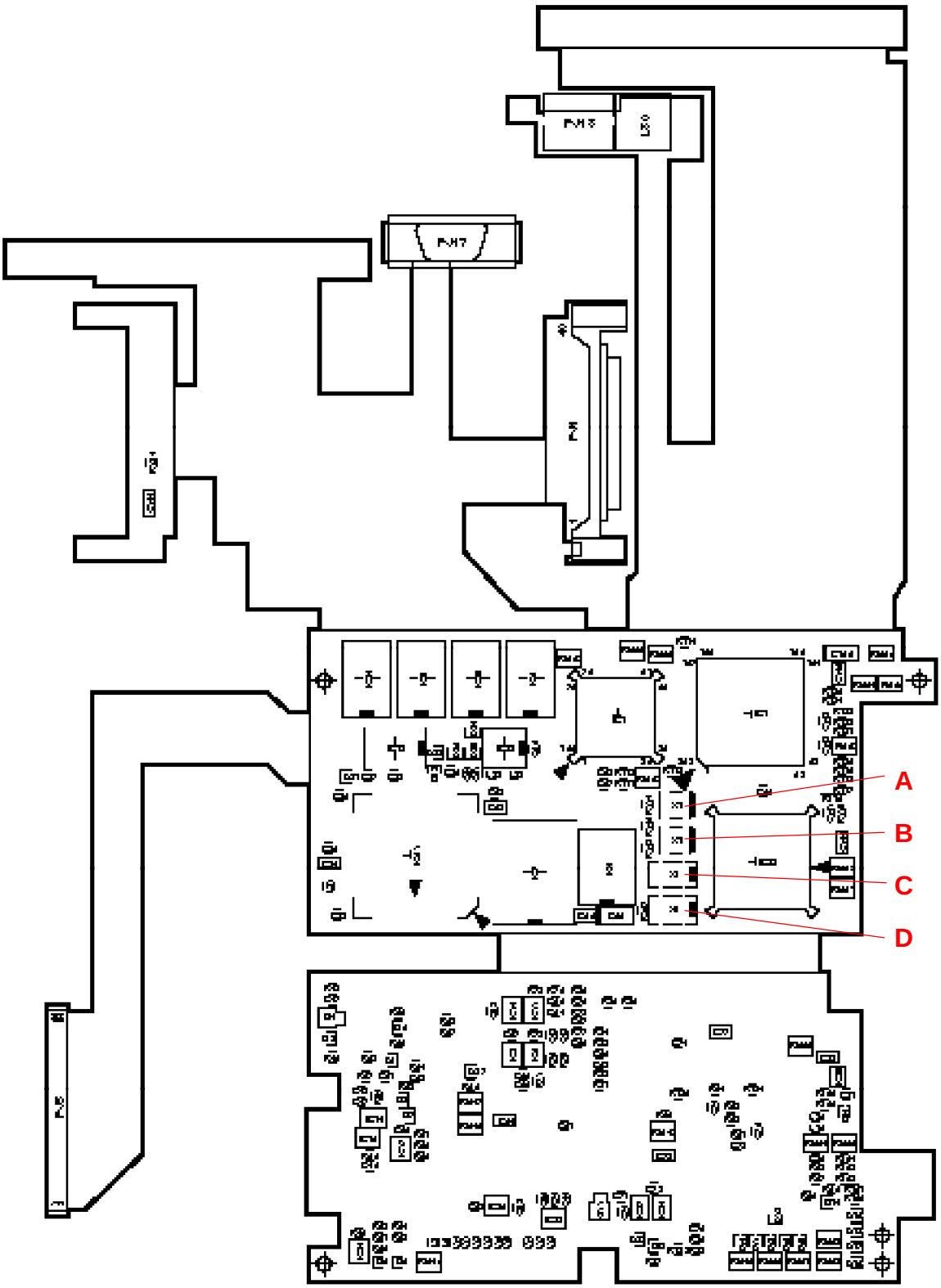


Figure A-6 System board FSTFGx (OSCs) (back)

Table A-3 OSCs on the system board FSTFGx

Callout	Number	Name
(A)	X1	40.0 MHz Oscillator for CPU
(B)	X2	44.9 MHz Oscillator for video
(C)	X3	28.322 MHz Oscillator for video
(D)	X4	25.175 MHz Oscillator for video
(E)	X5	14.7456 MHz Oscillator for COM
(F)	X6	14.31818 MHz Oscillator for KBC
(G)	X7	32.768 KHz Oscillator for RTC
(H)	X8	24 MHz Oscillator for FDC and VFO

Appendix B Pin Assignments

B.1 PJ1 EXP MEM Connector

Table B-1 EXP MEM connector pin assignment (40-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		21	RAMV	
2	D03;100		22	MA07;101	
3	D04;100		23	MA06;101	
4	D05;100		24	MA05;101	
5	D06;100		25	MA04;101	
6	D07;100		26	MA03;101	
7	D08;100		27	MA02;101	
8	D09;100		28	MA01;101	
9	D10;100		29	DRMEM;100	
10	MA08;101		30	GND	
11	GND		31	MA00;101	
12	CASH;002		32	D00;100	
13	RAS4;000		33	D01;100	
14	RAS3;000		34	D02;100	
15	MEMWE;002		35	D11;100	
16	CASL;002		36	D12;100	
17	RAS5;000		37	D13;100	
18	RAS2;000		38	D14;100	
19	EMA09;101		39	D15;100	
20	RAMV		40	GND	

B.2 PJ2 RTC Connector

Table B-2 RTC connector pin assignment (2-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	S10	3.6V	2	GND	

B.3 PJ3 PRT/FDD (Ext) Connector

Table B-3 PRT/FDD (Ext) connector pin assignment (25-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		14	AUTFD;000	
2	PDB00;100		15	ERROR;000	
3	PD01;100		16	PINT;000	
4	PD02;100		17	SLIN;000	
5	PD03;100		18	GND	
6	PD04;100		19	GND	
7	PD05;100		20	GND	
8	PD06;100		21	GND	
9	PD07;100		22	GND	
10	ACK;000		23	GND	
11	BSY;100		24	GND	
12	PE;100		25	GND	
13	SELCT;100		---	---	---

B.4 PJ4 FDD (Int) Connector

Table B-4 FDD (Int) connector pin assignment (25-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	ISSEL;000		14	GND	
2	GND		15	IDIRC;000	
3	IRDAT;000		16	ILOWD;000	
4	GND		17	IMON;000	
5	IQPR;000		18	IRMED;000	
6	GND		19	IRDY;000	
7	ITR0;000		20	VCC	
8	GND		21	DSKCHG;000	
9	IWEN;000		22	VCC	
10	GND		23	IDSL;000	
11	IWDAT;000		24	VCC	
12	GND		25	IINDEX;000	
13	ISTEP;000		---	---	---

B.5 PJ5 HDD I/F Connector

Table B-5 HDD I/F connector pin assignment (50-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	(N/C)		26	VCC	
2	(N/C)		27	(N/C)	
3	(N/C)		28	GND	
4	(N/C)		29	IOWR;000	
5	(N/C)		30	GND	
6	(N/C)		31	IORD;000	
7	RESET;000		32	GND	
8	GND		33	(N/C)	
9	SD07;102		34	(N/C)	
10	SD08;102		35	IIRDY;100	
11	SD06;102		36	GND	
12	SD09;102		37	IRQ14;100	
13	SD05;102		38	IIO16;000	
14	SD10;102		39	SA01;100	
15	SD04;102		40	(N/C)	
16	SD11;102		41	SA00;100	
17	SD03;102		42	SA02;100	
18	SD12;102		43	HDC0C5;000	
19	SD02;102		44	HDC1C9;000	
20	SD13;102		45	DRVBL;000	
21	SD01;102		46	GND	
22	SD14;102		47	VCC	
23	SD00;102		48	VCC	
24	SD15;102		49	GND	
25	GND		50	VCC	

B.6 PJ6 Asynchronous I/F Connector

Table B-6 Asynchronous I/F connector pin assignment (9-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	DCD1;100		6	OSR1;100	
2	RD1;000		7	RTS1;100	
3	SD1;000		8	CTS1;100	
4	DTR1;100		9	RI1;100	
5	GND		---	---	---

B.7 PJ7 I/O Card (Modem) Connector

Table B-7 I/O card (modem) connector pin assignment (68-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		35	GND	
2	SD03;100		36	(N/C)	
3	SD04;100		37	DRQ1;100	
4	SD05;100		38	DRQ2;100	
5	SD06;100		39	DRQ3;100	
6	SD07;100		40	DRQ4;100	
7	GND		41	IRQ4;100	
8	SA10;100		42	(N/C)	
9	SMER;000		43	(N/C)	
10	SA11;100		44	CIORD;000	
11	SA09;100		45	CIOWR;000	
12	SA08;100		46	SA17;100	
13	SA13;100		47	SA18;100	
14	SA14;100		48	SA19;100	
15	SMEW;000		49	DACK1;000	
16	IRQ9;100		50	DACK2;000	
17	VCC		51	VCC	
18	(N/C)		52	(N/C)	
19	SA16;100		53	DACK3;000	
20	SA15;100		54	TC;100	
21	SA12;100		55	IOCLK;101	
22	SA07;100		56	BALE;100	
23	SA06;100		57	(N/C)	
24	SA05;100		58	RESET;100	
25	SA04;100		59	IOCRDY;100	
26	SA03;100		60	(N/C)	
27	SA02;100		61	REG;000	
28	SA01;100		62	BSPTON;000	
29	SA00;100		63	(N/C)	
30	SD00;100		64	IRQ5;100	
31	SD01;100		65	IRQ6;100	
32	SD02;100		66	IRQ7;100	
33	(N/C)		67	(N/C)	
34	GND		68	GND	

B.8 PJ8 Speaker Connector

Table B-8 Speaker connector pin assignment (3-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	SPOUT0;100		3	(N/C)	
2	SPOUT1;100		---	---	---

B.9 PJ9 PS I/F Connector

Table B-9 PS I/F connector pin assignment (30-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	CURNT		16	CPCNF;100	
2	CURNT		17	BEEP;000	
3	CURNT		18	PCLR;001	
4	DSPV		19	GND	
5	GND		20	LB;100	
6	DCIN		21	CRG;100	
7	DCIN		22	(N/C)	
8	DCIN		23	P12V	
9	DCIN		24	N9V	
10	GND		25	GND	
11	CBLON;000		26	VCC	
12	ADPCN1;100		27	VCC	
13	PSSD;100		28	VCC	
14	PSRD;100		29	RAMV	
15	PNLOFF;000		30	GND	

B.10 PJ10 KB I/F Connector

Table B-10 KB I/F connector pin assignment (19-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	KBOT00;001		11	KBOT03;001	
2	KBRT6;100		12	KBOT04;001	
3	KBRT0;100		13	KBOT05;001	
4	KBRT2;100		14	KBOT06;001	
5	KBRT3;100		15	KBOT08;001	
6	KBRT1;100		16	KBOT02;001	
7	KBRT7;100		17	KBOT07;001	
8	KBRT5;100		18	KBOT09;001	
9	KBRT4;100		19	KBOT10;001	
10	KBOT01;001		---	---	---

B.11 PJ11 LED Connector

Table B-11 LED connector pin assignment (11-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	CHG;100		7	CAPLED;100	
2	LB;100		8	GND	
3	DRVSL;000		9	VCC	
4	ALED;100		10	GND	
5	OVERLED;100		11	GND	
6	NUMLED;100		---	---	---

B.12 PJ12 LCD Connector

Table B-12 LCD connector pin assignment (12-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		7	SUD3;120	
2	SCLK;110		8	SLD0;120	
3	GND		9	SLD1;120	
4	SUD0;120		10	SLD2;120	
5	SUD1;120		11	SLD3;120	
6	SUD2;120		12	GND	

B.13 PJ13 LCD Connector

Table B-13 LCD connector pin assignment (6-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		4	GND	
2	LP;020		5	DSPV	
3	FP;020		6	CBLON;000	

B.14 PJ14 Expansion Connector

Table B-14 Expansion connector pin assignment (150-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	DCIN		39	SA18;101	
2	DCIN		40	SA19;101	
3	DCIN		41	SD00;101	
4	DCIN		42	SD01;101	
5	CURNT		43	SD02;101	
6	CURNT		44	SD03;101	
7	CURNT		45	GND	
8	CURNT		46	SD04;101	
9	ADPCN;100		47	SD05;101	
10	GND		48	SD06;101	
11	RVCC		49	SD07;101	
12	GND		50	SMEW;001	
13	CPCNF;100		51	SMER;001	
14	MDMSL;001		52	GND	
15	COMCLK;101		53	IOWR;001	
16	MIRQ;001		54	IORD;001	
17	SPKTON;001		55	TC;101	
18	GND		56	BALE;101	
19	SA00;101		57	RESET;101	
20	SA01;101		58	DACK1;001	
21	SA02;101		59	IRQ9;101	
22	SA03;101		60	GND	
23	SA04;101		61	(N/C)	
24	SA05;101		62	IOCLK;101	
25	SA06;101		63	IRQ5;101	
26	SA07;101		64	DRQ3;101	
27	GND		65	DACK3;001	
28	SA06;101		66	AEN;101	
29	SA09;101		67	DRQ1;101	
30	SA10;101		68	IOCRDY;101	
31	SA11;101		69	GND	
32	SA12;101		70	IRQ10;101	
33	SA13;101		71	IRQ14;101	
34	SA14;101		72	SD08;101	
35	SA15;101		73	SD09;101	
36	GND		74	IRQ11;101	
37	SA16;101		75	SD10;101	
38	SA17;101		---	---	---

Table B-14 Expansion connector pin assignment (150-pin) (continued)

Pin	Signal	I/O	Pin	Signal	I/O
76	SD11;101		114	PHYSYNC;100	
77	SD12;101		115	PVSYNC;100	
78	IRQ12;101		116	GND	
79	GND		117	EKBDAT;100	
80	SD13;101		118	EKBCLK;100	
81	SD14;101		119	TENKEY;100	
82	IRQ5;101		120	MDUSED;100	
83	SD15;101		121	MDSECK;100	
84	LA22;101		122	GND	
85	LA23;101		123	STROB;000	
86	DRQ2;101		124	PDB00;100	
87	LA21;101		125	PDB01;100	
88	LA19;101		126	PDB02;100	
89	LA20;101		127	PDB03;100	
90	DACK6;001		128	PDB04;100	
91	GND		129	PDB05;100	
92	REFMD;001		130	PDB06;100	
93	LA18;101		131	PDB07;100	
94	MASTER;001		132	ACK;000	
95	LA17;101		133	BUSY;100	
96	SBHE;001		134	PE;100	
97	IOCHCK;001		135	SELCT;100	
98	MMCS16;001		136	AUTFD;000	
99	GND		137	ERROR;000	
100	IOCS16;001		138	PINT;000	
101	DACK2;001		139	SLIN;000	
102	DRQ6;101		140	GND	
103	DRQ5;101		141	SD1;000	
104	DACK5;001		142	DTR1;100	
105	MERD;001		143	RTS1;100	
106	IRQ4;101		144	DCD1;100	
107	MEWR;001		145	RD1;000	
108	IRQ7;101		146	DSR1;100	
109	GND		147	CTS1;100	
110	RED;101		148	RI1;100	
111	LGREN;101		149	GND	
112	BLUE;101		150	GND	
113	GND		---	---	---

B.15 PJ15 Ten Keypad Connector

Table B-15 Ten keypad connector pin assignment (2-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	PNLOFF;001		2	GND	

B.16 PJ16 Numeric Keypad Connector

Table B-16 Numeric keypad connector pin assignment (3-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	GND		3	TENKEY;100	
2	(N/C)		---	---	---

B.17 PJ17 CRT I/F Connector

Table B-17 CRT I/F connector pin assignment (15-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	RED;101	O	9	(N/C)	
2	LGREN;101	O	10	GND	
3	BLUE;101	O	11	(N/C)	
4	(N/C)		12	(N/C)	
5	GND		13	PHSYNC;100	O
6	GND		14	PVSYNC;100	O
7	GND		15	(N/C)	
8	GND		---	---	---

B.18 PJ18 DC IN 18V Connector

Table B-18 DC IN 18V connector pin assignment (6-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	DCIN		4	ADPCN;100	
2	CURNT		5	GND	
3	GND		6	GND	

B.19 PJ19 PS/2 Mouse Connector

Table B-19 PS/2 mouse connector pin assignment (4-pin)

Pin	Signal	I/O	Pin	Signal	I/O
1	(N/C)		3	VCC	
2	GND		4	(N/C)	

Appendix C ASCII Character Codes

Table C-1 ASCII character codes

HEXA-DECIMAL VALUE	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	BLANK (NULL)	▶	BLANK (SPACE)	0	@	P	‘	p	Ç	É	á	⁞⁞⁞	└	╨	α	Ξ
1	☺	◀	!	1	A	Q	a	q	ü	æ	í	⁞⁞⁞	┴	═	β	±
2	☻	↕	“	2	B	R	b	r	é	Æ	ó	⁞⁞⁞	┬	╥	⌜	≥
3	♥	!!	#	3	C	S	c	s	â	ô	ú	⁞	├	╙	π	≤
4	♦	¶	$	4	D	T	d	t	ä	ö	ñ	┤	─	╘	Σ	⌠
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	╡	┼	╒	σ	⌡
6	♠	▬	&	6	F	V	f	v	å	û	ª	╢	╞	╓	µ	÷
7	•	↨	’	7	G	W	g	w	ç	ù	º	╖	╟	╫	ϒ	≈
8	◘	↑	(	8	H	X	h	x	ê	ÿ	¿	╕	╚	╪	Φ	°
9	○	↓	)	9	I	Y	i	y	ë	Ö	⌐	╣	╔	┘	Θ	∙
A	◙	→	*	:	J	Z	j	z	è	Ü	¬	║	╩	┌	Ω	·
B	♂	←	+	;	K	[	k	{	ï	¢	½	╗	╦	▉	δ	√
C	♀	∟	’	<	L	\	l	¦	î	£	¼	╝	╠	▄	φ	n
D	♪	↔	-	=	M	]	m	}	ì	¥	¡	╜	═	▌	ϕ	2
E	♫	▲	▪	>	N	^	n	~	Ä	Pt	«	╛	╬	▐	∈	■
F	☼	▼	/	?	O	_	o	⌂	Å	ƒ	»	┐	╧	▀	∩	BLANK FF

Appendix D Keyboard Scan/Character Codes

Table D-1 Scan codes (set 1 and 2)

Cap No.	Keytop	Code set 1		Code set 2		Note
		Make	Break	Make	Break	
01	` ~	29	A9	0E	F0 0E	
02	1 !	02	82	16	F0 16	
03	2 @	03	83	1E	F0 1E	
04	3 #	04	84	26	F0 26	
05	4 $	05	85	25	F0 25	
06	5 %	06	86	2E	F0 2E	
07	6 ^	07	87	36	F0 36	
08	7 &	08	88	3D	F0 3D	*2
09	8 *	09	89	3E	F0 3E	*2
10	9 (	0A	8A	46	F0 46	*2
11	0)	0B	8B	45	F0 45	
12	- _	0C	8C	4E	F0 4E	
13	= +	0D	8D	55	F0 55	
15	BkSp	0E	8E	66	F0 66	
16	Tab	0F	8F	0D	F0 0D	
17	Q	10	90	15	F0 15	
18	W	11	91	1D	F0 1D	
19	E	12	92	24	F0 24	
20	R	13	93	2D	F0 2D	
21	T	14	94	2C	F0 2C	
22	Y	15	95	35	F0 35	
23	U	16	96	3C	F0 3C	*2
24	I	17	97	43	F0 43	*2
25	O	18	98	44	F0 44	*2
26	P	19	99	4D	F0 4D	*2
27	[{	1A	9A	54	F0 54	
28	] }	1B	9B	5B	F0 5B	
29 (42)	\ |	2B	AB	5D	F0 5D	*5
30	Caps Lock	3A	BA	58	F0 58	
31	A	1E	9E	1C	F0 1C	
32	S	1F	9F	1B	F0 1B	
33	D	20	A0	23	F0 23	
34	F	21	A1	2B	F0 2B	
35	G	22	A2	34	F0 34	
36	H	23	A3	33	F0 33	
37	J	24	A4	3B	F0 3B	*2
38	K	25	A5	42	F0 42	*2
39	L	26	A6	4B	F0 4B	*2
40	; :	27	A7	4C	F0 4C	*2
41	' "	28	A8	52	F0 52	
43	Enter	1C	9C	5A	F0 5A	

Table D-1 Scan codes (set 1 and 2) (continued)

Cap No.	Keytop	Code set 1		Code set 2		Note
		Make	Break	Make	Break	
44	Shift (L)	2A	AA	12	F0 12	
45	No. 102 key	56	D6	61	F0 61	
46	Z	2C	AC	1A	F0 1A	
47	X	2D	AD	22	F0 22	
48	C	2E	AE	21	F0 21	
49	V	2F	AF	2A	F0 2A	
50	B	30	B0	32	F0 32	
51	N	31	B1	31	F0 31	
52	M	32	B2	3A	F0 3A	*2
53	, <	33	B3	41	F0 41	*2
54	. >	34	B4	49	F0 49	*2
55	/ ?	35	B5	4A	F0 4A	*2
57	Shift (R)	36	B6	59	F0 59	
58	Ctrl	1D	9D	14	F0 14	*3
60	Alt (L)	38	B8	11	F0 11	*3
61	Space	39	B9	29	F0 29	
62	Alt (R)	E0 38	E0 B8	E0 11	E0 F0 11	
75	Ins	E0 52	E0 D2	E0 70	E0 F0 70	*1
76	Del	E0 53	E0 D3	E0 71	E0 F0 71	*1
79	←	E0 4B	E0 CB	E0 6B	E0 F0 6B	*1
80	Home	E0 47	E0 C7	E0 6C	E0 F0 6C	*1
81	End	E0 4F	E0 CF	E0 69	E0 F0 69	*1
83	↑	E0 48	E0 C8	E0 75	E0 F0 75	*1
84	↓	E0 50	E0 D0	E0 72	E0 F0 72	*1
85	PgUp	E0 49	E0 C9	E0 7D	E0 F0 7D	*1
86	PgDn	E0 51	E0 D1	E0 7A	E0 F0 7A	*1
89	→	E0 4D	E0 CD	E0 74	E0 F0 74	*1
110	Esc	01	81	76	F0 76	
112	F1	3B	3B	05	F0 05	

Table D-1 Scan codes (set 1 and 2) (continued)

Cap No.	Keytop	Code set 1		Code set 2		Note
		Make	Break	Make	Break	
113	F2	3C	BC	06	F0 06	
114	F3	3D	BD	04	F0 04	
115	F4	3E	BE	0C	F0 0C	
116	F5	3F	BF	03	F0 03	
117	F6	40	C0	0B	F0 0B	
118	F7	41	C1	83	F0 83	
119	F8	42	C2	0A	F0 0A	
120	F9	43	C3	01	F0 01	
121	F10	44	C4	09	F0 09	
122	F11	57	D7	78	F0 78	*3
123	F12	58	D8	07	F0 07	*3
124	PrintSc	*6	*6	*6	*6	*6
126	Pause	*7	*7	*7	*7	*7
202	Fn	---	---	---	---	*4

NOTES:

*1 Scan codes differ by mode.
*2 Scan codes differ by overlay function.
*3 Combination with **Fn** key makes different codes.
*4 **Fn** key does not generate a code by itself.
*5 This key corresponds to key No. 42 in the 102-key mode.
*6 Refer to Table D-6 Scan codes with **Ctrl** key.
*7 Refer to Table D-7 Scan codes with **Alt** key.

*Table D-2 Scan codes with **Shift** key*

Cap No.	Keytop	Code set 1		Code set 2	
		Make	Break	Make	Break
75	Ins	E0 AA E0 52	E0 D2 E0 2A	E0 F0 12 E0 70	E0 F0 70 E0 12
76	Del	E0 AA E0 53	E0 D3 E0 2A	E0 F0 12 E0 71	E0 F0 71 E0 12
79	←	E0 AA E0 4B	E0 CB E0 2A	E0 F0 12 E0 6B	E0 F0 6B E0 12
80	Home	E0 AA E0 47	E0 C7 E0 2A	E0 F0 12 E0 6C	E0 F0 6C E0 12
81	End	E0 AA E0 4F	E0 CF E0 2A	E0 F0 12 E0 69	E0 F0 69 E0 12
83	↑	E0 AA E0 48	E0 C8 E0 2A	E0 F0 12 E0 75	E0 F0 75 E0 12
84	↓	E0 AA E0 50	E0 D0 E0 2A	E0 F0 12 E0 72	E0 F0 72 E0 12
85	PgUp	E0 AA E0 49	E0 C9 E0 2A	E0 F0 12 E0 7D	E0 F0 7D E0 12
86	PgDn	E0 AA E0 51	E0 D1 E0 2A	E0 F0 12 E0 7A	E0 F0 7A E0 12
89	→	E0 AA E0 4D	E0 CD E0 2A	E0 F0 12 E0 74	E0 F0 74 E0 12

NOTE: The table above shows the scan codes using the left **Shift** key. In case of a combination with the right **Shift** key, the scan codes will change as indicated below:

	With left **Shift**	With right **Shift**
Set 1	E0 AA	E0 B6
	E0 2A	E0 36
Set 2	E0 F0 12	E0 F0 59
	E0 12	E0 59

Table D-3 Scan codes in NumLock mode

Cap No.	Keytop	Code set 1		Code set 2	
		Make	Break	Make	Break
75	Ins	E0 2A E0 52	E0 D2 E0 AA	E0 12 E0 70	E0 F0 70 E0 F0 12
76	Del	E0 2A E0 53	E0 D3 E0 AA	E0 12 E0 71	E0 F0 71 E0 F0 12
79	←	E0 2A E0 4B	E0 CB E0 AA	E0 12 E0 6B	E0 F0 6B E0 F0 12
80	Home	E0 2A E0 47	E0 C7 E0 AA	E0 12 E0 6C	E0 F0 6C E0 F0 12
81	End	E0 2A E0 4F	E0 CF E0 AA	E0 12 E0 69	E0 F0 69 E0 F0 12
83	↑	E0 2A E0 48	E0 C8 E0 AA	E0 12 E0 75	E0 F0 75 E0 F0 12
84	↓	E0 2A E0 50	E0 D0 E0 AA	E0 12 E0 72	E0 F0 72 E0 F0 12
85	PgUp	E0 2A E0 49	E0 C9 E0 AA	E0 12 E0 7D	E0 F0 7D E0 F0 12
86	PgDn	E0 2A E0 51	E0 D1 E0 AA	E0 12 E0 7A	E0 F0 7A E0 F0 12
89	→	E0 2A E0 4D	E0 CD E0 AA	E0 12 E0 74	E0 F0 74 E0 F0 12

Table D-4 Scan codes with Fn key

Cap No.	Keytop	Code set 1		Code set 2	
		Make	Break	Make	Break
43	ENT	E0 1C	E0 9C	E0 5A	E0 F0 5A
58	CTRL	E0 1D	E0 9D	E0 14	E0 F0 14
60	LALT	E0 38	E0 B8	E0 11	E0 F0 11
122	NUML	45	C5	77	F0 77
123	SCRL	46	C6	7E	F0 7E

Table D-5 Scan codes with overlay mode

Cap No.	Keytop	Code set 1		Code set 2	
		Make	Break	Make	Break
08	7 (7)	47	C7	6C	F0 6C
09	8 (8)	48	C8	75	F0 75
10	9 (9)	49	C9	7D	F0 7D
11	0 (≠)	37	B7	7C	F0 7C
23	U (4)	4B	CB	6B	F0 6B
24	I (5)	4C	CC	73	F0 73
25	O (6)	4D	CD	74	F0 74
26	P (-)	4A	CA	7B	F0 7B
37	J (1)	4F	CF	69	F0 69
38	K (2)	50	D0	72	F0 72
39	L (3)	51	D1	7A	F0 7A
40	; (+)	4E	CE	79	F0 79
52	M (0)	52	D2	70	F0 70
53	, (,)	33	B3	41	F0 41
54	(.)	53	D3	71	F0 71
55	/ (/)	E0 35	E0 B5	40 4A	E0 F0 4A

Table D-6 Scan codes with Ctrl key

Key Top	Shift	Code set 1		Code set 2	
		Make	Break	Make	Break
Prt Sc	Common	E0 2A E0 37	E0 B7 E0 AA	E0 12 E0 7C	E0 F0 7C E0 F0 12
	Ctrl*	E0 37	E0 B7	E0 7C	E0 F0 7C
	Shift*	E0 37	E0 B7	E0 7C	E0 F0 7C
	Alt*	54	D4	84	F0 B4

Table D-7 Scan codes with Alt key

Key Top	Shift	Code set 1	Code set 2
		Make	Make
Pause	Common	E1 ID 45 E1 SD C5	E1 14 77 E1 F0 14 F0 77
	Ctrl*	E0 46 E0 C6	E0 7E E0 F0 7E

* This key generates only make codes.

Appendix E Keyboard Layouts

E.1 U.S.A. Keyboard

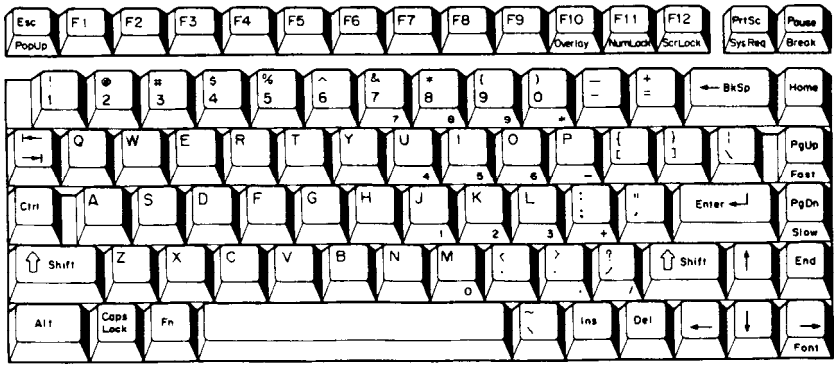


Figure E-1 U.S.A. keyboard

E.2 U.K. Keyboard

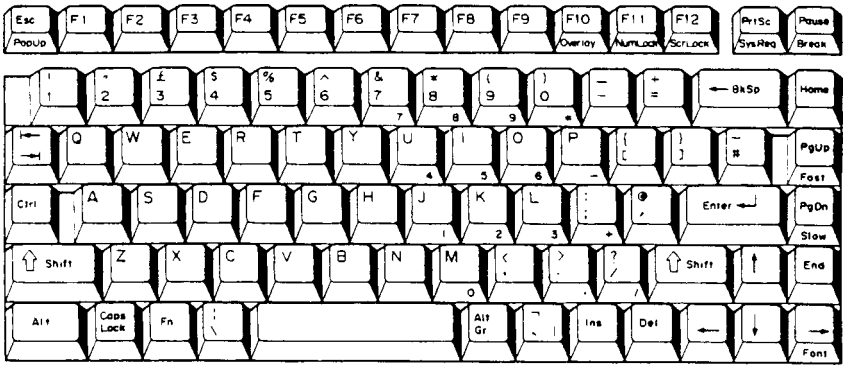


Figure E-2 U.K. keyboard

E.3 German Keyboard

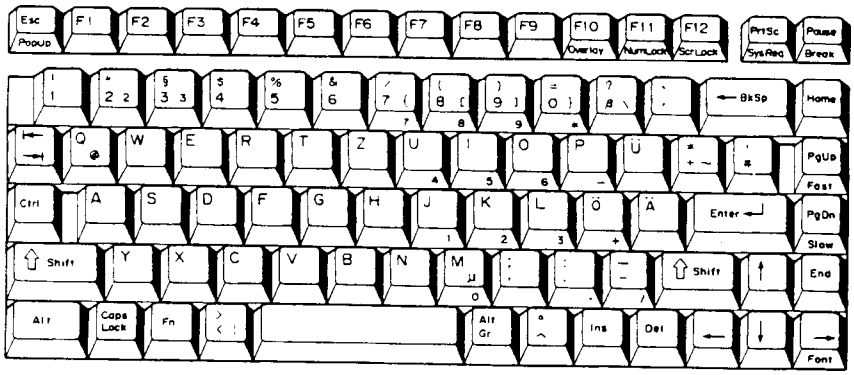


Figure E-3 German keyboard

E.4 French Keyboard

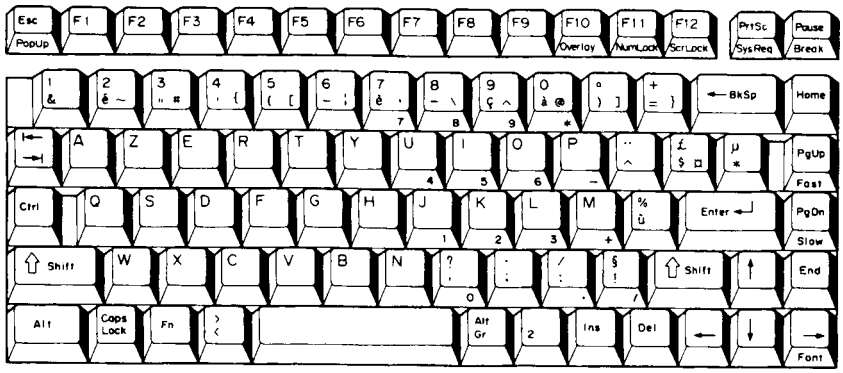


Figure E-4 French keyboard

E.5 Spanish and Latin Keyboard

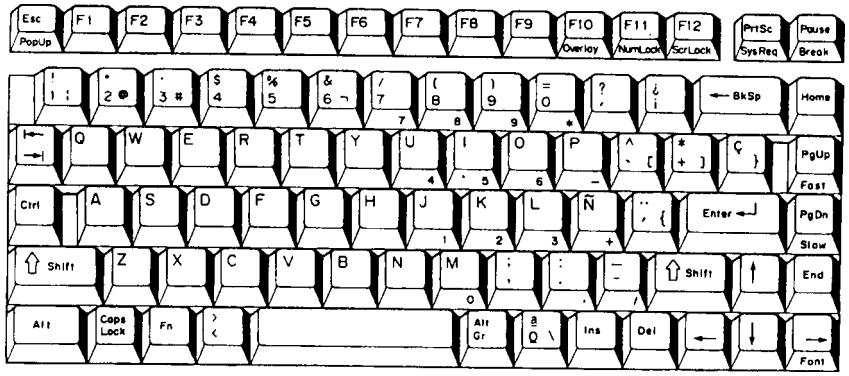


Figure E-5 Spanish and Latin keyboard

E.6 Italian Keyboard

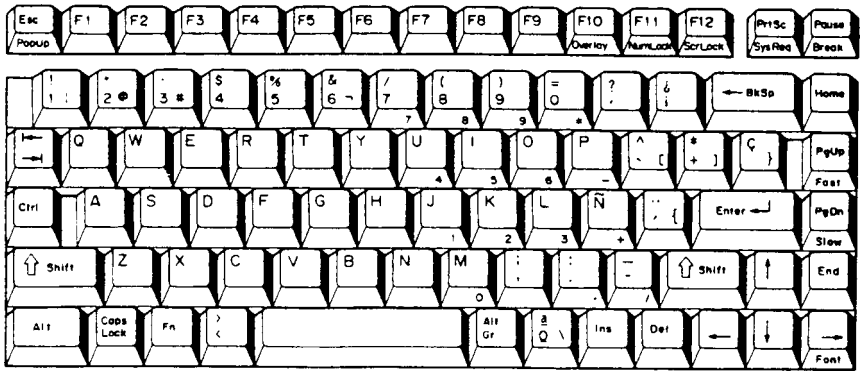


Figure E-6 Italian keyboard

E.7 Scandinavian (DK, NO, SW) Keyboard

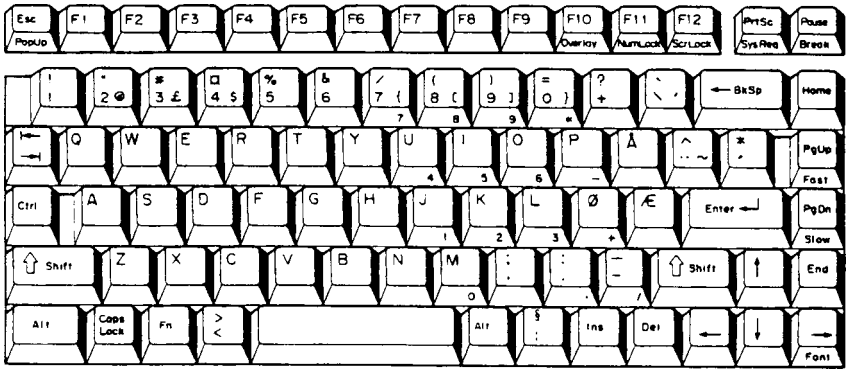


Figure E-7 Scandinavian (DK, NO, SW) keyboard

E.8 Swiss (French/German) Keyboard

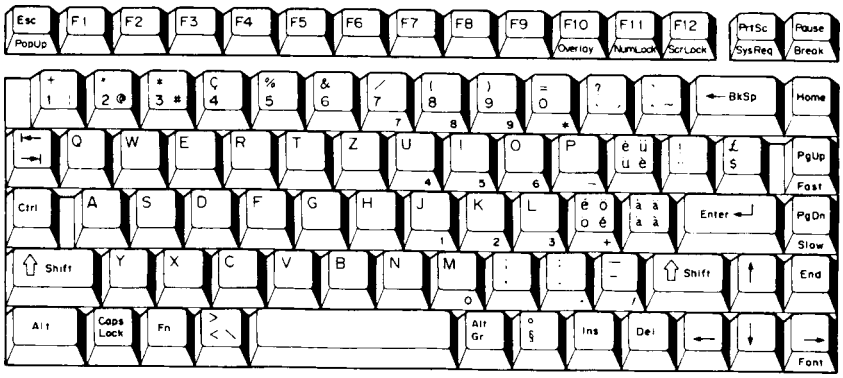


Figure E-8 Swiss (French/German) keyboard

E.9 Canadian Keyboard

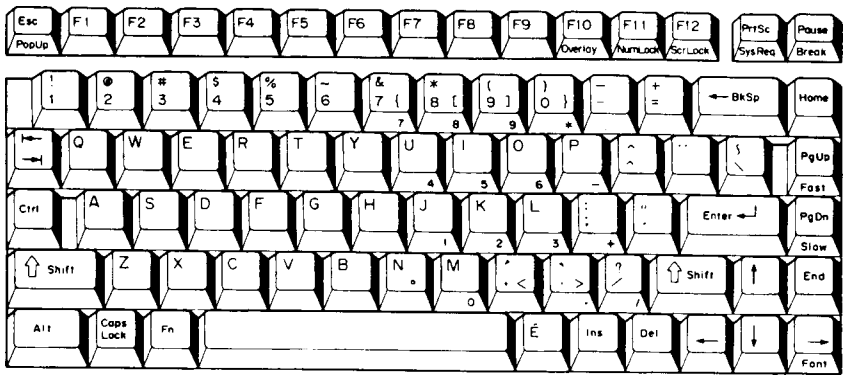


Figure E-9 Canadian keyboard

E.10 Keycap Number Keyboard

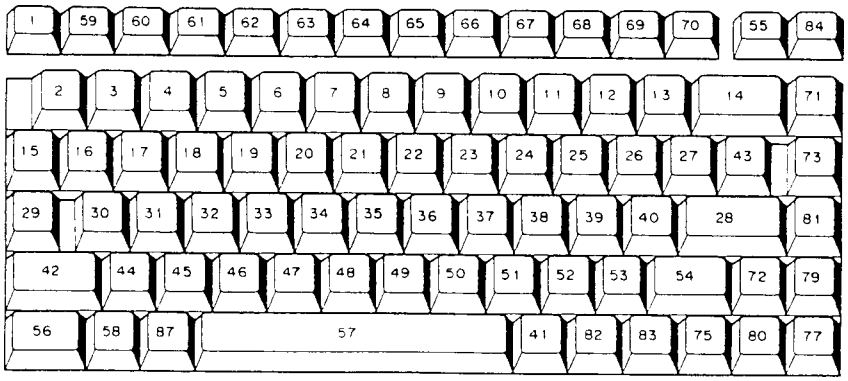


Figure E-10 Keycap number keyboard

Appendix F Wiring Diagrams

F.1 Printer Wraparound Connector

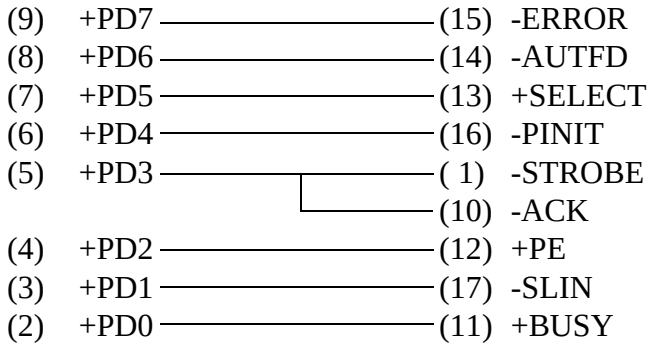


Figure F-1 Printer wraparound connector

F.2 RS-232-C Wraparound Connector

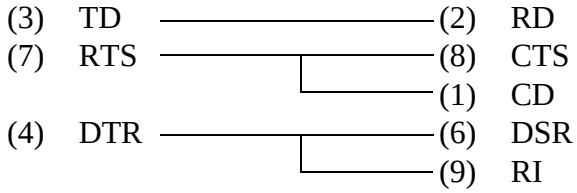


Figure F-2 RS-232-C wraparound connector

F.3 RS-232-C Direct Cable (9-pin to 9-pin)

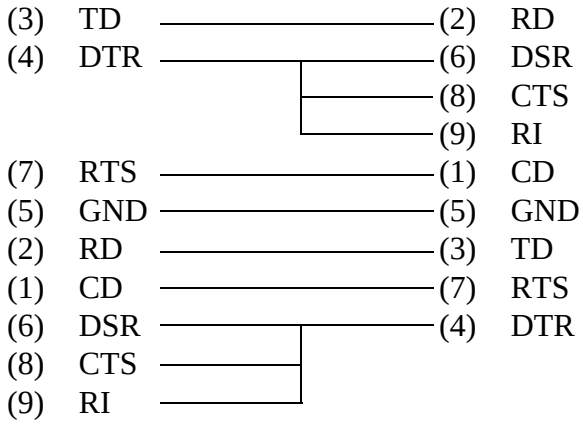


Figure F-3 RS-232-C direct cable (9-pin to 9-pin)

F.4 RS-232-C Direct Cable (9-pin to 25-pin)

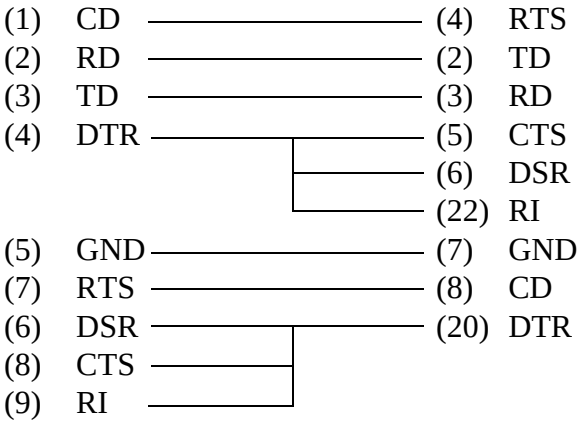


Figure F-4 RS-232-C direct cable (9-pin to 25-pin)

Appendix G Understanding Hexadecimal

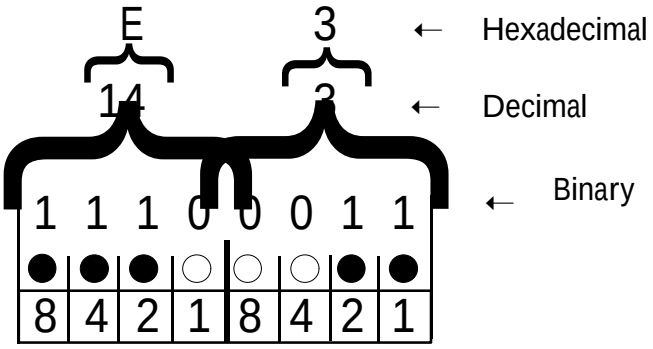
The table and explanation shown below are intended for those who are familiar with the binary numbering system but wish to have a review of the hexadecimal numbering system. Knowing how to convert from binary notation to hexadecimal and decimal notations will help you to interpret the Printer Port LED Connector.

As shown in the table below, hexadecimal and decimal values are identical for numbers 1 through 9. Numbers 10 through 15 however are represented by the letters "A" through "F" in the hexadecimal numbering system.

Table B-1 Hexadecimal Conversion Chart

Binary Notation	Decimal Value	Hexadecimal Notation	Binary Notation	Decimal Value	Hexadecimal Notation
0000	0	0	1000	8	8
0001	1	1	1001	9	9
0010	2	2	1010	10	A
0011	3	3	1011	11	B
0100	4	4	1100	12	C
0101	5	5	1101	13	D
0110	6	6	1110	14	E
0111	7	7	1111	15	F

The eight-digit binary notation shown below is representative of how the digits are separated into four bits, with each group of four bits being converted to a hexadecimal value. The four bits on the left consist of a binary 1110. Using Table A-1, this would stand for the hexadecimal value of "E." The second group of four bits consists of a binary 0011. This would symbolize the hexadecimal value of "3."



Appendix H Using the Printer Port LED

The Printer Port LED provides an eight digit hexadecimal (hex) code used in determining which portion of the Initial Reliability Test (IRT) has failed. After the Printer Port LED is attached to the Printer Port and the system is turned on, the Printer Port LED will indicate an error status in hex code. For information on how to read the hex code, please refer to Appendix G of this manual. Figure H-1 is an illustration of the Printer Port LED Connector with a sample hex code displayed on the LEDs.

> ***NOTE:*** *With the back of the computer facing you, connect the Printer Port LED to the Printer Port. When the computer is turned on, the Printer Port LED should be read from left to right. If you prefer to use this connector with the front of the computer facing you, read the connector from right to left to avoid reading it backward.*

Procedure 2 in Section 3.4 of this manual explains the use of the Printer Port LED.

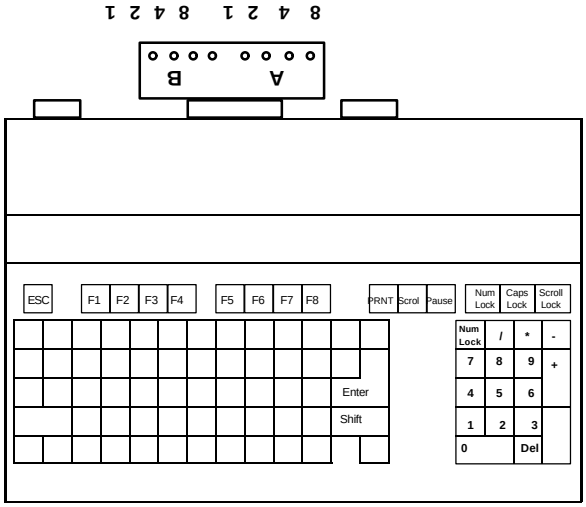


Figure H-1 Printer Port LED Example

Appendix I Acronym Glossary

ACRONYM	DEFINITION
BIOS	Basic Input/Output System
CPU	Central Processing Unit
DSPV	Display Voltage
ESD	Electrostatic Discharge
FDD	Floppy Disk Drive
FL	Fluorescent Light (Lamp)
HDD	Hard Disk Drive
HEX	Hexadecimal
IDE	Integrated Device Electronic
IPS	Intelligent Power Supply
IRT	Initial Reliability Test
LCD	Liquid Crystal Display
LED	Light Emitting Diode
RAM	Random Access Memory
RAMV	Random Access Memory Voltages
RTC	Real Time Clock
TFT	Thin Film Transistor
VCC	Voltage Controlled Circuit
VDC	Voltage Direct Current
VGA	Video Graphics Array