

1.1 GENERAL

The Toshiba T1600 is one of the lightest portable computers available offering high technology, high speed, excellent legibility, IBM PC AT compatibility and battery machine. The T1600's operating system is used the MS-DOS version 3.30 and a powerful 80C286-12 microprocessor which has 16-bit data width on the data bus line. The memory capacity is one megabyte as standard. The system can be add one or two 2-megabyte memory cards, thus the system can be had up to 5 megabytes of RAM. The internal 3.5-inch HDD (hard disk drive) has capacity of 20 megabytes. The internal 3.5-inch FDD (floppy disk drive) supports 1.44-megabyte 2HD (double-sided, high-density, double-track) and 720-kilobyte 2DD (double-sided, double-density, double-track) disks. The keyboard is compatible with IBM enhanced keyboard which has 86 or 88 keys. A backlit LCD (liquid crystal display) comes with your T1600. It can be replace this display with optional light reflecting LCD. The screen supports 640 by 400 pixels with TEGA (Toshiba enhanced graphics adapter) graphics and a 16-level gray scale. The power supply system is composed of AC adapter, batteries, and one board which has two microprocessor.

The T1600 provides connecting ports with the optional devices at the rear panel of the system. There are one external drive port, one parallel printer port, two serial ports, one RGB port, and one keypad port. Also, it provides the expansion slot for Toshiba-size card.



Figure 1-1 T1600 System Unit

1.2 SYSTEM UNIT

Figure 1-2 shows the T1600's system block diagram.

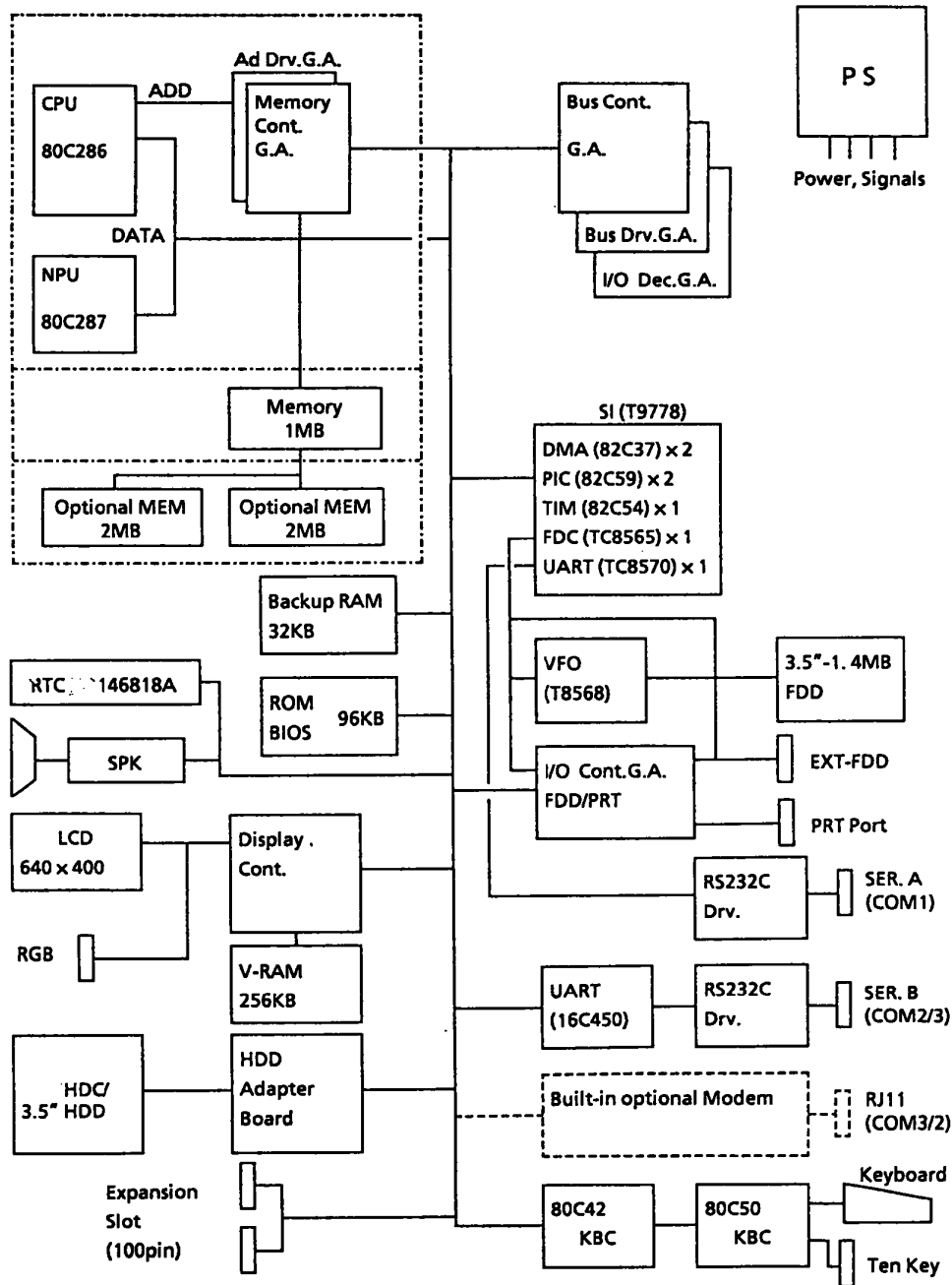


Figure 1-2 Block Diagram

The T1600 has CPU board, system board, and memory board in the system which are composed of the following components :

CPU board

- * Central processing unit : CPU (80C286-12)

The CPU is a 16-bit microprocessor operated at 12MHz or 6MHz clock speed.

- * Numeric data processor socket : NDP (80C287)

T1600 provides the 40-pin socket (DIP type) for NDP.

- * Gate arrays :

The following gate arrays are mounted in the CPU board.

- * Address driver gate array : ADDRIV-GA (100 pin)
- * Memory controller gate array : MEMC-GA (100 pin)

System board

- * Supper Integration : SI (U9778)

The SI is stored the following components :

Direct Memory Access x2 : DMA (82C37)
Programmable interrupt controller x2 : PIC
(82C59)

Timer x1 : TIM (82C54)

Floppy disk controller x1 : (TC8565)

Universal acyncronus receive transmitter : UART
(TC8570)

- * Variable frequency oscillator : VFO (TC8568AF)

The VFO chip is used for FDD control logic.

- * Real time clock : RTC (146818AF)

The RTC has memory in this chip which keeps the date, time and system configuration by RTC battery.

- * Asynchronus communication element : ACE (U80C5F)

- * Keyboard controller : KBC (80C42 and 80C50)

* Memories :

Backup RAM : 32 Kbytes

This backup RAM is stored the data of the resume feature.

BIOS ROM : 96 Kbytes

This BIOS ROM is programed system BIOS and AGS BIOS programs

Video RAM : 256 Kbytes

* Gate arrays :

Bus controller gate array : BUSC-GA (100 pin)

Bus driver gate array : BUSD-GA (100 pin)

I/O decoder gate array : IODEC-GA (48 pin)

Display controller gate array : DISC-GA (144 pin)

Memory board

This memory board is mounted the 1 Mbyte of RAM which are used such as working memory, Hard RAM, Virtual disk.

1.3 3.5-INCH FLOPPY DISK DRIVE

The 3.5-inch internal FDD (floppy disk drive) is a high performance, reliable, and thin drive that supports 720-kbyte (formatted) 2DD and 1.44-Mbyte (formatted) 3.5-inch floppy disk. The FDD is shown in figure 1-3 and its specifications are described in table 1-1.

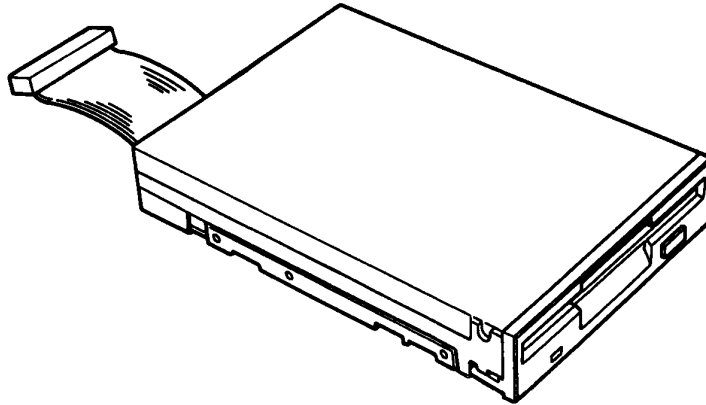


Figure 1-3 3.5-inch FDD

Table 1-1 3.5-inch FDD Specifications

ITEM	SPECIFICATIONS	
	2-Mbyte mode	1-Mbyte mode
Storage Capacity (Kbytes)		
Unformatted	2,000	1,000
Formatted	1,440	720
Number of Heads	2	2
Number of Cylinders	80	80
Access Time (ms)		
1 Track Access	3	3
Average	94	94
Head Settling Time	15	15
Recording Density (bit per inch)	135	135
Data Transfer Rate (K bytes per second)	500	250
Rotational Speed (revolutions per minute)	300	300
Recording Method	MFM (Modified Frequency Modulation)	

1.4 3.5-INCH HARD DISK DRIVE

The 20-Mbyte (formatted) HDD (hard disk drive) is a random access type storage device. It is equipped with non-removal 3.5-inch magnetic disks and mini-winchester type magnetic heads. The HDD is shown in figure 1-4 and its specifications are described in table 1-2.

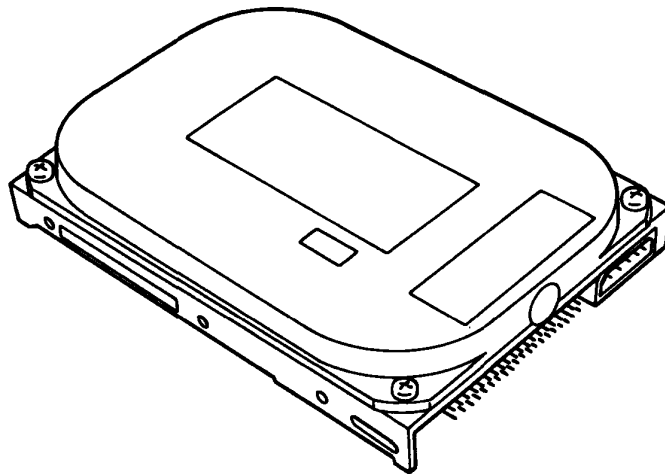


Figure 1-4 3.5-inch HDD

Table 1-2 3.5-inch HDD Specifications

ITEM	SPECIFICATIONS
Storage Capacity : Formatted	21.4 Mbytes
Number of Disks	1
Data Surfaces	2
Data Heads	2
Tracks per Surface	636
Track Capacity : Formatted	1150 tracks per inch
Sectors per Track :	
Physical sectors	34 bytes per sector
User sectors	33 bytes per sector
Access time	
Track to Track	8 ms
Average	27 ms
Maximum	50 ms
Rotation Speed	3575 rpm (+1%)
Data Transfer Rate :	
To/From Media	1.25 Mbytes per Second
To/From Buffer	4 Mbytes per second
Start Time (0-3575RPM) : Typical	5 seconds
Maximum	10 seconds
(0 RPM-READY) : Typical	7 seconds
Maximum	15 seconds
Stop Time : Typical	5 seconds
Maximum	10 seconds
Interleave	3 : 1
Recording Method	2-7 RLL code (Run Length Limited)
Recording Density (ID)	21,594 bits per inch

Jumper straps

The hard disk drive has three jumper straps which are located on the hard disk control board.

Table 1-3 HDD Jumper Strap Status

Type	E5	E6	E7
Single drive	Short	Open	Short
Two drive, master	Open	Short	Short
Two drive, slave	Open	Short	Open

1.5 KEYBOARD

The 86 or 88-keyboard is mounted on the system unit. The 86-key is for USA version and 88-key is for Europe version. The keyboard is a key-matrix with one of the 86 or 88 keys at each vertex.

The keyboard is connected to the keyboard controller on the system board through a 22-pin flat cable. The keyboard layout of the U.K. version is shown in figure 1-5. Other keyboard layout is described in appendix C.

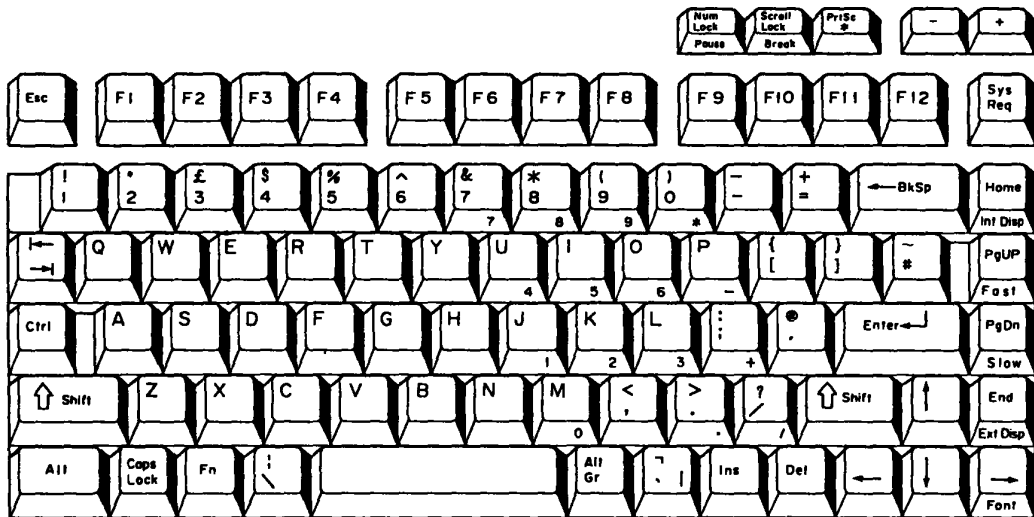


Figure 1-5 Keyboard

1.6 BACKLIT LIQUID CRYSTAL DISPLAY

The backlit liquid crystal display (LCD) is composed of a LCD module, EL panel and EL power supply board. The backlit LCD is an LCD illuminated from the rear. Thus, the you can read its clear display even in poor light condition. It receives vertical and horizontal synchronizing signals, four bit data signals, and shift clock for data transmission. All signals are TTL level compatible. The specifications are described in table 1-4.

The backlit LCD has 16-level of gray scale and the display quality can be adjusted by contrast and brightness controls. The backlit LCD is shown in figure 1-6.

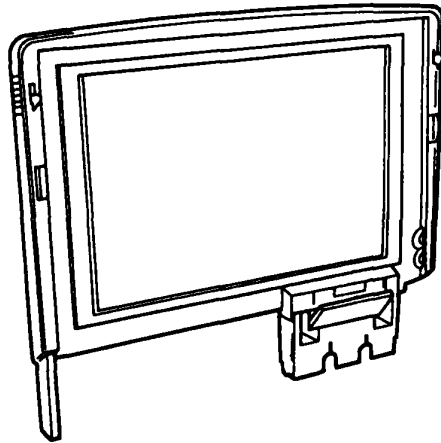


Figure 1-6 Backlit LCD

Table 1-4 Backlit LCD Specifications

ITEM	SPECIFICATIONS
Number of Dots (dots)	640 X 400
Dot Dimension (mm)	0.32 (W) X 0.32 (H)
Dot Pitch (mm)	0.35 (W) X 0.35 (H)
Display Area (mm)	232.0 (W) X 148.0 (H)
Contrast	Approx.1 : 4

1.7 POWER SUPPLY BOARD

The power supply board supplies dc 5, 12, -22, and -9 volts to all the components in the system. It is an intelligent power supply using two microprocessors and it contains the following functions.

1. More accurate low battery detection.
2. Calculations of remaining battery capacity.
3. Over charge protection for battery.
4. Over voltage and over current protection for DC outputs.
5. Over voltage protection for DC input from AC adapter.
6. Control of DC output regulation

Output rating is as following table.

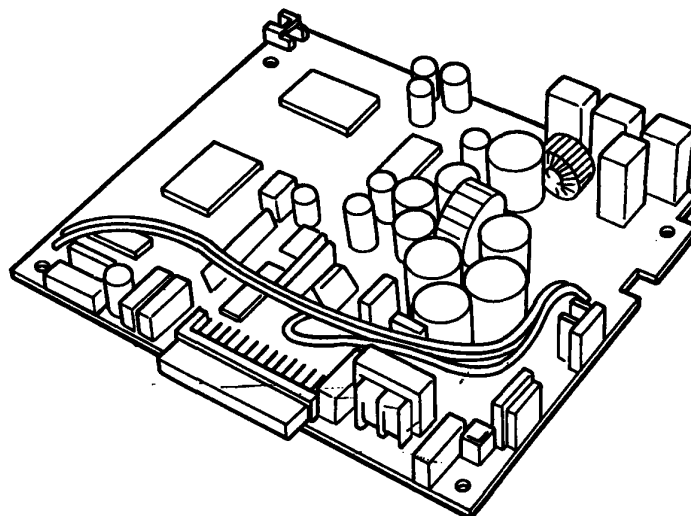


Figure 1-7 Power Supply Board

Table 1-5 Power Supply Board Output Rating

FUNCTION	DC VOLTAGE	REGULATION TOLERANCE (%)	MAX. CURRENT
System logic, FDD			
HDC, HDD	+5	+/-5	1850mA
HDD logic	+5	+/-5	350mA
Backup RAM	+5	+/-5	200mA
LCD VEE	-22	+/-5	10mA
RS232C, Modem, IO-slot	+12	+/-10	40mA
RS232C, Modem, IO-slot	-9	+/-10	40mA
Backlit EL	+12	+/-10	400mA

2.1 GENERAL

The problem isolation procedures described in part 2 are used to isolate defective FRUs (field replaceable units). The FRUs covered are:

1. Power supply unit
2. System board
3. CPU board
4. Memory board
5. FDD
6. HDD
7. Keyboard
8. Display

Detailed replacement procedures instructions are described in part 4 and test program operations are described in part 3.

The following items are necessary for implementing the problem isolation procedures.

1. T1600 diagnostics disk
2. Phillips head screwdriver
3. Work disk (for FDD testing)
4. Cleaning disk kit (for FDD testing)
5. Printer port LED
6. RS-232-C, printer wraparound connectors

The problem isolation flowchart described in section 2.2 can be used to determine which isolation procedures are necessary to isolate a T1600 problem.

2.2 PROBLEM ISOLATION FLOWCHART

The flowchart in figure 2-1 is used as a guide for determining which FRU is defective. Please confirm the followings before performing the flowchart procedures.

1. No disk is in the FDD.
2. All optional equipments are disconnected.
3. MS-DOS has been installed in drive C before a trouble happens.

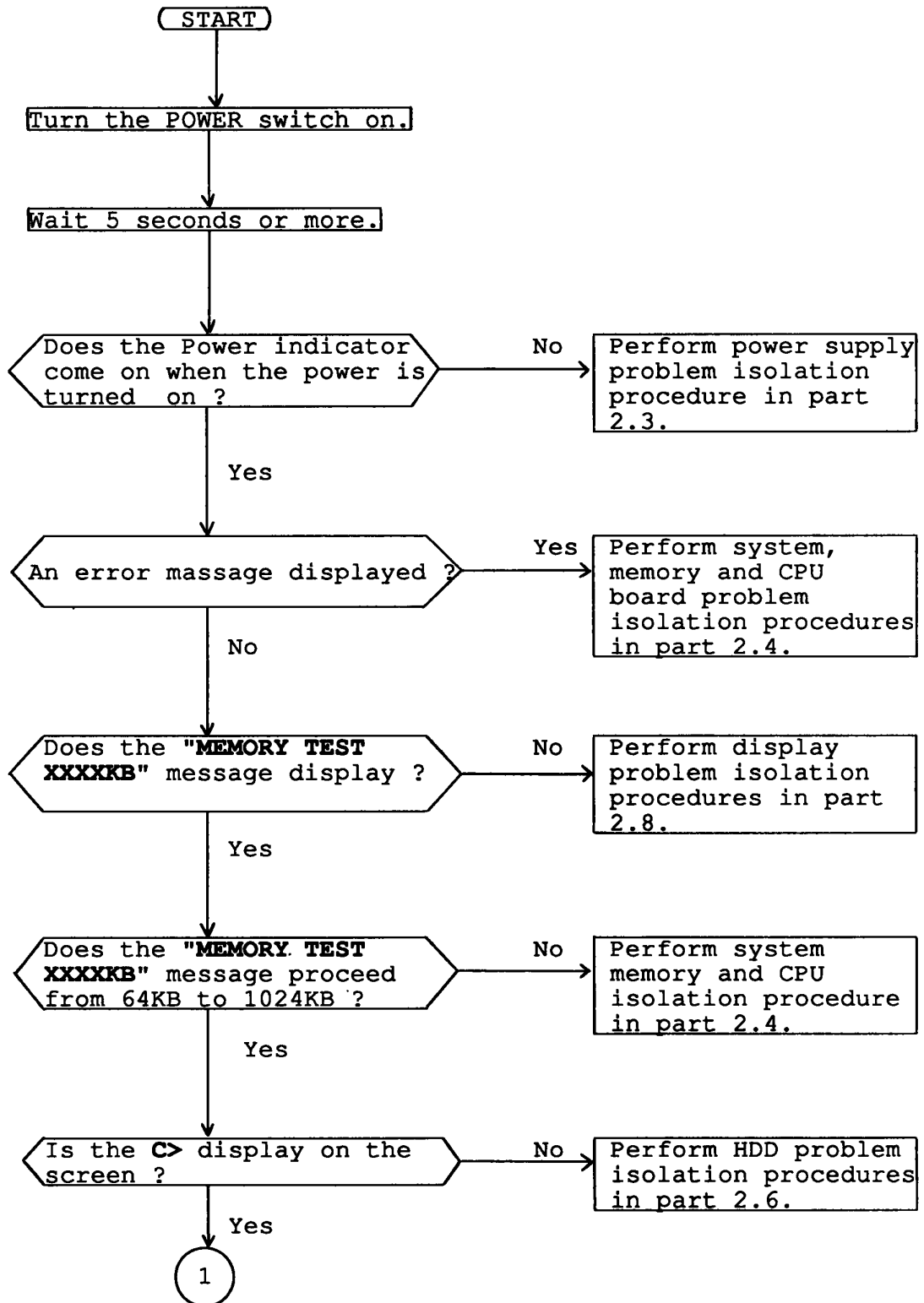
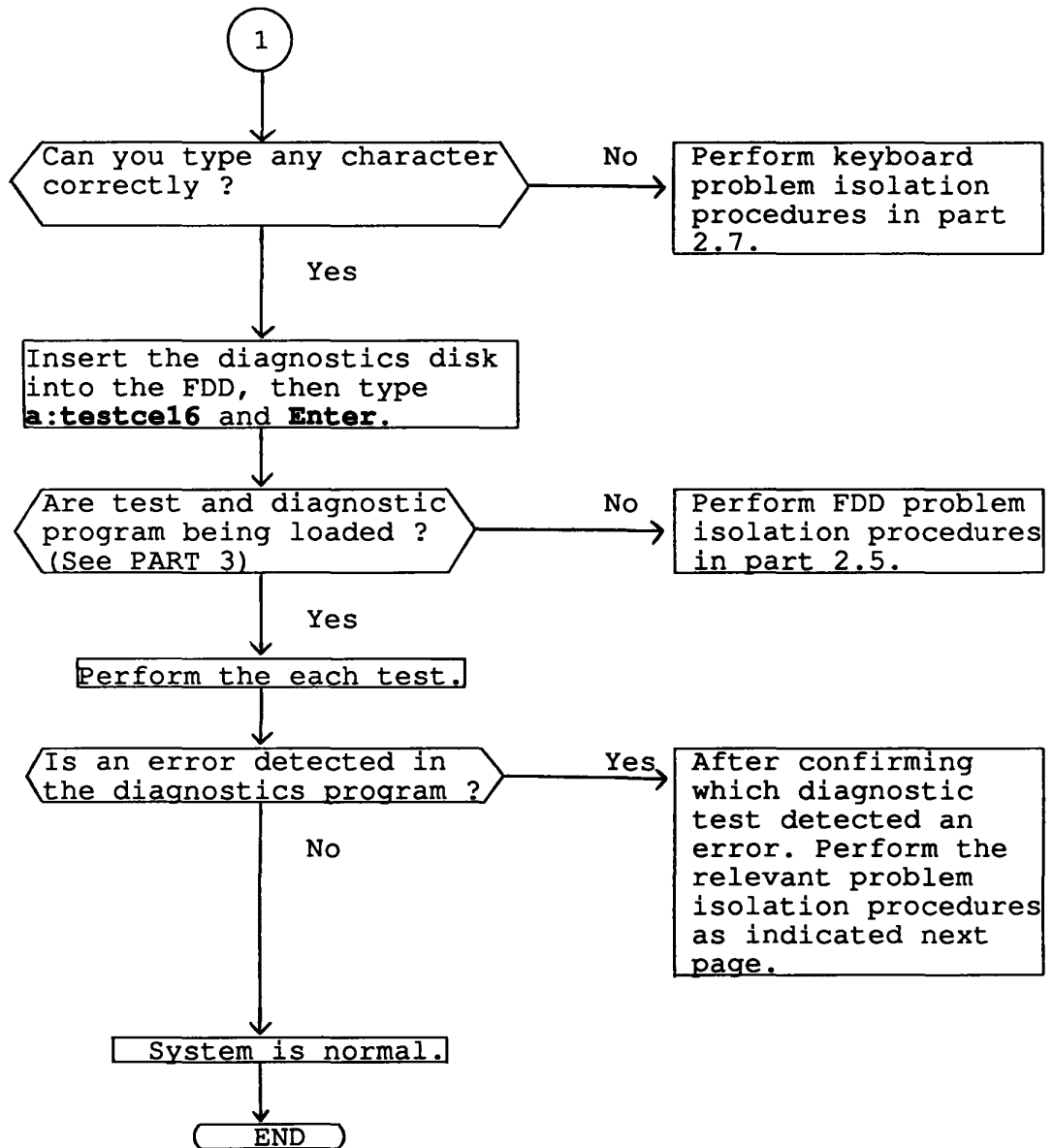


Figure 2-1 Problem Isolation Flowchart



If the diagnostics program cannot detect any error, it may be an intermittent error. Running test is required to check a computer for a while.

1. 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 isolation procedures in section 2.4.
2. If an error is detected on the hard disk test, perform the HDD problem isolation procedures in section 2.6.
3. If an error is detected on the keyboard test, perform the keyboard problem isolation procedures in section 2.7.
4. If an error is detected on the floppy disk test, perform the FDD problem isolation procedures in section 2.5.

2.3 POWER SUPPLY PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the power supply board is defective. Start with PROCEDURE 1 and continue with other procedures as instructed. The procedures described in this section are:

- PROCEDURE 1 DC IN indicator check
- PROCEDURE 2 Connector check

PROCEDURE 1

DC IN indicator check

This indicator lights red if power is supplied from AC adapter to the T1600 when you connect the AC adapter's to T1600 and a wall outlet. If the AC adapter's output voltage is abnormal or the power supply board malfunctions, the indicator labeled "DC IN" flashes red.

If the DC IN indicator flashes red or does not glow when connecting with the AC adapter to the computer, check the following items.

- Check 1 Unplug the AC adapter from the wall outlet and the computer, then remove the both battery packs. Plug the AC adapter into the computer, then the wall outlet and power on the computer. If still its phenomenon remains, perform the check 2.
- Check 2 The AC adapter may be damaged. Replace a new AC adapter. If still its phenomenon remains, perform the PROCEDURE 2.

PROCEDURE 2

Connector check

The power supply board is connected to the other unit by some cables. These cables may be disconnected from the power supply board. Disassemble the T1600 system unit for checking these cables. Disassemble procedures is described in part 4.

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

- o Bus interface connector -----> PJ2
- o Two main battery connector -----> PJ3, PJ4

NOTE: One connector having red cables have to connect to the PJ4 labeled "RED" on the power supply board.

- o Sub battery connector -----> PJ5
- o DC IN indicator connector -----> PJ6

If these cables are disconnected, connect them. Try again the normal operation. If the phenomenon remains, perform the check 2.

Check 2 The power supply board may be damaged. Replace a new power supply board. If still its phenomenon remains, the other unit may be damaged.

2.4 SYSTEM/CPU/MEMORY BOARD PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the system board is defective. Start with PROCEDURE 1 and continue with 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 check

PROCEDURE 1

Message check

After power on, the system performs initial reliability test (IRT) which program is stored in BIOS ROM on the system board. If the error message appears, perform the check 1. If no displayed on the screen, perform the PROCEDURE 2

Check 1 If the following error message appears on the screen, press any key. This program confirms the current system configuration and the configuration stored to RTC memory. If it is different, the following message will appear. You can easily set the current configuration in the RTC memory by pressing any key. If another error message appears, perform check 2.

***** Error in CMOS. Bad Battery *****
Check system. Then press any key

***** Error in CMOS. Bad check sum *****
Check system. Then press any key

***** Error in CMOS. Bad memory configuration *****
Check system. Then press any key

***** Error in CMOS. Bad time function *****
Check system. Then press any key

Check 2 If the following message appears, press any key. At this time the resumed data will be erased. If another error message appears, perform check 3.

WARNING: RESUME FAILURE.
PRESS ANY KEY TO CONTINUE.

Check 3 The IRT program tests the CPU board, memory board, and system board. If an error occurs on the IRT program, the error message appears on the screen. If the following error message or none appears, perform PROCEDURE 3.

ERROR INTERRUPT CONTROLLER #1

ERROR INTERRUPT CONTROLLER #2

**MEMORY VERIFY ERROR AT xxxx:xxxx FOUND xxxx
EXPECTED xxxx**

ERROR INTERRUPTS AND STUCK NMI

ERROR PROTECT MODE

ERROR PROCESSOR EXCEPTIONAL INTERRUPT

If the following message appears on the screen, perform the FDD problem isolation procedures.

***** FDD A is not installed *****

PROCEDURE 2

Printer port LED check

The printer port LED informs the IRT program status and error status as a hexadecimal value after power on the system. Connect the printer port LED to the printer port. After power on, read the LED status from left to right. If the final LED status is **AAH**, perform the PROCEDURE 3. If the final LED status matches any of the error status code or normal status code value in the table 2-1, replace the CPU board, memory board, or system board as indicated as follows.

1. If one of the **81H**, **87H**, **A3H**, or **A6H** is indicated on the printer port LED, replace the CPU board. If the error code still appears, system board or memory board may be damaged.
2. If one of the **95H**, **9FH**, or **A5H** is indicated on the printer port LED, replace the memory board. If the error code still appears, system board or CPU board may be damaged.
3. If an error code other than the above is indicated on the printer port LED, replace the system board. If the error code still appears, CPU board or memory board may be damaged.

Table 2-1 Normal Status and Error Status
of the Printer Port LED

Normal status	Error status	Meaning	Process
01H	81H	CPU test 1 (flag test)	halt
02H	82H	KBIC IBF/OBF test, Video initialization	halt
03H	83H	KBIC IBF test (0AAH command)	halt
04H	84H	KBIC OBF test (55H check)	halt
05H		Reserved	
06H		LSI initialization (DMA, PIT, PIC, RTC)	continue
07H	87H	CPU test 2 (registers)	halt
08H		RTC initialization (register B)	continue
09H	89H	ROM checksum test (64KB)	halt
0AH	8AH	Video initialization	halt
0BH		Reserved	
0CH		Reserved	

Normal status	Error status	Meaning	Process
0DH	8DH	PIT ch2 test and its initialization	halt
0EH		Reserved	
0FH	8FH	CMOS RAM test	halt
10H	90H	DMA ch0 test	halt
11H	91H	DMA ch1 test	halt
12H	92H	DMA page register test	halt
13H	93H	KBSC test and its initialization	halt
14H	94H	Memory refresh test	halt
	A7H	Backup RAM test	halt
	14H	Protect mode test	halt
15H	95H	1st 64KB RAM test	halt
16H		Interrupt vector setup	continue
17H	97H	Video option test	halt
18H	98H	V-RAM test	halt
19H	99H	PIC ch1 test	3 beeps continue
		ERROR INTERRUPT CONTROLLER #1 message appears.	
1AH	9AH	PIC ch2 test	3 beeps continue
		ERROR INTERRUPT CONTROLLER #2 message appears.	
1BH	9BH	CMOS battery test	1 beep key wait
		*** Error in CMOS. Bad Battery *** Check system. Then press any key message appears.	
1CH		Reserved	continue
1DH	9DH	Setup RAM size from CMOS (413H)	continue
1EH	9EH	Size conventional RAM	continue
1FH	9FH	Conventional RAM test	3 beeps continue
		MEMORY VERIFY ERROR AT xxxx:xxxx FOUND xxxx EXPECTED xxxx message appears.	
20H	A0H	PIC #1, #2 test	continue
21H	A1H	NMI check	continue
22H	A2H	Interrupt process test (INT8)	3 beeps continue
		ERROR INTERRUPT AND STUCK NMI message appears.	
23H	A3H	Protect mode test	3 beeps continue
		ERROR PROTECT MODE message appears.	
24H	A4H	Size extended RAM	continue

Normal status	Error status	Meaning	Process
25H	A5H	Conventional & extended RAM test	3 beeps continue
		MEMORY VERIFY ERROR AT xxxx:xxxx FOUND xxxx EXPECTED xxxx message appears.	
26H	A6H	Protect mode exception test	3 beeps continue
		ERROR PROCESSOR EXCEPTIONAL INTERRUPT message appears.	

NOTE: If the error occurs on the 19H to 24H normal status, printer port LED status does not halt. Error message remains on the screen, and when the IRT program is finished, these error messages are disappeared.

PROCEDURE 3

Test program check

The test program has several programs for testing the system board, memory board, and CPU board which is stored in T1600 diagnostics disk. Perform the following test. Detail operation is described in part 3.

System test
Memory test
Display test
Printer test
ASYNC test
Real timer test

If an error is detected during the above tests, replace the CPU board, memory board, or system board as indicated as follows.

1. If an error is detected during the system test, replace the system board. If still the error is detected, system board or memory board may be damaged.
2. If an error is detected during the memory test, replace the memory test. If still the error is detected, system board or CPU board may be damaged.
3. If an error is detected during the display, printer, ASYNC, or real timer test, replace the system board. If still the error is detected, CPU board or memory board may be damaged.

2.5 FLOPPY DISK DRIVE PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the floppy disk drive is defective. Start with PROCEDURE 1 and continue with other procedures as instructed. The procedures described in this section are:

- PROCEDURE 1: Format check
- PROCEDURE 2: Test program check
- PROCEDURE 3: Connector check

PROCEDURE 1

Format check

Prepare the new floppy disk, the format it using MS-DOS FORMAT command.

If the floppy disk is not formatted, check the following items.

- Check 1 Check that the FDD indicator lights. If it does not light, perform the PROCEDURE 3. If it lights, perform check 2.

- Check 2 Check that the MS-DOS FORMAT command is used correctly.
When media type is 2DD, use the FORMAT/3 command.
When media type is 2HD, use the FORMAT command.
If FORMAT command is used correctly, perform the check 3. If FORMAT command is not used correctly, try again.
If still the phenomenon remains, perform the check 3.

- Check 3 Perform the head cleaning by cleaning kit of the 3.5-inch FDD. If still remains, perform the PROCEDURE 2.

PROCEDURE 2

Test program check

The FDD test program is stored the T1600 diagnostics disk. After run the MS-DOS using hard disk, load the diagnostic program. Detail operation is described in part 3. Prepare the formatted floppy disk, then perform the FDD test. The error code and status is described in table 2-2. If the error occurs, perform the check 1.

Table 2-2 FDD Error code and Status

CODE	STATUS
01	Bad Command
02	Address Mark Not Found
03	Write Protected
04	Record Not Found
06	Media Removed On Dual Attach Card
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 (Not Ready)
EE	Write Buffer Error

- Check 1 If the "Write protected" message appears, remove the write protect by moving the write protect tab. If the another error message appear, perform the check 2.

- Check 2 Check that the floppy disk is formatted correctly. If it correctly, perform the PROCEDURE 3.

PROCEDURE 3
Connector check

The FDD is connected to the system board by one cable. Disassemble the system unit for checking the FDD cable. Detail procedures is described in part 4. If it is not connected, connect it to the system board. If it is connected to the system board correctly, performs check 1.

o FDD I/F connector -----> PJ5

Check 1 The FDD may be damaged. Replace the FDD to a new FDD, then check the PROCEDURE 1 and 2. If still the error occurs, the system board (floppy disk controller or other controller) may be defective. Replace the system board.

2.6 HARD DISK DRIVE PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the hard disk drive is defective. Start with PROCEDURE 1 and continue with other procedures as instructed. The procedures described in this section are:

PROCEDURE 1: Logical format check
PROCEDURE 2: Test program check
PROCEDURE 3: Connector check

CAUTION: The contents of the hard disk will be erased when perform the HDD problem isolation procedures. Before performing isolation, transfer the contents of the hard disk to floppy disks. This can be done with the MS-DOS BACKUP command. (See the *MS-DOS manual* for details.)

PROCEDURE 1

Logical format check

Using the MS-DOS system disk, make partition of the hard disk by entering the FDISK command, then format the hard disk by entering the FORMAT command. At this time use /s switch to transfer the system program.

If normal operation is restored, the HDD is normal.

If normal operation is not restored, perform the PROCEDURE 2.

PROCEDURE 2

Test program check

The HDD test program is stored in T1600 Diagnostics disk. Perform the all HDD test. Detail operation is described in part 3.

If the error is detected during the HDD test, an error code and status will be displayed; perform the PROCEDURE 3. The error code and status are described in table 2-3
If no error is generated, HDD is normal.

Table 2-3 HDD Error Status

CODE	STATUS
01	Bad command error
02	Bad address mark
04	Record not found
05	HDC not reset
07	Drive not initialize
09	DMA boundary error
0A	Bad sector error
0B	Bad sector 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 (HW. code=FF)

PROCEDURE 3

Connector check

The HDD is connected to the HDD adapter board by two connectors which are power connector and signal connector. The signal cable is connected to the system board through the HDD adapter board. Disassemble the system unit for checking the HDD cables. Detail procedures is described in part 4. If it is not connected, connect them to the system board. If it is connected to the system board correctly, perform check 1.

Check 1 The HDC has jumper which is located bottom side of the HDD. Check that the jumper status is correctly. The correct jumper setting is described as follows.

E5 -----> short
E6 -----> open
E7 -----> short

If the jumper setting is not correctly, set the jumper to correct setting.

If the jumper setting is correctly, perform the check 2.

Check 2 The HDD and HDC may be damaged. Replace the HDD unit to a new HDD unit, then check the PROCEDURE 1 and 2. If still the error occurs, perform the check 3.

Check 3 The HDD adapter board may be damaged. Replace the HDD adapter board to a new HDD adapter board. If still the error occurs, system board may be damaged.

2.7 KEYBOARD PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the keyboard is defective. Start with PROCEDURE 1 and continue with 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 in T1600 diagnostics disk. Perform the test program. Details operation is described in part 3.

If the error occurs, perform the PROCEDURE 2. If the error does not occur, the keyboard is normal.

PROCEDURE 2

Connector check

The keyboard is connected to the system board by one 22-pin flat cable. Disassemble the system unit for checking the keyboard cable. Detail procedures is described in part 4. If it is not connected, connect it. If it connected correctly, check 1.

o Keyboard I/F connector -----> PJ1

Check 1 The keyboard may be damaged. Replace the keyboard to a new keyboard, then check the PROCEDURE 1. If still error occurs, the keyboard controller on the system board may be damaged

2.8 DISPLAY PROBLEM ISOLATION PROCEDURES

This section describes how to determine whether or not the DISPLAY is defective. Start with PROCEDURE 1 and continue with other procedures as instructed. The procedures described in this section are:

- PROCEDURE 1: Brightness and contrast volume check
- PROCEDURE 2: Test program check
- PROCEDURE 3: Connector check
- PROCEDURE 4: Replacement check

PROCEDURE 1

Brightness and contrast volume check

The system has brightness and contrast dials on the display. Using the two dials to fine tune the display screen to your satisfaction. If the brightness does not change, EL element may be lifetime. Replace the EL panel. If the character light does not change, perform the PROCEDURE 2. If brightness and contrast of the display change, perform the PROCEDURE 2.

PROCEDURE 2

Test program check

Using T1600 diagnostics disk, perform the display test. The display test checks the display controller on the system board.

If the error is detected, perform the PROCEDURE 3. If the error is not detected, the display is normal.

PROCEDURE 3

Connector check

The display unit has LCD module, EL power supply board, and volume board. The LCD module are connected to the EL power supply board, volume board, and system board by connector. Disassemble the display unit for checking these connector. Detail procedures are described in part 4.

If these connector are not connected, connect them. If these connector are connected, perform the PROCEDURE 4.

PROCEDURE 4

Replacement check

Replace the EL power supply board, then perform the normal operation. If still the phenomenon remains, replace the LCD module. If still the phenomenon remains, system board may be damaged.

3.1 GENERAL

This part explains test and diagnostics programs. That checks the functions of all hardware modules of the T1600.

There are 17 programs grouped into two modules: the service program module (DIAGNOSTICS MENU) and test program module (DIAGNOSTIC TEST MENU).

The service program module is composed of 6 tasks:

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

The test program module is composed of 11 tests:

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
11. EXPANSION TEST

The following items are necessary for carrying out the test and diagnostic programs.

1. T1600 diagnostics disk
2. MS-DOS system disk
3. Formatted work disk (For FDD test)
4. Cleaning disk kit (For read cleaning)
5. Printer wraparound connector
(For printer wraparound test)
6. RS-232-C wraparound connector
(For ASYNC wraparound test)

Service personnel can use these programs to isolate problems by selecting the appropriate program and operation procedures described in section 3.2.

3.2 OPERATIONS

1. After run the MS-DOS, insert the diagnostics disk in the floppy disk drive.
2. Type in **TESTCE16**, then press **Enter**.
3. The following display will appear:

**TOSHIBA personal computer T1600 DIAGNOSTICS
Version X.XX (C) copyright TOSHIBA Corp. 1988**

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

PRESS [1] - [9] KEY

Detailed explanations of the service programs and the operations are given in section 3.17 to 3.24.

<p>NOTE: To stop the test program: (1) During keyboard operation, press Ctrl + C (2) While running the test program, press Ctrl + Break</p>
--

4. Type in 1, then press **Enter** and the following display will appear:

```
TOSHIBA personal computer T1600 DIAGNOSTICS
version X.XX (C) copyright TOSHIBA Corp. 1988
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
11 - EXPANSION TEST
88 - FDD & HDD ERROR RETRY COUNT SET
99 - EXIT TO DIAGNOSTICS MENU
```

PRESS [1] - [9] KEY

Numbers, 1 to 11 are diagnostic tests.
Number 88 is for setting the floppy disk drive and hard disk drive error retry count.
Number 99 is for returning to the DIAGNOSTIC MENU.
When selecting the floppy disk test or hard disk test, special sub-messages will appear, as described in sections 3.8 and 3.11.

5. After typing in a test number (1 to 11) of the DIAGNOSTIC TEST MENU, pressing Enter displays as follows:

```
TEST NAME                               XXXXXXXX
SUB TEST   : XX                       ERROR COUNT : XXXXX
PASS COUNT : XXXXX                     READ DATA  : XX
WRITE DATA : XX                       STATUS      : XXX
ADDRESS    : XXXXX
SUB-TEST MENU :
01 - ROM CHECKSUM
02 - HW status
99 - Exit to DIAGNOSTIC TEST MENU
```

SELECT SUB-TEST NUMBER ? _

The screen shown above, for example, appears when you type 1 and **Enter**.

6. Select a subtest. Type in the subtest number, then press **Enter**. The following message will appear:

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

NOTE: If you select KEYBOARD TEST, this message will not appear.

If you select YES (by typing in **1**, then pressing **Enter**):
Each time a test cycle ends, it increments the pass counter by one and repeats the test cycle.
If you select NO (by typing in **2**, then pressing **Enter**):
At the end of a test cycle, the test execution is terminated and you exit to the subtest menu.

7. Type in **1** or **2**, then press **Enter**. The following message will appear:

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

If you select YES (by typing in **1**, then pressing **Enter**):
When an error occurs, the error status is displayed and execution of the test program stops and the operation guide is displayed on the right side of the display screen.
If you select NO (by typing in **2**, then pressing **Enter**):
When an error occurs, the error status is displayed then the error counter is incremented by one and you go to the next test.

8. Type in **1** or **2**, then press **Enter** and the test program will run. Each subtest is described in section 3.3.
9. When an error occurs during the test program, the following message will appear: (if you answer YES for ERROR STOP question,)

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: Retries the test.

The error code and error status names are described in section 3.15.

3.3 SUBTEST NAMES

Table 3-1 lists the subtest of each test program.

TABLE 3-1 Subtest Names and Execution Time

No.	TEST NAME	SUBTEST No.	SUBTEST ITEM	TIME (s)
1	SYSTEM	01	ROM checksum	1
		02	HW status	-
2	MEMORY	01	RAM constant data	21
		02	RAM address pattern data	6
		03	RAM refresh	12
		04	Protected mode (4MB)	7 (107)
		05	Extended memory	32
		06	Backup memory	
		07	RAM on BIOS	
		08	H-RAM	
		09	LIN/EMS mode	
3	KEYBOARD	01	Pressed key display	-
		02	Pressed key code display	-
4	DISPLAY	01	VRAM read/write	1
		02	Character attributes	
		03	Character set	
		04	80*25 Character display	
		05	Graphics display (color set 0/1)	
		06	640*200 Graphics display (mode 6, E)	
		07	640*400 Graphics display (mode 10, 74, 75)	16
		08	Display page	15
		09	"H" pattern display	
		10	LED & Font change	
5	FDD	01	Sequential read	104
		02	Sequential read/write	168
		03	Random address/data	25
		04	Write specified address	1
		05	Read specified address	1

TABLE 3-1 Subtest Names and Execution Time (Continued)

No.	TEST NAME	SUBTEST No.	SUBTEST ITEM	TIME(s)
6	PRINTER	01	Ripple pattern	110
		02	Function	15
		03	Wrap around	1
7	ASYNC	01	Wrap around (channel #1)	1
		02	Wrap around (channel #2)	1
		03	Point to point (send)	1
		04	Point to point (receive)	1
		05	Card modem loopback	5
		06	Card modem on-line test	10
		07	Dial tester test	60
		08	Interrupt test (IRQ4, 3, 5)	
8	HDD	01	Sequential read	227
		02	Address uniqueness	
			1. Forward sequential	272
			2. Reverse	270
			3. Random	125
		03	Random address/data	16
		04	Cross talk & peak shift	219
		05	Write/read/compare (CE)	1
		06	Write specified address	1
		07	Read specified address	1
08	ECC circuit (CE cylinder)	2		
09	Sequential write	116		
10	W-R-C specified address	1		
9	REAL TIMER	01	Real time test	
		02	Real time carry test	1
10	NDP	01	NDP test	1
11	EXPANSION UNIT	01	Box wrap around test	3
		02	Box mono video ram test	1
		03	Wrap around test (16bit bus)	

3.4 SYSTEM TEST

Subtest 01 ROM checksum

This test performs the ROM checksum test on the system board.
(Test extent : F0000H - FFFFFH 64KB)

Subtest 02 H/W status

This test reads the system hardware status, then displays the status as shown below. Press **Enter** to return to the system test's SUB-TEST MENU. Table 3-2 describes the hardware status bits. If you want to return to the SYSTEM TEST menu, press **Enter**.

```

                                76543210
H/W status = 10101100

Bit7 --- Display mode = Internal
Bit6 --- CPU clock    = 12MHZ
Bit5 --- Media type   = 2HD
Bit4 --- FDD type     = 2MB
Bit3 ---
Bit2 --- Drive A/B    = Ext. =B
Bit1 --- External FDD = OFF
Bit0 --- Internal FDD = 2MB
    
```

TABLE 3-2 Hardware Status Bit

Items	H/W Status	1	0
Bit7	Display mode	Internal	External
Bit6	CPU clock	6MHz	12MHz
Bit5	Media type	1.0MB	2MB
Bit4	FDD type	1MB	2MB
Bit3	Reserved		
Bit2	Drive A/B	Ext. =B	Ext. =A
Bit1	External FDD	ON	OFF
Bit0	Internal FDD	1MB	2MB

3.5 MEMORY TEST

Subtest 01 RAM constant data (in real mode)

This subtest writes constant data to memory, 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 (in real mode)

This subtest creates an address pattern by XORing (Exclusive-ORing) the address segment and address offset, writes the address pattern into the segment address and the offset address, then reads and compares it with the original data.

Subtest 03 RAM refresh (in real mode)

This subtest writes 256 bytes of constant data to memory, 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 fixed data and address data to memory (addresses 100000H to the max.) in protected mode, then reads and compares it with the original data.

Subtest 05 Extended memory

For the memory located at the address 100000H or more, the test program writes data, reads it back, and compares in the microprocessor's protected mode. The data patterns used by the program are one address pattern and four constant (i.e. fixed) data patterns. Address pattern data is a data generated by some logical operation with its memory address information. Four constant data patterns are FFFFH, AAAAH, 5555H, and 0000H.

Subtest 06 Backup memory

This subtest writes constant data (FFFFH, AAAAH, 5555H, 0000H) to memory at addresses 0E8000H to 0EFFFFH, then reads and compares it with the original data.

Subtest 07 RAM on BIOS

A register controlling the RAM on BIOS function is checked by a write/read/compare algorithm. And, the functions specified by the register are also verified. Then, the program compares the copied BIOS code in the RAM with the original code in the ROM.

Subtest 08 H-RAM

Registers controlling the Hard-RAM function is checked by a write/read/compare algorithm. And, the functions specified by the registers are also verified. Then, the program compares the copied BIOS code in the RAM with the original code in the ROM. Finally, the memory assigned as Hard-RAM is checked by a write/read/compare algorithm using a Hard-RAM window.

Subtest 09 LIM (in real mode)

Registers controlling the LIM-EMS are checked. Page information is written at the beginning of each page to verify its paging function. Then, the memory assigned as LIM-EMS is checked by a write/read/compare algorithm using a LIM-EMS window.

3.6 KEYBOARD TEST

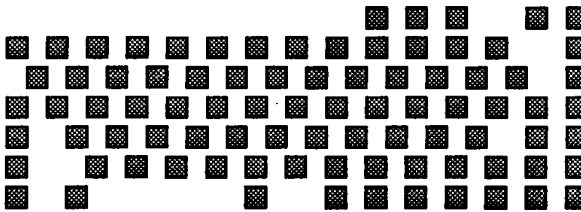
Subtest 01 Pressed key display

NOTE: Make sure the Num-lock key is off. If this key is on, the test cannot be carried out. The Fn key is not subjected to the test.

When the keyboard layout (as shown below) is drawn on the display, press any key and check that the corresponding key on the screen is changed to the character "*".

When a key is held depressed, the display will blink designating the auto-repeat function.

KEYBOARD TEST IN PROGRESS 30100



IF TEST OK, PRESS [DEL] THEN [ENTER] KEY

Subtest 02 Pressed key code display

When a key is pressed, its 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 screen when pressed.

The scan codes, character codes and key top names are shown in table 3-3.

KEYBOARD TEST IN PROGRESS 30200

Scan code = XX
Character code = XX
Keytop = XXXX

Ins Lock Caps Lock Num Lock Scroll Lock
Alt Ctrl Left Shift Right Shift

PRESS [ENTER] KEY

TABLE 3-3 Scan Code, Character Code, and Key Top Names

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
1	~ ,	29 60	29 7E	29 60	29 7E	-	*29 00
2	! 1	02 31	02 21	02 31	02 21	-	78 00
3	@ 2	03 32	03 40	03 32	03 40	03 00	79 00
4	# 3	04 33	04 23	04 33	04 23	-	7A 00
5	\$ 4	05 34	05 24	05 34	05 24	-	7B 00
6	% 5	06 35	06 25	06 35	06 25	-	7C 00
7	^ 6	07 36	07 5E	07 36	07 5E	07 1E	7D 00
8	& 7	08 37	08 26	08 37	08 26	-	7E 00

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
9	* 8	09 38	09 2A	09 38	09 2A	-	7F 00
10	(9	0A 39	0A 28	0A 39	0A 28	-	80 00
11	) 0	0B 30	0B 29	0B 30	0B 29	-	81 00
12	_	0C 2D	0C 5F	0C 2D	0C 5F	0C 1F	82 00
13	+ =	0D 3D	0D 2B	0D 3D	0D 2B	-	83 00
15	Back space	0E 08	0E 08	0E 08	0E 08	0E 7F	*0E 00
16	Tab	0F 09	0F 00	0F 09	0F 00	*94 00	*A5 00
17	Q	10 71	10 51	10 71	10 51	10 11	10 00
18	W	11 77	11 57	11 77	11 57	11 17	11 00
19	E	12 65	12 45	12 65	12 45	12 05	12 00
20	R	13 72	13 52	13 72	13 52	13 12	13 00
21	T	14 74	14 54	14 74	14 54	14 14	14 00
22	Y	15 79	15 59	15 79	15 59	15 19	15 00
23	U	16 75	16 55	16 75	16 55	16 15	16 00
24	I	17 69	17 49	17 69	17 49	17 09	17 00

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
25	O	18 6F	18 4F	18 6F	18 4F	18 0F	18 00
26	P	19 70	19 50	19 70	19 50	19 10	19 00
27	{ [	1A 5B	1A 7B	1A 5B	1A 7B	1A 1B	*1A 00
28	}]	1B 5D	1B 7D	1B 5D	1B 7D	1B 1D	*1B 00
29	| \	2B 5C	2B 7C	2B 5C	2B 7C	2B 1C	*2B 00
30	Caps Lock	-	-	-	-	-	-
31	A	1E 61	1E 41	1E 61	1E 41	1E 01	1E 00
32	S	1F 73	1F 53	1F 73	1F 53	1F 13	1F 00
33	D	20 64	20 44	20 64	20 44	20 04	20 00
34	F	21 66	21 46	21 66	21 46	21 06	21 00
35	G	22 67	22 47	22 67	22 47	22 07	22 00
36	H	23 68	23 48	23 68	23 48	23 08	23 00
37	J	24 6A	24 4A	24 6A	24 4A	24 0A	24 00
38	K	25 6B	25 4B	25 6B	25 4B	25 0B	25 00
39	L	26 6C	26 4C	26 6C	26 4C	26 0C	26 00
40	: ;	27 3B	27 3A	27 3B	27 3A	-	*27 00

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
41	" ,	28 27	28 22	28 27	28 22	-	*28 00
43	Enter	1C 0D	1C 0D	1C 0D	1C 0D	1C 0A	*1C 00
44	Shift (L)	-	-	-	-	-	-
46	Z	2C 7A	2C 5A	2C 7A	2C 5A	2C 1A	2C 00
47	X	2D 78	2D 58	2D 78	2D 58	2D 18	2D 00
48	C	2E 63	2E 43	2E 63	2E 43	2E 03	2E 00
49	V	2F 76	2F 56	2F 76	2F 56	2F 16	2F 00
50	B	30 62	30 42	30 62	30 42	30 02	30 00
51	N	31 6E	31 4E	31 6E	31 4E	31 0E	31 00
52	M	32 6D	32 4D	32 6D	32 4D	32 0D	32 00
53	< ,	33 2C	33 3C	33 2C	33 3C	-	*33 00
54	> .	34 2E	34 3E	34 2E	34 3E	-	*34 00
55	? /	35 2F	35 3F	35 2F	35 3F	-	*35 00
57	Shift (R)	-	-	-	-	-	-
58	Ctrl (L)	-	-	-	-	-	-
60	Alt (L)	-	-	-	-	-	-

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
61	Space	39 20	39 20	39 20	39 20	39 20	39 20
62	Alt (R)	-	-	-	-	-	-
+75	Ins	52 00 52 E0	52 00 52 E0	52 00 52 E0	52 00 52 E0	*92 E0	*A2 00
+76	Del	53 00 53 E0	53 00 53 E0	53 00 53 E0	53 00 53 E0	*93 E0	*A3 00
+79	<-	4B 00 4B E0	4B 00 4B E0	4B 00 4B E0	4B 00 4B E0	73 00 73 E0	*9B 00
+80	Home	47 00 47 E0	47 00 47 E0	47 00 47 E0	47 00 47 E0	77 00 77 E0	*97 00
+81	End	4F 00 4F E0	4F 00 4F E0	4F 00 4F E0	4F 00 4F E0	75 00 75 E0	*9F 00
+83	|	48 00 48 E0	48 00 48 E0	48 00 48 E0	48 00 48 E0	*8D E0	*98 00
+84	|	50 00 50 E0	50 00 50 E0	50 00 50 E0	50 00 50 E0	*91 E0	*A0 00
+85	PgUp	49 00 49 E0	49 00 49 E0	49 00 49 E0	49 00 49 E0	84 00 *84 E0	*99 00
+86	PgDn	51 00 51 E0	51 00 51 E0	51 00 51 E0	51 00 51 E0	76 00 76 E0	*A1 00
+89	->	4D 00 4D E0	4D 00 4D E0	4D 00 4D E0	4D 00 4D E0	74 00 74 E0	*9D 00
90	Num Lock	-	-	-	-	-	-

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
105	-	4A 2D	4A 2D	4A 2D	4A 2D	*8E 00	*4A 00
106	+	4E 2B	4E 2B	4E 2B	4E 2B	*90 00	*4E 00
110	Esc	01 1B	01 1B	01 1B	01 1B	01 1B	*01 00
112	F1	3B 00	54 00	3B 00	54 00	5E 00	68 00
113	F2	3C 00	55 00	3C 00	55 00	5F 00	69 00
114	F3	3D 00	56 00	3D 00	56 00	60 00	6A 00
115	F4	3E 00	57 00	3E 00	57 00	61 00	6B 00
116	F5	3F 00	58 00	3F 00	58 00	62 00	6C 00
117	F6	40 00	59 00	40 00	59 00	63 00	6D 00
118	F7	41 00	5A 00	41 00	5A 00	64 00	6E 00
119	F8	42 00	5B 00	42 00	5B 00	65 00	6F 00
120	F9	43 00	5C 00	43 00	5C 00	66 00	70 00
121	F10	44 00	5D 00	44 00	5D 00	67 00	71 00
122	F11	*85 00	*87 00	*85 00	*87 00	*89 00	*8B 00
123	F12	*86 00	*88 00	*86 00	*88 00	*8A 00	*8C 00

Cap No.	Key Top	Lower Case	Upper Case	Num Lock		With (Ctrl)	With (Alt)
				Lower	Upper		
125	Scrol Lock	-	-	-	-	-	-
200	PrtSc *	37 2A	-	37 2A	-	*96 00	*37 00
201	Sys Req	-	-	-	-	-	-
202	Fn	-	-	-	-	-	-

3.7 DISPLAY TEST

Subtest 01 VRAM read/write

This subtest writes constant data (FFFFH, AAAAH, 5555H, 0000H) and address data to video RAM (256 Kbytes), then reads the data written and compares it with the original data.

Subtest 02 Character attributes

This subtest checks:

- Normal Display
- Intensified Display
- Reverse Display
- Blinking Display

For color displays, all seven colors used (blue, red, magenta, green, cyan, yellow, white) are displayed. The background and foreground colors can then be checked for brightness. The display below appears on the screen when this test is run.

CHARACTER ATTRIBUTES

NEXT LINE SHOWS NORMAL DISPLAY.

NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN

NEXT LINE SHOWS INTENSIFIED DISPLAY.

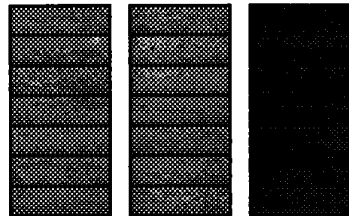
I I I I I I I I I I I I I I I I

NEXT LINE SHOWS REVERSE DISPLAY.

RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR

NEXT LINE SHOWS BLINKING DISPLAY

BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB



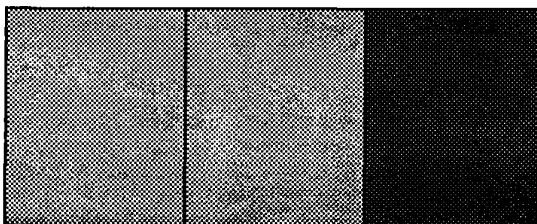
- BLUE**
- RED**
- MAGENTA**
- GREEN**
- CYAN**
- YELLOW**
- WHITE**

PRESS [ENTER] KEY

Subtest 05 320*200 Graphics display

This subtest displays two of color sets for the color display in the 320*200 dots graphics mode (Mode 4 and D) as shown below.

320*200 GRAPHICS DISPLAY : [X]



PRESS [ENTER] KEY

Subtest 06 640*200 Graphics display

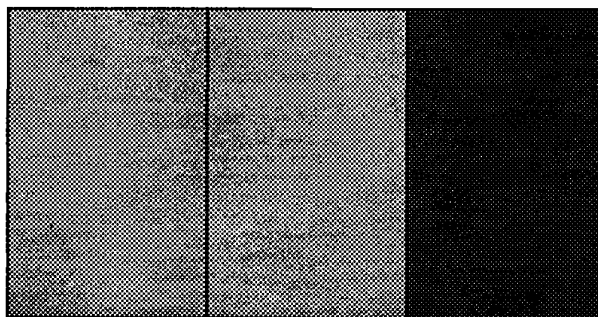
This subtest displays the color blocks for the black and white display in the 640*200 dots graphics mode (Mode 6 and E) as shown below.

640*200 GRAPHICS DISPLAY [X]

**EVEN DOTS
DRIVEN**

**ODD DOTS
DRIVEN**

**ALL DOTS
DRIVEN**



PRESS [ENTER] KEY

Subtest 07 640*400 Graphics display

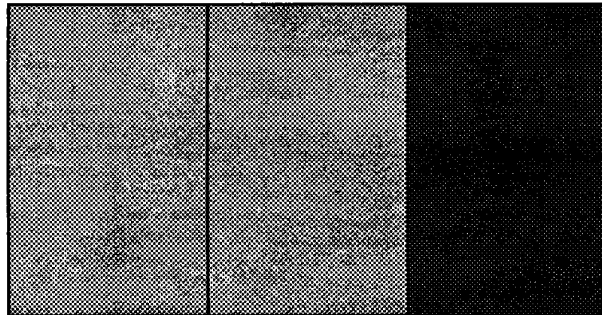
This subtest displays the color blocks for the black and white display in the 640*350 and 640 x 400 pixels graphics mode (Mode 10/ 74) as shown below.

640*XXX GRAPHICS DISPLAY : [XX]

**EVEN DOTS
DRIVEN**

**ODD DOTS
DRIVEN**

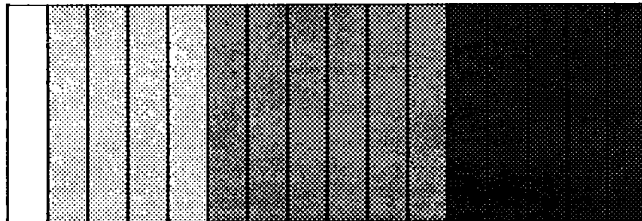
**ALL DOTS
DRIVEN**



PRESS [ENTER] KEY

640*400 graphic display : [75]

Color 0 1 4 5 8 6 2 9 3 C D 7 A B E F



PRESS [ENTER] KEY

Subtest 08 Display page

This subtest confirms that the pages can be changed in order (page 0 to page 7) in the 40 x 25 character mode.

```

DISPLAY PAGE 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

```

Subtest 09 "H" pattern display

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

```

HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH

```

Subtest 10 LED & Font change

This subtest displays as follows:

[Speed/CRT/Caps/Num/Scroll 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 [Scroll lock] key! ...Scroll (on/off)
- (6) Press [Fn + End] key! ...CRT (on)
- (7) Press [Fn + Home] key! ...CRT (off)
- (8) Press [Fn +] key! ...FONT change test

Press [ENTER] KEY

3.8 FLOPPY DISK TEST

CAUTION: Before running the floppy disk test, prepare a formatted work disk and remove the diagnostics disk. Then insert the work disk into the FDD. Because the contents of the floppy disk will be erased.

OPERATION

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

Test drive number select (1:FDD1,2:FDD2,0:FDD1&2) ?

2. Select the test drive number, then press the **Enter**. The following message will appear.

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

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

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

4. You can select the start track number of the floppy disk test.
When pressing the **Enter** only, the start track number will be zero.
If you desire, select the start track number. Then the subtest menu of the floppy disk test will appear.
5. During the floppy disk test, the message shown below will appear. The **ADDRESS** number indicates that the first **XX** shows a cylinder number, the third **X** shows a head number, and the last **XX** shows a sector number.
The **STATUS** number indicates that the first **X** shows a drive number and the last **XX** shows an error status code.

FLOPPY DISK

XXXXXXXX

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

CONTENTS

Subtest 01 Sequential read

This test performs the CRC (cyclic redundancy check) with a continuous read operation of all tracks on a floppy disk.
2D (Double-sided, double-density): Track 0 to 39.
2DD (Double-sided, double-density, double-track) and 2HD (Double-sided, high-density, double-track): Track 0 to 79.
The start track can be specified at the previous stage.

Subtest 02 Sequential read/write

This test 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 is B5ADADH repeated.)

Subtest 03 Random address/data

This test writes random data to random address on all tracks (as defined in subtest 01) and then reads the data out and compares it with the original data.

Subtest 04 Write specified address

This test writes the specified data on the specified address that you enter from the keyboard. You can specify the test data, track number, and head number.

Subtest 05 Read specified address

This subtest performs read operation on the specified address that you enter from the keyboard. You can specify the track number and head number.

3.9 PRINTER TEST

CAUTION: A printer (IBM compatible) must be connected to the system in order to execute the test. Confirm that the A-B-PRT switch is set to PRT position.

CONTENTS

Subtest 01 Ripple pattern

This subtest prints characters for code 20H through 7EH line by line while shifting one character to the right at the beginning of each new line.

```

    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 EMPASIZED PRINT.
    5. THIS LINE SHOWS DOUBLE STRIKE PRINT.
    6. ALL CHARACTERS PRINT
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmn
    opqrstuvwxyz{|}

```

Subtest 02 Function

This subtest prints out various print type as shown below.

```

    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmn
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnop
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnop
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqr
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqr
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqrst
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqrstuv
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqrstuv
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqrstuvwx
    !"#%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN
    OPQRSTUVWXYZ[\]`_~abcdefghijklmnopqrstuvwxy

```

Subtest 03 Wraparound

NOTE: A printer wraparound connector is necessary for executing this test. Wiring diagram of the printer wraparound connector is described in the part 3.25.
The data, control, and status lines will be checked with the printer wraparound connector.

OPERATION

Subtest 01 and 02

1. When you select the subtest 01 or 02, the following message will appear.

Select the channel number (1-3) ?

Select the printer channel number, then type in the number. The T1600 supports three printer channels.

2. After pressing the **Enter**, the subtest is executed.

Subtest 03

1. When you select this subtest, the following message will appear.

Select the channel number (1-3) ?

Select the printer channel number, then type in the number. The T1600 supports three printer channels.

2. After pressing the **Enter**, this subtest is executed.

3.10 ASYNC TEST

In subtest 01 to subtest 05, data transmission is done with the following format:

Speed: 9600 BPS
Data 8 bits and one parity bit (EVEN)
One stop bit
Data pattern: 20H to 7EH

Subtest 01 Wrap around (channel 1)

NOTE: The RS-232-C wraparound connector must be connected to channel 1 to execute this test. The wiring diagram of the RS-232-C wraparound connector is described in part 3.25.

A data send/receive test is performed with the wraparound connector for the channel 1.

Subtest 02 Wrap around (channel 2)

The same test as the subtest 01 is performed for the channel 2.

Subtest 03 Point to point (send)

NOTE: This subtest must be executed in condition that two machines are connected with the RS-232-C direct cable and one side should be set as 'send' and the other set as 'receive'. The wiring diagram of the RS-232-C direct cable is described in part 3.25. The subtest 03 executed in one side and the subtest 04 executed in the other will check the communication capability as follows:

A block of data (20H to 7EH) is sent from one side to the other, and then returned back. The returned data is compared with the original one. This test is used to check whether the returned data are same as the original ones.

Subtest 04 Point to point (receive)

This subtest is used with the subtest 03 as described above.

Subtest 05 300/1200 BPS card modem loopback

NOTE: If there is no modem card in the system, this test can no be executed.

This subtest is used to check whether the data to be sent from the modem card to the RS-232-C line is correct or not. This can be done with the loopback function inside the modem card.

Subtest 06 Card modem on-line test

NOTE: This test requires two machines which are connected to the PBX (Private Branch Exchange). One side is set as 'send' and the other set as 'receive'. When both sides are ready, you can start the test.

In this subtest, data are sent from the 'send' side to the 'receive' side through the PBX. This subtest is used to check whether data transmission through a telephone line is done properly or not.

Subtest 07 Dial tester test

NOTE: To execute this subtest, a dial tester must be connected to the system.

This subtest is carried out by sending the pulse dial and tone dial twice automatically.

[Pulse dial]: "1-2-3-4-5-6-7-8-9-0-1-2"
[Tone dial]: "1-2-3-4-5-6-7-8-9-*0-#"

Subtest 08 Interrupt test (IRQ4, 3, 5)

This subtest genarates the interrupt request levels 4, 3, 5 in this order, then checks if this function works correctly.

3.11 HARD DISK TEST

CAUTION: The contents of the hard disk will be erased when subtest 02, 03, 04, 06, 08 or 09 is run. Before running the test, transfer the contents of the hard disk on the floppy disk. This can be done with the MS-DOS BACKUP command. After the test, enter the MS-DOS FDISK command, which will set the partition. Then enter the MS-DOS FORMAT command. (See the MS-DOS manual for details.)

OPERATION

1. When you select the hard disk test of the DIAGNOSTIC TEST MENU, the following message will appear.

Test drive number select (1:HDD,2:HDD2,0:HDD1&2) ?

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

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

3. This message is used to select whether to do retry operation or not when the hard disk controller detects an error. Select yes or no and press the **Enter**. The following message will appear.

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

4. This message is used to select whether to do dump operation or not when data compare error is detected. Select yes or no and press the **Enter**. The following message will appear.

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

5. This message is used to select whether to display the detail status on the screen or not. The detail status are described in section 3.16. Select yes or no and press the **Enter**.

6. During the hard disk test, the message shown below will appear. The **ADDRESS** number indicates that the first **XXX** shows a cylinder number, the fourth **X** shows a head number, and the last **XX** shows a sector number. The **STATUS** number indicates that the first **X** shows a drive number and the last **XX** shows an error status code.

```

HARD DISK TEST                                XXXXXXXX

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

```

CONTENTS

Subtest 01 Sequential read

This subtest performs forward reading of contents from track 0 to Max. track and then performs reverse reading of the contents from Max. track to track 0.

Subtest 02 Address uniqueness

1. Selecting this subtest, the following message will appear.

Read sequential select ?

```

1 : Forward sequential
2 : Reverse sequential
3 : Random

```

2. Select one of the above and press the **Enter**.

This subtest writes the address data that is different sector by sector at each track, then reads and compares it to the original data. This test is done for all tracks.

Subtest 03 Random address/data

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

Subtest 04 Cross talk & peak shift

This subtest writes the eight types of worst pattern data (shown below) to cylinders then reads the data while shifting cylinder by cylinder.

Worst pattern data

1. B5ADAD
2. 4A5252
3. EB6DB6
4. 149249
5. 63B63B
6. 9C49C4
7. 2DB6DB
8. D24924

Subtest 05 Write/Read/Compare (CE)

This subtest writes B5ADAD worst pattern data 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 (CE cylinder)

This subtest checks the ECC (Error check and correction) circuit functions to a specified cylinder and head.

Subtest 09 Sequential write

This subtest writes specified data of the two bytes to all cylinder.

Subtest 10 W-R-C specified address

This subtest writes specified data to the specified cylinder and head, then read and compare with original data.

3.12 REAL TIMER TEST

Subtest 01 Real time

A new date and time can be input during this subtest when the current date and time are displayed.

Operations for the test are as follows.

1. Selecting the subtest, the following message will appear.

REAL TIME TEST

901000

Current data: XX-XX-XXXX

Current time: XX:XX:XX

Enter new date:

PRESS [ENTER] KEY TO EXIT TEST

2. If current date is not correct, input the current new date. Press the **Enter**, the enter new time:message will appear.
3. If current time is not correct, input the current new time. Press the **Enter**, return to the subtest menu of the REAL TIME TEST.

Subtest 02 Real time carry

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

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

3.13 NDP TEST

CAUTION : This test cannot be run if there is no NDP mounted on the system BOARD.

Subtest 01 NDP test

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

3.14 EXPANSION UNIT TEST

NOTE: If there is no expansion unit connected to the system, this test cannot be executed.

Subtest 01 Box wrap around (8 bits bus)

NOTE: As this subtest required a special tool to be executed, it cannot be carried out here.

Subtest 02 Box mono video ram

NOTE: If there is no monochrome display card in the expansion unit, this test cannot be executed.

This subtest writes data (FF, AA, 55, 00H) into the monochrome display memory (B0000H to B0F9FH), then reads the data out and compares it with the original data.

Subtest 03 Wrap around test (16 bit bus)

NOTE: As this subtest requires a special tool to be executed, it cannot be carried out here.

3.15 ERROR CODE AND ERROR STATUS NAMES

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

TABLE 3-4 Error Code and Error Status Names

DEVICE NAME	ERROR CODE	ERROR STATUS NAME
EVERYTHING	FF	Compare Error
SYSTEM	01	ROM Checksum Error
MEMORY	01	Parity Error
	02	Protected Mode Not Change Error
	12	Exception Interrupt
	13	Address 20 Line Failure
	14	Memory Read/Write Error
	15	RAM-on BIOS Unestablish
	16	Register Read.Write Error
	17	Write Protect Error (write/read)
	18	EGA-BIOS-Disable Error
	19	BIOS Copy Error (System-BIOS)
	1A	BIOS Copy Error (EGA-BIOS)
	1B	H-RAM Mapping Error
	1C	H-RAM Write/Read Error
	1D	EMS Mapping Error
	1E	EMS Write/Read Error
FDD	01	Bad Command
	02	Address Mark Not Found
	03	Write Protected
	04	Record Not Found
	06	Media Removed On Dual Attach Card
	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 (Not Ready)
	EE	Write Buffer Error
RS-232-C	01	DSR Off Time Out
	02	CTS Off Time Out
	04	EX Empty 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)

TABLE 3-4 Error Code and Error Status Names (continued)

DEVICE NAME	ERROR CODE	ERROR STATUS NAME
PRINTER	01	Time Out
	08	Fault
	10	Select Line
	20	Out Of Paper
	40	Power Off
	80	Busy Line
HDD	01	Bad Command Error
	02	Bad Address Mark
	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 Error
	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 (HW.code=FF)	
NDP	01	Not Co-processor
	02	Control Word Error
	03	Status Word Error
	04	Bus Error
	05	Addition Error
	06	Multiply Error

3.16 HARD DISK TEST DETAIL STATUS

When an error occurs on the hard disk test, the following message will appear.

HDC status = XXXXXXXX

Detailed status of the hard disk test error is shown on the screen by eight-unit number. The first **XXXX** is error status and the last **XXXX** is not used.

Error status is composed of 2 bytes; the first byte shows the contents of the HDC status register in hexadecimal form and the other the error register of the HDC.

These contents are described in the table 3-5 and 3-6.

TABLE 3-5 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 command was terminated with some error.

TABLE 3-6 Error Register Contents

BIT	NAME	DESCRIPTION
7	BBK (bad block mark)	"0" ... Otherwise "1" ... A bad block mark is detected.
6	UNK (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	TK0 (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.

3.17 HARD DISK FORMAT

There are two types of hard disk formatting:

1. Physical formatting
2. Logical formatting

This program is for physical formatting of the hard disk; it can execute the following items.

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 run. Before running the program, transfer the contents of the hard disk on to a floppy disk. This can be done with the MS-DOS BACKUP command. (See the MS-DOS manual for details.)

3.17.1 Program description**1. All track FORMAT**

Performs physical formatting of hard disk in the manner shown below.

Sector sequences:	3
Cylinders:	0 to 614
Heads:	0 to 3
Sectors:	1 to 16
Sector length:	512 bytes per sector
Bad track:	MAX. 20 tracks

2. Good track FORMAT

Executes the formatting of a specified cylinder and track as a good track.

3. Bad track FORMAT

Executes the formatting of a specified cylinder and track as a bad track.

4. Bad track CHECK

Checks for bad tracks by performing a read operation for all tracks on the hard disk; a list of bad tracks is then displayed

3.17.2 Operations

CAUTION: After physical formatting is finished, enter the MS-DOS FDISK command, which will set the partition. Then enter the MS-DOS FORMAT command. (See the MS-DOS manual for details.)

1. After pressing **2** and **Enter** in the DIAGNOSTICS MENU, the following display will appear.

DIAGNOSTIC - HARD DISK FORMAT V2.00

- 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 Selection

- (1) When all track FORMAT(1) is selected, the following message will appear.

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

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

Interleave number (3/1-3) ?

- (3) Select an interleave number. (Usually select 3.) Type the number and press **Enter**. The following display will appear.

```
[HDD TYPE] : CYLINDER = XXX
[HDD TYPE] : HEAD     = X
[HDD TYPE] : SECTOR   = XX
```

[WARNING : Current DISK data will be completely destroyed]

Press [Bad track number (CCCH) key ?

[[cylinder, head = XXX X]]

- (4) After pressing the **Enter**, the **[[cylinder, head = XXX X]]** message will appear; then all cylinders of the hard disk are formatted and checked.

- (5) After formatting the hard disk, the **Format complete** message will then appear.
- (6) Press the **Enter** to return to the HARD DISK FORMAT menu.

3. Good track FORMAT or Bad track FORMAT Selection

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

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

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

Interleave number (3/1-3) ?

- (3) Select an interleave number. (Usually select 3.) Type the number and press **Enter**. The following message will appear.

```
[HDD TYPE] : CYLINDER = XXX
[HDD TYPE] : HEAD     = X
[HDD TYPE] : SECTOR   = XX
```

Press [track number (CCCH)] key ?

- (4) Type a track number (four digits) and press **Enter**. (The first three digits are the cylinder number and the last digit is the head number.) This executes the formatting of good tracks or bad tracks.

NOTE: This program can format only one track per operation. If it is desired to format several good tracks or bad tracks, repeat the operation as many times as necessary.

- (5) After formatting the track of the hard disk, the **Format complete** message will appear.
- (6) Press the **Enter** to return to the HARD DISK FORMAT menu.

4. Bad track CHECK Selection

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

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

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

Interleave number (3/1-3) ?

- (3) Select an interleave number. (Usually select 3.) Type the number and press **Enter**.
When the following message appears, and bad tracks of the hard disk are checked.

[HDD TYPE] : CYLINDER = XXX
[HDD TYPE] : HEAD = X
[HDD TYPE] : SECTOR = XX

[[cylinder,head = XXX XX]]

- (4) After checking the bad tracks of the hard disk, the **Format complete** message will appear.
- (5) Press the **Enter** to return to the HARD DISK FORMAT menu.

3.18 HEAD CLEANING

3.18.1 Program description

This program executes head loading and seek/read operations for head cleaning. A cleaning kit is necessary for cleaning the FDD head.

3.18.2 Operations

1. After pressing **4** and **Enter** in the DIAGNOSTICS MENU, the following message will appear.

DIAGNOSTIC FLOPPY DISK HEAD CLEANING: VX.XX

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

2. After above message appears, remove the Diagnostics disk, insert the cleaning disk, and press any key.
3. When the **Cleaning start** message appears, FDD head cleaning will begin.
4. When cleaning is finished, the display automatically returns to the DIAGNOSTICS MENU.

3.19 LOG UTILITIES

3.19.1 Program description

This program logs error information generated, while a test is in progress; the information is stored in the RAM. However if the POWER switch is turned off the error information will be lost. The error information itself is displayed as the following.

1. Error count (CNT)
2. Test name (TEST)
3. Subtest number (NAME)
4. Pass count (PASS)
5. Error status (STS)
6. Address (FDD, HDD 1 or memory; ADDR)
7. Write data (WD)
8. Read data (RD)
9. Error status name

This program can store data on a floppy disk or output information to a printer.

3.19.2 Operations

- After pressing **5** and **Enter** in the DIAGNOSTICS MENU, the error information logged in the RAM or on the floppy disk is displayed as shown below.

XXXXX ERRORS									
CNT	TS-NAME	PASS	STS	ADDR	WD	RD	HSTS	[ERROR STATUS NAME]	
001	FDD	02	0000	103	00001	00	00	FDD - WRITE PROTECTED	
001	FDD	01	0000	180	00001	00	00	FDD - TIME OUT ERROR	

Vertical lines in the original image connect the following labels to specific fields in the table above:
 - **Test name** points to the **TS-NAME** column.
 - **Error count** points to the **CNT** column.
 - **Subtest number** points to the **PASS** column.
 - **Pass count** points to the **STS** column.
 - **Error status** points to the **ADDR** column.
 - **Write data** points to the **WD** column.
 - **Read data** points to the **RD** column.
 - **Error status name** points to the **[ERROR STATUS NAME]** column.

[[1:Next,2:prev,3:Exit,4:Clear,5:Print,6:FD LogRead,
7:FD LogWrite]]

- Error information displayed on the screen can be manipulated with the following key operation.

The 1 key scrolls the display to the next page.
 The 2 key scrolls the display to the previous page.
 The 3 key returns the display to the DIAGNOSTIC MENU.
 The 4 key erases all error log information in RAM.
 The 5 key outputs error log information to a printer.
 The 6 key reads log information from a floppy disk.
 The 7 key writes log information to a floppy disk.

3.20 RUNNING TEST

3.20.1 Program description

This program automatically runs the following tests in sequence.

1. System test (subtest number 01)
2. Memory test (subtest number 01, 02, 03, 04, 06)
3. Display test (subtest number 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 number 01, 05)
8. Real timer (subtest number 02)

When running an FDD test, this system automatically decides whether there are one or two FDDs.

3.20.2 Operations

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

1. Remove the diagnostics disk and insert the work disk into the floppy disk drive.
2. After pressing **6** and **Enter** in the DIAGNOSTIC MENU, the following message will appear.

Printer wrap around test (Y/N) ?
3. Select whether to execute the printer wraparound test (Yes) or not (No). Type **Y** or **N** and press **Enter**. (If Y is selected, a wraparound connector must be connected to the printer connector on the back of the unit.) The following message will appear.

Async#1 wrap around test (Y/N) ?
Async#2 wrap around test (Y/N) ?
4. Select whether to execute the test (Yes) or not (No). Type **Y** or **N** and press **Enter**. (If Y is selected, an RS-232-C wraparound connector must be connected to the SER. A OR SER. B connector on the back of the unit.)
5. This program is repeated continuously. To stop the program, press **Ctrl + Break**.

3.21 FDD UTILITIES

3.21.1 Program description

These programs format and copy floppy disks, and display dump list for both the FDD and the HDD.

1. FORMAT

CAUTION: The program is for only floppy disk drive test. The program is different the MS-DOS FORMAT command.

This program can format floppy disk (5.25-inch/3.5-inch) as follows.

- (1) **2D:**Double-sided, double-density, 48/67.5 TPI, MFM mode, 512 bytes, 9 sectors/track.
- (2) **2DD:**Double-sided, double-density, double-track, 96/135 TPI, MFM mode, 512 bytes, 9 sectors/track.
- (3) **2HD:**Double-sided, high-density, double-track, 96/135 TPI, MFM mode, 512 bytes, 18 sectors/track.

2. COPY

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

3. DUMP

This program displays the contents of floppy disks (both 3.5" and 5.25") and hard disk (designated sectors).

3.21.2 Operations

1. After pressing 7 and Enter key in the DIAGNOSTICS MENU, the following display will appear before program execution.

[FDD UTILITIES]

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

PRESS [1] - [9] KEY

2. FORMAT Selection

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

**DIAGNOSTICS - FORMAT(V1.00)
Drive number select (1:A, 2:B) ?**

- (2) Select a drive number. Type the number and the following message will then appear.

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

- (3) Select a media-drive type number. Type the number and the message similar to the below will appear.

Warning : Disk data will be destroyed.

**Insert work disk in to drive A :
Press any key when ready.**

- (4) Remove the diagnostics disk from the FDD and insert the work disk; press any key.
The following message will appear; formatting is then 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** key, the display will return to the message in (3) above. If you type **2** the display will return to the DIAGNOSTICS MENU.

3. COPY Selection

- (1) When COPY is selected, the following message will appear.

DIAGNOSTICS - COPY
Type select (0:2DD-2DD,1:2D-2D,2:2D-2HD,3:2HD-2HD) ?

- (2) Select a media/drive type number. Type the number. The following message will then appear.

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

- (3) Remove the diagnostics disk from the FDD and insert the source disk; press any key. The following message will appear, then start the copy to memory.

[FDD TYPE] : TRACK = XXX
[FDD TYPE] : HEAD = X
[FDD TYPE] : SECTOR - XX

Copy start

[[track, head = XXX XX]]

- (4) Remove the source disk from the FDD and insert the work disk (formatted); press any key. The **[[track, head = XXX X]]** message will appear, then start the copy to work disk. When coping cannot be done with one operation, message (2) is displayed again. Repeat the operation. After the floppy disk has been copied, the following message will appear.

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

- (5) If you type **1** the display will return to the message in (1) above. If you type **2** the display will return to the DIAGNOSTICS MENU.

4. DUMP Selection

- (1) When dump is selected, the following message will appear.

**[HDD&FLOPPY DISK DATA DUMP]
format type select (0:2DD,1:2D,2:2HD,3:HDD) ?**

- (2) Select a format type number. Type the number. If 3 is selected, the dump lists for the hard disk are displayed automatically.

0: Display a dump list for a floppy disk (2DD)
1: Display a dump list for a floppy disk (2D).
2: Display 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. If 3 is selected, the dump list will appear.

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

- (4) Select an FDD drive number; the following message will then appear.

**Insert target 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. The **Track number ??** message will then appear. Type the track number and press **Enter**.

- (6) The **Head number ?** message will then appear. Type the head number and press **Enter**.

- (7) The **Sector number ??** message will then appear. Type the sector number and press **Enter**. The dump list for the floppy disk will be displayed.

- (8) After a dump list appears on the screen, the **Press number key (1:up,2:down,3:end) ?** message will appear.

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

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

- (9) If you type 1 the display will return to the message shown after (4) above. If you type 2 the display will return to the DIAGNOSTICS MENU.

3.22 SYSTEM CONFIGURATION

3.22.1 Program description

This program displays the following system configuration.

1. BIOS ROM VERSION = VX.XX
2. Base memory size
3. Display type
4. A number of floppy disk drives
5. A number of async ports
6. A number of hard disk drives
7. A number of printer ports
8. Extended memory size
9. Co-processor presents or not

3.22.2 Operations

After pressing **8** and **Enter** key to select from the DIAGNOSTICS MENU, the following display will appear.

SYSTEM CONFIGURATION

- *- BIOS ROM VERSION = X.XX
- *- 640KB MEMORY
- *- COLOR/GRAPH (80 column)
- *- 1 FLOPPY DISK DRIVE(S)
- *- 2 ASYNC ADAPTER(S)
- *- 1 HARD DISK DRIVE(S)
- *- 1 PRINTER ADAPTER(S)
- *- 0 MATH CO-PROCESSOR
- *- 0000KB EXTENDED MEMORY

PRESS [ENTER] KEY

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

3.23 WIRING DIAGRAM

1. Printer wraparound connector

(9) + DATA7 (4) + DATA2	_____	+ SELECT	(13)
(8) + DATA6 (3) + DATA1	_____	+ P.END	(12)
(7) + DATA5 (2) + DATA0	_____	+ BUSY	(11)
(6) + DATA (16) - INTPRT	_____	- ACKNOWLEDGE	(10)
(5) + DATA3 (1) - STROBE	_____	- ERROR	(1)

Figure 3-1 Printer Wraparound Connector

2. RS-232-C Wraparound connector

(3) TRANSMIT DATA	_____	RECEIVE DATA	(2)
(7) REQUEST TO SEND	_____	CLEAR TO SEND	(8)
	└──┬──	CARRIER DETECT	(1)
(4) DATA TERMINAL	_____	DATA SET READY	(6)
	└──┬──	RING INDICATE	(9)

Figure 3-2 RS-232-C Wraparound Connector

3. RS-232-C direct cable (9-pin to 9-pin)

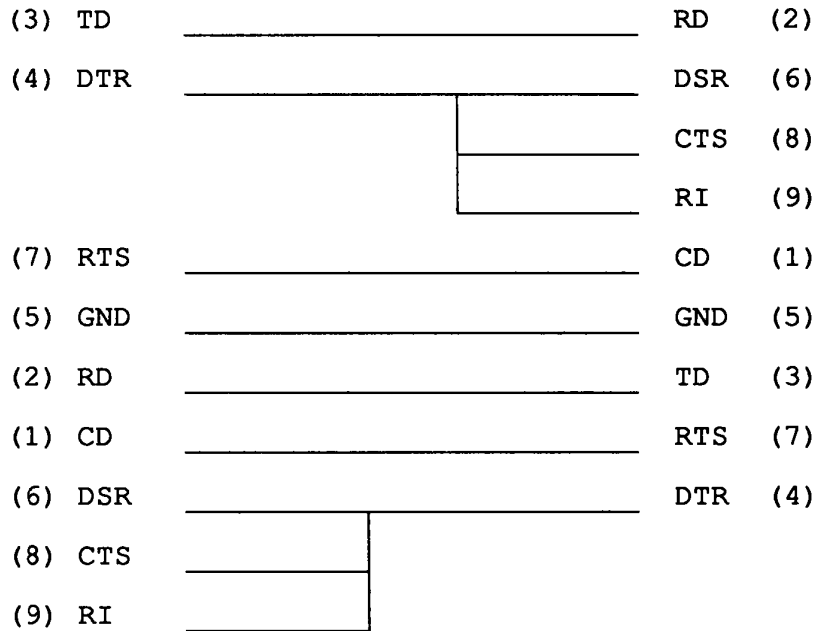


Figure 3-3 RS-232-C Direct Cable (9-pin to 9-pin)

4. RS-232-C direct cable (9-pin to 25-pin)

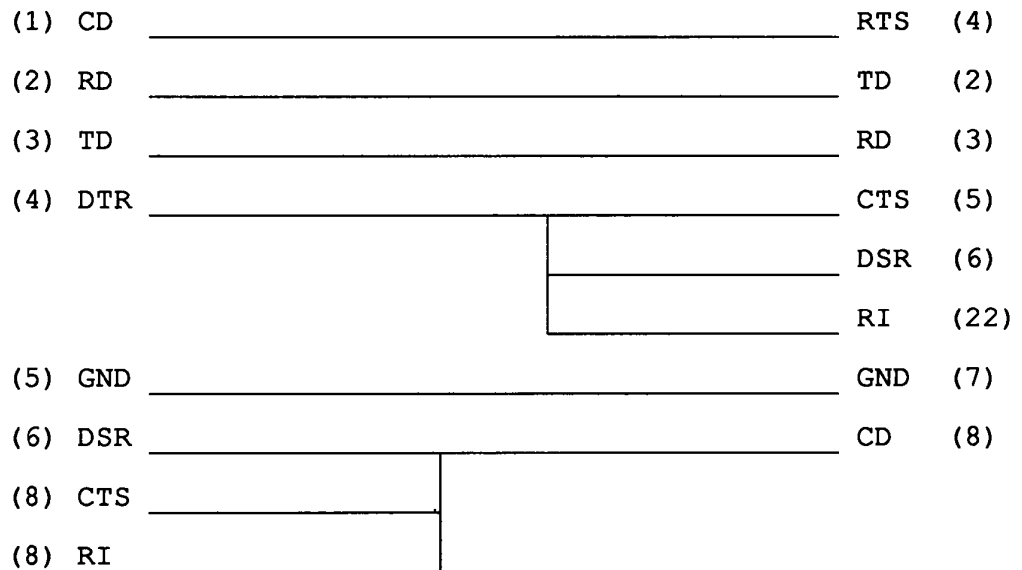


Figure 3-4 RS-232-C Direct Cable (9-pin to 25-pin)

File No. : 960-009

4.1 GENERAL

This section gives a detailed description of the procedures for removing and replacing FRUs (field replaceable units).

FRUs are listed as follows:

1. Keyboard
2. Top cover
3. Speaker
4. CPU board
5. Memory board
6. Hard disk drive (HDD)
7. LED board
8. DC IN indicator board
9. Power supply board
10. Sub battery
11. HDD adapter board
12. Floppy disk drive (FDD)
13. System board
14. LCD module
15. LCD cable
16. Handle
17. EL power supply board
18. LCD cable unit

The following points must be kept in mind:

1. The system should never be disassembled unless there is a problem (abnormal operation, etc.)
2. Only approved tools may be used.
3. After deciding the purpose of replacing the unit, and the procedures required, do not carry out any other procedures which are not absolutely necessary.
4. Be sure to turn the POWER switch off before beginning.
5. Be sure to disconnect the AC adapter and all external cables from the system.
6. Follow the only fixed, standard procedures.
7. After replacing a unit, confirm that the system is operating normally.
8. Be sure not to be wounded by thin steel plate.

Tools needed for unit replacement:

1. Phillips head screwdriver

4.2 REMOVING/REPLACING THE KEYBOARD

1. Remove the AC adapter from the unit.
2. Turn the unit upside down and remove the two battery packs (A).

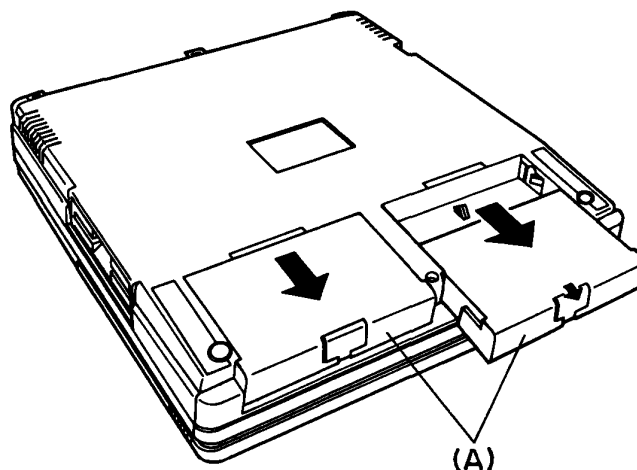


Figure 4-1 Removing the Battery Packs

3. Remove the three screws (B) from the bottom cover.

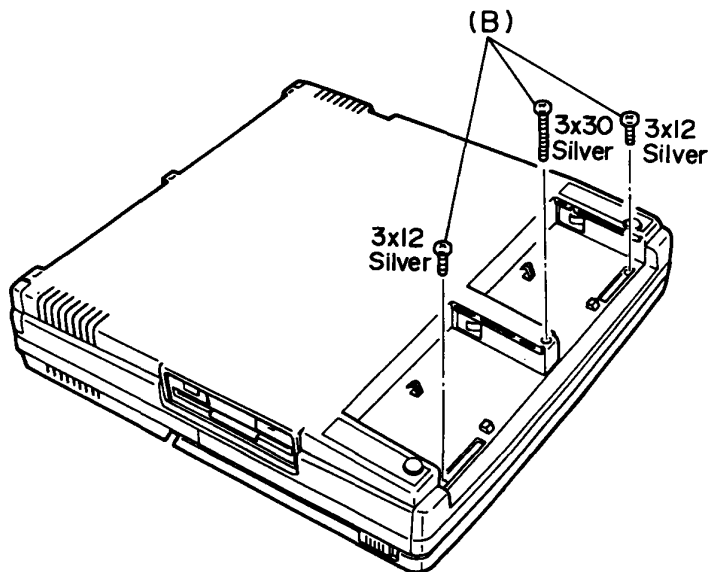


Figure 4-2 Removing the three Screws

4. Turn the unit back over then open the display.
5. Lift up the front edge of the keyboard unit and place it front of the computer. At this time, you can not discount the keyboard cable yet.
6. Remove the three screws (C) to remove the shield plate (D) for CPU board.
7. Release the pressure plate (E) of the PJ1 keyboard I/F connector (F) to disconnect the keyboard cable (G) from the system board (H).

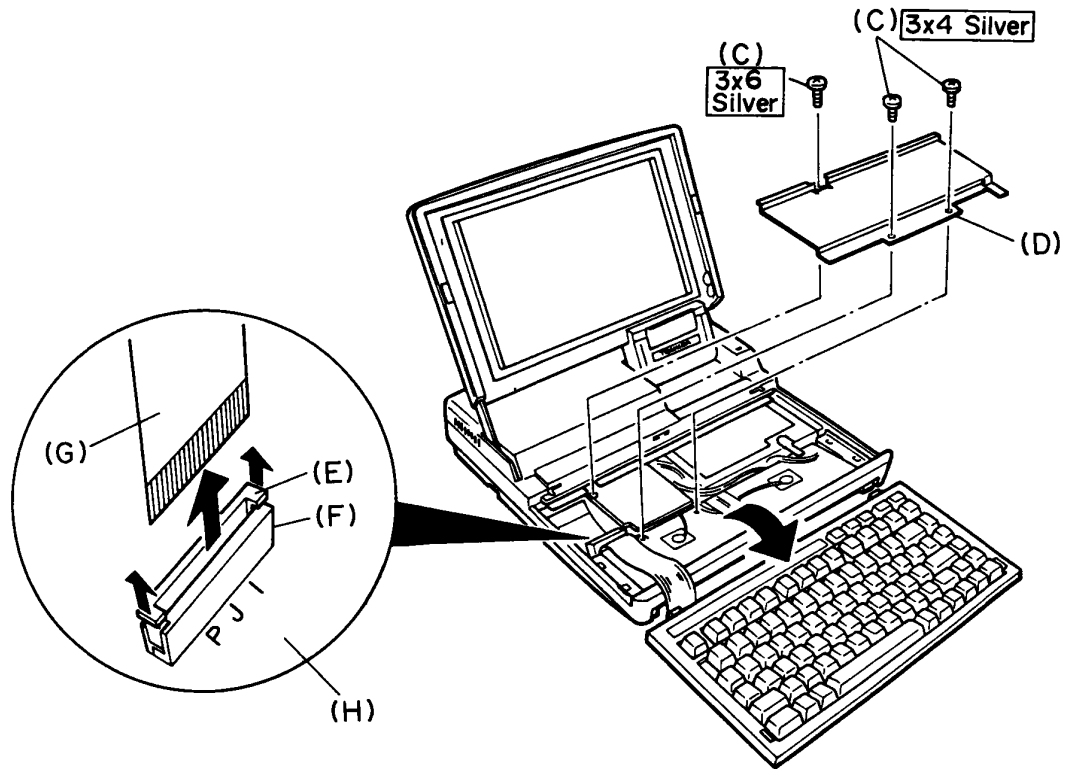


Figure 4-3 Removing the keyboard Unit

8. Unlatch the four latches (I) of the keyboard bracket, then pull out the keyboard (J).

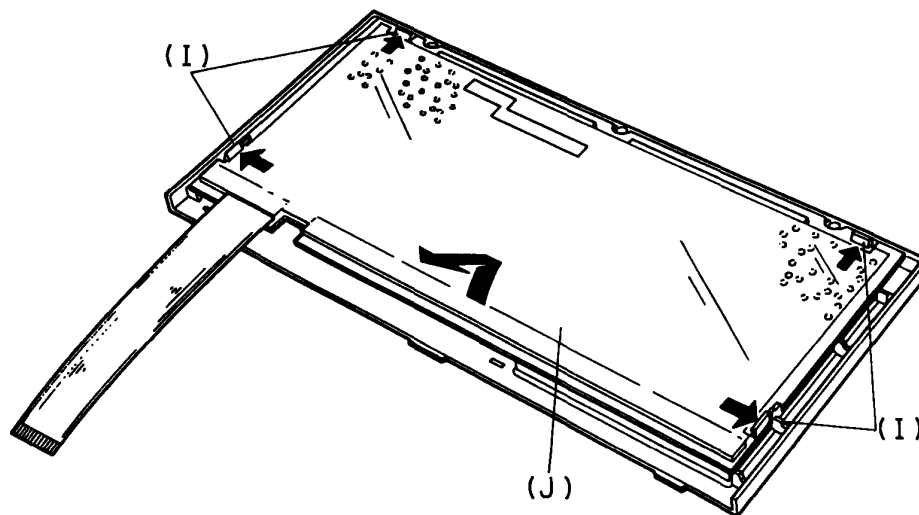


Figure 4-4 Removing the keyboard

9. To install the keyboard, follow the above procedures in reverse.

CAUTION: When insert the shield plate, you must fix the assembly with correct screws marked in figure 4-3. If you use the wrong screw, it will damage the system unit.

4.3 REMOVING/REPLACING THE TOP COVER

1. Remove the AC adapter from the unit.
2. Turn the unit upside down, then set up the stand (A) and remove it.
3. Remove the two screws (B) from the bottom cover.

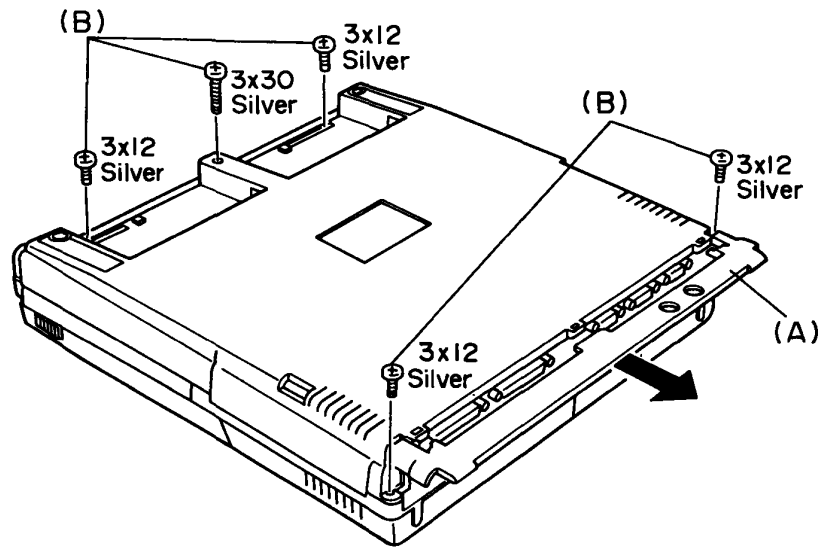


Figure 4-5 Removing the five Screws

4. Turn the unit back over and remove the display so that it is perpendicular to system unit.

CAUTION : Pulling out the internal display when it is not perpendicular to the system unit will damage the display. Excessive removal and replacement of the display will prematurely wear its connects.

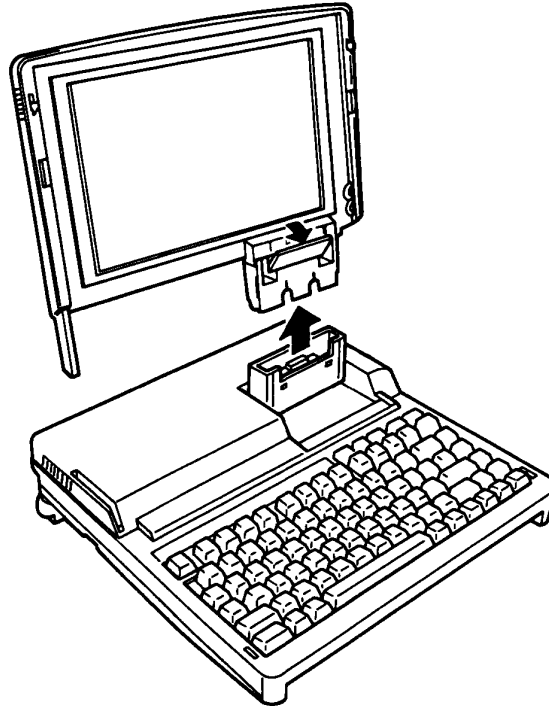


Figure 4-6 Removing the LCD

5. Remove the keyboard as directed in section 4.2, and remove the five screws (C).
6. Disconnect the display I/F connector (D) from the PJ3 system board, and take off the latch (E) of the top cover from the, to remove the top cover. Also keyboard bridge (F) is removed.

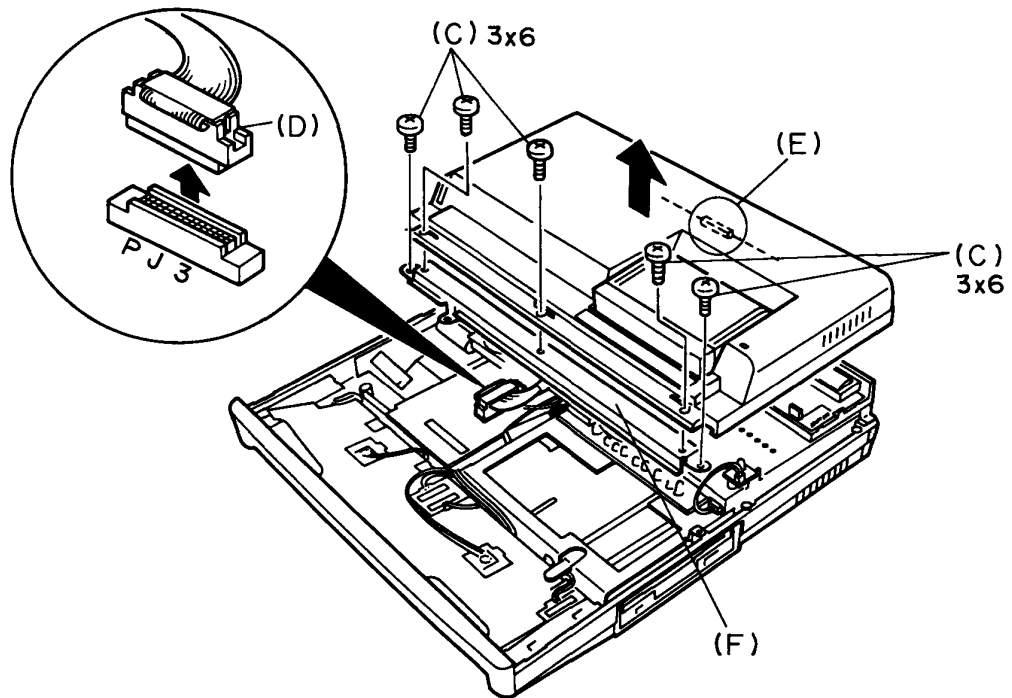


Figure 4-7 Removing the Top Cover

7. To install the top cover, follow the above procedures in reverse.

NOTE : Confirm that the top cover is locked into the bottom cover with the latch. Insert the shield plate for memory board between the top cover and keyboard bridge.

4.4 REMOVING/REPLACING THE CPU BOARD

1. Remove the keyboard unit as directed in section 4.2 and remove the five screws (A), then remove the keyboard bridge (B).
2. CPU board is fixed by two connectors which one connector is located front of it and the other connector is located back of it. If the optional memory board(S) is installed, remove them as directed in section 4.16.
3. Unplug the CPU board connector (C) from the PJ2 system board.
4. Draw out the CPU card (D) and disconnect the connector (E) from the memory card flexible cable (F).

NOTE : Make sure the flexible cable is not pinched when replacing the CPU board.

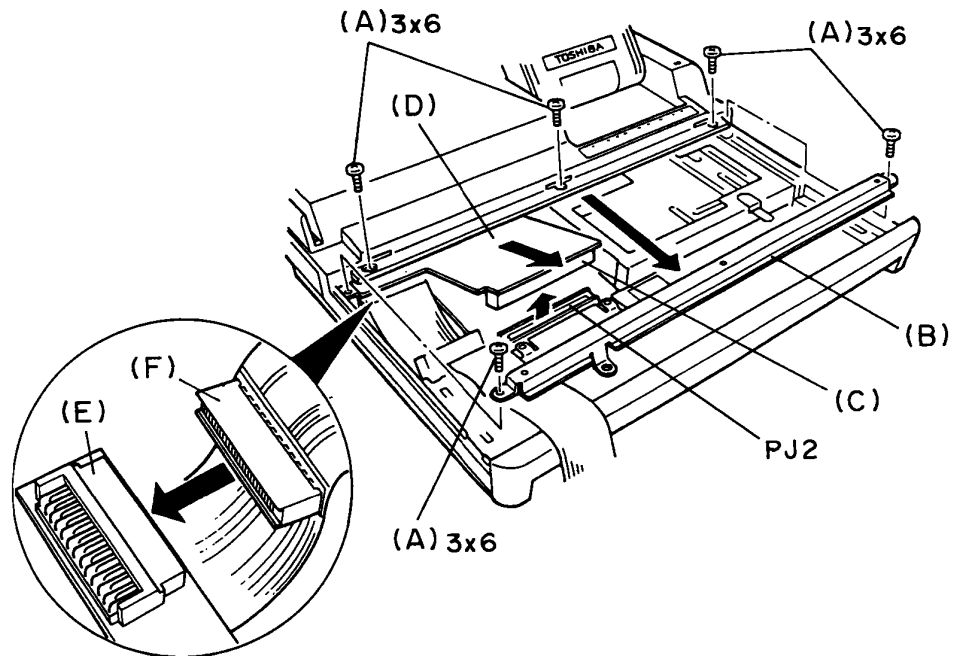


Figure 4-8 Removing the CPU Board

5. To install the CPU board, follow the above procedures in reverse.

4.5 REMOVING/REPLACING THE MEMORY BOARD AND SPEAKER

1. Remove the top cover and CPU board as directed in section 4.3 and 4.4.
2. Disconnect the speaker connector (A) from the PJ4 system board, to remove the speaker (B) from the speaker holder (C).

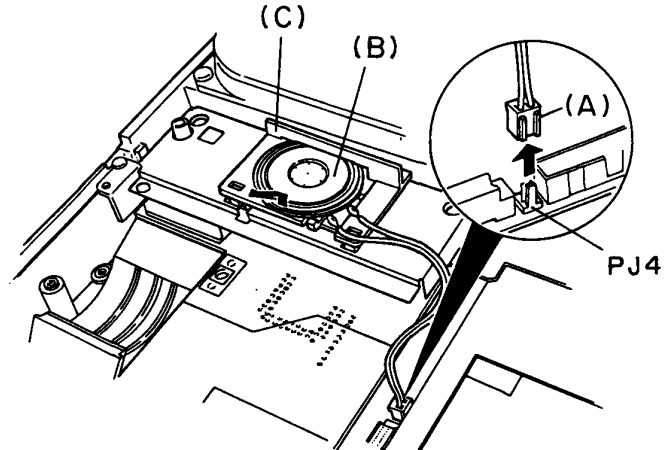


Figure 4-9 Removing the speaker

3. Remove the three screws (D), then remove the memory board (E) with shield plate (F) and speaker holder.

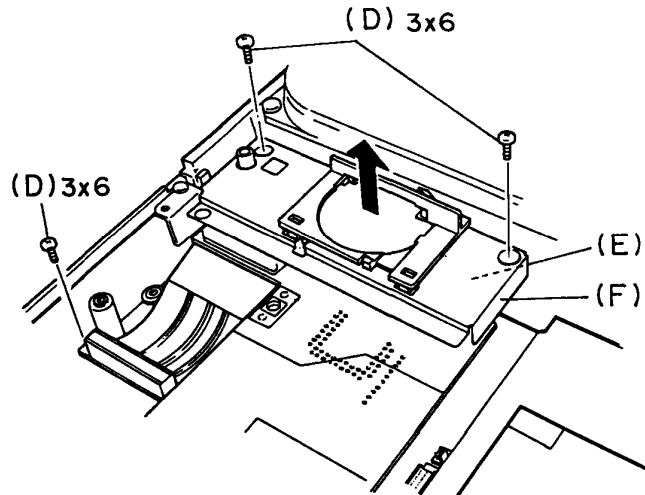


Figure 4-10 Removing the Memory board

4. To remove the speaker holder and shield plate, release the three latches (G), then lift it up.

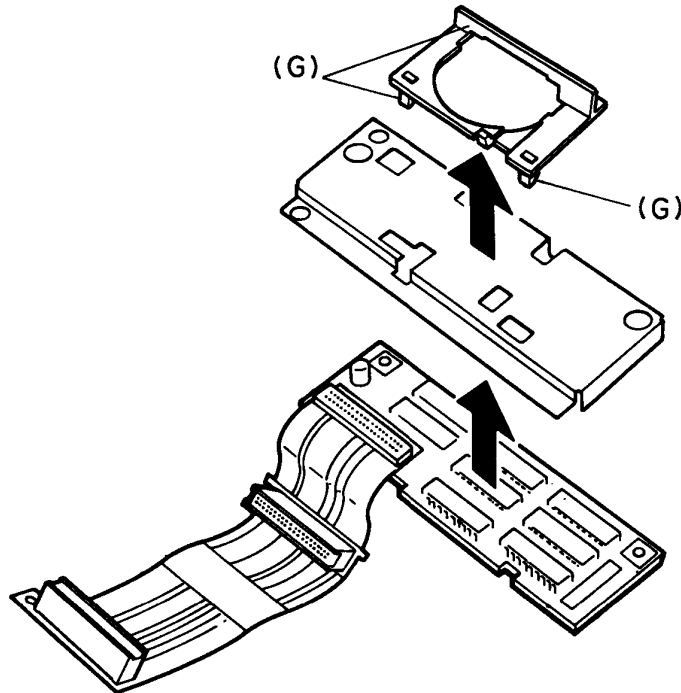


Figure 4-11 Removing the Speaker Holder and Shield Plate

5. To install the speaker and the memory board, follow the above procedures in reverse.

CAUTION : After replace the memory, insert the CPU board for avoiding the short-circuit of memory board and FDD support (G) .

4.6 REMOVING/REPLACING THE HDD

CAUTION : If you can back up the contents of the hard disk, transfer the contents of the hard disk on to a floppy disk. This can be done with the MS-DOS BACKUP command. (See the MS-DOS manual for details)

1. Remove the AC adapter from the system unit.
2. Remove the memory board as directed in section 4.5.
3. Remove the two screws (A) from modem case (B), and remove the modem case.

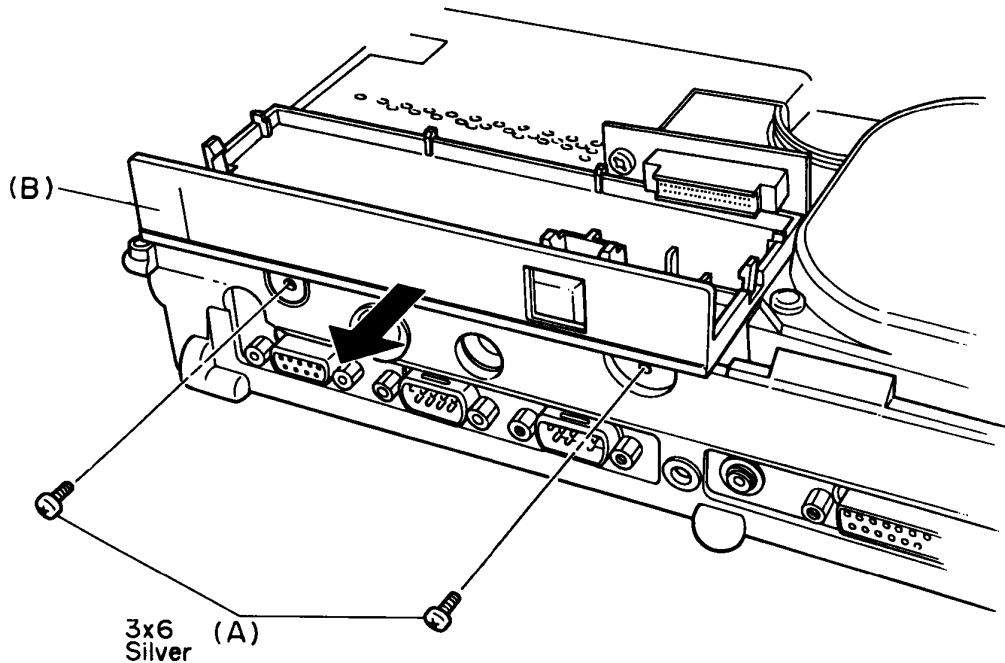


Figure 4-12 Removing the Modem Case

4. Remove the memory board as directed in section 4.5 and remove the screw (D) from built-in modem socket (E).
5. Remove the DC IN indicator board (F), then remove the five screws (G) and pass the built-in modem socket through the hole (H) of the HDD support (I).

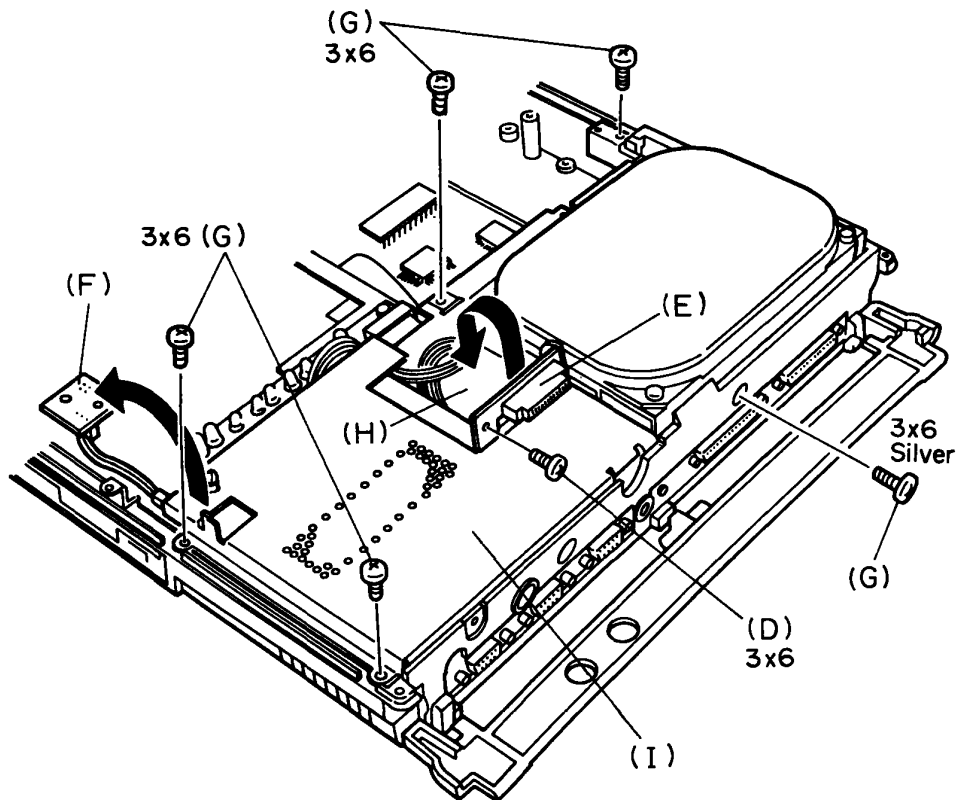


Figure 4-13 Removing the Screws from HDD Support and removing the Built-in Modem Connector

6. Lift up the HDD support, then disconnect the two cables (J) from the HDD (K).

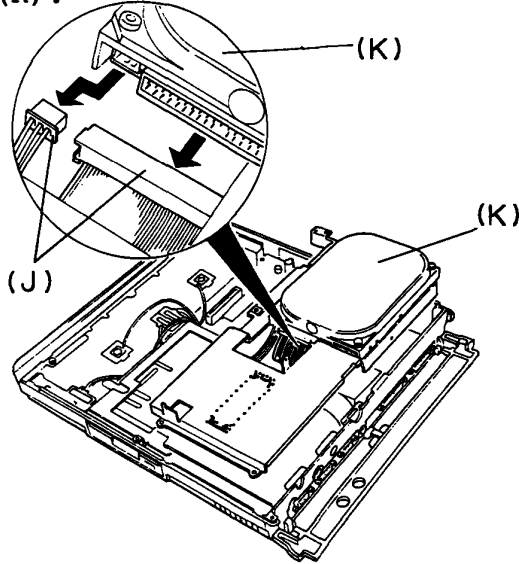


Figure 4-14 Removing the HDD Support

7. Remove the three screws (L) from HDD support, then remove the HDD from the HDD support.

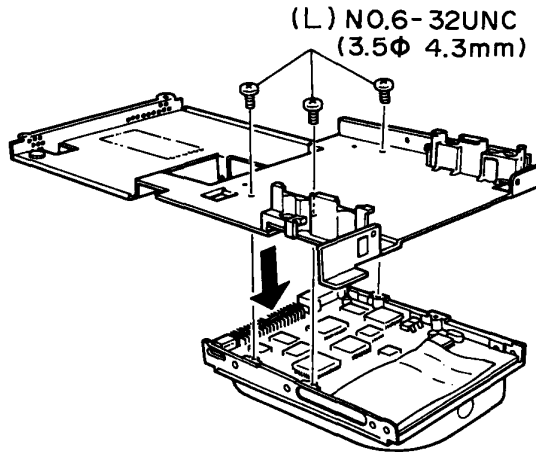


Figure 4-15 Removing the HDD

8. To install the HDD, follow the above procedures in reverse.

NOTE: When you install the HDD support on which you have fixed the HDD, the HDD cable should be at the power supply board side.

4.7 REMOVING/REPLACING THE LED BOARD AND DC INDICATOR BOARD

1. Remove the top cover as directed in section 4.3.
2. Disconnect the DC IN indicator connector (A) from the PJ6 power supply board, and remove the DC IN indicator board (B) from the board support (C).
3. Remove the screw (D), then release the pressure plate (E) of the PJ601 LED board connector (F) to disconnect the LED board cable (G) and remove LED board (H).

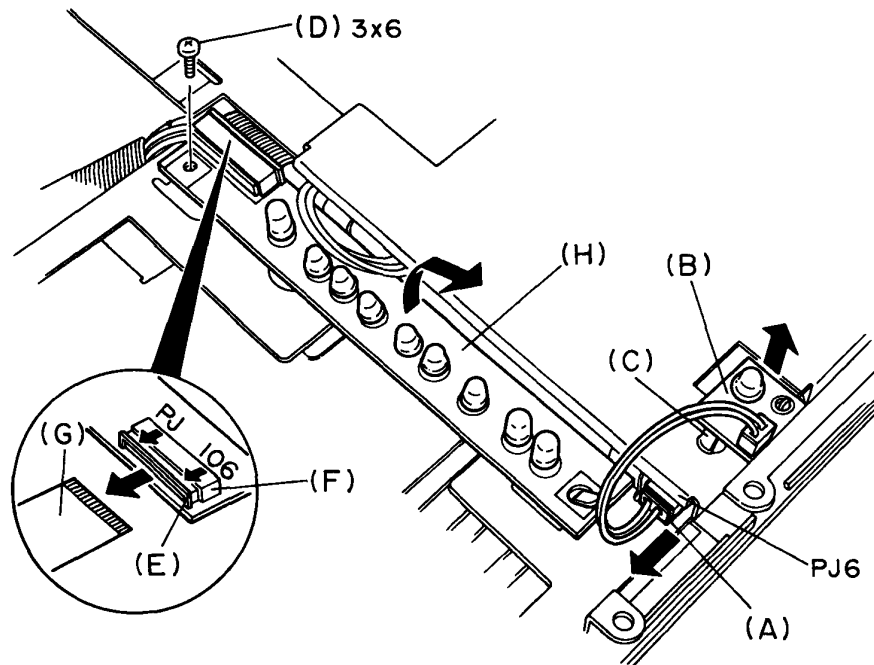


Figure 4-16 Removing the LED Board and DC IN Indicator Board

4. To install the LED board and DC IN indicator board, follow the above procedures in reverse.

4.8 REMOVING/REPLACING THE POWER SUPPLY BOARD AND SUB BATTERY

1. Remove the HDD support as directed in section 4.6 and remove the four screws (A) from the power supply board (B).
2. Disconnect the connector (C) from the PJ2 power supply board.

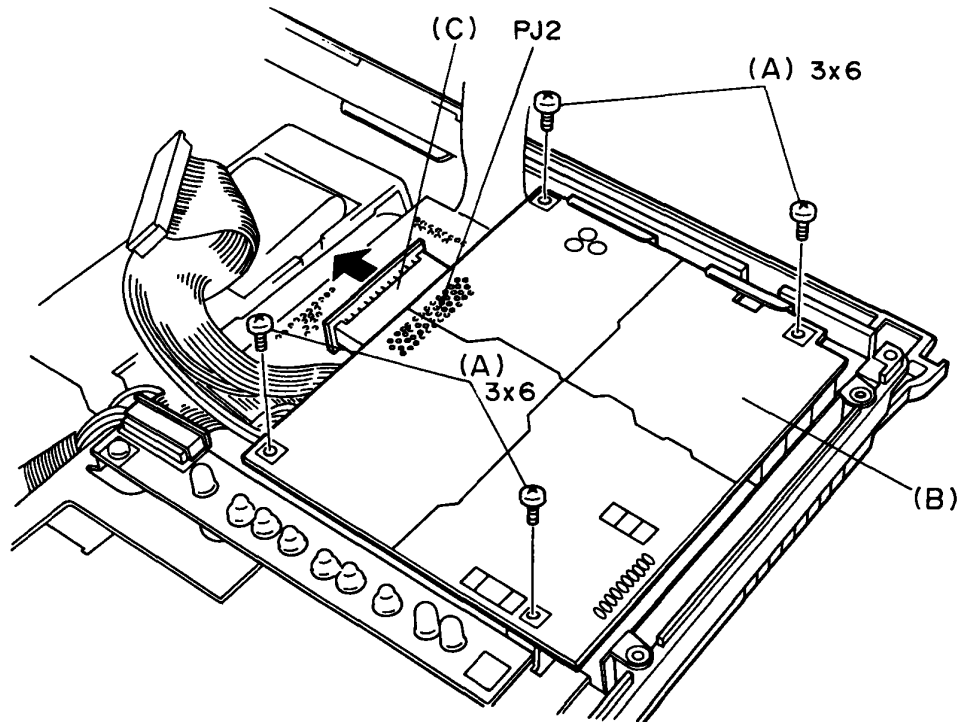


Figure 4-17 Removing the Screws from the Power Supply Board

3. Lift up rear of power supply board, then disconnect the three cable (D) from the PJ3, 4, 5 power supply board.
4. Peel the tape (E), then remove the power supply board.
5. Remove the sub battery (F).

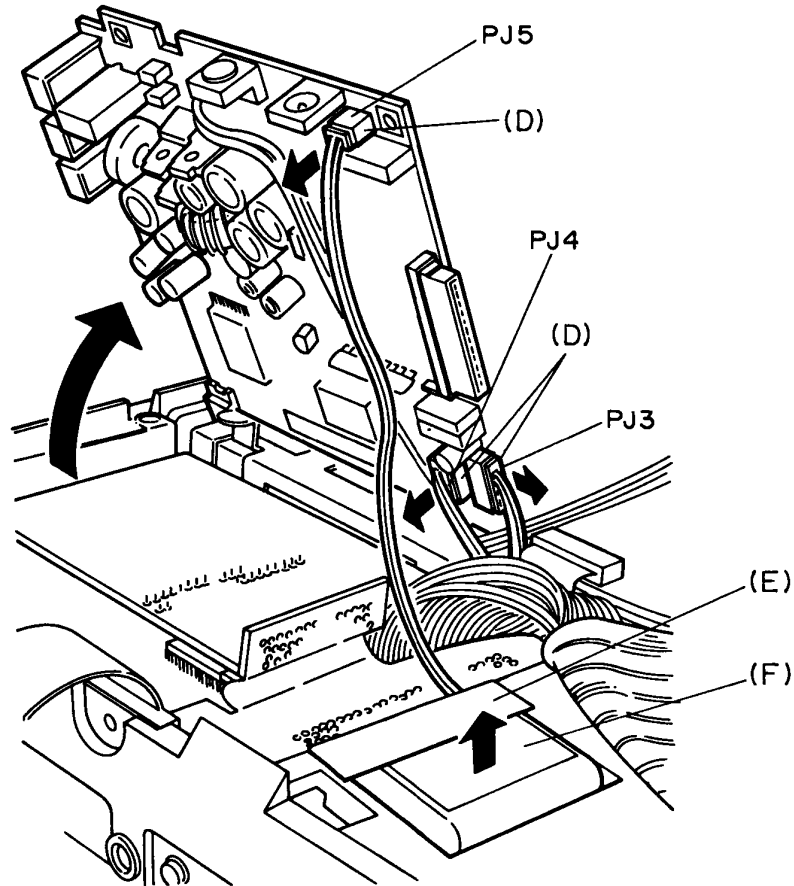


Figure 4-18 Removing the Power Supply Board and Sub Battery

6. To install the power supply board, follow the above procedures in reverse.

CAUTION : When inserting connector into PJ4, 5, the connector with red cable should be inserted into PJ4.

4.9 REMOVING/REPLACING THE HDD ADAPTER BOARD AND FDD

1. Remove the power supply board as directed in section 4.8.
2. Remove the two screws (A) from the HDD adapter board (B), to remove the HDD adapter board.
3. Unplug the HDD adapter board from the PJ8 system board.
4. Release the pressure plate (C) of the PJ601 LED board connector (D) to disconnect the LED board cable (E).
5. Remove the two screws (F) from the expansion bus connector assembly (G), then unplug them from the PJ6 and PJ7 system board.

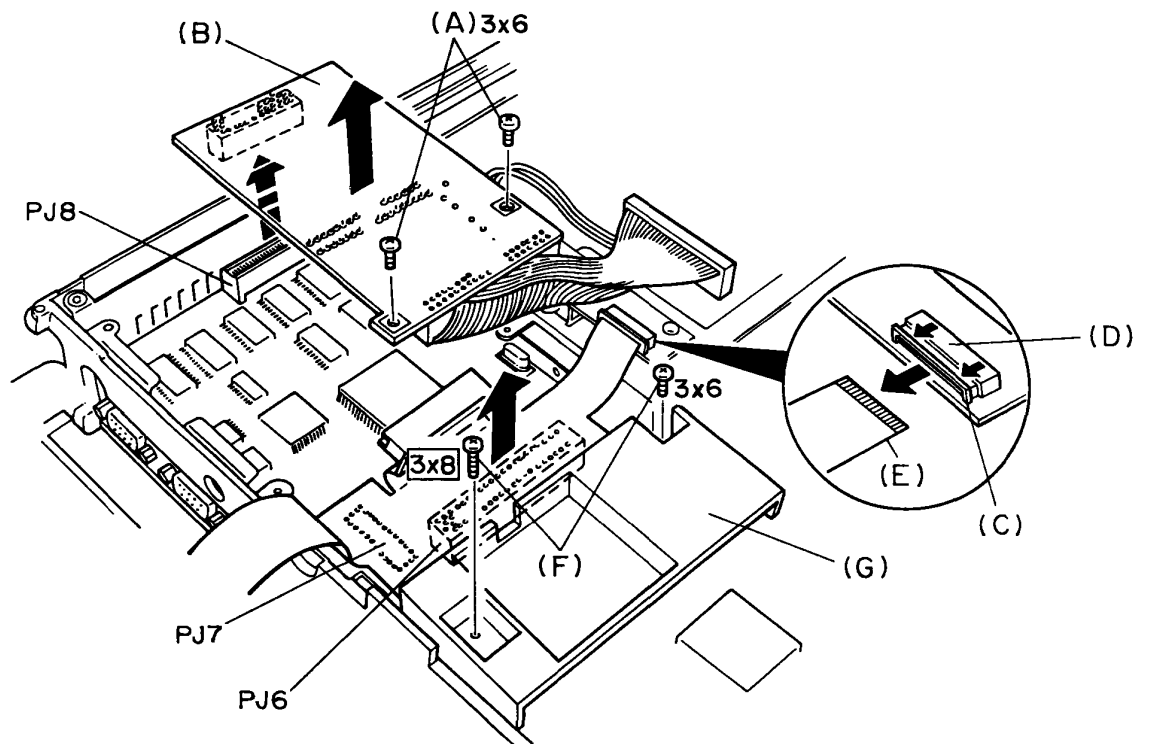


Figure 4-19 Removing the HDD Adapter Board

6. Remove the three screws (H) and one nut (I) from the FDD support (J) and lift up the FDD support, then disconnect the FDD cable (K) from the PJ5 system board.

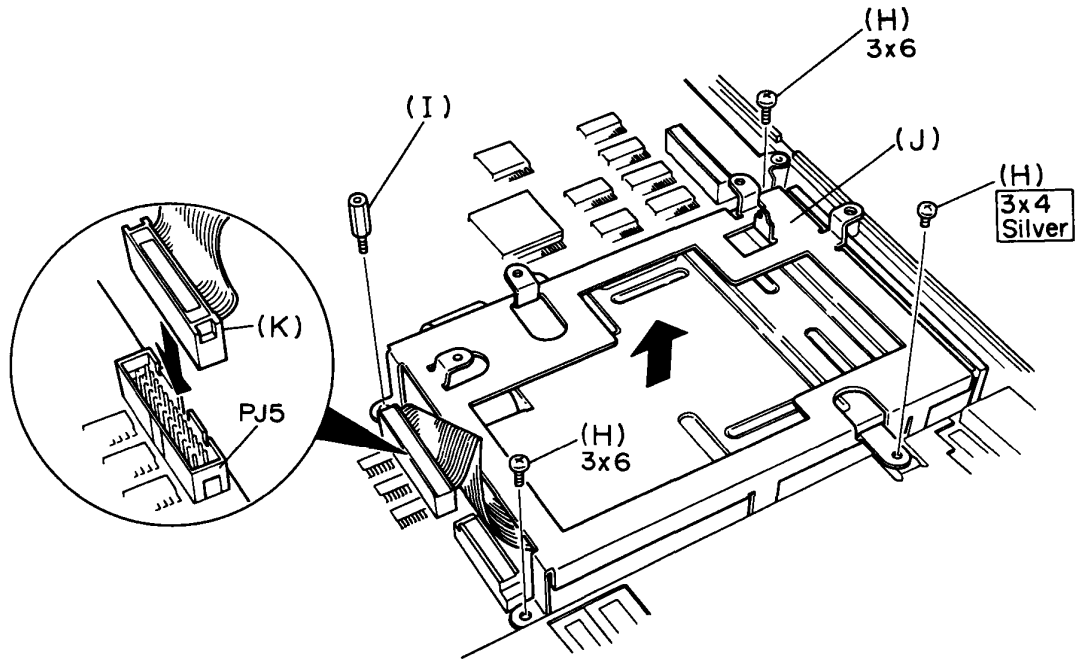


Figure 4-20 Removing the FDD Support

7. Remove the four screws (L) from the FDD support, then take off the FDD (M) from the FDD support.

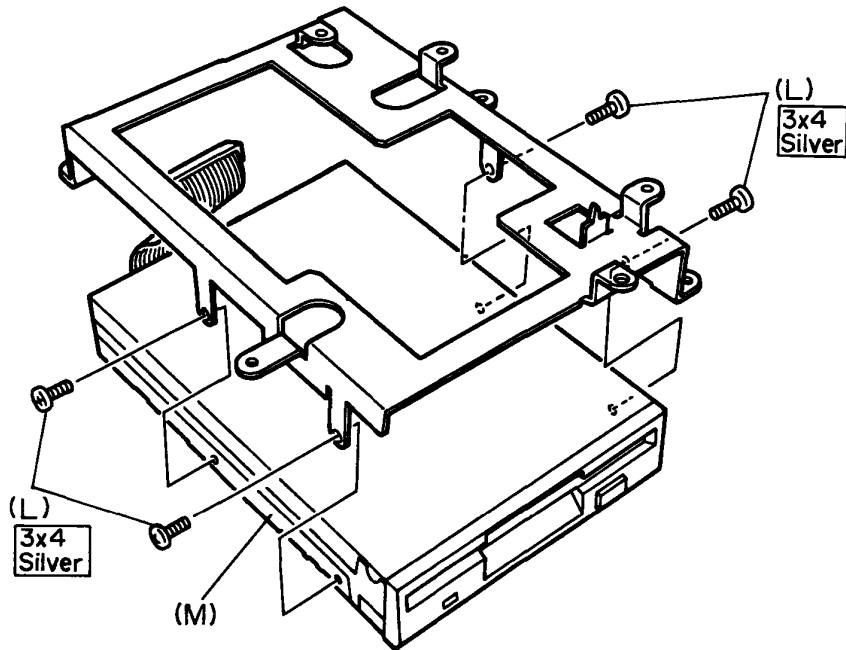


Figure 4-21 Removing the FDD

8. To install the HDD adapter board and FDD, follow the above procedures in reverse.

CAUTION: When you install the expansion bus connector assembly, you must fix the assembly with correct screws marked in figure 4-19. Also, install the FDD support with FDD, you fix it with correct screws marked in figure 4-20. If you use the wrong screw, it will damage the system board.

4.10 REMOVING/REPLACING THE SYSTEM BOARD

1. Remove the FDD support as directed in section 4.9.
2. Remove the four screws (A) and one nut (B) from the system board (C), and remove the system board.

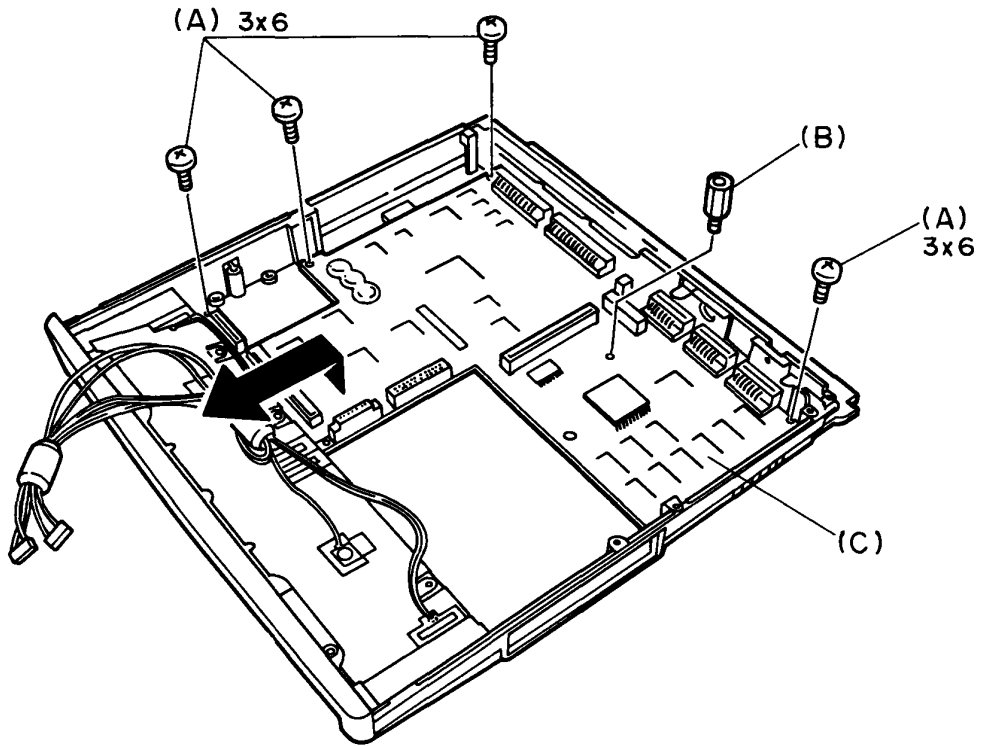


Figure 4-22 Removing the System Board

3. To install the system board, follow the above procedures in reverse.

4.11 REMOVING/REPLACING THE LCD MODULE AND LCD CONNECTOR

WARNING: High voltages are applied to the display. When you disassemble or assemble the display, be sure to remove the display from the system unit.

1. Remove the display unit.
2. Release the three latches (A) and five latches (H) of LCD cover (B), then unlatch the two latches (C) to remove the LCD mask (D).
3. Remove the four screws (E) and lift up the LCD module (F), then disconnect the five connectors (G) from the LCD module.

NOTE: Pull out the cable by its connector. Never disconnect it by pulling out the cable itself.

4. Remove the LCD module.

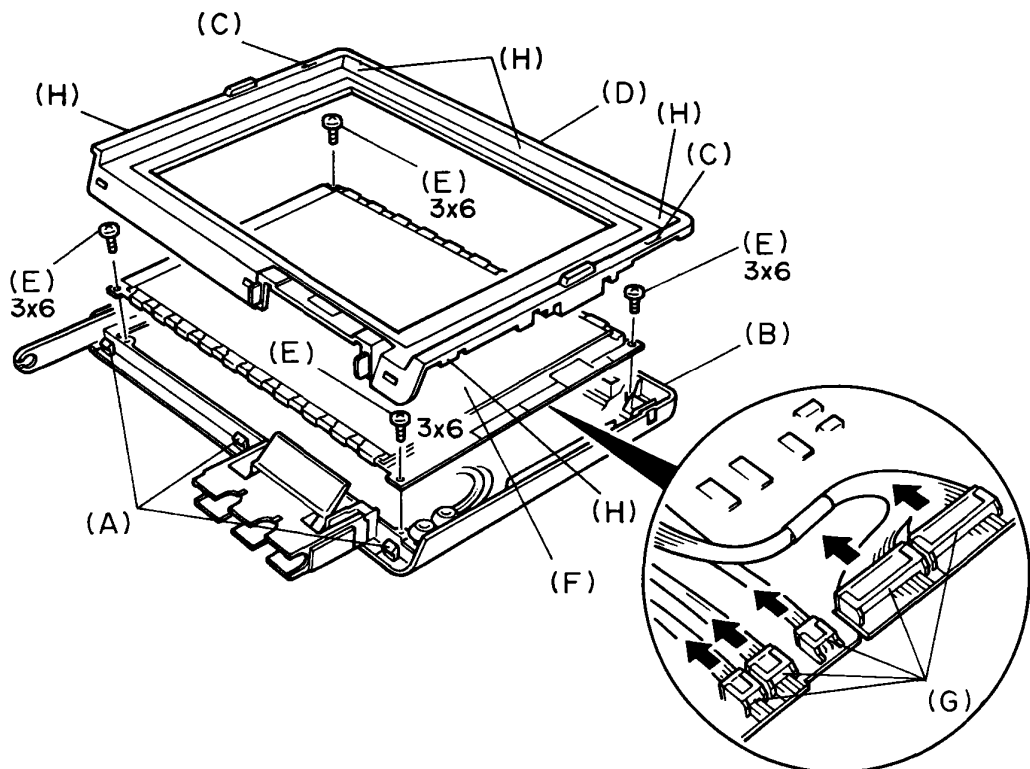


Figure 4-23 Removing the LCD Module

5. Remove the two screws (H) from release plate block (I) and lift up the release plate block.
6. Remove the LCD connector (J).

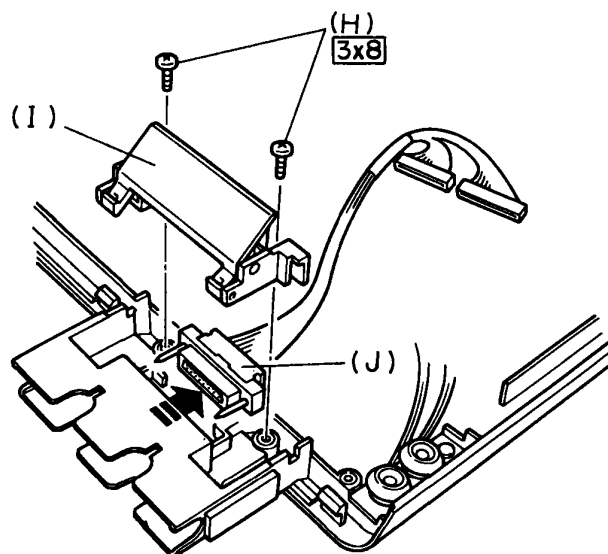


Figure 4-24 Removing the LCD Connector

7. To install the LCD module and LCD connector, follow the above procedures in reverse.

4.12 REMOVING/REPLACING THE VOLUME BOARD AND EL POWER SUPPLY BOARD

1. Remove the LCD module as directed in section 4.11.
2. Disconnect the three connector (A) from EL power supply board (B) and remove the screw (C) from volume board (D), to lift up the volume board.
3. Remove the four screws with washer (E) from EL power supply board to remove the EL power supply board.

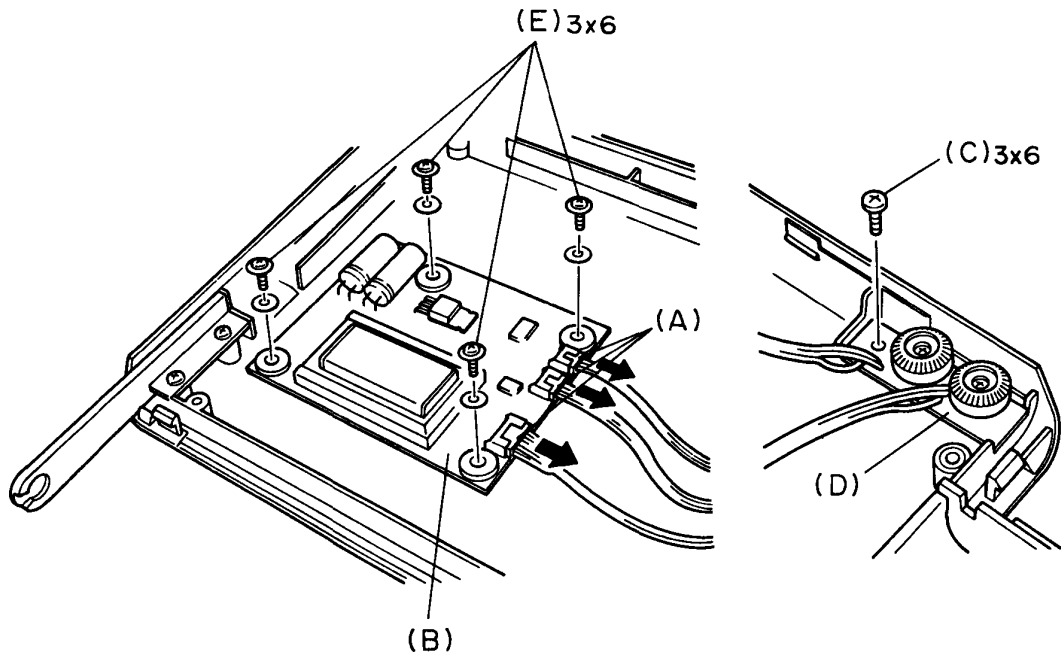


Figure 4-25 Removing the Volume Board and EL power supply

4. To install the volume board and EL power supply board, follow the above procedures in reverse.

CAUTION : When connect the volume board cable to EL power supply board, long connector cable should be connected to EL power supply board and short one should be connected to the LCD module respectively.

4.13 REMOVING/REPLACING THE EL PANEL

1. Remove the LCD module as directed in section 4.11.
2. The EL panel is held in place by two fasteners (A). Each fastener consists of a pin (B) and a collar (C) as shown in the figure 4-33. Push up the tip of a pin, then using tweezers, pull out each pin from above.
3. The collars may come out when you pull out the pins, if not, push up the tip of each collar, then using tweezers, pull out each collar from above.

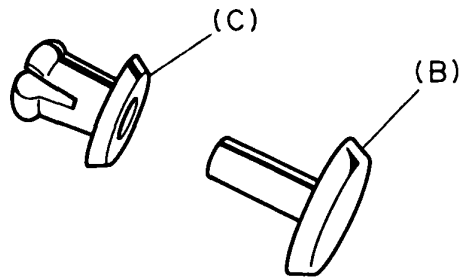


Figure 4-26 Fastener

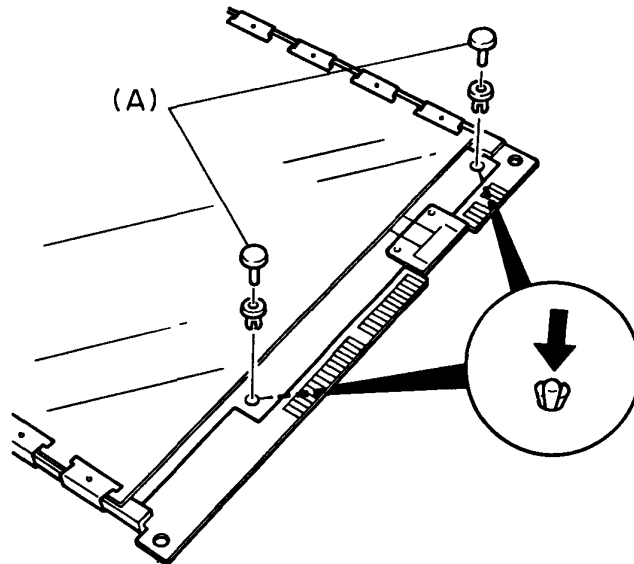


Figure 4-27 Removing the Two Fasteners

4. Pull out the EL panel (D) from the LCD module (E).

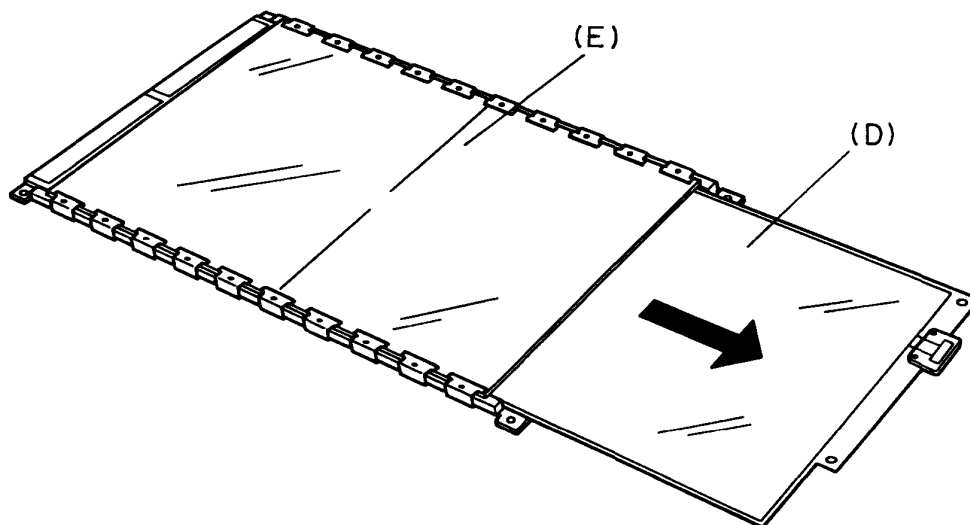


Figure 4-28 Removing the EL Panel

5. To install a new EL panel, follow the above procedures in reverse.

NOTE : When installing the EL panel into the LCD module, be sure the orange side of the EL panel is facing up. When inserting a fastener, insert the inner collar, then insert the pin. Carefully press each pin until it snaps into place.

4.14 REMOVING/REPLACING THE LCD CABLE UNIT

1. Remove the top cover as directed in section 4.3 and turn it upside down.
2. Remove the four screws (A) from hinge cover (B), to remove the hinge cover.
3. Lift up the LCD cable unit (C) and remove the hinge block (D).

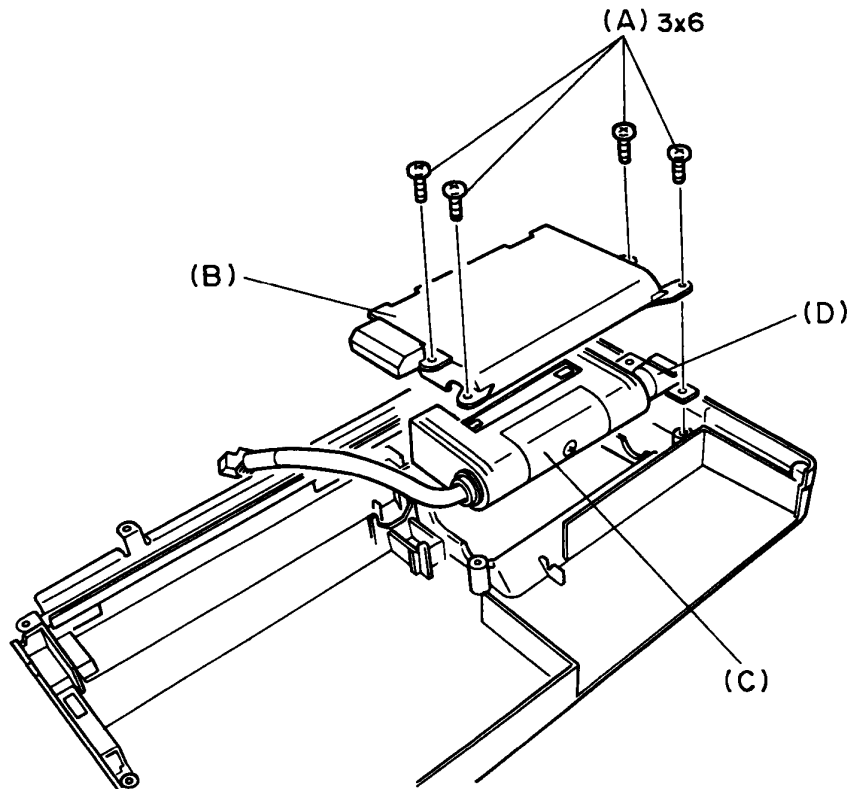


Figure 4-29 Removing the LCD Cable Unit

4. To install the LCD cable unit, follow the above procedures in reverse.

4.15 REMOVING/REPLACING THE HANDLE

1. Remove the FDD as directed in section 4.9 and remove the two screws (A) from handle stopper (B).
2. Remove the shield (C) and handle stopper, to remove the handle (D).

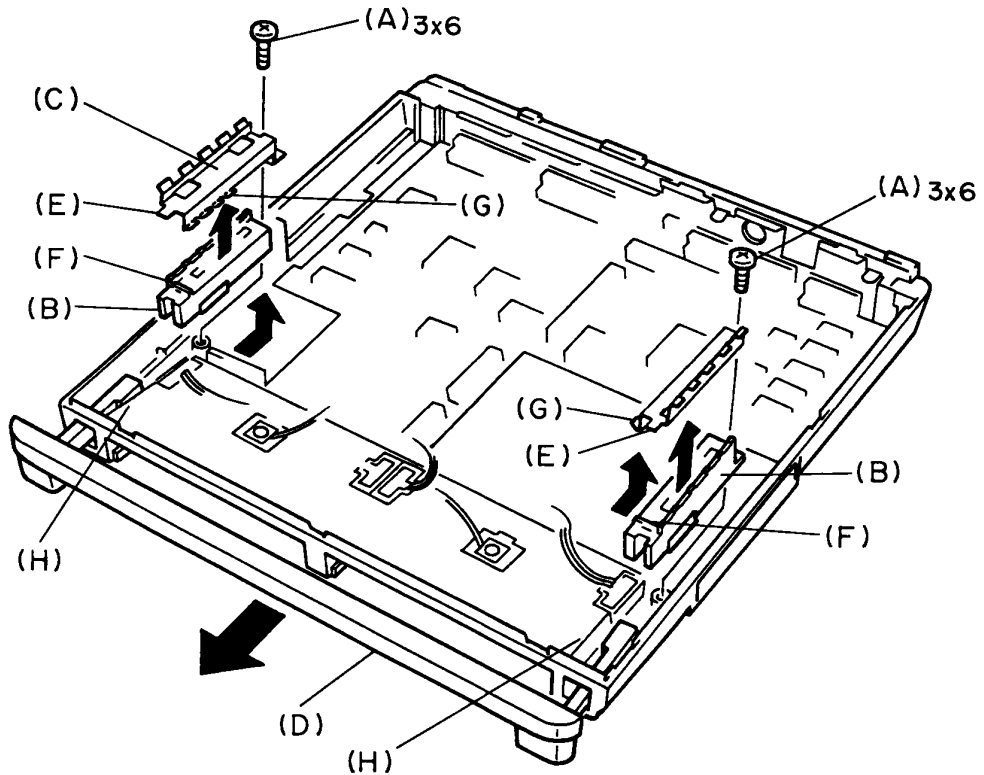


Figure 4-30 Removing the Handle

3. To install the handle, follow the above procedures in reverse.

NOTE: When you restore the shield, put the notch (E) into the hole (F) of the handle stopper. Then set (G) part to between handle stopper and battery case (H).

4.16 REMOVING/REPLACING THE MEMORY EXPANSION CARD(S)

CAUTION : Sub battery keeps supplying to the computer's memory after the power is switched off, or you remove the AC adapter or main battery pack. Pay high attention not to short-circuit the exposed part of memory board and its flexible cable with the metal part of the computer, such as a screw hole or keyboard bridge.

1. Remove the keyboard unit and shield for CPU board as directed in section 4.2.
2. Remove the screw (A) from memory expansion card (B) of upper, then unplug the upper socket (C) to remove the memory expansion card of upper.

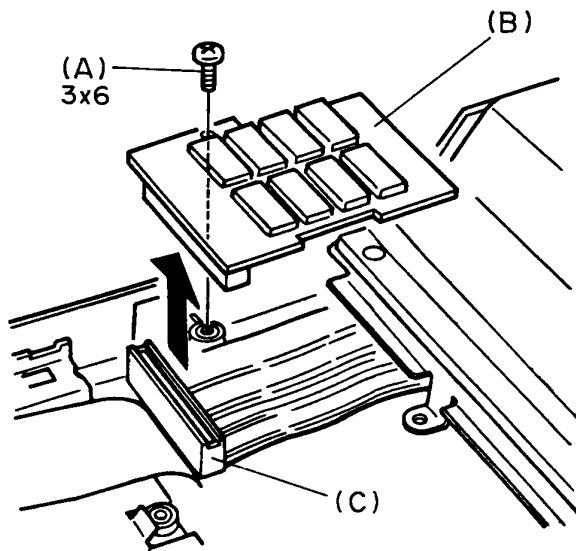


Figure 4-31 Removing the memory expansion card of upper

3. Remove the screw (D) from memory expansion card (E) of lower, then unplug the lower socket (F) to remove the memory expansion card of lower.

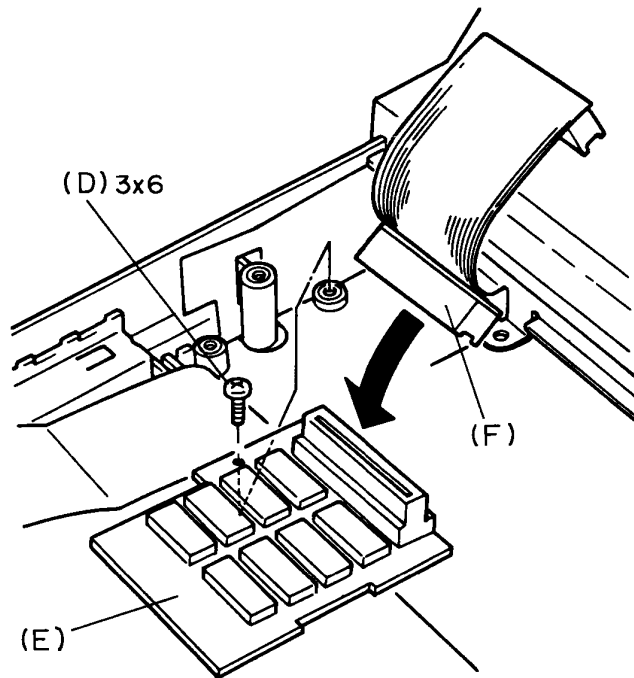


Figure 4-32 Removing the memory expansion card of lower

4. To install the memory expansion card(S), follow the above procedures in reverse.

File No. : 960-009

APPENDIX A
BOARD LAYOUT

1. System board FISYS1 (ICs)

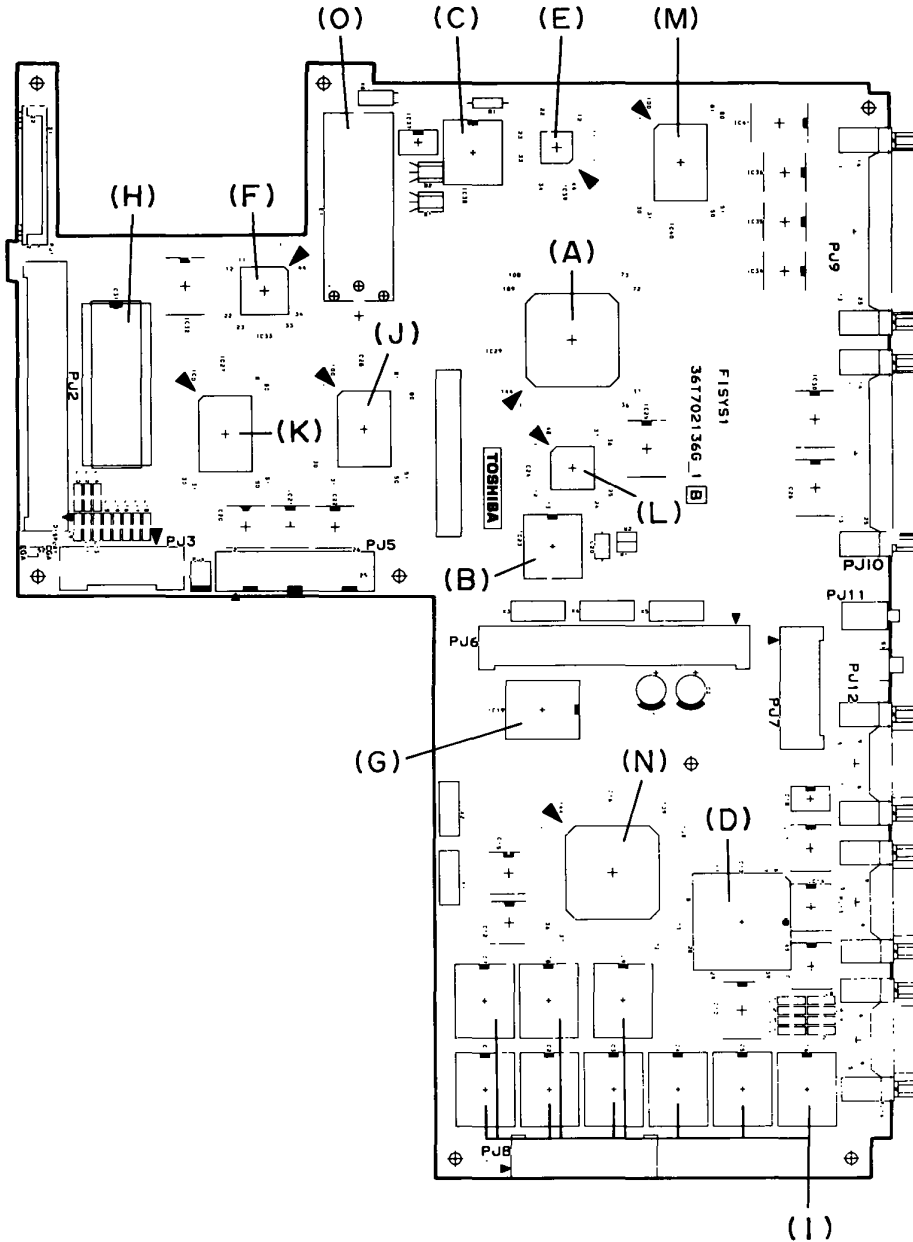


Figure A-1 System Board FISYS1 (ICs)

2. System board FISYS2 (ICs)

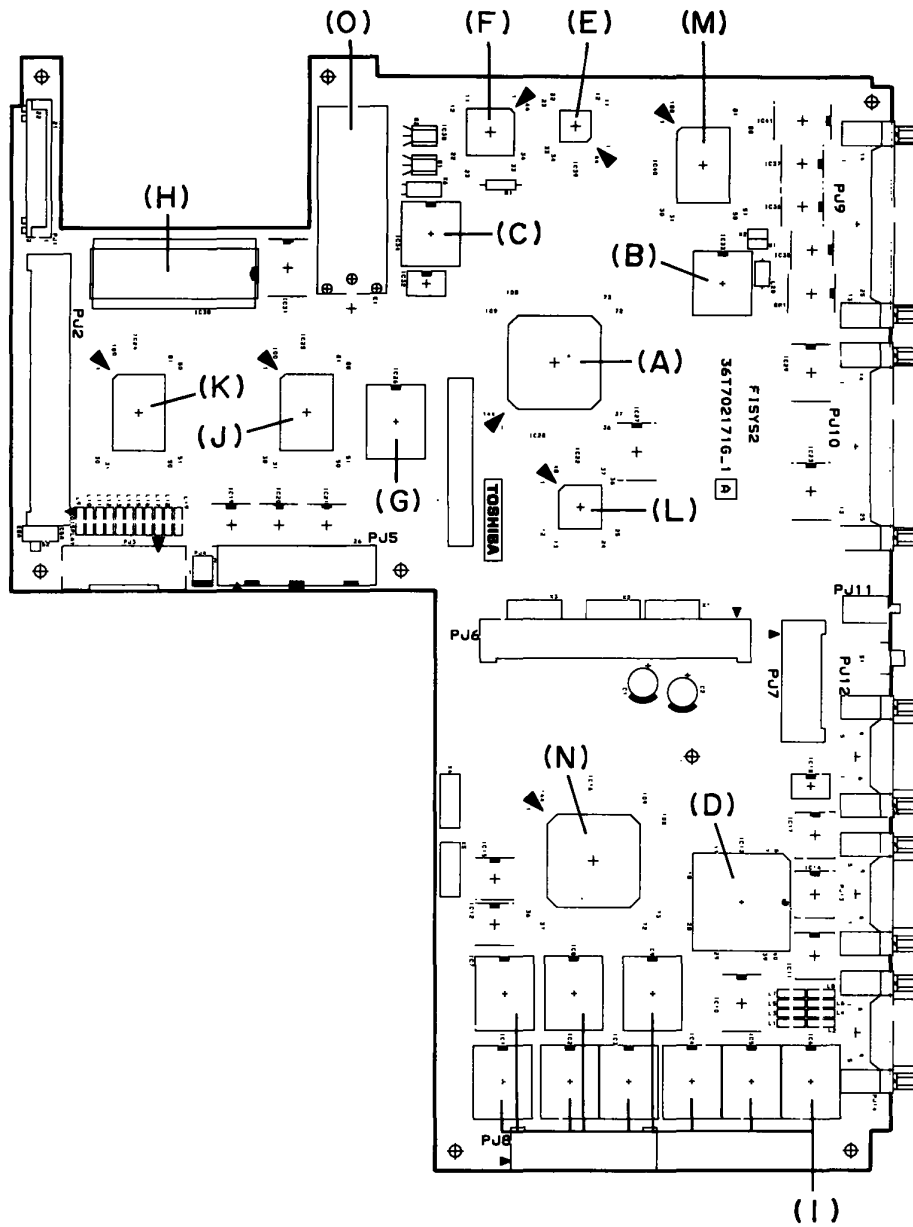


Figure A-2 System Board FISYS2 (ICs)

- (A) SI : Supper integration (U9778)
- (B) VFO : Variable frequency osillator (TC8568AF)
- (C) RTC : Real time clock (HD146818A)
- (D) ACE : Asynchronus communication element (U80C5F)
- (E) KBC : Keyboard controller (80C42)
- (F) KBC : Keyboard controller (80C50)
- (G) Backup RAM : Backup randam access memory
- (H) BIOS ROM : Basic input output system read only memory
- (I) V-RAM : Video randam access memory
- (J) BUSC-GA : Bus controller gate array
- (K) BUSD-GA : Bus driver gate array
- (L) IODEC-GA : I/O decorder gate array
- (M) IOCNT-GA : I/O controller gate array
- (N) DISCONT-GA : Display controller gate array
- (O) RTC battery : Real time clock battery

3. System board FISYS1 (connector's)

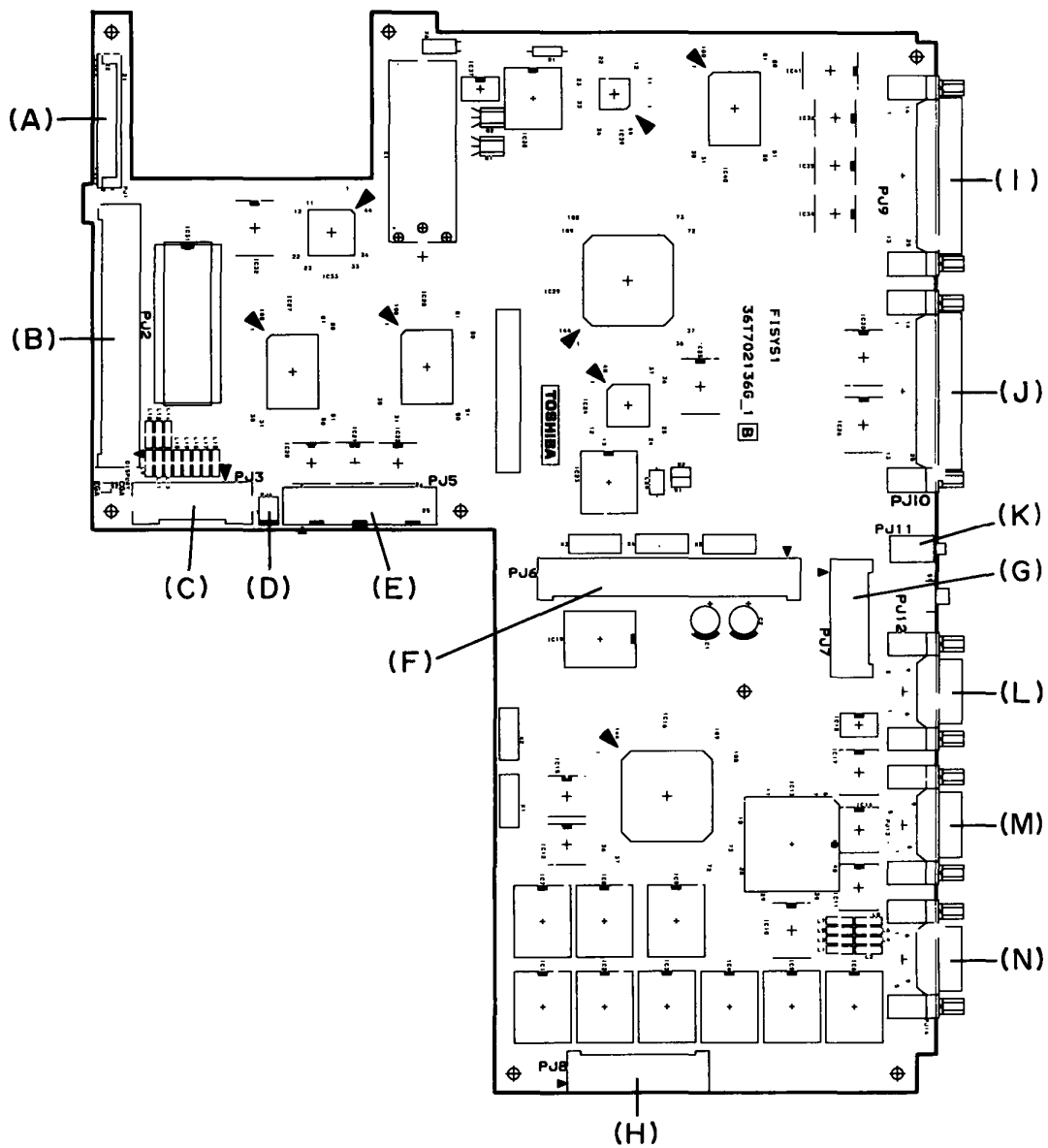


Figure A-3 System board FISYS1 connector's

4. System board FISYS2 (connector's)

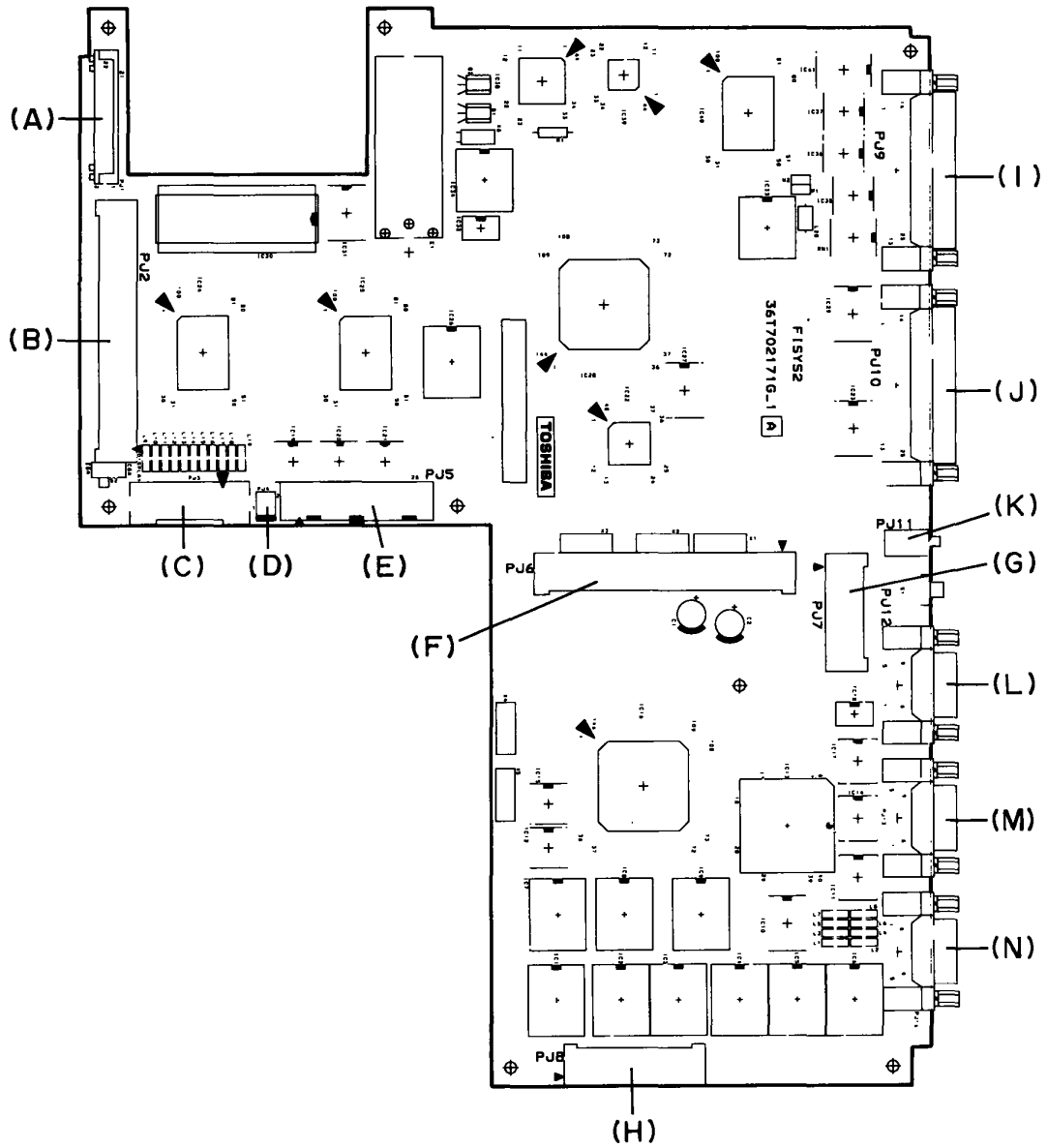


Figure A-4 System board FISYS2 connector's

- (A) PJ1 keyboard I/F connector
- (B) PJ2 CPU board/Memory board I/F connector
- (C) PJ3 Display I/F connector
- (D) PJ4 Speaker connector
- (E) PJ5 FDD I/F connector
- (F) PJ6 Exp/PS/LED I/F connector
- (G) PJ7 Exp/PS/LED I/F connector
- (H) PJ8 HDD adapter board connector
- (I) PJ9 Printer connector
- (J) PJ10 Ext-FDD I/F connector
- (K) PJ11 Keypad I/F connector
- (L) PJ12 Asynchronous I/F connector
- (M) PJ13 Asynchronous I/F connector
- (N) PJ14 RGB I/F connector

5. CPU board FICPU1 and FICPU2 (ICs and connectors)

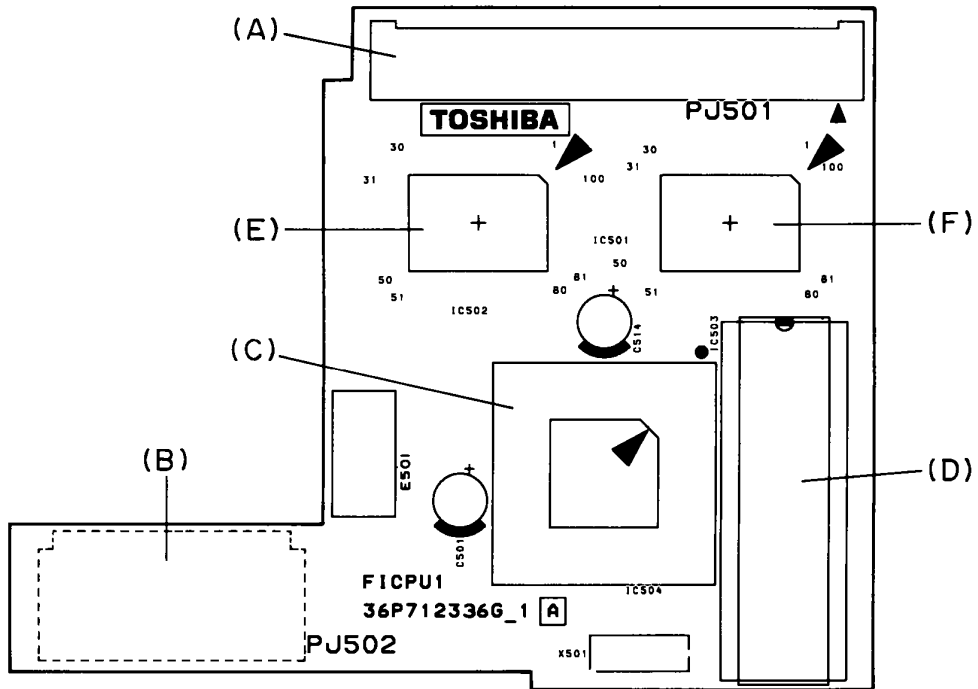


Figure A-5 CPU board FICPU1 and FICPU2 ICs and connectors

- (A) PJ501 System bus connector
- (B) PJ502 Memory connector
- (C) CPU : Central processing unit (80C286-12)
- (D) NDP : Numeric data processor socket
- (E) MEMC-GA : Memory controller gate array
- (F) ADDRIV-GA : Address driver gate array

APPENDIX B**PIN ASSIGNMENT**

1. PJ 1 Keyboard I/F Connector

TABLE B-1 keyboard I/F Connector Pin Assignment (22-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	KB0T00;000	O	12	KBT0T09;000	O
2	KB0T01;000	O	13	KBT0T10;000	O
3	KB0T02;000	O	14	KBRT0;000	I
4	GND		15	KBRT1;000	I
5	KB0T03;000	O	16	KBRT2;000	I
6	KB0T04;000	O	17	KBRT3;000	I
7	KB0T05;000	O	18	GND	
8	KB0T06;000	O	19	KBRT4;000	I
9	GND		20	KBRT5;000	I
10	KB0T07;000	O	21	KBRT6;000	I
11	KB0T08;000	O	22	KBRT7;000	I

2. PJ 2 CPU board/Memory board I/F Connector

TABLE B-2 CPU board/Memory board I/F Connector Pin Assignment (100-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	VCC		2	VCC	
3	GND		4	VCC	
5	VCC		6	D00;100	I/O
7	D01;100	I/O	8	D02;100	I/O
9	D03;100	I/O	10	D04;100	I/O
11	GND		12	D05;100	I/O
13	D06;100	I/O	14	D07;100	I/O
15	D08;100	I/O	16	D09;100	I/O
17	D10;100	I/O	18	D11;100	I/O
19	D12;100	I/O	20	D13;100	I/O
21	D14;100	I/O	22	D15;100	I/O
23	GND		24	BYTESL;100	I/O
25	LA23;100	I/O	26	LA22;100	I/O
27	LA21;100	I/O	28	LA20;100	I/O
29	LA19;100	I/O	30	LA18;100	I/O
31	LA17;100	I/O	32	A20LOW;000	I/O
33	HLDA;100	O	34	BALE;100	O
35	GND		36	LMEN;000	I
37	SA19;100	I/O	38	SA18;100	I/O
39	SA17;100	I/O	40	SA16;100	I/O
41	SA15;100	I/O	42	SA14;100	I/O
43	SA13;100	I/O	44	SA12;100	I/O
45	SA11;100	I/O	46	SA10;100	I/O
47	GND		48	SA09;100	I/O
49	SA08;100	I/O	50	SA07;100	I/O
51	SA06;100	I/O	52	SA05;100	I/O
53	SA04;100	I/O	54	SA03;100	I/O
55	SA02;100	I/O	56	SA01;100	I/O
57	SA00;100	I/O	58	REFMED;000	O
59	GND		60	DME16A;100	O
61	DMEN8A;100	O	62	RAMSL;100	I
63	MEWR;000	O	64	MERD;000	O
65	IOWR;000	O	66	IORD;000	O
67	INTA;000	O	68	NPCS;000	I
69	SD07;100	I/O	70	SD06;100	I/O
71	GND		72	SD05;100	I/O
73	SD04;100	I/O	74	SD03;100	I/O
75	SD02;100	I/O	76	SD01;100	I/O
77	SD00;100	I/O	78	SYRDY;000	O
79	RESET;000	I	80	PNLOF;000	I
81	SYCLK;100	I	82	GND	
83	ROMSL;000	I	84	SBHE;000	I/O
85	SMI0;100	I	86	SS1;100	I
87	SS0;100	I	88	RSTCP;000	O
89	PCLR;000	O	90	CKHRO;100	O

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
91	GND		92	RFCLK;100	0
93	NM1;100	0	94	INT;100	0
95	RAMVC	0	96	IR013;100	I
97	RAMVC	0	98	CPHRQ;100	0
99	RAMVC	0	100	RAMVC	0

3. PJ 3 Display I/F Connector

TALBE B-3 Display I/F Connector Pin Assignment (30-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	L5V (5V)	0	16	BRCNTP;100	0
2	GND		17	GND	
3	GND		18	BRCNTM;100	0
4	LO3BE13	0	19	U03BE03	0
5	ELV (12V)	0	20	ELD;100	I
6	LO2BE12	0	21	U02BE02	0
7	ELV (12V)	0	22	FLT;000	I
8	GND		23	GND	
9	LPBHS	0	24	ELV (12V)	0
10	LO1BE11	0	25	U01BE01	0
11	FPBVS	0	26	GND	
12	L00BE10	0	27	U00BE00	0
13	GND		28	L5V (5V)	0
14	M22V (-22V)	0	29	GND	
15	SCK	0	30	GND	

4. PJ 4 Speaker I/F Connector

TABLE B-4 Speaker I/F Connector Pin Assignment (2-pin)

PIN	SIGNAL	I/O
1	SPOUT0;100	0
2	SPOUT1;100	0

5. PJ 5 FDD I/F Connector

TABLE B-5 FDD I/F Connector Pin Assignment (26-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	VCC		14	ISTEP;000	O
2	IINDX;000	I	15	GND	
3	VCC		16	IWDAT;000	O
4	IDSL;000	O	17	GND	
5	VCC		18	IWEN;000	O
6	DSKCHG;000	I	19	GND	
7	VCC		20	ITR0;000	I
8	IRDY;000	I	21	GND	
9	IHMED;000	O	22	IWPR;000	I
10	IMON;000	O	23	GND	
11	ILOWD;000	O	24	IRDAT;000	I
12	IDIRC;000	O	25	GND	
13	GND		26	ISSEL;000	O

6. PJ 6 Exp/PS/LED I/F Connector

TABLE B-6 Exp/PS/LED I/F Connector Pin Assignment (100-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	LA23;100	I/O	2	LA22;100	I/O
3	SD15;100	I/O	4	LR06;100	I
5	SD14;100	I/O	6	GND	
7	SD13;100	I/O	8	IRQ12;100	I
9	SD12;100	I/O	10	VCC	
11	SD11;100	I/O	12	SD10;100	I/O
13	IRO11;100	I	14	VCC	
15	SDOB;100	I/O	16	IRQ10;100	I
17	GND		18	VCC	
19	IRO14;100	I	20	SD09;100	I/O
21	SPKTON;000	I	22	VCC	
23	SA06;100	I/O	24	DRQ1;100	I
25	VCC		26	VCC	
27	IOCRDY;100	I	28	DACK3;000	O
29	GND		30	VCC	
31	AEN;100	O	32	PSRD;100	O
33	DRQ3;100	I	34	PSSD;100	I
35	IRQ5;100	I	36	INTDSP;000	O
37	EIOCK;100	O	38	EXPCLR;000	I
39	IRO9;100	I	40	INITSW;0001	O
41	DACK1;000	O	42	BEEP;000	I
43	RESET;100	O	44	LCDV	I
45	GND	O	46	RAMV	I
47	BALE;100	O	48	RAMV	I
49	TC;100	O	50	EVL	I

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
51	IORD;000	I/O	52	EVL	I
53	IOWR;000	I/O	54	EVL	I
55	SMER;000	O	56	EVL	I
57	GND		58	BRCNTP;100	I
59	SD07;100	I/O	60	SMEW;000	I/O
61	SD06;100	I/O	62	BRCNTM;100	I
63	SD04;100	I/O	64	SD05;100	I/O
65	SD03;100	I/O	66	SD02;100	I/O
67	SD01;100	I/O	68	SD00;100	I/O
69	SA19;100	I/O	70	HSPDLED;100	O
71	SA18;100	I/O	72	SA17;100	I/O
73	GND		74	NUMLED;000	O
75	SA16;100	I/O	76	SA15;100	I/O
77	SA14;100	I/O	78	OVRLED;000	O
79	SA13;100	I/O	80	SA12;100	I/O
81	SA11;100	I/O	82	CAPLED;000	O
83	SA10;100	I/O	84	SA08;100	I/O
85	GND		86	CLED;000	O
87	EXCMCK;100	O	88	SA07;100	I/O
89	SA05;100	I/O	90	ALED;000	O
91	SA04;100	I/O	92	SA03;100	I/O
93	SA00;100	I/O	94	CRTLED;000	I/O
95	GND		96	MIRQ;000	I
97	SA09;100	I/O	98	MDMSL;000	O
99	SA02;100	I/O	100	SA01;100	I/O

7. PJ 7 Exp/PS/LED I/F Connectors

TABLE B-7 Exp/PS/LED Connector Pin Assignment (40-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	DR06;100	I	21	HDLV	I
2	IR04;100	I	22	IOCHCKZ;000	I
3	DACK2;000	O	23	DR02;100	I
4	DR05;100	I	24	LA19;100	I/O
5	IOCS16;000	I/O	25	LA21;100	I/O
6	DACK5;000	O	26	BMDMSL;000	O
7	MMCS16;000	I/O	27	HDHV	I
8	GND		28	HDHV	I
9	SBHE;000	I/O	29	HDMV	I
10	IR07;100	I	30	E14R7M;100	O
11	MASTER;000	I	31	HDMV	I
12	LA17;100	I/O	32	GND	
13	LA18;100	I/O	33	HDMV	I
14	MEWR;000	I/O	34	BMPOF;100	I
15	DACK6;000	O	35	HDMV	I
16	REFMD;000	I/O	36	BSPTON;000	I
17	LA20;100	I/O	37	HDMV	I
18	MERD;000	I/O	38	BMIRQ;000	I
19	HDLV	I	39	N9V	I
20	GND		40	P12V	I

8. PJ 8 HDC I/F Connector

TABLE B-8 HDC I/F Connector Pin Assignment (50-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	RESET;000	O	2	GND	
3	RSD07;100	I/O	4	RSD08;100	I/O
5	RSD06;100	I/O	6	RSD09;100	I/O
7	RSD05;100	I/O	8	RSD10;100	I/O
9	GND		10	GND	
11	RSD04;100	I/O	12	RSD11;100	I/O
13	RSD03;100	I/O	14	RSD12;100	I/O
15	RSD02;100	I/O	16	RSD13;100	I/O
17	GND		18	GND	
19	RSD01;100	I/O	20	RSD14;100	I/O
21	RSD00;100	I/O	22	RSD15;100	I/O
23	GND		24	GND	
25	IOWR;000	O	26	BALE;100	I/O
27	IORD;000	O	28	HIOS16;000	I
29	IRQ14;100	I	30	GND	
31	SA01;100	O	32	SA02;100	O
33	SA00;100	O	34	HDLV(5V)	O
35	HDCOCS;000	O	36	HDC1CS;000	O
37	GND		38	GND	
39	HDHV(12V)	O	40	GND	
41	VCC		42	GND	
43	DRVSEL;100	I	44	GND	
45	IOCLK;100	O	46	GND	
47	IOCRDY;100	I	48	HDMV(5V)	
49	HDMV(5)	O	50	HDMV(5V)	

9. PJ 9 Printer I/F Connector

TABLE B-9 Printer I/F Connector Pin Assignment (25-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	STROB;000	O	13	SELEC;100	I
2	PD0;100	I/O	14	AUTFD;000	O
3	PD1;100	I/O	15	ERROR;000	I
4	PD2;100	I/O	16	PINT;000	O
5	PD3;100	I/O	17	SLIN;000	O
6	PD4;100	I/O	18	GND	
7	PD5;100	I/O	19	GND	
8	PD6;100	I/O	20	GND	
9	PD7;100	I/O	21	GND	
10	ACK;000	I	22	GND	
11	BUSY;100	I	23	GND	
12	PE;100	I	24	GND	
			25	GND	

10. PJ 10 Ext-FDD I/F Connector (Int/Ext)

TABLE B-10 Ext-FDD I/F Connector Pin Assignment (25-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	ERDY;000	I	13	EWEN;000	O
2	EINDX;000	I	14	ELOWD;000	O
3	ETRO;000	I	15	ESSEL;000	O
4	EWPR;000	I	16	EDIRC;000	O
5	ERDAT;000	I	17	ESTEP;000	O
6	EDKCH;000	I	18	GND	
7	GND		19	GND	
8	GND		20	GND	
9	GND		21	GND	
10	EDSL;000	O	22	GND	
11	EMON;000	O	23	GND	
12	EWADAT;000	O	24	GND	
			25	GND	

11. PJ 11 Keypad I/F Connector

TABLE B-11 Keypad I/F Connector Pin Assignment (2-pin)

PIN	SIGNAL	I/O
1	GND	
2	TENKEY;100	I/O

12. PJ 12 Asynchronous I/F Connector

TABLE B-12 Asynchronous I/F Connector Pin Assignment (9-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	DCD0;100	I	5	GND	
2	RD0;000	I	6	DSRO;100	I
3	SD0;000	O	7	RTS0;100	O
4	DTR0;100	O	8	CTS0;100	I
			9	RI0;100	I

13. PJ 13 Asynchronous I/F Connector

TABLE B-13 Asynchronous I/F Connector Pin Assignment (9-pin)

PIN	SIGNAL	I/O	PIN	SIGNAL	I/O
1	DCD1;100	I	5	GND	
2	RD1;000	I	6	DSR1;100	I
3	SD1;000	O	7	RTS1;100	O
4	DTR1;100	O	8	CTS1;100	I
			9	RI1;100	I

14. PJ 14 RGB I/F Connector

TABLE B-14 RGB I/F Connector Pin Assignment (9-pin)

PIN	I/O	SIGNAL	MONOCHROME	STANDARD RGB	ENHANCED RGB
1		GND	GROUND	GROUND	GROUND
2	O	SR1	GROUND	GROUND (*1)	S.RED (*2)
3	O	FR1	NOT CONNECTED	RED	RED
4	O	FG1	NOT CONNECTED	GREEN	GREEN
5	O	FB1	NOT CONNECTED	BLUE	BLUE
6	O	SG1	INTENSITY	INTENSITY	S.GREEN
7	O	SB1	VIDEO	NOT CONNECTED	S. BLUE
8	O	HS1	H. SYNC	H. SYNC	H. SYNC
9	O	VS1	V. SYNC	V. SYNC	V. SYNC

(*1): When EGA/CGA switch (SW3) is set to CGA side, this signal is output to pin number 2.

(*2): When EGA/CGA switch (SW3) is set to EGA side, this signal is output to pin number 2.

APPENDIX C
KEY LAYOUT

1. USA keyboard

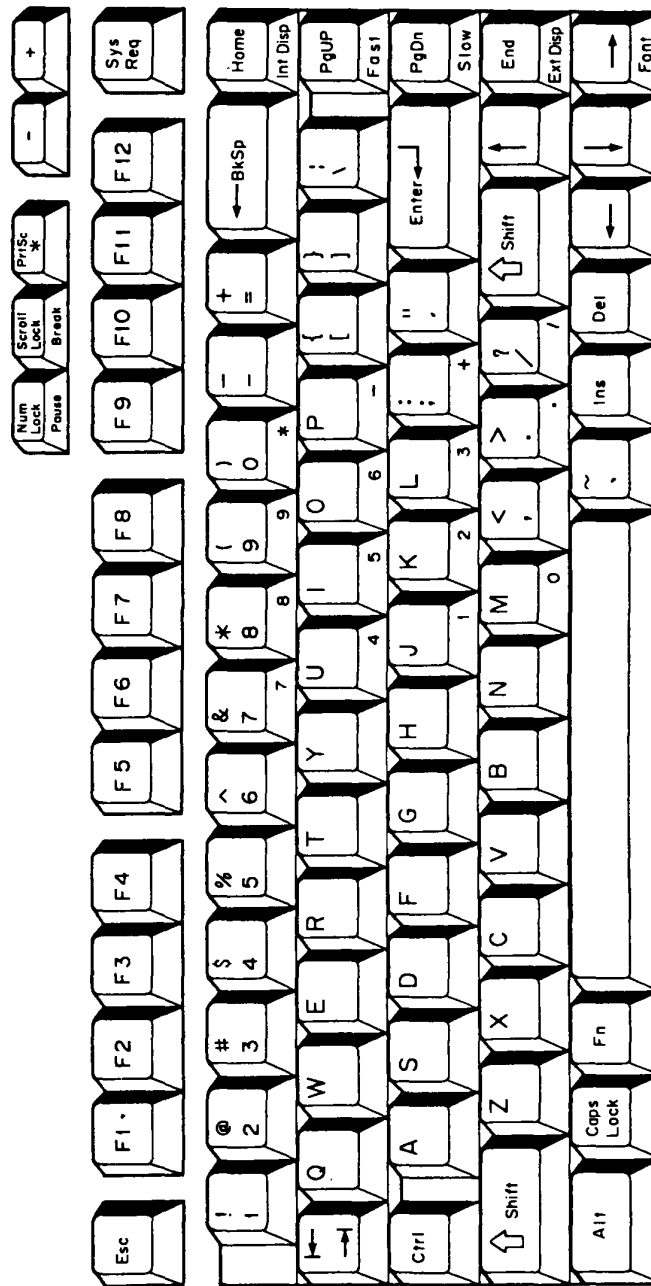


Figure C-1 USA Keyboard

3. German keyboard

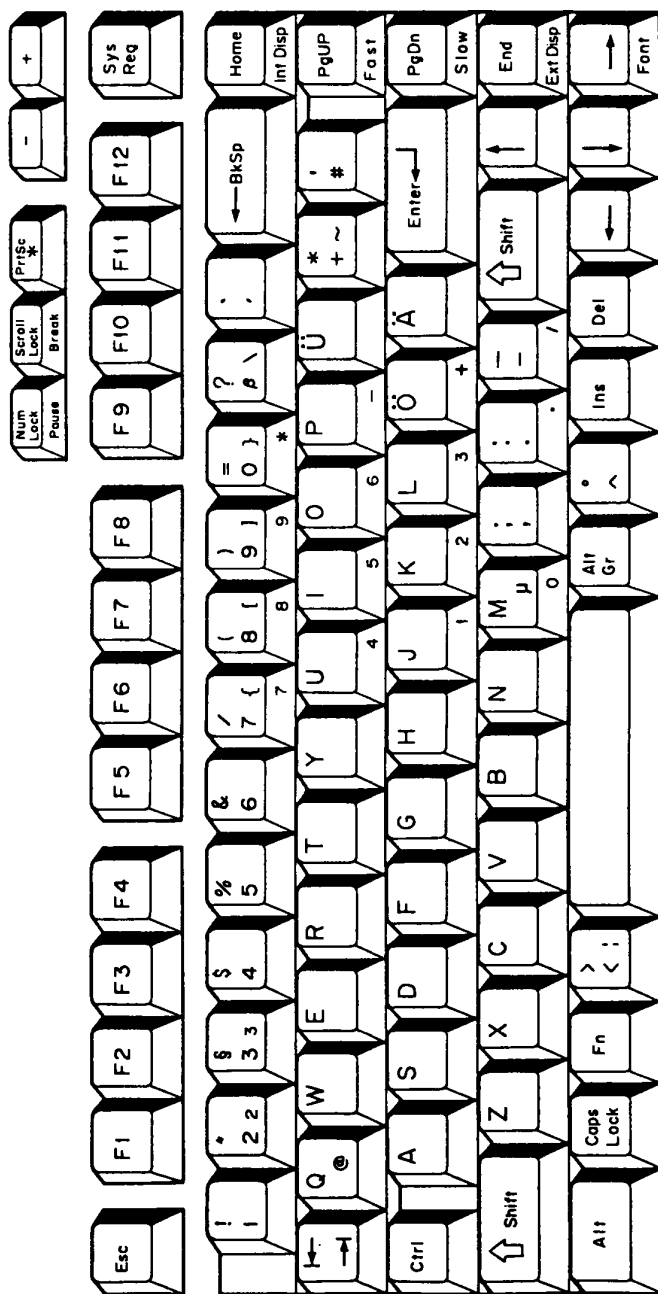


Figure C-3 German Keyboard

4. French keyboard

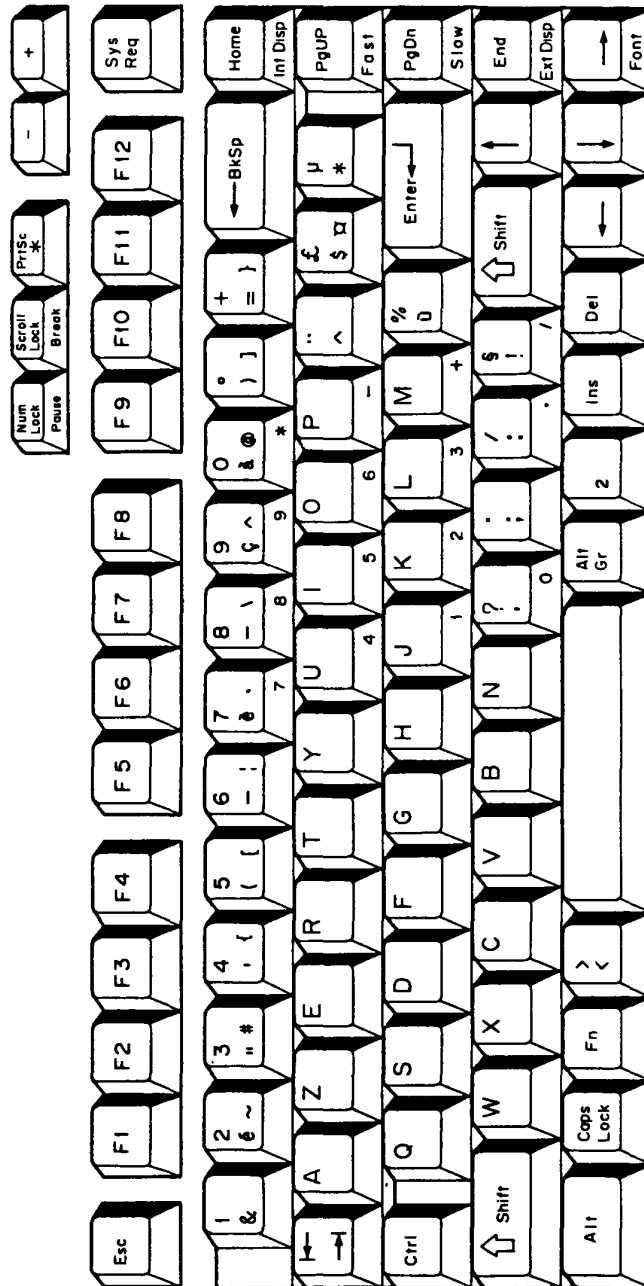


Figure C-4 French Keyboard

5. Spanish keyboard

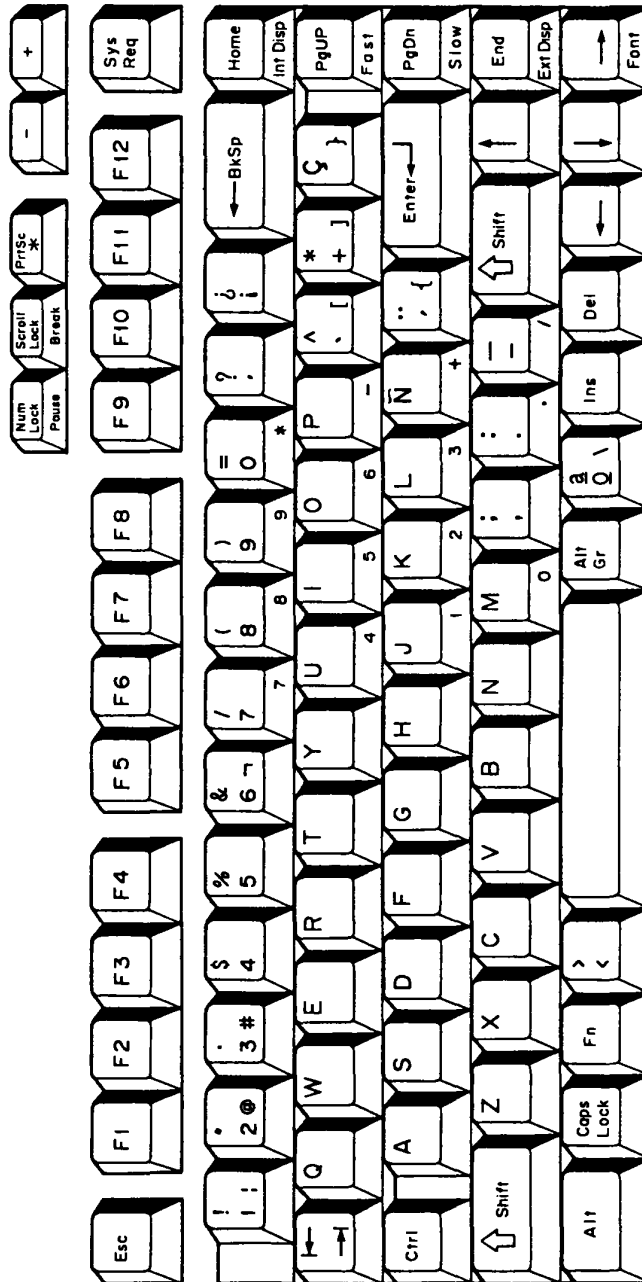


Figure C-5 Spanish Keyboard

7. Scandinavian keyboard

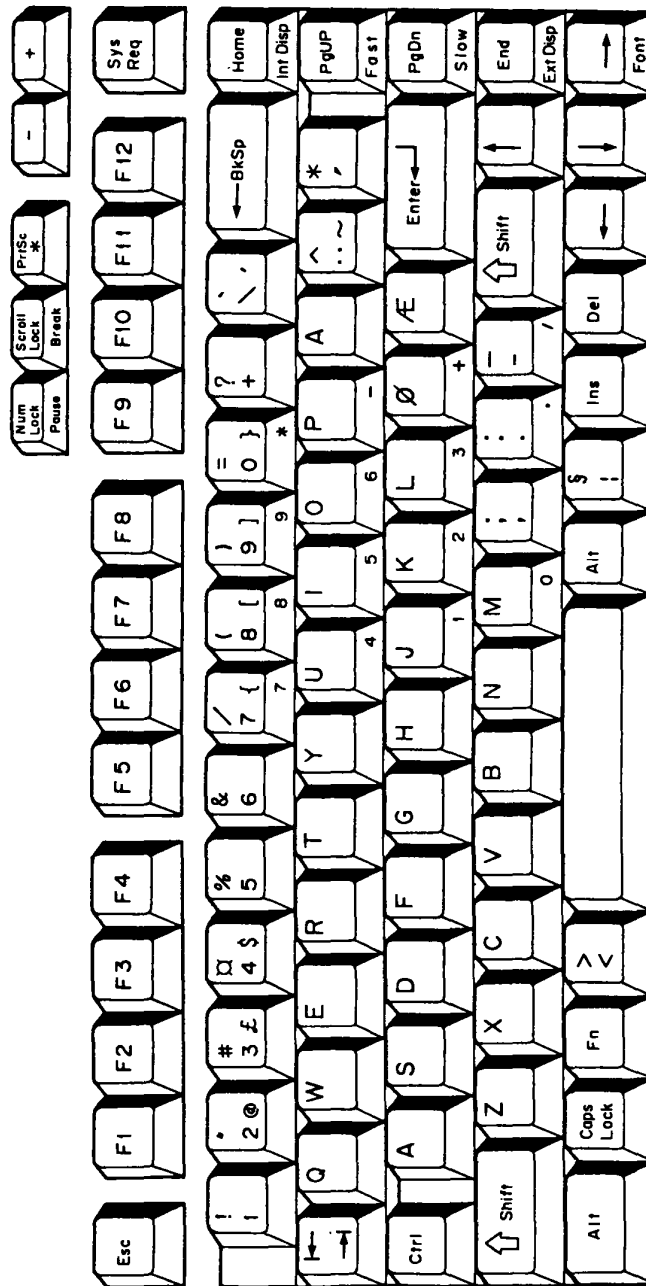


Figure C-7 Scandinavian Keyboard

8. Swiss keyboard

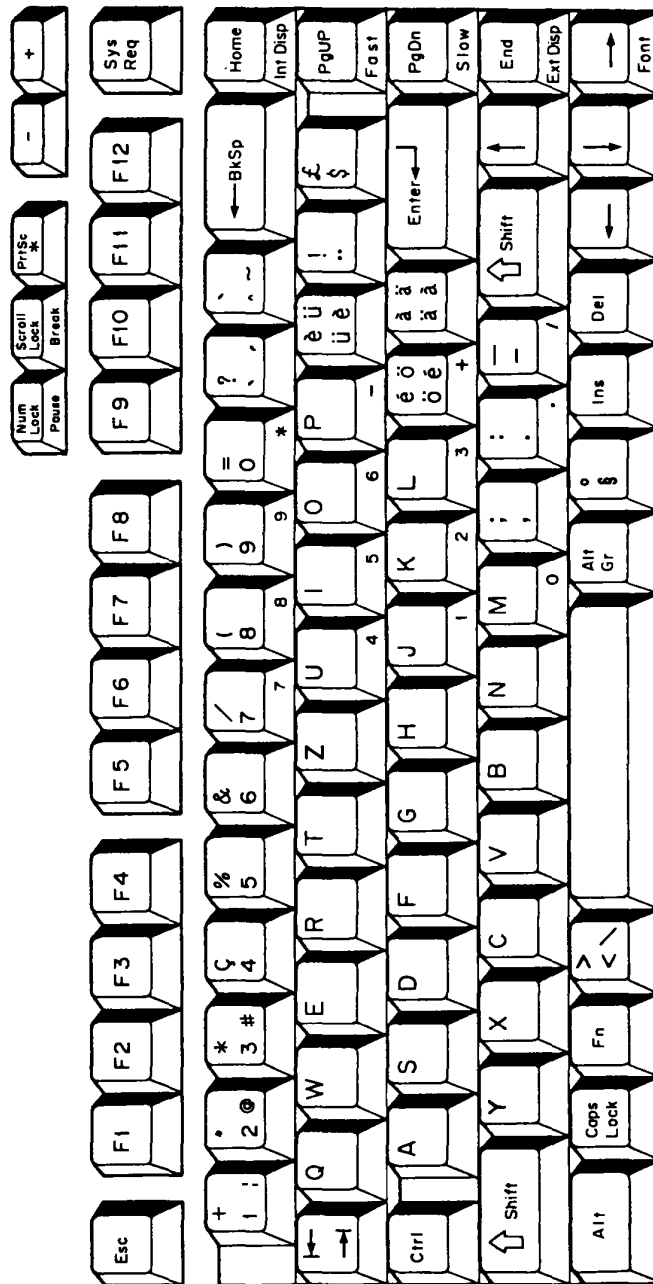


Figure C-8 Swiss Keyboard

9. Special canadian keyboard

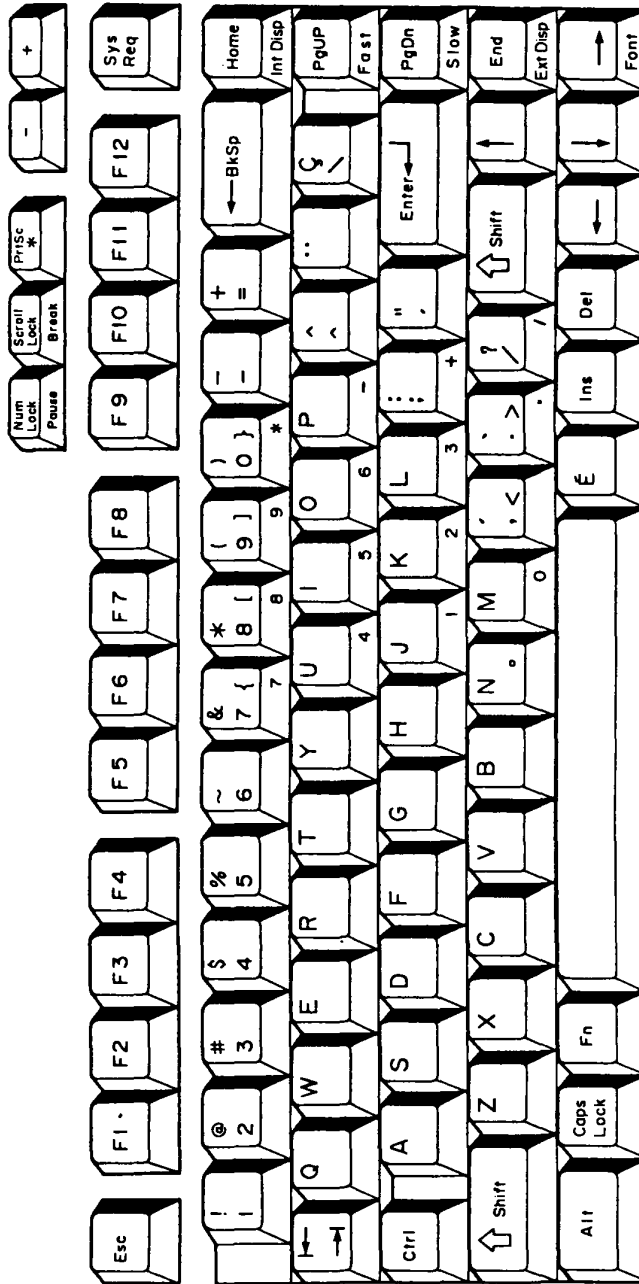
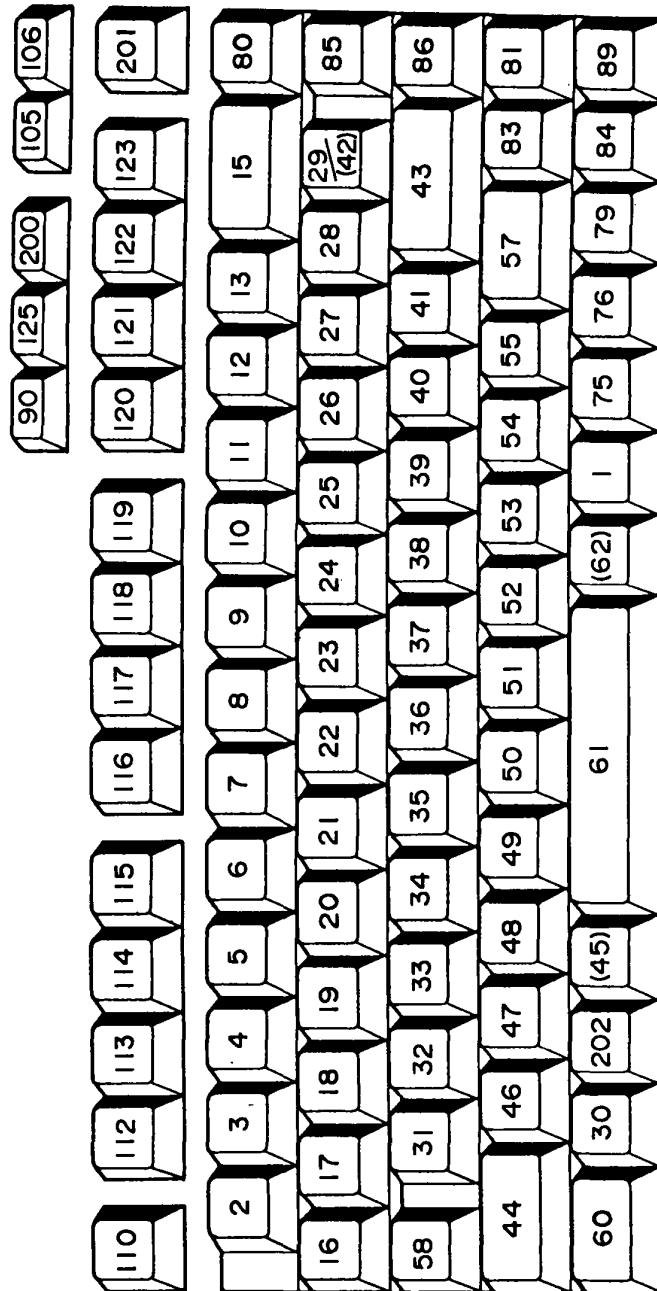


Figure C-9 Special canadian keyboard

10. Keycap number



(): 88-key keyboard

Figure C-10 Keycap Number

APPENDIX D
 DISPLAY CODE

TABLE D-1 Display Code

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	≡
1	☺	◀	!	1	A	Q	a	q	ü	æ	í	⋮	⌌	⌌	β	±
2	☹	↕	"	2	B	R	b	r	é	Æ	ó	⋮	⌌	⌌	Γ	≥
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	â	û	ä	⋮	⌌	⌌	μ	÷
7	•	↕	'	7	G	W	g	w	ç	ù	ö	⋮	⌌	⌌	τ	≈
8	●	↑	(8	H	X	h	x	ê	ÿ	ï	⋮	⌌	⌌	ϑ	°
9	○	↓)	9	I	Y	i	y	ë	Ö	∟	⋮	⌌	⌌	θ	•
A	◐	→	*	:	J	Z	j	z	è	Ü	∟	⋮	⌌	⌌	Ω	•
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