

PC ARCHITECTURE & TROUBLESHOOTING

T - III

CES

Centre for Electronics Design & Technology of India

A Scientific Society under Department of Electronics,
Govt. of India, New Delhi

**Published by CFS Documentation Cell
Centre for Electronics Design and Technology of India
An Autonomous Scientific Society under Department of Electronics,
Govt. of India,
New Delhi.**

First Edition: 1999

TRADEMARKS: All brand name and product names mentioned in this book are trademarks or registered trademark of their respective companies.

Every effort has been made to supply complete and accurate information. However, CEDTI assumes no responsibility for its use, nor for any infringement of the intellectual property rights of third parties which would result from such use.

No part of this publication may be stored in a retrieval system, transmitted or reproduced in any forms or by any means, electronic, photocopy, photograph, magnetic or otherwise, without written permission of CEDTI.

CEDTI/CFS/99/6/T-III/R1

FOREWORD

The information technology and telecom sectors have suddenly opened up avenues, which require a very large specially trained manpower. These sectors are highly dynamic and need training and re-training of manpower at a rapid rate. The growing gap of requirement of the industry and its fulfillment has created a challenging situation before manpower training institutes of the country. To meet this challenge most effectively, Centre for Electronics Design and Technology of India (CEDTI) has launched its nation-wide franchising scheme.

Centre for Electronics Design and Technology of India (CEDTI) is an Autonomous Scientific Society under the Govt. of India, Department of Electronics with its Headquarters at New Delhi. It operates seven centres located at Aurangabad, Calicut, Gorakhpur, Imphal, Mohali, Jammu and Tezpur. The scheme will be implemented and coordinated by these centres.

The scheme endeavours to promote high quality computer and information technology education in the country at an affordable cost while ensuring uniform standards in order to build a national resource of trained manpower. Low course fees will make this education available to people in relatively small, semi urban and rural areas. State-of-the-art training will be provided keeping in view the existing and emerging needs of the industrial and Govt. sectors. The examinations will be conducted by CEDTI and certificates will also be awarded by CEDTI. The scheme will be operated through all the seven centres of CEDTI.

The CEDTI functions under the overall control and guidance of the Governing Council with Secretary, Department of Electronics as its Chairman. The members of the council are drawn from scientific, government and industrial sectors. The Centres have separate executive committees headed by Director General, CEDTI. The members of these committees are from academic/professional institutes, state governments, industry and department of electronics.

CEDTI is a quality conscious organisation and has taken steps to formally get recognition of the quality and standards in various activities. CEDTI, Mohali was granted the prestigious ISO 9002 certificate in 1997. The other centres have taken steps to obtain the certification as early as possible. This quality consciousness will assist CEDTI in globalizing some of its activities. In keeping with its philosophy of 'Quality in every Activity', CEDTI will endeavour to impart state of the art – computer and IT training through its franchising scheme.

The thrust of the Software Courses is to train the students at various levels to carry out the Management Information System functions of a medium sized establishment, manufacture Software for domestic and export use, make multimedia presentations for management and effectively produce various manufacturing and architectural designs.

The thrust of the Hardware Courses at Technician and Telecommunication Equipment Maintenance Course levels is to train the students to diagnose the faults and carry out repairs at card level in computers, instruments, EPABX, Fax etc. and other office equipment. At Engineer and Network Engineer levels the thrust is to train them as System Engineers to install and supervise the Window NT, Netware and Unix Networking Systems and repair Microcontrollers / Microprocessor based electronic applications.

An Advisory Committee comprising eminent and expert personalities from the Information Technology field have been constituted to advise CEDTI on introduction of new courses and revising the syllabus of existing courses to meet the changing IT needs of the trade, industry and service sectors. The ultimate objective is to provide industry-specific quality education in modular form to supplement the formal education.

The study material has been prepared by the CEDTI, document centre. It is based on the vast and rich instructional experience of all the CEDTI centres. Any suggestions on the improvement of the study material will be most welcome.

(R. S. Khandpur)
Director General (CEDTI)

TABLE OF CONTENTS

UNIT	CHAPTER NAME	PAGE NO.
1	Architecture of IBM PC/XT, PC/AT	11
2	Study of Various Adapter Cards	21
3	Display	35
4	Floppy Disk Drive	41
5	Hard Disk Drive	51
6	Switch Mode Power Supply	61
7	Printers	75
8	Pentium Motherboard	85
9	Troubleshooting & Maintenance	99

PREFACE

This volume of course material has been designed as an introductory course in PC Architecture and Troubleshooting as a part of the T-Level course under CFS. The aim is to enable a student, executive or a working professional to effectively assemble, install and upgrade a computer and know various sub-assemblies involved in the process.

Our approach is to stress the fundamental concepts of IBM PC, IBM PC-XT, PC-AT. By this approach with a diversity of application. We hope to convey both the substance and flavour of the subject. The breadth and depth of treatment also make this volume a valuable adjunct to continuing education of Practicing technicians and engineers.

This book has substantial amount of new material that has been added to reflect changes in technology and curricula. This book helps you by way of offering useful and practical tips suggestions.

The chapter one deals with Architecture of IBM PC, PC/XT and PC/AT. It covers the basic hardware components required by the personal computers. Chapter two deals with various peripheral adapter cards such as FDC, IDE, CGA and GIST cards. Chapter four deals with Floppy Disk Drives, Chapter Five, Six and Seven focusses on the SMPS, hard Disk Drives and Printers. Chapter Eight deals with Pentium Motherboards. Chapter Nine focuses on troubleshooting techniques used in repairing and maintenance of PCs.

The assimilation exercises are given at the end of each chapter.

ARCHITECTURE OF IBM PC/XT, PC/AT

COMPETENCY OBJECTIVES

The objective of this Chapter is to make students understand the basic architecture of PC/XT Motherboard and PC/AT Motherboard. At the end of this section, a student should be able to :-

- ❖ Logically differentiate between XT and AT motherboards.
- ❖ Visualize the differences between the two motherboards.
- ❖ Understand various sub-components of a PC.

CHAPTER - 1**ARCHITECTURE OF IBM PC/XT, PC/AT****1.0 INTRODUCTION TO ARCHITECTURE OF IBM PC/XT**

PC/XT is Personnel Computer with Extended technology. There are five key parts of a computer. These are Processor (sometimes called as Central Processing Unit) the input/output circuitry, disk storage and Program. There are also other components that form parts of packaging and support such as power supply, the motherboard, the bus and peripherals.

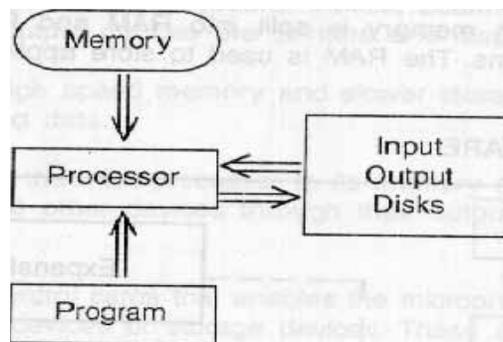


Figure 1.1 Components of a PC

The usual Components on the motherboard are the main Processor chip & its support chips; memory and I/O interface (Serial Port, Parallel Port, Keyboard interface, disk interface, and so on).

The PC/XT may have following specifications,

CPU (Processor)	8088 - 2 Or V - 20
Data (Bus)	16-Bits
Crystal Frequency	4.77 to 13 MHz.
Memory (Primary)	640 KB
Floppy Disks (FD)	360 KB
Hard disk (HD)	20 MB to 40 MB

1.1 MEMORY SPACE

The 8088 has a 20-bit address bus. Hence it can address upto 1 Megabyte of memory. Since each location is one byte, theoretically the PC can have upto 1-megabit program. 1MB memory space includes both Random Access Memory (RAM) and Read only Memory (ROM).

1.1.1 CPU

The PC/XT has Intel 8088 processor, which has a 16-bit internal data bus while but an 8-bit external data bus. The 16-bit internal bus provides high speed Processing Power. The 8-bit data bus provides an easy interfacing capability and compatibility with 8-bit systems. In PC/XT there is provision for the 8087 a floating-point processor to work as a co-processor with 8088 CPU.

The program memory is split into RAM and ROM. The ROM contains Permanent programs. The RAM is used to store application programs and also system programs.

1.1.2 PC HARDWARE

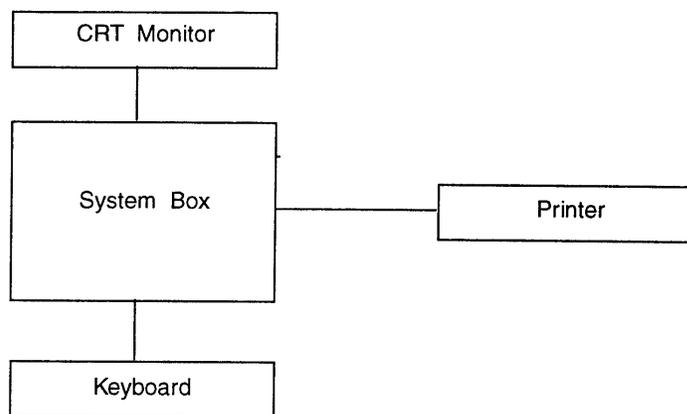


Fig. 1.2 Block Diagram of the system

The blocks shown in figure are the system unit, which houses CPU, Memory, DMA, and Peripheral controllers. The external units, which are outside the system box, are keyboard, CRT Monitor, Printer, Modem etc. Additional memory, Peripheral Controllers can also be used in case the application software needs.

The System Box has a separate Power Supply Unit inside. It is called as Switched Mode Power Supply (SMPS). Four different voltages are generated by SMPS +5, -5, +12, and -12. The SMPS supplies required DC voltages to all internal units in the system box and to the keyboard. All other external units like Monitor, Printer, have their own Power Supplies.

1.2 HARDWARE COMPONENTS OF A COMPUTER SYSTEM

PC System has eight major hardware elements

- 1) Central Processing Unit (CPU) : In most PCs today that is Intel 486 or Pentium or any Intel Compatible Processor are used.
- 2) IO Devices : Input devices are Keyboard, mouse, Scanner, CD ROM drives etc. While the common output devices are printers and displays monitors.
- 3) Memory : A set of high speed memory and slower storage devices to save and retrieve programs and data.
- 4) BUS : A set of connect the microprocessor to its memory and to the adapters that enable connections to other devices through their output ports or expansion slots.
- 5) Adapters : A set of control cards that enables the microprocessor to communicate with and control I/O devices or storage devices. These adapters that are set of hardware circuitry that attach to the system bus and convert each bus to an interface port supporting the attachment of specific I/O ports.
- 6) Ports : Ports are hardware interfaces created by the adapters supporting the attachments of I/O devices.
- 7) Expansion slots : Permits easy expansion or upgrading of PC system with new I/O devices and or memory.
- 8) Low speed storage devices : In these devices, data and programs are stored on media used by used for long term storage.

ARCHITECTURE OF IBM PC/XT, PC/AT

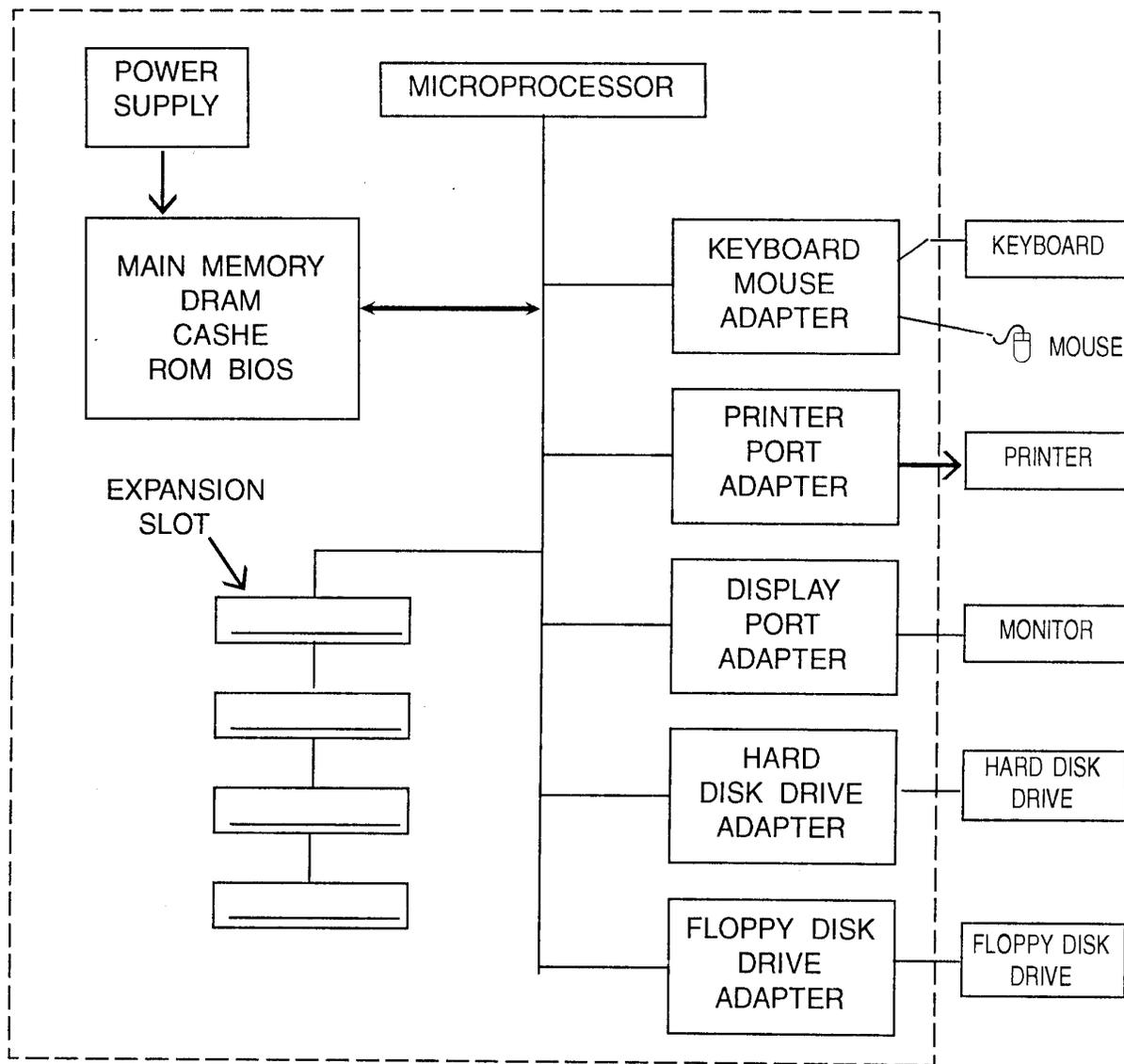


Fig. 1.3 : A Simplified Block Diagram of a PC System

1.3 ARCHITECTURE OF IBM PC-AT

IBM Personal computer with advanced Technology are usually referred as IBM PC/AT used in high performance applications such as Desk Top Publishing, CAD, CAM, LAN.

IBM PC/AT VERSIONS

There are two versions of IBM PC/AT

1. A Base Model
2. An Enhanced Model

The base model does not have a hard disk whereas enhanced model has a hard disk. The original base model has a 256KB RAM on the motherboard and enhanced model has a 512KB RAM on motherboard. Both the models can support 360KB FDD and 1.2MB FDD.

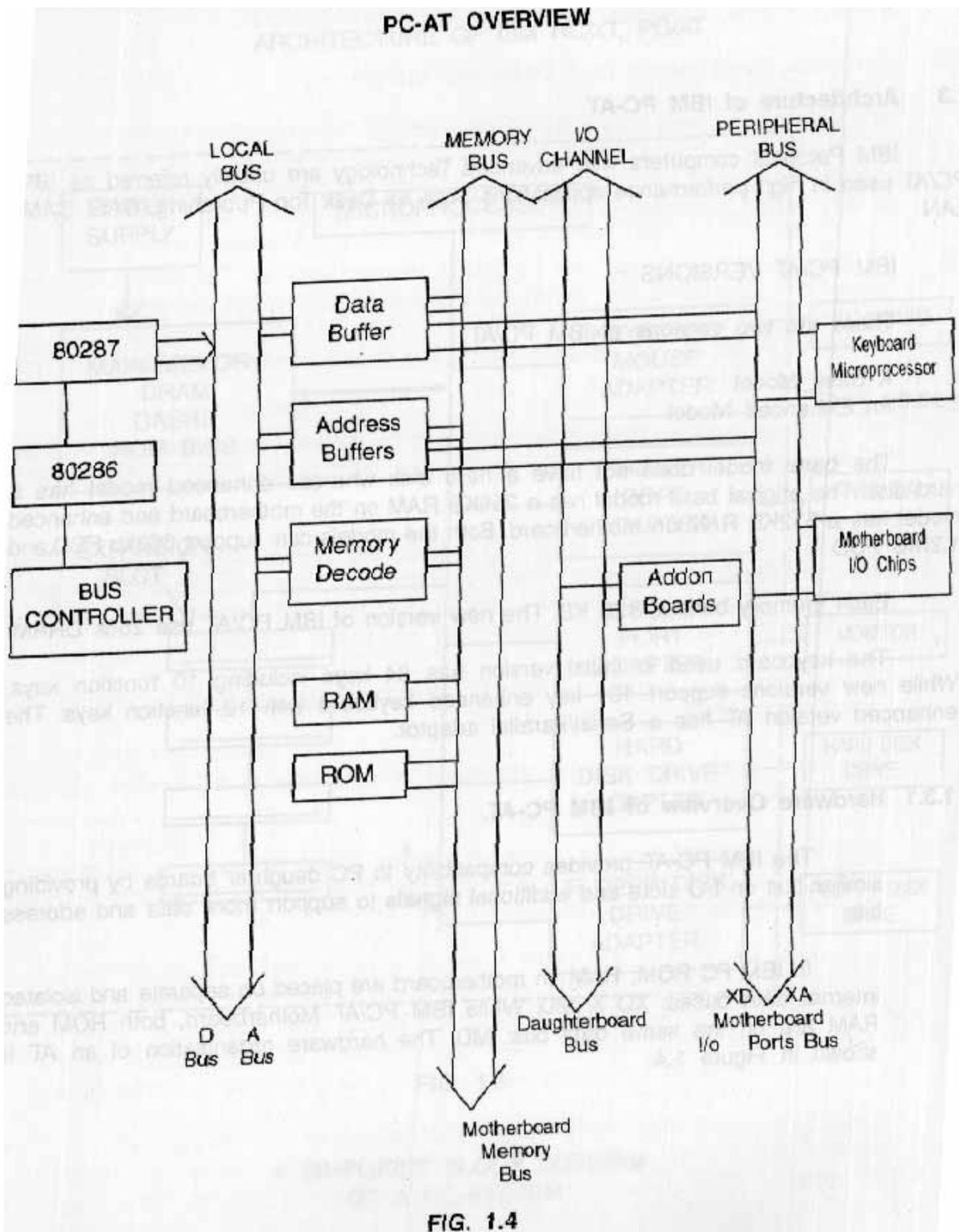
Each memory bank is 128 KB. The new version IBM PC/AT uses 256 KB DRAM.

The keyboard used in initial version has 84 keys including 10 function keys. While new version support 101 key enhanced keyboard with 12 function keys. The enhanced version AT has a Serial /Parallel adapter.

1.3.1 Hardware Overview of IBM PC-AT

The IBM PC-AT provides compatibility to PC daughter board by providing similar bus on I/O slots and additional signals to support more data and address bits.

In IBM PC ROM, RAM on motherboard are placed on separate and isolated internal data buses: XD & MD. While IBM PC-AT Motherboard, both ROM and RAM are on the same data bus: MD. The Hardware organization of an AT is shown in Figure 1.4.



1.3.2. PC-AT-286 HARDWARE OVERVIEW

The PC-AT-286 uses an Intel 80286 Microprocessor. The Co-processor used by IBM is 80287. The PC-AT-286 uses two clock generator chips an 82284 & 82284. The 8284 is used to generate 14.318 MHz clock signal. The purpose of this signal is to provide compatibility for CGA board. The 82286 is used to generate clock signals to 80285 & 80857. The 80285 divides input clock frequency by two. The input clock frequency can be typically 12 MHz, 16 MHz, or 20 MHz. The clock generator also generates RESET, READY signal to 80286. The 82288 bus controller is used for generating bus control signals which identify the type of bus i.e. for 80286.

The PC-AT uses two 8237A DMA Controllers for providing eight DMA Channels. The DMA Channels 0,1,2,3 are used for data transfer involving 8-bit I/O, adapters & 8 or 16-bit system memory. The channels 5,6,7 are used for 16 bit data transfer involving 16-bit I/O adapters and 16 bit system memory.

Two 8259A chips are cascaded to provide 15 interrupt level in the PC-AT.

PC-AT uses 8254-2 timer/counter chip, which has three programmable time/counters. The use of three counters is as shown in below.

TIMER CHANNEL	FUNCTION
0	IRQo-System timer
1	Memory Refresh Request
2	Speaker Tone Generator

The ROM chips used are byte organized. But the width of the system data is 2 bytes (16-bits). Hence Two ROM chips are used. One to store odd location & other to store even locations.

The keyboard interface is provided by a single chip microcomputer such as 8042 & 8742.

1.3.3. Display Switch

This is only DIPSwitch used in PC-AT it indicates whether an MDA or CGA board is installed in PC-AT. If the switch is set wrongly the post senses the error, and indicates this to the user by the error beeps.

1.3.4. Jumper Options

In PC-AT jumper options are provided to select the system configuration such as speed, number of wait states, selection of parallel ports, selection of serial ports, RAM banks, etc.

1.3.5. Memory Refresh in AT

The DRAM refresh in PC/AT is done through channel 0 of the DMA Controller. In the PC-AT the refresh is taken care by a counter which keeps track of the address to be refreshed. This

counter gives LSB address bits. Along with this counter, DMA page register is used to generate MSB address bits.

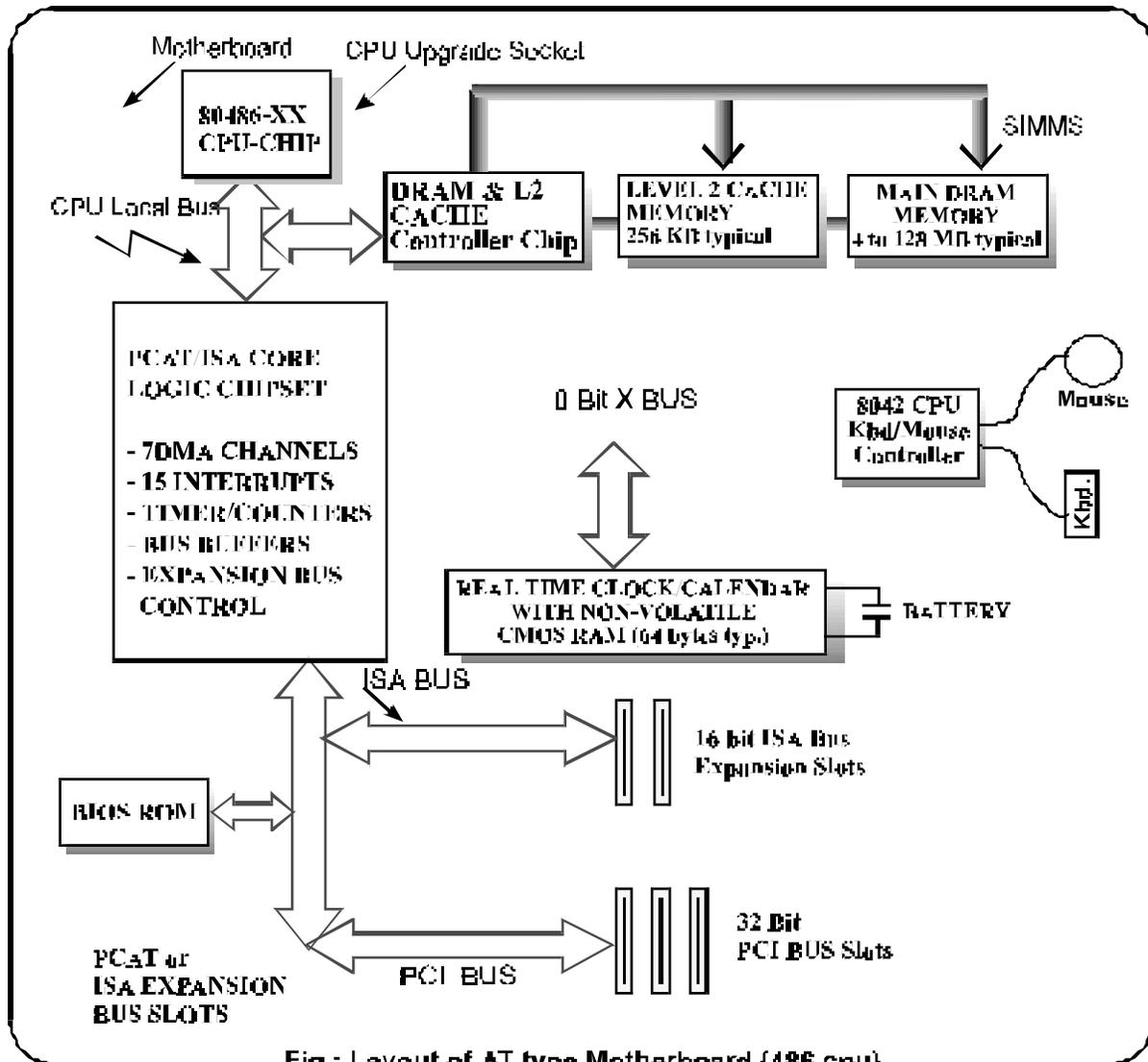


Fig.: Layout of AT type Motherboard (486 cpu)

ASSIMILATION EXERCISE

- Q.1 What are Hardware Components of a system?
- Q.2 What is data width of 8088?
- Q.3 What is the difference between PC/XT & PC/AT?
- Q.4 How many expansion slots are there in PC & PC-XT?
- Q.5 List the input and output devices of PC?
- Q.6 How many pins are there on Power Connector on PC-AT motherboard?
- Q.7 What is the necessity of 8087 in PC-XT?
- Q.8 Which Peripheral devices use +12V Supply output of SMPS?
- Q.9 How many IRQ's are uses in PC-XT?
- Q.10 How many keys are used in PC-XT? What additional keys used in PC-AT?

STUDY OF VARIOUS ADAPTER CARDS

COMPETENCY OBJECTIVES

The objective of this Chapter is to make students understand the the types of various add-on cards. At the end of this section, a student should be able to :-

- ❖ Logically differentiate between various display adapter cards.
- ❖ Visualize various signals available in a Floppy drive controller card.
- ❖ Understand various Hard disk controllers.
- ❖ Understand external Modem to PC Connection.
- ❖ Study SCSI cards.

CHAPTER - 2**STUDY OF VARIOUS ADAPTER CARDS****2.0 VARIOUS DISPLAY ADAPTER CARDS AND THEIR IDENTIFICATION**

The PC is connected to the monitor through display adapter cards. The present PC display adapter card is mounted on motherboard expansion slots.

There are number of display adapter cards, the list of them is as below :

- 1) MDA - Monochrome Display Adapter
- 2) CGA - Color Graphics Adapter
- 3) HGA - Hercules Graphics Adapter
- 4) EGA - Enhanced Graphics Adapter
- 5) VGA - Video Graphics Adapter
- 6) SVGA - Super Video Graphics Adapter
- 7) XGA - Extended Graphics Adapter

These cards can be identified by the following points.

Sr.No	Card Type	Connector Pins	Video Memory	Edge Connector	Additional Connector
1.	MDA	D Shell 9 Pin	4 KB	16 PIN	Nil
2.	CGA	D Shell 9 Pin	16 KB	32 PIN	Printer Connector
3.	EGA	9 Pin D Shell	64KB-256KB	32 PIN	Printer Connector
4.	VGA	15 Pin Female	256KB-1 MB	16 PIN	NIL
5.	SVGA	15 Pin	1MB - 2MB	16 PIN	NIL

2.0.1 The signals of display adapter cards

On the Pin Connector

MDA 9 PIN CONNECTOR

PIN NOS.	SIGNAL (MDA)
1	Ground
2	Ground
3, 4, 5	Not used
6	Intensity
7	Video
8	Hsync
9	Vsync

CGA 9 PIN CONNECTOR

PIN NOS.	SIGNAL (MDA)
1	Signal
2	Ground
3	Ground
4	Red
5	Blue
6	Intensity
7	Reserved
8	Hsync
9	Vsync

EGA 9 PIN FEMALE CONNECTOR

PIN NOS.	SIGNAL (MDA)
1	Signal
2	Ground
3	Secondary Red
4	Primary Red
5	Primary Green
6	Primary Blue
7	Secondary Green / Intensity
8	Secondary Blue/Mono Intensity
9	Vsync

STUDY OF VARIOUS CARDS

2.2 FDC CARD

Floppy Disk Control board is linked to the system bus of the PC. It appears as a set of I/O parts to the CPU. A single FDC can support upto 4 Floppy Disk Drives. The FDC communicates with the CPU and the FDD.

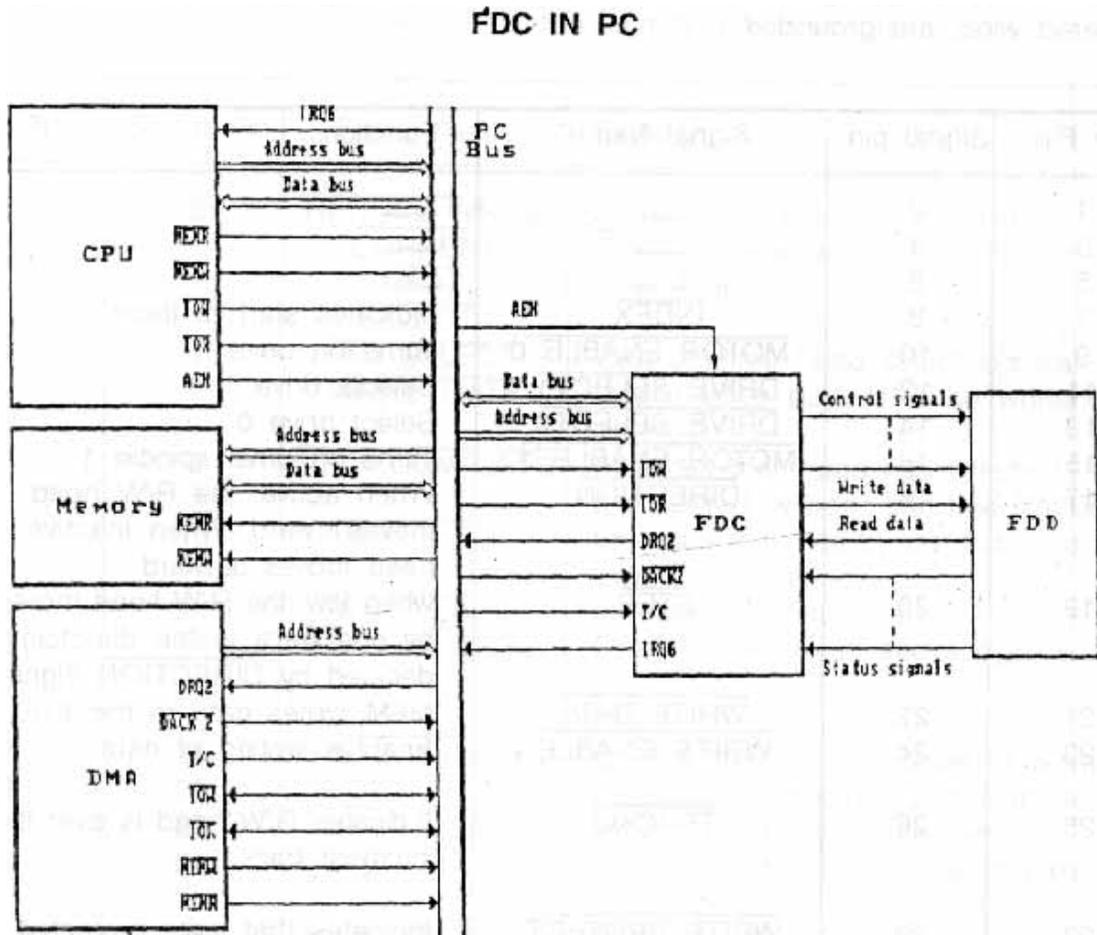


FIG. 2.1

The FDD has two connectors

1. Signal connector P1/J1
2. DC Power connector P2/J2

The signal connector is a 34 pin PCB edge connector whose Pins are numbered from 1 to 34. A key slot is provided between pin 4 & 6 to prevent wrong insertion.

Table gives voltages on different pins of this connector.

PIN NO.	COLOR CODE WIRE	SUPPLY VOLTAGE
1.	YELLOW	+12V DC
2.	BLACK	+12V Return
3.	BLACK	+5V Return
4.	RED	+5V DC

All the device signals are low active. A 34 pin flat cable is used and odd numbered wires are grounded.

GND Pin	Signal Pin	Signal Name	Function
1	2	-----	-----
3	4	-----	-----
5	6	-----	-----
7	8	INDEX	Indicates start of track
9	10	$\overline{\text{MOTOR ENABLE 0}}$	Turns on drive
11	12	$\overline{\text{DRIVE SELECT 1}}$	Selects drive 1
13	14	$\overline{\text{DRIVE SELECT 0}}$	Select drive 0
15	16	$\overline{\text{MOTOR ENABLE 1}}$	Turns on drive spindle 1
17	18	$\overline{\text{DIRECTION}}$	When active, the R/W head moves inward. When inactive head moves outward.
19	20	$\overline{\text{STEP}}$	When low, the R/W head moves by <u>one track</u> in the direction decided by <u>DIRECTION</u> signal
21	22	$\overline{\text{WRITE DATA}}$	MFM writes data to the FDD Enables writing of data.
23	24	$\overline{\text{WRITE ENABLE}}$	Enables writing of data
25	26	$\overline{\text{TRACK 0}}$	Indicates R/W head is over the outmost track.
27	28	$\overline{\text{WRITE PROTECT}}$	Indicates that write protected diskette is present in FDD.
29	30	$\overline{\text{READ DATA}}$	MFM Read data from FDD.
31	32	$\overline{\text{HEAD SELECT 1}}$	When high selects head 0, When low indicates head 1.
33	34	-----	-----

2.3 HARD DISK CONTROLLER CARD

Hard disk is magnetically coated disks. The disks are rigid platters of an aluminum alloy. The hard disk controller is connected to hard disk card itself. The hard disk drive and hard disk controller have a plug in connector on the connectors of the edges of the Printed Circuit Boards.

The controller and data cable should then be connected to the controller. The connector often used for this purpose can often be connected incorrectly so be careful when attaching the cable. The various control signals are listed below.

GND Pin	Signal Pin	Signal Name	Description
1	2	<u>REDUCE WRITE CURRENT HEAD SELECT3</u>	Some controllers use this pin as RWC, to reduce write current on inner cylinder.
3	4	<u>HEAD SELECT 2</u>	One of three head select signals
5	6	<u>WRITE GATE</u>	Issued when data is to be written on HDD
7	8	<u>SEEK COMPLETE</u>	Indicates that head has reached the desired cylinder and has stabilised.
9	10	<u>TRACK 000</u>	Indicates that heads are positioned over the cylinder 0.
11	12	<u>WRITE FAULT</u>	Indicates a write error.
13	14	<u>HEAD SELECT 0</u>	One of the three head select signals.
15		-	-
16		-	-
17	18	<u>HEAD SELECT</u>	One of the three head select signals.
19	20	<u>INDEX PULSE</u>	Indicates the beginning of a track
21	22	<u>DRIVE READY</u>	Indicates motor is up to speed.
23	24	<u>STEP PULSE</u>	For each step pulse, head moves by one track.
25	26	<u>DRIVE SELECT 0</u>	The controller issues this signal when drive 0 has to be selected.
27	28	<u>DRIVE SELECT 1</u>	The controller issues this signal when drive 1 has to be selected.
29	30	<u>DRIVE SELECT 2</u>	Not used
31	32	<u>DRIVE SELECT 3</u>	Not used
33	34	<u>DIRECTION IN</u>	Defines the direction of the head movement Active inward inactive outward.

POWER CONNECTOR

The power supply requires is +5v and +12v . DC power connector pin assignments.

PIN NOS.	COLOR CODE WIRE	SUPPLY VOLTAGE
1	YELLOW	+12 V DC
2	BLACK	12 V DC
3	BLACK	- 5 V DC
4	RED	+5 V DC

Data cable connection to be added

2.4 IDE CARD

The IDE is intelligent drive electronics also known as ATA port. This card supports attachment of two hard drives with maximum capacity of 528 MB each. When PC/AT was announced by IBM, the hard disk drive adapter was a separate adapter board installed in an PC/AT.

The interface cable from drive is attach to a 40 pin header organised as two rows of 20 pins with 20 functioning keys. Two drives are connected by a single cable connected in a daisy chain system.

PIN	DESCRIPTION	PIN	DESCRIPTION
1	Host	21	DMA Request
2	Not used	22	GND
3	Data bus bit 7	23	I/O Write
4	Data bus bit 8	24	GND
5	Data bus bit 6	25	I/O Read
6	Data bus bit 9	26	GND
7	Data bus bit 5	27	I/O Ready
8	Data bus bit 10	28	Spindle Syne
9	Data bus bit 4	29	DMA acknowledge
10	Data bus bit 11	30	GND
11	Data bus bit 3	31	Interrupt Request
12	Data bus bit 12	32	16 bit I/O
13	Data bus bit 2	33	Device address bit 1
14	Data bus bit 13	34	Passed Diagnostic
15	Data bus bit 1	35	Device address bit 0
16	Data bus bit 14	36	Device address bit 2
17	Data bus bit 0	37	Chip select 0
18	Data bus bit 15	38	Chip select 2
19	Ground	39	Device active
20	Not used	40	Ground

IDE Card has cable header of Floppy disk & Hard disk drive.

2.5 MULTI I/O PORT ADAPTER BOARD

This board supports a number of peripheral interface adapter and ports fig 2.2 is as shown below.

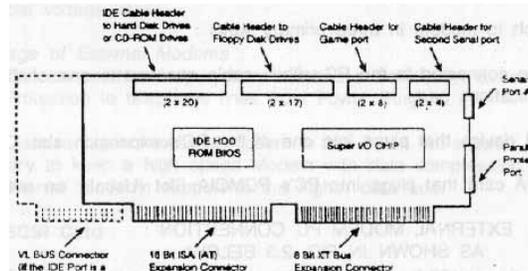


Fig. 2.2

The Board permits to attach IDE (hard disk controller port) typically all the device adapter and ports on the multi I/O port board are integrated on a single chip called super I/O. The board has.

1. Hard Disk Drive cable header.
2. Cable header for FDD
3. Cable header for Game port.
4. Cable header for second Game port.
5. Serial port connector.
6. Parallel printer port.

2.6 STUDY OF SVGA CARD

SVGA is Super Video Graphics Adapter Card. Most of the available boards today are Super VGA cards.

It supports

- Text 128x48
- Character size 8x16
- Graphics 1024x768
- Display Mode 1280x1024 pixel raster with 24 bit /pixel

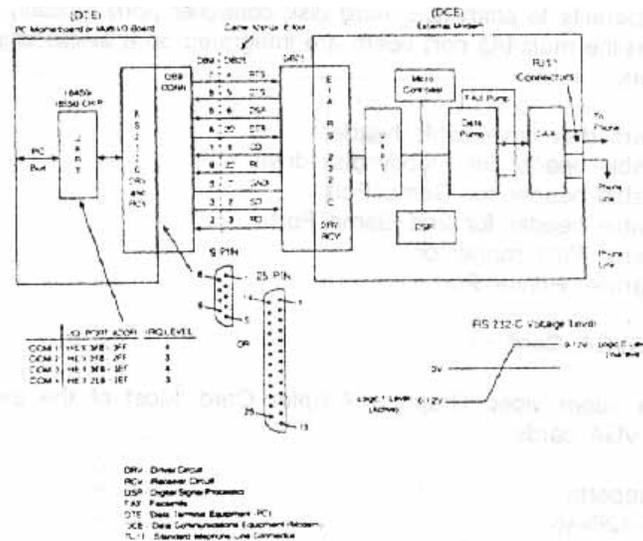
2.7 MODEMS AND THE PC CONNECTION

The modem allows the PC to communicate with other computers over standard voice grade telephone lines. Most modem support the transmission and reception of faxes.

PCs can attach to modem in three primary ways :

1. External device connected to the PC with a cable attached to one of the PC's serial communications parts.
2. As an internal device that plugs into one of the PC's expansion slot.
3. As a PCMCIA card that plugs into PC's PCMCIA slot(usually on notebook).

External Modem PC Connection as shown in Fig. 2.3 below:



The external Fax/Modem attached to one of the PC's serial communication ports on the PC, the serial communication ports are often referred as com1 , com2, com3, com4. Most PC's today have com1, com2 as Multi I/O ports. On the PC, the COM ports are created by chips called UART, which interfaces two PC IAS buses, and take bytes of data and convert them to a serial bit stream.

Each byte of the data is framed in a start bit and followed by a parity check bit and 1, 1½ or 2 stop bits. The UART generates a set of control signals and senses input signals and from the modem signals that are used to ensure that a connection with external modem is in place. Both the serial ports send and receive data streams and modem control and status leads are then converted electrically to special voltage level.

Advantage of External Modems

1. Can be used on any system that has a serial port and not limited to just PCs.
2. Protection to telephone lines from power surge.

Disadvantages of External Modem is that it can not support the higher data rates necessary to keep a high speed data link, as older generation PC-AT which had 8250 UART for Serial

communication could not support faster data transmission. Newer UART 16550 overcomes all these shortcomings.

Internal modem is an ADD ON CARD, which has on board 16550 UART thereby it supports the higher data rate.

2.8 SCSI CARD

SCSI is Small Computer System Interface. The SCSI specification first served the needs of the hard disk industry. The SCSI interface is an intelligent and high performance I/O interface. It is a common interface incorporated in disk drives, printers and type drives. The SCSI specification defines a logical command set for each generic peripheral type. Any device can communicate directly with any other device over SCSI bus. The specification defines bus phases that allow for bus arbitration and temporary disconnection. The SCSI specification device can queue multiple commands in the local controller and execute them in correct order. Therefore SCSI I/O is used for multi-user multitasking system application. This SCSI bus also serves as cost effective because it supports variety of peripherals such as hard disk drives and CD-ROM drives and high speed tape backup drives. SCSI is a host independent interface, it is also possible to move SCSI device from say on Apple MAC system to a PC system. SCSI software device driver must be installed on to PC to support the SCSI port and devices. The manufacturer provides this driver.

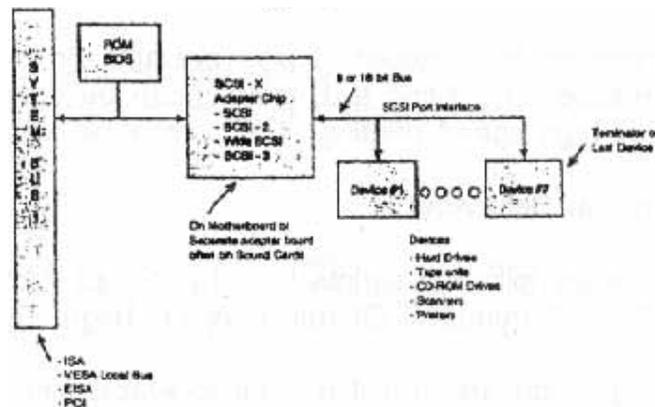


Fig. 2.4

2.9 GIST INTRODUCTION

GIST is hardware and software product.

GIST is registered trademark of Centre for Development of Advanced Computing. GIST is a terminal that allows the user to use as a Standard English terminal as well as multi-script terminal on any multi-user system. GIST is powerful and intelligent stand alone system for Indian, scripts, Perso-Arabic scripts and some other foreign scripts. GIST terminal provides a simple and powerful setup menu facility for selecting various operating modes.

GIST provides a special SCRIPT PAGE, which is used by custom packages like the script processor for allowing versatile word processing in multiple scripts. Script page provides various attributes like bold, outline, etc., which can arbitrarily mixed along with multiple script. Scripts page even allows proper mixing of scripts which flow in different direction such as is required when English words are to be display within Urdu text. DATA PAGE looks identical to IBM screen, while allowing display of complex scripts within the same 80 characters by 25-row format. Although the non-English scripts are proportionally spaced they still remain aligned properly in columnar text display. In addition data page provide 7-bit mode which allows use of environment that only 7-bit data.

GIST uses standard (ISCII) Indian Standard Code for Information Interchange and inscript keyboard to chatter to all the Indian scripts in uniform way. This also is the basis of instantaneous transliteration facility provided by it between different Indian scripts.

2.9.1 Compatibility

The GIST terminal is compatible with VT52, VT100, VT200, VT300 terminal i.e. video terminals.

GIST is compatible with all the available dot matrix printers, which have graphic printing mode.

Depending on the number of pins available on print head, 2 or 3 passes are needed for printing text, printing can be done in one pass on a 24 pin printer. For high-speed printing, it is compatible with laser jet printers.

2.9.2 Multilingual Behaviour

GIST provides following scripts in Indian script family Devnagari, Bengali, Assamese, Oriya, Gurumukhi, Gujrati, Kanada, Telgu, Temil and Malyalam.

Following scripts are available in Perso-Arabic family ARBIC, Persian, Urdu, Kashmiri, Sindhi.

GIST also supports foreign language like Thi, Tibetan, Bhutanese and Sinhalese.

In the linear script GIST currently supports Russian scripts.

2.9.3 Script Processing

The script processor software for word processing multiple script is provided along with GIST terminal. SPX allows microjustification of the text, which contains proportionally spaced character. This eliminates the need of hyphenation in Indian scripts.

2.9.4 Typing in Indian Languages

The inscript overlay on the standard IBM keyboard(Standardized by DOE) is used for typing in any Indian languages. The keyboard defines characters required for all Indian script defined by ISCII character set. Using the common inscript overlay is possible to type in any Indian script. A particular Indian script is chosen using a menu command.

2.9.5 Character Sets

A set of different codes have been designed considering multilingual applications. Considering various working platforms, different codes set have been formulated.

ISCII CODES

Indian Standard Codes for Information Interchange, the 8-bit code standard was standardized by DOE. The upper half contains characters required for all the Indian scripts. All composite characters in Indian Language get formed through combinations of these basic characters.

ISCII cords contains the alphabets of different scripts occupy the same code.

ISCII codes

In many English computer software/hardware only 7-bit ASCII codes was needed. As a result some hardware/software prevented effective use of 8-bit. This prevented the use of 8-bit codes such as ISCII.

If the Indian script code were defined only in place of upper and lower case English alphabets, then exiting English software would allow their usage whenever English alphabets are allowed.

DISPLAYING INDIAN SCRIPTS

The GIST terminal by default displays data page. It is possible to switch to the script page by using menu command. Software script processor would automatically switch to the script page.

2.9.6 Data Page (Page 1)

Data page is meant for total compatibility with IBM PCs English displays which has 20 rows of 80 characters each. The English characters have a fixed width, while the Indian script characters have to be proportionally spaced. The English fonts are much simpler and fit in 14 dot height while Indian script fonts on the script page 24 dot height. In spite of this complexities, Indian scripts are compressed the 24 dot height font to 14 dot height.

Data Page (Page 2)

This data page is used to display the screen for bigger character. It gives a 40-column mode display.

Script Page (Page 3)

This page has a special provision for effective word processing in multiple scripts. Script page contains 14 rows, each of which can contain 256 characters. Each row can display proportionally spaced 24-dot height near print quality fonts. The ISCII code are used for storing Indian script characters.

Script page compatible with all line oriented English packages. It allows mixing of attributes like underline, highlight, bold, outline, shadow, double width and double height. Script page also define some character, within the control codes, for effective micro justification.

The script cursor is vertical blinking line. It normally moves between boundaries of composite character.

ASSIMILATION EXERCISES

- Q.1 What are the various display adapter cards? Which card is used now -a-days?
- Q.2 Which CRT controller IC chip is used in CGA card?
- Q.3 How many pins are there in monochrome display adapter card in connector?
- Q.4 What is fullform of XGA?
- Q.5 What is definition of resolution?
- Q.6 On which factor resolution depends?
- Q.7 What is fullform of SCSI? What are advantages of SCSI?
- Q.8 Which code system is used in GIST?
- Q.9 Which chip is used in FDC controller card?
- Q10 How much system memory is used in CGA video RAM? Give address rang reserved for this purpose. Does CGA card has any on board ROM?

DISPLAY

COMPETENCY OBJECTIVES

The objective of this Chapter is to make students understand the display. At the end of this section, a student should be able to :-

- ❖ Differentiate between various display monitor and display adapter cards.
- ❖ Understand various terminologies associated with display.
- ❖ Understand text characters generation.

CHAPTER - 3**DISPLAY****3.1 MONITOR BASICS**

A computer monitor consists of following parts: 1) CRT Cathode Ray Tube, 2) Control Cards & Power Supply

A CRT is evacuated glass tube, conical in shape, with phosphor coating on the inside of the large screen end. The gun fires a narrow beam of electrons at the screen when the beam hits the phosphorous coating the phosphor glows, there by giving out light . CRT displays have the advantage of graphics & full color compatibility. Electrons are emitted at the base of tube by indirectly heated cathode. The flow of electrons from cathode is controlled by the grid. These electrons are accelerated towards Face Plate by a high voltage applied to the anode.

The electrons beam is aimed at a particular spot on face plate by the deflection coils. One coil provides horizontal deflection & vertical deflection. To generate an image raster scan technique is used. Beam always traces a standard pattern of horizontal lines. Beginning at the top left corner, the beam traces across right side and then returns quickly to the left edge. This retrace line is blanked by turning off the electron beam via a control grid. The next scan line follows a path parallel to the first, but slightly lower. This repeats until entire screen has been filled with closely spaced horizontal lines. At the end of last line, beam quickly returned to the top of screen, this is called vertical retrace. The set of horizontal lines is called raster. By turning on and off as each line is scanned & the desired image is created on the display.

3.2 GRAPHIC GENERATION TECHNIQUE

In Character Oriented display or true graphics display. When character graphics are used, the character must supply data for the entire character cell. Full graphics capability is obtained by using a bit mapped display, there is 1 bit at screen memory is needed . For color or gray scale, additional bits are required e.g. using 8 bit/pixel provides 256 different colors or gray levels. Tables shows Bit Mapped Graphics Display.

The memory requirement for graphics display increase rapidly as resolution increases.

3.3 GRAPHICS CRT CONTROLLER

The Graphics CRT controller requires scan synchronization, memory addressing, arbitration & dot clock supply. The special DRAM are required for display memories in a bit mapped graphics system.

Colors CRT controller must produce three video signals red, green & blue. For video generation portion of eight color, CRT controller, a separate memory array is used for each color. All three arrays are accessed in parallel, three video signals are clocked out of the shift register simultaneously. Since only one bit per pixel is used for each array; shift register reduces the access time.

Graphic displays require high performance D/A converter. The D/A output must produce a new output level for each pixel, for high resolution it requires $BW=100$.

Colour CRT's uses same basic scanning approach but have several additional components. Colour displays uses a matrix of red, green, and blue phosphor dots. For each pixel, there is a phosphor dot of each colour. There are three electron guns, one for each colour.

The information generated is done for two modes. First is Text mode & second is Graphics mode. When PC's application software or operating system wants to communicate with the user through PC's screen it first builds the message in a virtual screen in PC's memory. The message to be displayed is passed on to application to operating system as a block memory.

The operating system then formats the message & transfers it to display adapter memory as a pattern of pixels that represents the image or text message.

PIXELS

The dots used to form the image on the screen are referred as pixels.

DOT PITCH

Dot pitch is the shortest distance between two dots of same colour. Most dot pitches measure the dot pitch in millimeters.

RESOLUTION

If we know the dot pitch and size of the display, we can calculate the maximum resolution in pixels that can be displayed. Typical aspect ratio of PC's are 0.75. Today's PC are 15" displays with 0.28 pitch that can comfortably display a 1024x768 pixels resolution image.

TEXT CHARACTER ON SCREEN

Each Pixel of the image is addressable by the processor and can be modified, or moved by the processor to change the image or a new image such a display is called All Point Addressable (APA) displays. The character code values was applied to the address inputs of the character generator ROM, which locates the block of ROM data that contained the bitmap pattern represented the character to be displayed. Today's PC store the display adapters RAM, typically in an OFF screen undisplayed area.

ASSIMILATION EXERCISE

- Q.1 What do you mean by Horizontal Sync?
- Q.2 For colour CRT's which three signals are required?
- Q.3 Explain the term Pixel?
- Q.4 What are two modes generated for PC?
- Q.5 What is vertical frequency?

FLOPPY DISK DRIVE

COMPETENCY OBJECTIVES

The objective of this Chapter is to make students understand the sub-assembly of FDD, Floppy Disk Controllers Sub-systems, FDC System Interface. At the end of this section, a student should be able to :-

- ❖ Understand various parts of Floppy disk drive.
- ❖ Formulate the functional block diagram operation of FDD.
- ❖ Understand the geometry of a floppy.
- ❖ Understand floppy disk drive alignment.
- ❖ Format a floppy diskette and make it bootable.

CHAPTER - 4**FLOPPY DISK DRIVE****4.0 FLOPPY DISK DRIVE****4.1 Various Part of Floppy Disk Drive**

The floppy disk drive consists of mainly two parts

1. Mechanical parts
2. Electronics cards

The data is recorded in the floppy disk in the MFM/FM form. The diskette has the head assembly moves to and fro between outermost and innermost tracks in steps.

4.1.1 Head Movement

The heads are moved forward or backward by a head actuator mechanism . This consists of a stepper motor and a belt. The stepper motor rotates in discrete steps and can rotate in both the directions. It is coupled to head assembly by metal belt, which is coiled split steel band. The rotational movement of the stepper motor is converted to linear movements of the heads by the steel band, which winds and unwinds around the spindle of the stepper motor.

4.1.2 Head Coils

The R/W head consists of a core with an air gap and set of coils. This consists of a R/W coils and one erase coil also. For writing data onto medium , data is converted into current and is passed through R/W head coils. This current direction is controlled to produce the opposite magnetic field in air gap. This current generates magnetic field in the air gap. This current directly controlled to produce opposite magnetic field in the air gap. The result is a series of flux reversals on the medium. During reading, when the flux transition pass under head gap, a voltage is introduced in R/W coils which is converted to data pulses.

The erase winding is energized during winding to reduce width of the track.

4.1.3 Spindle Motor

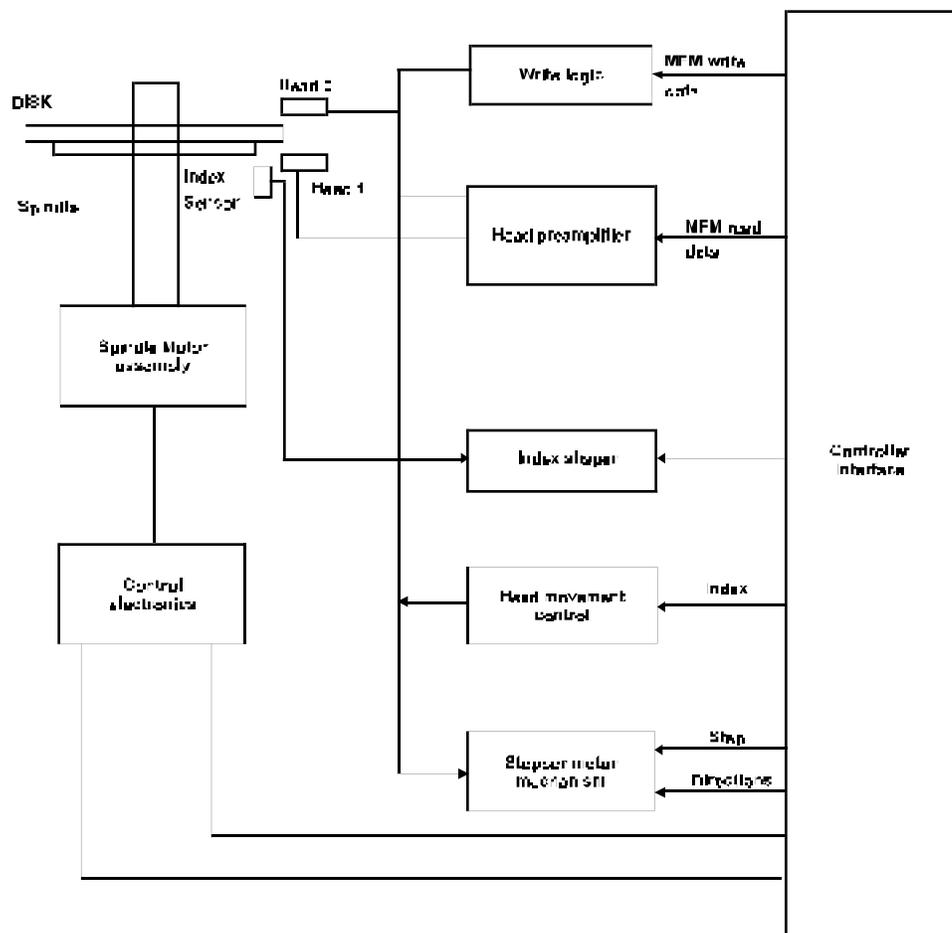
The spindle motor is used to rotate diskette at 360 rpm.

4.1.4 Index motor

There is a small hole punched near the center of the diskette. This is called index hole. When the diskette rotates, the index sensor senses the passing of the index hole, which is a reference point beginning of track. Initial writing on any track is done after the index hole is sensed.

4.1.5 Write Protected Feature

This is a facility to use of diskette only for reading previously stored information and to prevent any attempt to write new information on it for this purpose, there is a small notch. If this notch is open writing is permitted incase of $5\frac{1}{4}$ inch disk. In case of $3\frac{1}{2}$ inch disk, if the notch is closed, writing is allowed. When insulated sticker covers it, writing on it is not allowed.



4.2 TYPES OF FLOPPY DISKETTE

A) Depending on sizes

1. 8" : old standard diskette presently not used.
2. 5 $\frac{1}{4}$ " : this was widely used with PC, PC/XT, PC/AT, 286, 386, 486.
3. 3 $\frac{1}{2}$ " : this is new to industry standard called microfloppy used in IBMPS/2 and PC-AT-386 systems, widely used now-a-days with all 486 based, Pentium & higher systems.

B) Depending on storage

1. Single sided : Earlier version, only one side of the diskette is used to store information.
2. Double sided : Both sides are used for storing information.

C) Depending on recording technique

1. Single density diskette : FM technique is used.
2. Double density diskette : MFM technique is used.

4.3 Geometry of Floppy

Floppy disk is made of Mylar plastic material coated with magnetic oxide and enclosed in a protective jacket. In oval access hole is made on jacket to provide contact between R/W head and diskette.

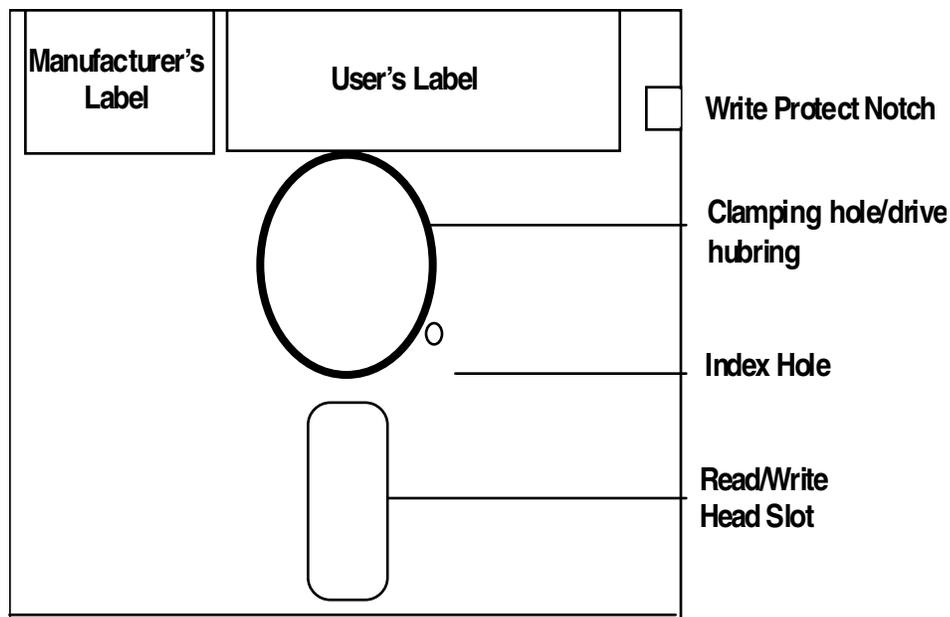


Fig. 4.2

WRITE PROTECTED NOTCH

When it is closed information cannot be written. Floppy reading is possible when it is open, both reading and writing is possible.

INDEX HOLE

Index hole is used to identify the starting sector of any track.

DRIVE HUB

Sits on drive hub, so that diskette rotates whenever motor in the drive rotates.

READ/WRITE HEAD SLOT

This is used for the movement of the Read/Write head over the disk surface.

USER'S LABEL

It is the space provided for user to write any name, which indicates the contents of diskette.

FLOPPY DISK DRIVE

The Floppy diskette surface is logically divided into a fixed number of tracks concentric circles as shown in figure. The number of tracks in one surface of a diskette are 77,40,80 for 8 inch, 5 $\frac{1}{4}$ inch, double density diskette respectively. Reading or writing takes place on specified tracks and not in between the tracks.

The Read/Write head are mounted on a common assembly in FDD. The head assembly moves to and fro in steps between outermost track and innermost track. It can move in both directions(towards the centre) and backwards(towards outermost the centre). The subsequent tracks are numbered sequentially.

The diskette having a small hole called index hole. This is reference point indicating the beginning of a track. When the diskette rotates, the index sensor in FDD senses the passing of index hole. Initial writing of any track is done after the index hole is sensed.

Each track is divided into number of sectors. The number of sectors in a track depends on the size and recording method used. In each sector, a fixed number of data bites are written.

Depending on sector organization, the floppy disk is classified in to two types

1. Hard sectored floppy diskette.
2. Soft sectored floppy diskette.

4.3.1 Hard Sectoring

The number of sector on each track is physically fixed while manufacturing the diskette. The beginning of every sector is identified by a sector hole punched on the plastic disk.

4.3.2 Soft Sectoring

The number of sector on each track is chosen by the software. This number can be varied for a given diskette by various software programs. There are no physical holes on the diskette for sector information.

4.3.3 Data Recording

Data is written on track bit by bit. The read/write head reads or writes on the diskette using standard electromagnetic recording technique. One head writes on the top surface of the diskette and the other head writes on the bottom surface.

4.3.4 FM technique

Each data bit is recorded in a cell along with clock pulse. Clock pulse is written for each data cell. The cell length is 4 msec on the magnetic medium; the information is stored in “FLUX Reversals” on the media and not in amplitude or direction of magnetization. Each bit is recorded as a flux change.

If data is 0 there is no data pulse. If data is 1 there is data pulse.

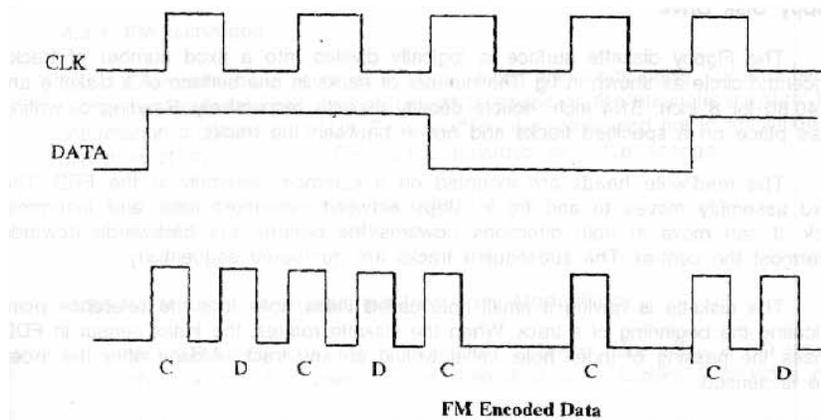


Fig. 4.3 FM Technique

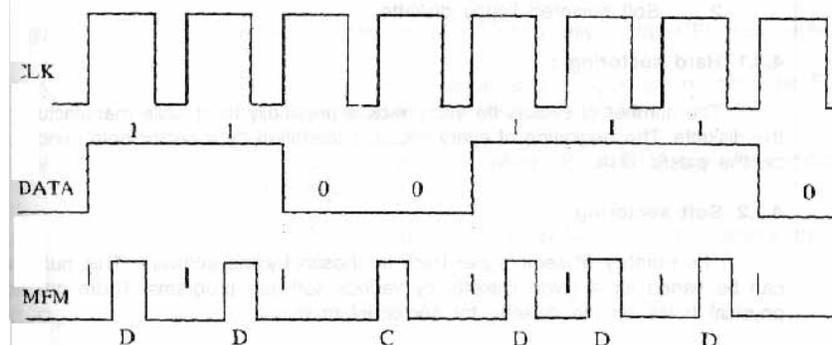


Fig. 4.4 MFM Technique

4.3.5 MFM technique (Modified Frequency Modulation)

For MFM technique, the cell duration is 2msec here pulse is not written for each data cell. It is present only when data is on present & previous cell.

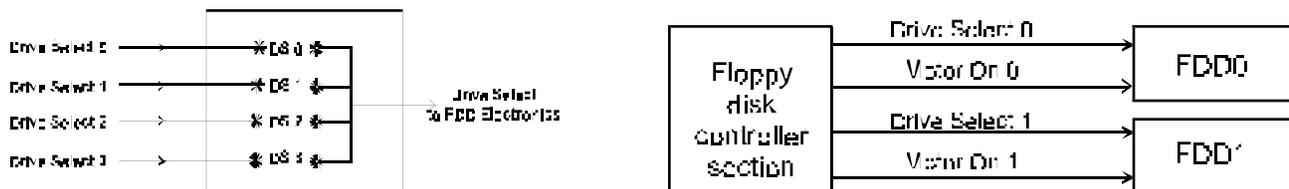
The diskette is logically divided into a fixed number of tracks or concentric circles. Reading or writing takes place only on these circles & not between tracks. There is a small hole punched on the diskette near the centre called index hole. This is reference point for start of track.

4.4 FDC SYSTEM INTERFACE

- AEN : To enable selection of I/O ports only during CPU bus cycle.
- $A_0 - A_9$: Only 10 LSBs of the address bus, $A_9 - A_0$ are decoded by FDC logic. The remaining six MSB are ignored.
- IOW : This signal becomes active when CPU or DMA controller conducts an I/O read cycle.
- $D_0 - D_7$: Bi-directional data bus.
- DRQ2 : When FDC is ready to transfer 1 byte of data to memory or FDC is ready to read 1 byte of data from memory, it is generated.
- DACK2 : Issued by DMA controller when it performs DMA cycle in response to DRQ2.
- T/C : This signal is issued by DMA controller to indicate that byte count for DMA channel is zero.
- IRQ6 : The FDC generates this signal, when it has completed execution of command.
- Reset Drive : Issued by motherboard circuit during reset sequence.

4.5 FDD INTERFACE

The 34-pin cable carries the signals between FDC & FDD. Except for the drive select and motor ON signals, rest all are same. Each FDD physically receives all the 4(Four) Drive select signals. Inside the FDD there is a jumper option to make FDD respond to any one of the drive select signal.



DOS can be loaded only from drive 0 since BIOS expects the diskette there only. Hence FDD after the twist in the cable becomes drive 0.

4.6 FLOPPY DISK DRIVE ALIGNMENT

The alignment adjustment in the IBM drives set the positioning of the read/write head correctly over the track on the disk, adjust the disk stop guide, adjust index hole sensor or adjust the hub that fits in the disk. A check is also made of the head azimuth compared with the disk track. These Procedures require special equipment including dual trace oscilloscope, disk management tools & special alignment disks.

4.6.1 Track 00 Adjustment

Adjustment of the track 00 properly positions drive read/write head over disk track 0. A stop screw holds the switch at a setting fixed at track 0. This switch setting rarely needs adjustment if it does the drive will not read at all. If the system does not boot and you think that Track-0 alignment may be out of tolerance, then start by setting the radial head alignment first.

TOOLS REQUIRED

- Flathead Screwdriver
- Philips head Screwdriver
- Protective Pad
- Adequate lighting
- Tray to hold loose Screws

1. Turn OFF computer
2. Disassemble the computer
3. Disconnect the disk drive data cable
4. Remove the silverhead screw holding to chassis
5. Gently pull drive forward about 2 inches out from the front chassis
6. Disconnect the power supply cable from back of PCB
7. Remove the drive from chassis.
8. Set drive aside towards you to adjust the screw at the back of drive.
9. Connect power supply cable again &
10. Reconnect data cable
11. Insert program disk in the drive(diagnostic)
12. Loosen the screw from bracket
13. Turn the screw in the clockwise till you get the message track 0 o.k.
14. If OK insert the drive inside the chassis, put a copy of program disk in drive, verify correct operation.

4.7 FORMATTING FLOPPIES

A floppy diskette can be used for different operating systems provided it is appropriately formatted. Formatting places special magnetic marking on the track and divides the tracks

into a number of sectors of fixed length, track contains the same number of sectors.

The formatted storage capacity of the diskette is less than unformatted storage capacity. The disk space that must be used to store location, identification & timing of information on the disk in order to let the system then at all time which track & sector is reading. It reserves first track Track0 to identify the type of information found on other track.

In a PC, DOS organizes 9 sectors, on a track with 512 bytes of data, each sector. Each ID field contains address of the sector. Data field contains actual data. ID field is seven bit long. The ID address mark, cylinder number, Head number, sector length, CRC bytes there are contains of ID field. The bad track is identified by writing hex FF in ID field.

Formatting a diskette removes previous data stored in it and writes the data in ID field.

4.8 Making a Diskette DOS Bootable

To make the diskette bootable in DOS, following steps can be taken:

1. Using the FORMAT command with /S switch (syntax FORMAT A: /S)
2. Using the SYS external command (syntax SYS A:)
3. Using utilities like Norton Disk Doctor, PC Tools, XT Gold etc.

ASSIMILATION EXERCISE

- Q.1 How is read/write head for a disk drive moved into position over a specified track ?
- Q.2 What additional information besides the actual data is recorded on each track of a softsectored floppy disk ?
- Q.3 Describe the purpose of CRC bytes included with each block of data recorded on the disk ?
- Q.4 Why must clock bit be recorded alongwith data bits on floppy disk ?
- Q.5 Under what condition will clock pulses be inserted in a bit cell when recorded data on a disk in MFM format ?
- Q.6 For a disk using MFM encoding and IBM Standard format with 26 sectors of 256 bytes each, what percentage of disk capacity is lost due to formatting ? What is this percentage if eight sectors of 1024 bytes are used instead ?
- Q.7 A double-sided floppy disk with 40 tracks per side has how many cylinders ?
- Q.8 What is interleaving sector ? What is interleave factor ?
- Q.9 Why does the FDD cable is twisted ?
- Q.10 What is significance of index hole ?

HARD DISK DRIVES

COMPETENCY OBJECTIVES

The objective of this Chapter is to make students understand the types of Hard Disks standards available, its installation. At the end of this section, a student should be able to :-

- ❖ Understand the geometry of a Hard disk.
- ❖ Differentiate between the various types of Hard disks.
- ❖ Display the Partition Information and Partition HDD.

CHAPTER - 5**HARD DISK DRIVE****5.0 TYPES OF HARD DISK**

Hard disks been very effective input/output device for computer. It is secondary or auxiliary memory.

Depending on the type of interface, HDD can be classified as

1. ST506
2. ESDI drive
3. IDE Drive
4. SCSI Drive

1. ST 506

ST506 are traditional types found in PC's, they are reliable, and they suffer from slow data transfer rate. The advantage is almost all ROM BIOS directly supports this. This interface standard is from Seagate Technology.

2. ESDI Standards

Enhanced Small Drive Interface. The advantage is ESDU control devices are on HDD itself. So ESDI can't be used with ST506/412 driver. But uses the same data and control cable.

ESDI are formatted for 34/35 sectors/track. So transfer speeds of 10MBPS can be achieved.

3. IDE drives

IDE means Integrated Drive Electronics. It is taking over ST506 controller in low and medium machines. This rapidly interface make use of single cost.

4. SCSI Standards

It is Small Computer System Interface used for attaching various types of devices to a computer system. SCSI is an 8-bit parallel bus that can support up to 8 devices.

SCSI is capable of data transfer rates up to 33 MBPS.

5.1 GEOMETRY OF HARD DISK

5.1.1 Construction of Hard Disk

In the case of hard disk the recording surfaces are permanently encased in a metal enclosure to shield them from dust and dirt. All that is visible is a hard disk drive, a metal box with some circuitry on it.

5.1.2 Platters

To increase the drive capacity, virtually all hard disk drives contain two or more magnetic disks. The disks are referred as platters. They are mounted around an axis called spindle. All the platters turn together at constant speed of 3600 RPM. The motor that turns the spindle that may be built into spindle, or it may be reside below this spindle.

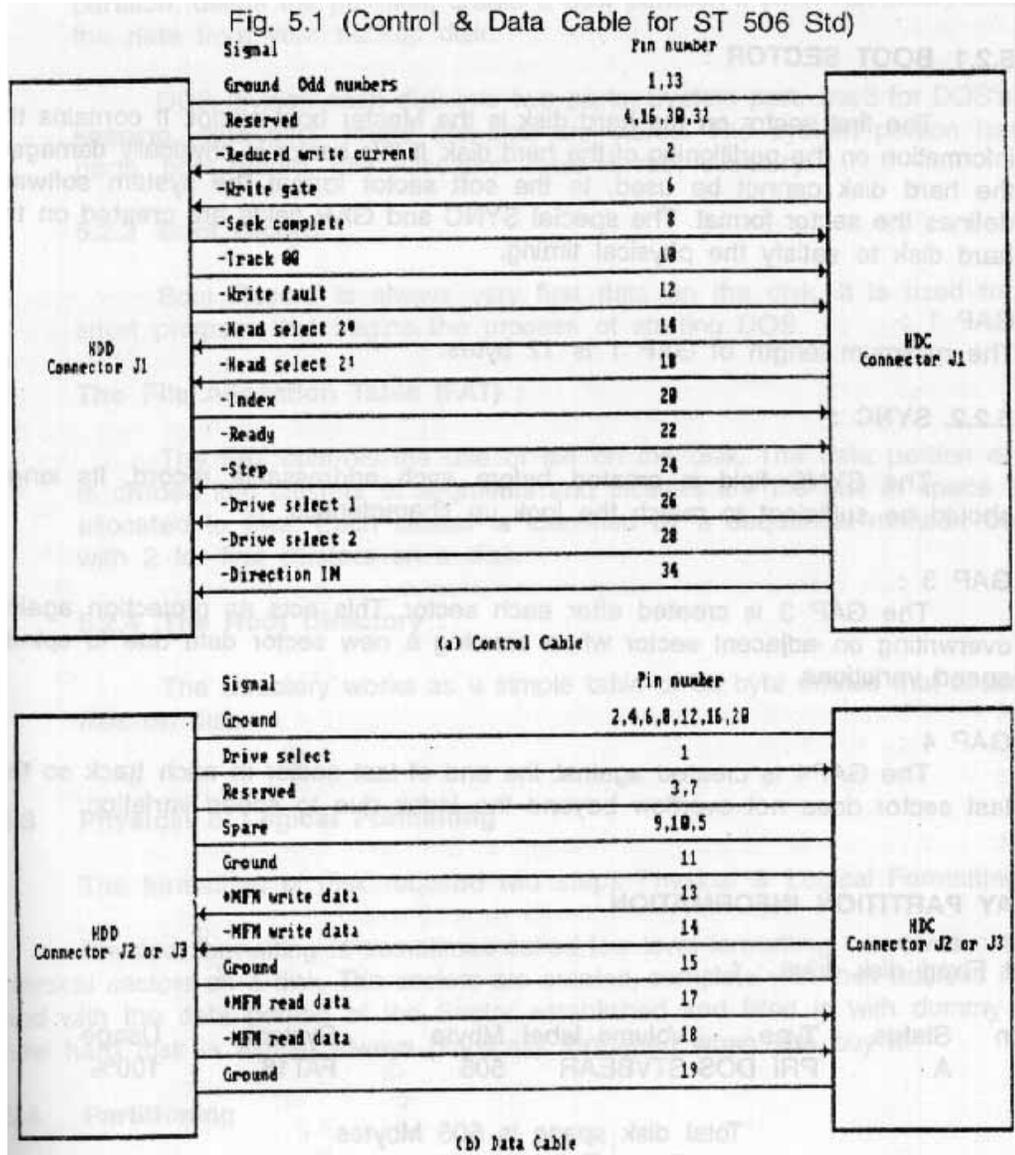
Both the sides of platters hold the data. Each side of a platter has one read/write head. The heads are connected to comb like arm, that moves all heads together.

The heads are to stay close to the platters(several microns) without touching because they actually flyover the surface on a cushion of air created by disk fast rotation. The heads slowly lift off when the drives start up and they gently land over when power is shut off. This concept of heads above disk surface prevents the head from weaving out the magnetic coating.

5.1.3 Stepper Motor Actuator

Stepper Motor rotates in terms of fixed steps as per the digital information fed to the motor. The distance the motor turns, for each step is fixed by the construction of the motor.

Stepper actuator are cheap and simple but have several disadvantages. So, to overcome the disadvantages, the voice coil actuators are used. The read/write heads of these types of drives have moving armature inside an electromagnetic coil. This is known as voice coil. With the coil technique for moving a particular distance in a straight line depends directly on how much electric current passes through the coil and for how long that current is applied. The heads can be positioned to any cylinder just by passing any appropriately varying current through coil for exactly the right amount of time. To make sure that the current is supplied in exactly right way, control circuit uses negative feedback.



5.2 HARD DISK FORMAT

The capacity of a hard disk depends on the number of cylinders, number of surfaces, number of heads and recording density. The DOS organizes tracks into 17 Sectors and 512 bytes/sector.

5.2.1 Boot Sector

The first sector on the hard disk is the Master boot sector. It contains the information on the partitioning of the hard disk. If this sector is physically damaged, the hard disk cannot be used in the soft format the system software defines the sector format. The special SYNC and GAP fields are created on the hard disk to satisfy the physical timing.

GAP 1

The minimum length of GAP 1 is 12 bytes.

5.2.2 SYNC

The SYNC field is created before each addressable record. Its length should be sufficient to match the look up characteristic.

GAP 3

The GAP 3 is created after each sector. This acts as protection against overwriting on adjacent sector when created a new sector data due to spindle speed variations.

GAP 4

The GAP 4 is created against the end of last sector in each track so that last sector does not overflow beyond the index due to speed variation.

DISPLAY PARTITION INFORMATION

Current Fixed disk drive : 1

Partition	Status	Type	Volume label	Mbytes	System	Usage
C:1	A	PRI DOS	STVBEAR	505	FAT16	100%

Total disk space is 505 Mbytes
Press Esc to continue

The FDisk Program enables you to manipulate the disk partition while working with DOS. If you are working with another operating system then FDisk enables you to create or delete DOS based partition.

If you need to resize DOS partition, you must back up the contents of the partition, delete the partition, create a new partition if(with FORMAT) and reload the data from your backup disk.

DOS divides each disk into two parts: System part, used for DOS's record keeping, data part, where the files are stored. The system portion has three parts, boot record, File Allocation Table & root directory.

5.2.3 Boot record

Boot Record is always very first data on the disk. It is used to hold a short program that begins the process of starting DOS.

The File Allocation Table(FAT)

The FAT controls the use of the disk. The data portion of a disk is divided into clusters of segments and clusters are unit of space that are allocated to files. Each cluster is identified by a sequential number, beginning with 2 for first clusters on a disk.

5.2.4 The Root Directory

The Directory works as a simple table of 32 byte entries that describe the files on disk.

5.3 PHYSICAL & LOGICAL FORMATTING

The formatting of disk required two steps Physical & Logical Formatting.

Physical formatting is sometimes called low level formatting - involves creation of physical sectors on a disk. The sectors are created, complete with their address markings and with data portion of the Sector established and filled in with dummy data. A new hard disk is almost always physically formatted when you buy it.

5.4 PARTITIONING

Partitioning is a procedure, which divides the hard disk into multiple sections or partitions. Each partition is composed of several cylinders or tracks. Different operating systems may be stored on different Partitions.

Partitioning the Disk

Partitioning means dividing into parts. Most of your disk is divided into Partitions in which you can store files of information. To partition on hard disk, DOS has a program called FDISK, which can change and Partition data. FDISK can list upto four partitions. Partition in the list has a starting and ending location & size in disk cylinders.

5.5 HANDLING OF HARD DISK

Hard drives are sealed units. This is necessary because of microscopic spacing of the heads over the rotating medium. When the computer is operating the read/write head of hard drive are “flying” on a cushion of last moving air, just above rotating disk. The air carried along with rotating at the normal 3,600 RPM: the head may damage the coating on the disks & cause catastrophic failure. This is called ‘head crash’, for this reason, NEVER MOVE OR JERK A COMPUTER WHILE IT IS IN OPERATION if it has hard disk installed.

A hard disk can be operated in horizontal position.

A few tips and tricks :

- Do not make too complicated directory
- Use CHKDSK regular.
- Try backing up data regularly. This is a good habit to recover data in case of hard disk failure.
- Always keep a bootable diskette in the same version as the hard disk .
- Make copy of system utilities like Norton Utilities, PCTOOLS, DISK Manager onto floppies. These floppies should be bootable.

Use latest Antivirus Program to check the hard disk regularly. The following table gives the hard disk parameters for PC/AT and PS/2 system.

Type	Cylinder	Hd	WPC	Ctrl	Lz	S/T	MB
1	306	4	128	00h	305	17	10.65
2	615	4	300	00h	615	17	21.41
3	615	6	300	00h	615	17	32.12
4	4940	8	512	00h	940	17	65.45
5	940	6	512	00h	940	17	49.09
6	615	4	65,535	00h	615	17	21.41
7	462	8	256	00h	511	17	32.17
8	733	5	65,535	00h	733	17	31.90
9	900	15	65,535	00h	901	17	117.50
10	820	3	65,535	00h	820	17	21.42
11	855	5	65,535	00g	855	17	37.21
12	855	7	65,535	00h	855	17	52.09
13	306	8	128	00h	319	17	21.31
14	733	7	65,535	00h	733	17	44.66
15	0	0	0	00h	0	0	0
16	612	4	0	00h	663	17	21.31
17	977	5	300	00h	977	17	42.52
18	977	7	65,535	00h	977	17	59.53
19	1024	7	512	00h	1023	17	62.39
20	733	5	300	00h	732	17	31.90
21	733	7	300	00h	732	17	44.66
22	733	5	300	00h	733	17	31.90
23	366	4	0	00h	336	17	10.54
24	612	4	305	00h	663	17	21.31
25	306	4	65,535	00h	340	17	10.65
26	612	4	65,535	00h	670	17	21.31
27	698	7	300	20h	732	17	42.53
28	976	5	65,535	20h	977	17	42.48
29	306	4	65,535	00h	340	17	10.65
30	611	4	65,535	20h	663	17	21.27
31	732	7	65,535	20h	732	17	44.60
32	1023	5	65,535	20h	1023	17	44.52
33	614	4	65,535	20h	663	25	31.44
34	775	2	65,535	20h	900	27	21.43
35	921	2	65,535	20h	1000	33	31.12
36	402	4	65,535	20h	460	26	21.41
37	580	6	65,535	20h	640	26	46.33
38	845	2	65,535	20h	1023	36	31.15
39	969	3	65,535	20h	1023	36	42.52
40	531	4	65,535	20h	532	39	42.41
41	577	2	65,535	20h	1023	36	21.27

42	654	2	65,535	20h	674	32	21.43
43	923	5	65,535	20h	1023	36	85.06
44	531	8	65,535	20h	532	39	84.82
45	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0.00

Type	=	Drive type number
cyls	=	Total cylinders
Heads	=	Total heads
WPC	=	Write Precompensation starting cylinder
ctrl	=	Control byte : Values
Bit 0	=	01h not used
Bit 1	=	02h not used
Bit 3	=	04h not used
Bit 3	=	08h more than 8 heads
Bit 4	=	10h not used
Bit 5	=	20 h OEM defect map
Bit 6	=	40h disable disk retries.
Bit 7	=	80h disable disk refries.
47	=	Landing Zone cylinder for head parking
ST	=	Number of sectors per track.
MB	=	Drive capacity in millions of bytes.

ASSIMILATION EXERCISE

- Q.1 What are signal sequence while reading data from Hard Disk Drive ?
- Q.2 What is the use of write precompensation circuitry in Hard Disk ?
- Q.3 What is size of sector buffer & why it is used ?
- Q.4 What are two functions performed by HDC BIOS ROM ? How presence of HDC or absence is determined ?
- Q.5 What are the parameter to determine the capacity of hard disk ?
- Q.6 What is Boot Sector ? Which information is stored in it ?
- Q.7 Why must hard disk be operated in a dust free environment ?
- Q.8 Two terms often encountered in hard disk system manuals are cylinder & partition. Define & tell the difference between these two terms.
- Q.9 A hard disk rotates at 3600 RPM & has an average seek time 35 ms. What is the average total access time, including rotational latency ?
- Q.10 Explain the procedure for connecting two harddisks in a master-slave configuration?

SWITCH MODE POWER SUPPLY

COMPETENCY OBJECTIVES

The objective of this Chapter is to introduce the students to SMPS operation. At the end of this section, a student should be able to :-

- ❖ Understand functional operation of SMPS.
- ❖ Differentiate between various functional Sub-blocks.
- ❖ Troubleshoot the SMPS.

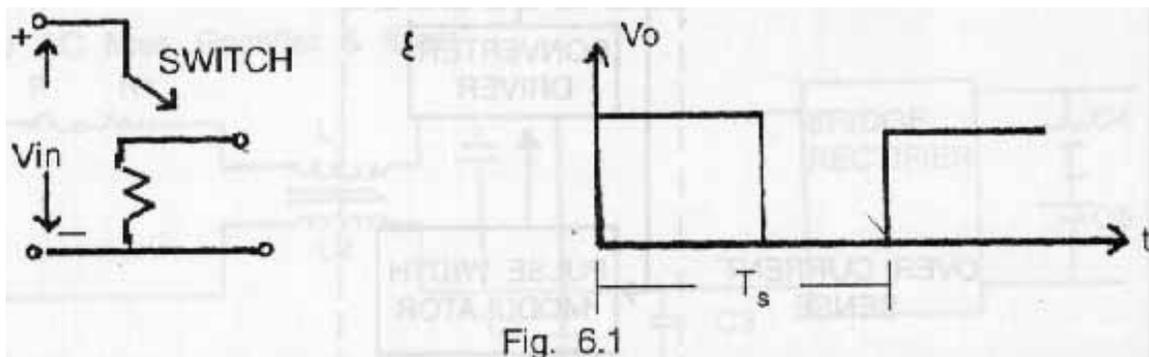
CHAPTER - 6**SWITCH MODE POWER SUPPLY****6.1 INTRODUCTION**

The power supply is the important element of any piece of electrical or electronic equipment. The successful operation of any piece of electrical or electronic equipment depends upon overall functioning of the power supply.

The primary function of any power supply is to provide a predetermined constant output voltage when the input voltage and/or output current vary widely & there is possibility of change in operating temp. The degree to which power supply provides a constant output voltage.

6.2 FUNDAMENTALS OF SWITCH MODE POWER SUPPLY

In contrast with linear DC regulated power supply, a switching power supply employs transistors which operates as a switch, either "ON" or "OFF". The output voltage is controlled by controlling the "ON" and "OFF" Duration's. This is called switch mode DC - DC conversion.



In the above figure, the average output voltage V_o is controlled employing switching at a frequency and adjusting the "ON" Duration to Control the output.

The ratio of "ON" duration to switch time period is called switch duty Ratio

$$D = t_{on} / T_s$$

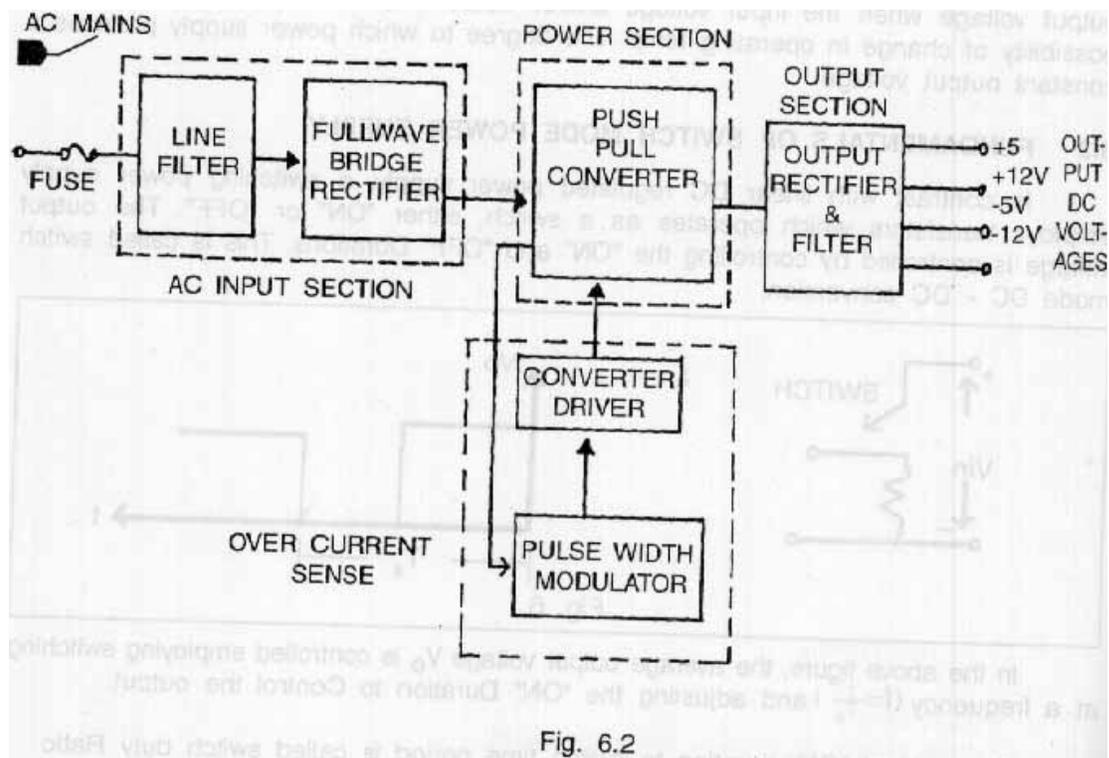
The above method is called PULSE WIDTH MODULATION switching.

The switching regulators can be of the free running type or driven type. The output voltage is used to generate a PWM signal, which is used to drive the regulator Switch such that the output voltage is maintained at predetermined level. This PWM signal can have one of the following characteristics.

- i) Fixed ON Period and variable OFF Period.
- ii) Variable ON and OFF Periods with fixed frequency.
- iii) Fixed OFF period and variable ON Period.

To enhance the Power capability, the above regulation are usually connected in parallel, and are operated in phase shift mode to reduce the EMI and problems of electromagnetic screening. To improve the performance characteristics (such as regulation, transient response etc.), the feedback control loop of the above regulation is modified to sense the AC changes besides DC changes on the output voltage and changes in the input voltages.

6.2.1 Block Diagram of SMPS



6.2.1 AC Filter

High frequency noise signals entering from the AC mains into the supply may cause data loss or any other malfunctioning of the PC. This section is used to suppress any spikes, surges and High frequency signals entering the Power supply.

6.2.3 Rectifier

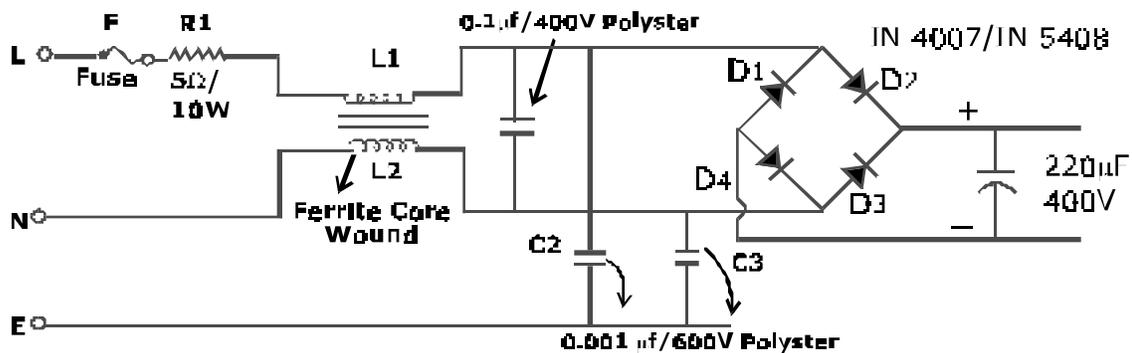
The filtered AC main voltage is rectified and converting into pulsating DC by a bridge rectifier. This pulsating DC is then filtered by a capacitor filter to get a pure DC.

6.2.4 Push Pull Converter

A Push pull converter is used to switch the DC voltage ON/OFF to the primary of a high frequency transformer to get a train frequency pulses at the output of the transformer.

The switched voltage at the secondary of the transformer is rectified and filtered to get a pure DC voltage at the output. The 5V DC voltage is sampled & fed to PWM IC. This voltage is compared with the reference voltage and depending on whether the output voltage is greater/ lesser than input voltage, the PWM IC controls the OFF/ON periods of the switching transistors to maintain the output voltage.

6.2.5 Schematic Circuit Study of Typical SMPS



The AC mains voltage is applied to the circuit through fuse 'f', Resistor R used to prevent the sudden inrush of current from AC main when the Power supply is switched ON. The inductors L1 and L2 prevent any high frequency signals to enter into circuit.

L1 & L2 are two inductors wound on the same core. The magnetic field that is produced are equal in both lines but opposite in direction. Therefore, they cancel out each other. Thus, filter action is obtained. This arrangement also provides very high inductance to common mode signals.

The filtered AC line voltage is then rectified and converted to DC by a bridge rectifier. Thus obtained signal is not a pure DC, but has a very high ripple content in it. This is called pulsating DC. This is then filtered by a capacitor to get a pure DC voltage. C3 and C4 are filter capacitors, which are in series across the bridge rectifier output. Thus the total dc voltage is divided and half of the voltage appears across C1 and other half across C2.

6.2.6 Push Pull Amplifier

The power converter has been configured as a half bridge push pull converter. The Power switching transistors Q1 & Q2 form one arm of the Converter & other arm is formed by

capacitor's C1 & C2.

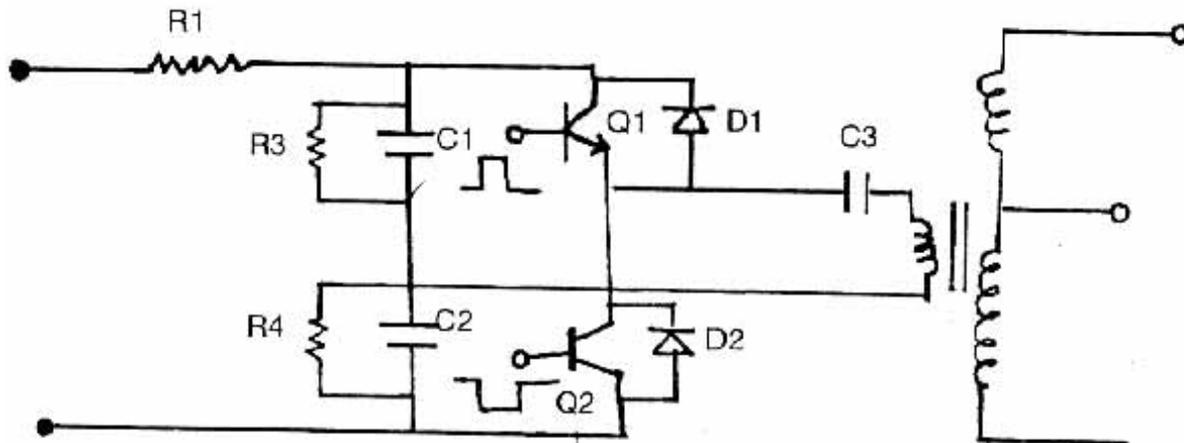


Fig. 6.4

In the half wave bridge configuration the power transformer has one side connected to a floating voltage potential created by the series capacitor C1 & C2 which has a value at $V/2$ 150V DC at junction of Q1 emitter & Q2 collector through a series capacitance C3. When Q1 turns ON, the transformer goes to positive bus generating (150 V) voltage pulse. When Q1 turns off & Q2 turns on the polarity at the transformer primary reverses since it is now connected to the negative bus generating negative pulse of 150V. The turn ON & turn OFF action of Q1 & Q2 will generate a 300 V peak to peak square wave.

6.2.7 Typical Output Section

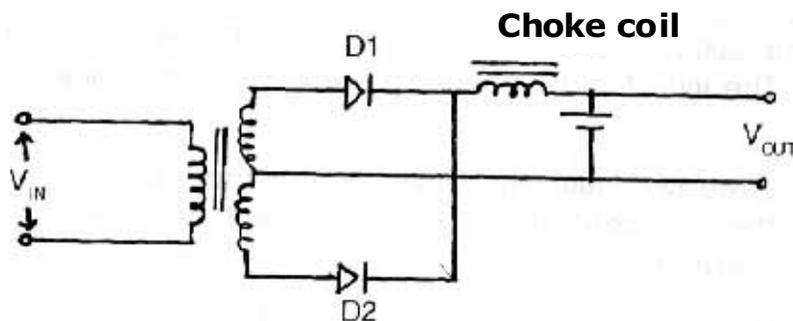


FIG. 6.6

The output section comprises of single or multiple DC voltages derived from rectification & filtering of transformer secondary voltages. As shown in circuit diagram there are two diodes D1 & D2 that provide current to the o/p for approximately half the cycle; they share the load current equally. Another point of interest is that no flywheel diode is needed because either diode acts as a flywheel when other one is turned off.

6.2.8 Control Section

Majority of today's switching power supplies are of the pulse width modulated type. The technique varies the conduction time at the switching transistor during the ON period to control and regulate the O/P voltage to a predetermined level.

6.2.8.1 PWm Section

The fixed frequency PWM technique is used. In this system, a square wave pulse is normally generated to drive the switching transistor ON or OFF. By varying the width of the Pulse, the conduction time of the transistor is varied, thus regulating output voltage. The PWM control circuit may be single ended capable of driving a single transistor converter; or dual channel PWM circuit is used.

6.2.9 Integrated PWM controller :

The Fig. No. 6-7 shows the basic building of PWM controller & the waveform is as shown in Fig. No. 6.8 circuit functions as OPAMP compares the feedback signal from the output of the Power supply to fixed reference voltage V_{ref} . The error signal is applied and fed into inverting input of a comparator. The non-inverting input accepts the sawtooth waveform with a linear slope, generated by a fixed frequency oscillator. The oscillator output is used to toggle a flip-flop, producing square wave output Q & \bar{Q}

The comparator square wave output and the flip flop output are both used to drive AND gates, enabling each output when both inputs to the gate are high. The result is a variable duty cycle pulse train at channel A & B fig. 6.8 waveform shows output pulse width modulated when the error signal changes its output (shown in dotted lines). The output of PWM controller are externally buffered to drive main power switching transistors.

Double ended controllers: SG 1525, SG 1526, TL 494, and TL495.

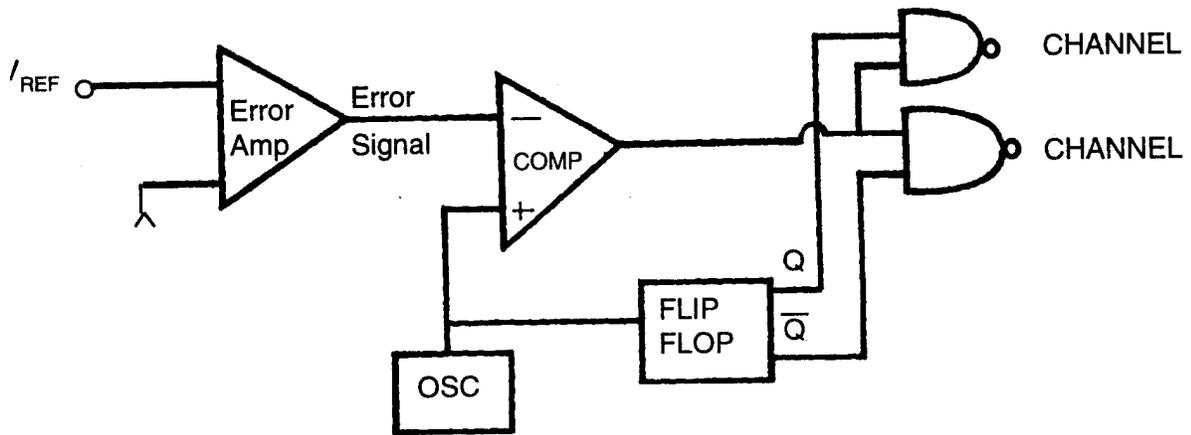


FIG. 6.7

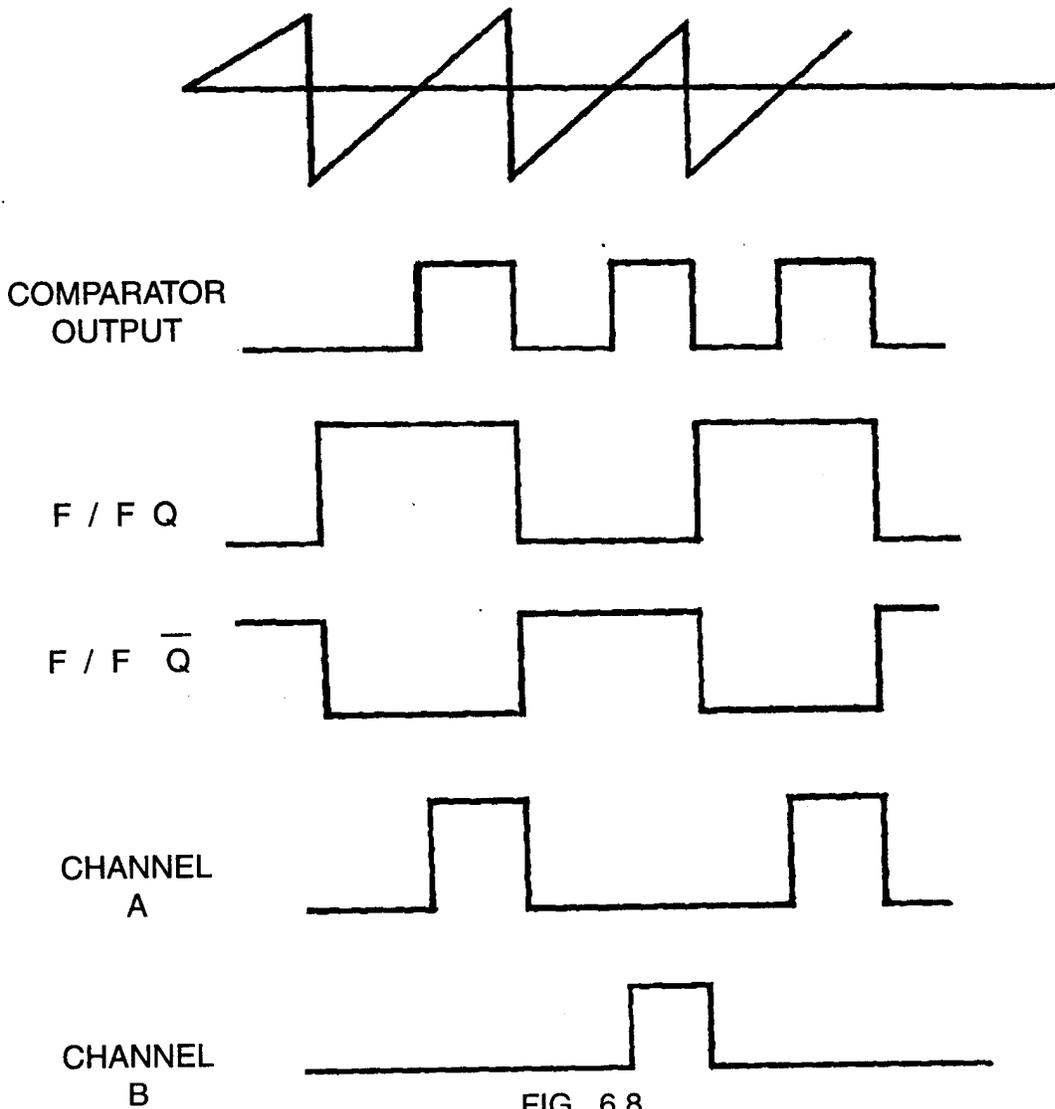


FIG. 6.8

6.3 THE FAN

A cooling fan is mounted on the cabinet of the supply. The air into the supply and air sucked in by the fan carries off the heat generated by components of Power supply, thereby maintaining the Power supply at room temperature. The supply for the fan is 12V.

6.3 POWER SUPPLIES USED IN P.C.

A PC needs power at two different voltage levels, both positive and negative Polarities. +5V DC, +12V DC, -5V DC, -12V DC. The power supply has to provide power at all these four voltages. Most of the power needed by electronic circuitry is +5V DC, +12V DC voltages are required by DC motors.

The total power requirements of a PC depends upon components within it. Each component will draw a certain quantity of current at each of the supply voltages it uses. Some components will draw a certain quantity of current depending on what they are doing.

Typical PC power supply rating :

Voltage	PC (65W) Current (A)		XT Current (A)		AT (200W) Current (A)	
	Min	Max	Min	Max	Min	Max
+ 5 ($\pm 5\%$)	1.5	7.0	2.5	15.6	7.0	19.8
+12 ($\pm 5\%$)	0.3	2.0	1.0	4.2	0.5	7.3
- 5 ($\pm 10\%$)	0.06	0.3	--	0.3	--	0.3
-12 ($\pm 10\%$)	0.06	0.3	--	0.3	--	0.3

6.4 TROUBLESHOOTING

Before opening the system box and going into the check-up of internal circuitry it is always a good practice to follow the following procedures.

- 1) Check input voltage.
- 2) Check mains supply.
- 3) Check Power Cable plugged is fully.
- 4) Test fuse and cable continuity.
- 5) Check operation of switch (Mechanically by inspection electrically by disconnecting from mains & then measuring the resistance across line & neutral terminals of main plug while operating the switch the resistance should be high with switch off, low with it on).
- 6) Check output voltages and Power good signal from Power supply using volt-ohm meter.
- 7) Remove expansion cards and disconnect Power connections from disk drives & check output voltages & Power good signal again, in case overload cutout is being triggered. Problems arise in SMPS mainly in components which carry high current and dissipate more energy.

1) VOLTAGE IS LESS/MORE AT THE OUTPUT

This problem may be due to fault in feedback or in PWM IC, the IC compares its reference voltage with improper one, thereby resulting in increase / decrease of voltage at the output. The Problem may also be due to improper reference generated to IC.

To correct this problem check whether the reference voltage is at 5V, if no, check for the power supply to the IC. If this is OK then the IC is faulty, replace the IC. If the IC is OK, check for the feedback loop, check the resistors in feedback path and replace the faulty one.

2) VERY HIGH RIPPLE IN THE OUTPUT

This problem is due to faulty capacitor, the capacitor may dry up their resulting in inefficient filtering of the rectified voltage. Replace the capacitor to get a good ripple free DC voltage.

The Power supply switched ON for a very brief period of time and then switches OFF.

The problem is either due to a short in the circuit resulting in a large current flowing in the circuit thereby IC switches of the power supply or it may be due to fault in the current sense circuit. Check for the faulty diodes in the output circuit & capacitors.

Check for the components that for the current sense circuit. Also check the reference voltage of IC.

3) THE POWER SUPPLY DOES NOT SWITCH ON AT ALL

First of all check whether DC voltage across the capacitors C1 & C2 is at the required level or not. If there is no voltage there is some problem in the line filter/rectifier. If it is OK, it is the problem in the rest of circuitry. The only way to find out the problem is to check the components individually in push pull, output & IC. Check the transistors Q1 & Q2, the driving transistors T1 & T2 rectifying diodes at the output, the driving transformer & the capacitor, resistors connected to the oscillator of PWM.

One way to check the IC is to isolate the output of Pin11, Pin9 of the IC with the power supply circuit. Power the IC with an external +12V supply and give a +5V to the feedback circuit. If the IC oscillates giving pulses at the output IC is OK.

To check for the fault in the push pull amplifier. Check whether transistors Q1 & Q2 are switching by checking the pulses at O/P of transformers X1. If found OK check for the fault in the O/P circuit by checking the diodes & capacitors. If OK problem is in feedback circuit or in current sense.

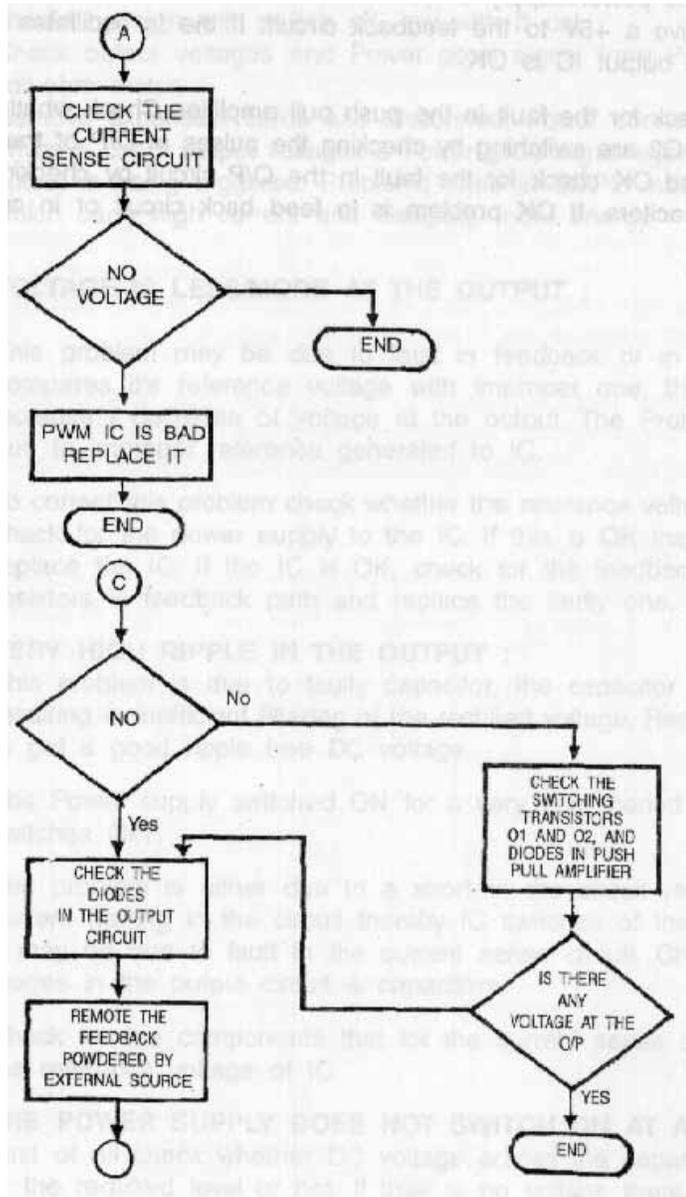


DIAGRAM 1

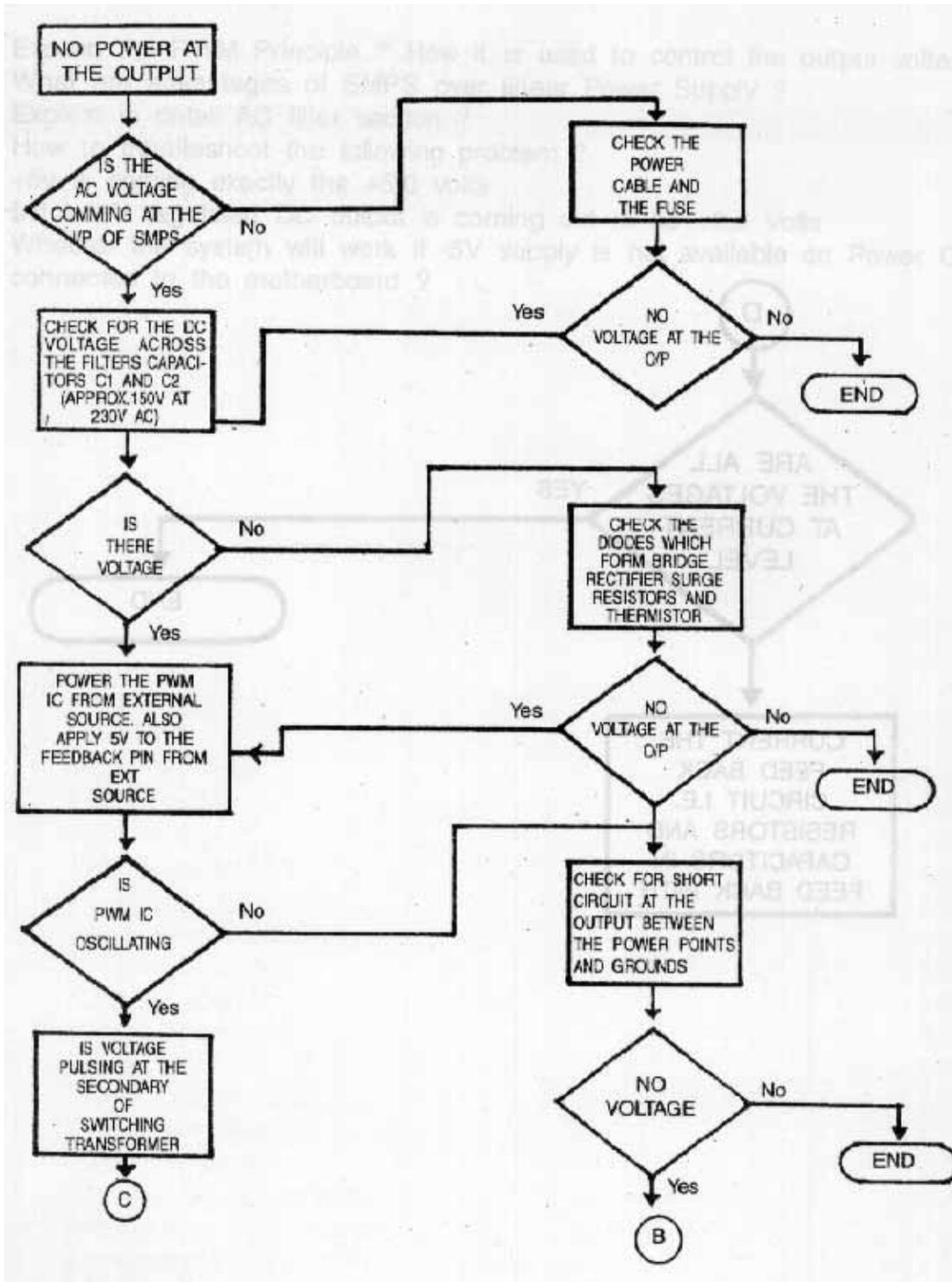


DIAGRAM 2

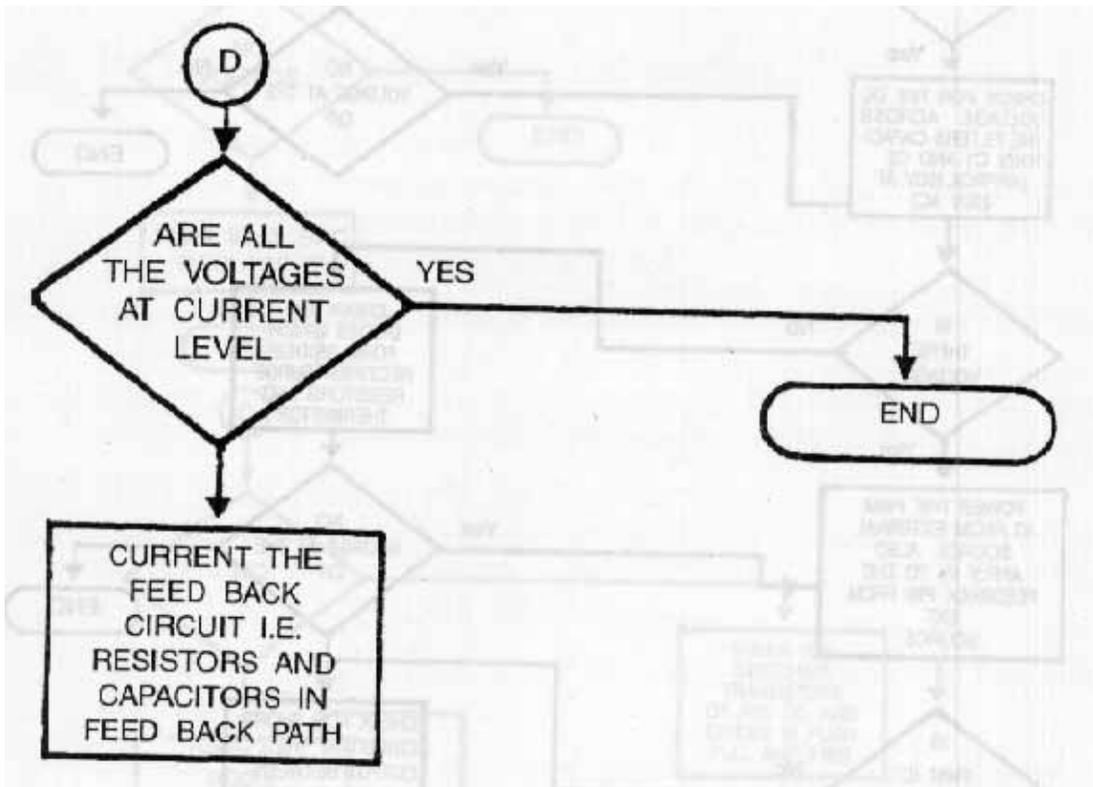


DIAGRAM 3

ASSIMILATION EXERCISE

- Q.1 Explain the PWM Principle ? How it is used to control the output voltage ?
- Q.2 What are advantages of SMPS over linear Power Supply ?
- Q.3 Explain in detail AC filter section ?
- Q.4 How to troubleshoot the following problem ?
 +5v is coming exactly the +5.0 volts
 but +12V regulated DC output is coming out to be +9.6 Volts
- Q.5 Whether the system will work if -5V supply is not available on Power Cable connected to the motherboard ?

PRINTERS

COMPETENCY OBJECTIVES

The objective of this Chapter is to make the students understand the operation and types of Printers. At the end of this section, a student should be able to :-

- ❖ Distinguish between various types of printers based on their operation.
- ❖ Understand the mechanism of a Dot-Matrix printer.
- ❖ Know various PC to Printer interface signals and cables for troubleshooting.

CHAPTER - 7**PRINTERS****7.0 TYPES OF PRINTERS**

Printers are broadly classified into two types

IMPACT : Some of the printer body makes contact with paper so that make impression or character formation

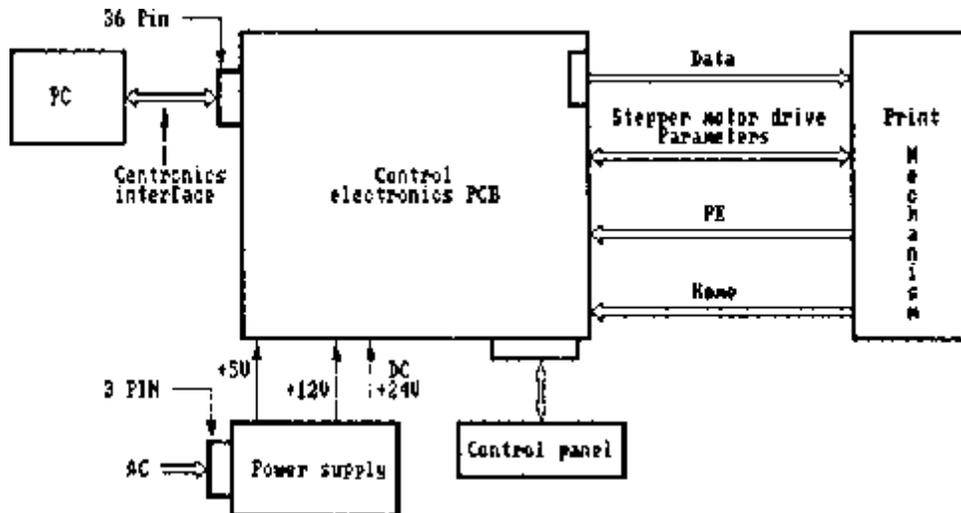
NON-IMPACT : There is no physical contact of the head with paper or ribbon.

IMPACT PRINTERS : Daisy Wheel Printer
Dot Matrix Printer
1) 80 Column
2) 132 Column

NON IMPACT PRINTER : Ink Jet Printers
Laser Printer
Thermal Printer

7.1 PRINTER

The Printer has three major sub-assemblies. Power supply, control electronics, Printer mechanism.



POWER SUPPLY

The Power supply converts the ac line voltage to dc voltage. It consists of a Power Transformer, dc regulator, a safety logic and filter. The safety logic shuts off the Power supply in abnormal conditions and prevents any damage to device.

DC VOLTAGE IN PRINTER

Sr.No.	Voltage	Logic
1.	+5V	Electronics Control PCB, Carriage Motor, Paper Feed Motor Control.
2.	+12V	Buzzer
3.	+24 V	Print Solenoid, Paper Feed Motor, Carriage Motor.

CONTROL ELECTRONICS

- Microprocessor and address latches.
- RAM
- ROM
- Address decoder
- Reset Logic
- Head driver
- CR Motor Drive
- LF Motor Drive
- Interface drivers/Receivers

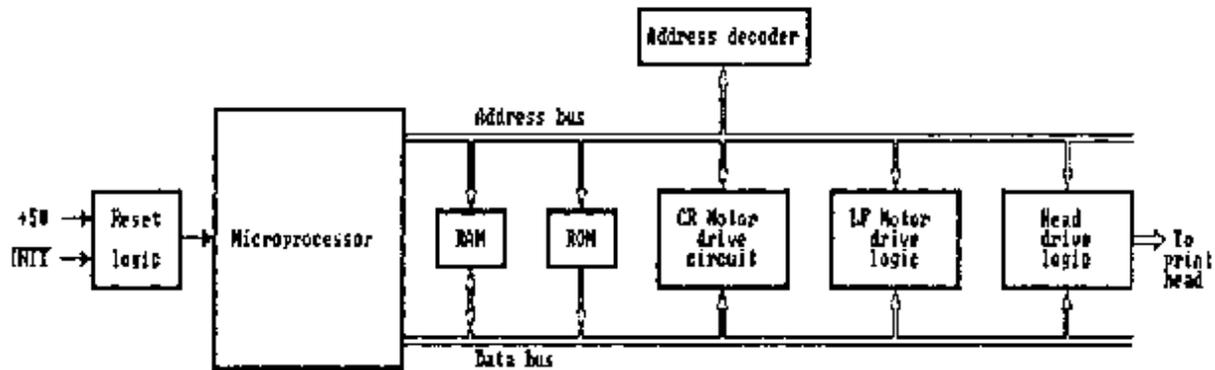


Fig. 7.2

CARRIAGE MOTOR CONTROL

This circuit controls the movement of the head carriage assembly. The carriage motor control consists of Power Transistors. The microprocessor controls the motor speed through a feedback signal.

PAPER FEED MOTOR CONTROL

Paper feed motor's control logic moves the platen by a fixed step.

PRINT HEAD CONTROL

Print Head control logic controls the firing of different needles at appropriate times corresponding to the matrix generation. The needle is current activated device. Each needle will be fired only for short duration.

CONTROL PANEL

Selecting Print mode NLQ, Emphasized, Double strike, condensed, Elite etc.

PRINTER MECHANISM

The Printer Mechanism has following subassemblies.

- Friction Platen
- Carriage Assembly
- Carriage Motor
- Print Head
- Paper Feed Motor
- Ribbon Feed Motor
- Ribbon Feed Mechanism
- Home Sensor
- Print Timing Sensor

CARRIAGE MECHANISM

The Print Carriage is moved in both Horizontal directions.

PAPER FEED MECHANISM

There are two types

- (a) Spricket Feed
- (b) Friction Feed

Friction Feed Mechanism consists of paper feed

SENSORS

Three major sensors in printer are:

- 1) Home Position Sensor

Home position sensors detects whether the head carriage is at left margin.

- a) Stationary Photo Sensor at Lower left of the Printer mechanism.
- b) Sensor flag on the head carriage. When the flag intercepts the photo sensor goes active high.

- 2) Print Timing Sensor

Print timing sensor provides timing signal related to carriage motor speed rotation. It consists of two parts

- (a) slotted disk on the motor shaft
- (b) photo sensor plate.

When the slot of the sensor disk crosses photo sensor, the output signal becomes high.

- 3) Paper end sensor

The paper end sensor provides a signal when there is no paper in the printer. It consists of a) Microswitch b) a lever on the paper guide. When there is no paper or paper is torn the microswitch operates & PE signal is generated.

INTERFACE SIGNALS and CABLE

The centronics Interface provides 36-pin connector from Printer side & PC side is 25-pin D type Connector. The PC uses 36-pin flat cable in which alternative wire is for ground. The signals are TTL level signals & twisted pair return ground wire for each signal is connected to the signal ground.

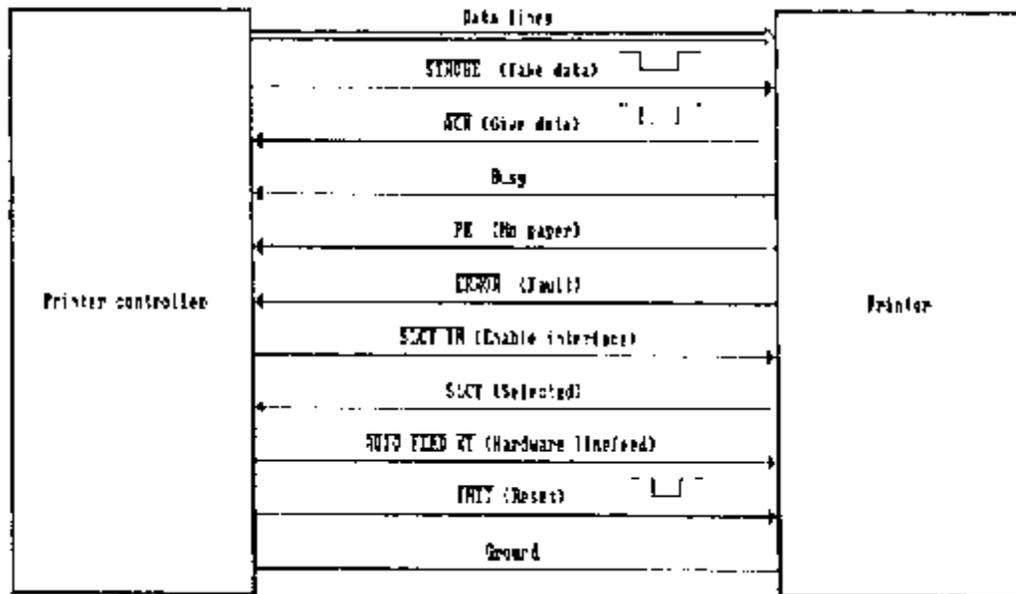
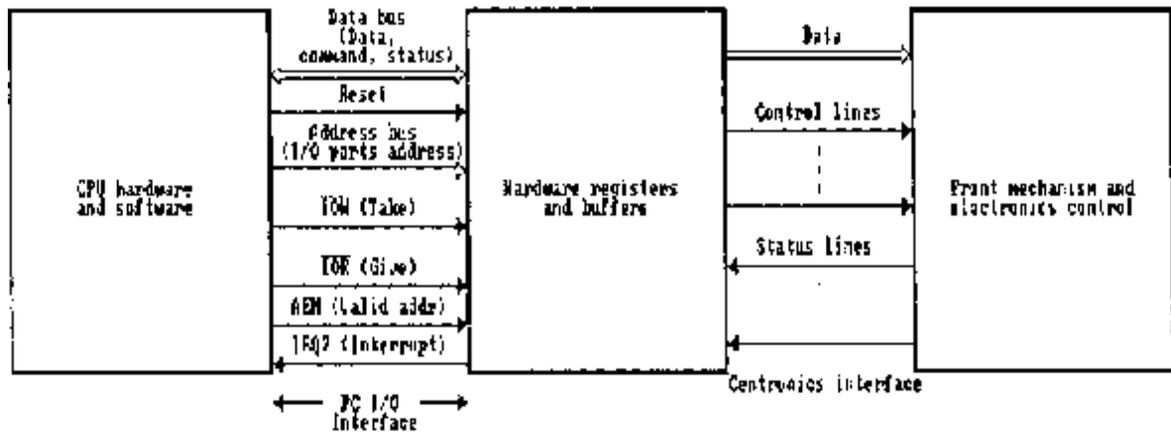


Fig. 7.3
Signals in Centronics Interface

SIGNALS FROM PC TO PRINTER

There are 12 signals from PC to printer out of these 8 signals are data bits and four control signals are

STROBE : The printer should take data when this signal is low.

INIT : When low, printer resets electronics logic & clears printer buffer.

SLST IN	:	When low, printer responds from controller.
AUTO FEED XT	:	After printing every line, the printer will provide one line feed automatically if this signal is low.

SIGNALS FROM PRINTER TO PC

Five status signals are

- 1) **ACK** - Acknowledgment for **STROBE** signal from the PC. When active, it indicates that printer has received data sent by PC and Printer is ready to accept next data byte.
- 2) **BUSY** - When busy signal is high, it indicates that Printer is busy and it can not receive data.
- 3) **PE** - PE signal is high, it indicates that there is no paper in the Printer.
- 4) **SLCT** - Indicates that printer is selected and logically connected to PC.
- 5) **ERROR** - Indicates that there is some error conditions in the Printer. The three reasons for this signal to go active are:
 - 1) Mechanical fault or electronic fault in Printer
 - 2) The Printer is in off-line state.
 - 3) There is no paper in printer.

PRINTER PORT

The PC supports both parallel and serial port. The parallel interface is called printer adapter or Printer Port. It may be physically present as a separate Printer adapter board or as a part of MDA board, multi I/O Port, motherboard, CGP or MGP.

The system software recognizes three different parallel interfaces: LPT1, LPT2, and LPT3. Usually parallel interface in the MDA board is primarily parallel port LPT1. The parallel interfaces present in multi I/O Port becomes secondary ports LPT2, LPT3 etc. The IDE card has a one parallel Port LPT1. The original PC designed selected 8 Bit output Port designed by company called centronics, thus the name centronics printer port.

PRINTER DRIVER

Each printer has got his own printer files. They are called as Printer Driver Files (PDF). The Printer manufacturer provides these softwares. Suppose you purchase a Printer say MODI XEROX, then they provide software, you can load these files in your PC before using the Printer.

PRINTER HEAD

The Print Head consists of 9, 18 or 24 pin wire arranged in vertical column. Each pin is attached to solenoid within a return spring.

When Power is applied to solenoid, the pin is fired with rapid speed and when the power is removed, the pin is brought back by return spring. These pins are sealed in a metal casing with a heatsink to dissipate the heat generated during printing.

LASER PRINTERS

These printers operate on the principle that it first form an image of the Page and basic approach is to be printed on a photosensitive drum in the machine “Toner” is applied to image on the drum. Next the image is electrolytically transferred from drum to a sheet of paper. Finally, the linked image on the paper is “fussed” with heat. The produced image on photosensitive drum is printed with a Laser. Turning on and off as it is swept back and forth across the drum produces an image in the same way that an image is produced on a raster Scan CRT. The rotating mirror sweeps the laser beam across the rotating drum. A modulator controlled by a microcomputer turns the laser beam on or off to produce dots. After image is linked and transferred to the paper, the drum is cleaned and is ready for next Page.

Lasers have advantage of very high quality print, very high speed (20,000 lines/minute).

INK JET PRINTERS

Earlier inkjet printers used a pump and tiny nozzles to send out a continuous stream of tiny ink globules. These ink globules were passed through an electronic field, which left them with an electric charge. The stream of charged ink globules was electrostatically deflected to produce characters on the paper. Excess ink was deflected & returned to ink reservoir. Ink jet printers can print 45,000 lines/min. Print quality is poor. So, never inkjet printers uses ink cartridges which contain a column of tiny heaters. When tiny heaters is pulsed on, it caused a drop of ink explode onto the paper. They can produce very good quality of Printing. But it required special paper for best results.

ASSIMILATION EXERCISE

- Q.1 What is the I/O addresses are dedicated to printer (LPT1) ?
- Q.2 List of important Parameters required to describe a dot matrix printer?
- Q.3 How many sensors are used in Printer ? Explain the function of each sensor in details?
- Q.4 When Printer Cable is removed from PC side, a dummy connector can be mounted which will simulate the Printer presence which signal should be looped and how ?
- Q.5 It is possible to share a Printer between two PCs ? Which signal in the centronics Interface can be used for this purpose ?
- Q.6 Describe the operation of Print mechanism of following type of Printer :
 - a) Thermal
 - b) Laser
 - c) Inkjet
- Q.7 What are five status signals from printer to PC ? Which signal sense the error conditions ?

PENTIUM MOTHERBOARD

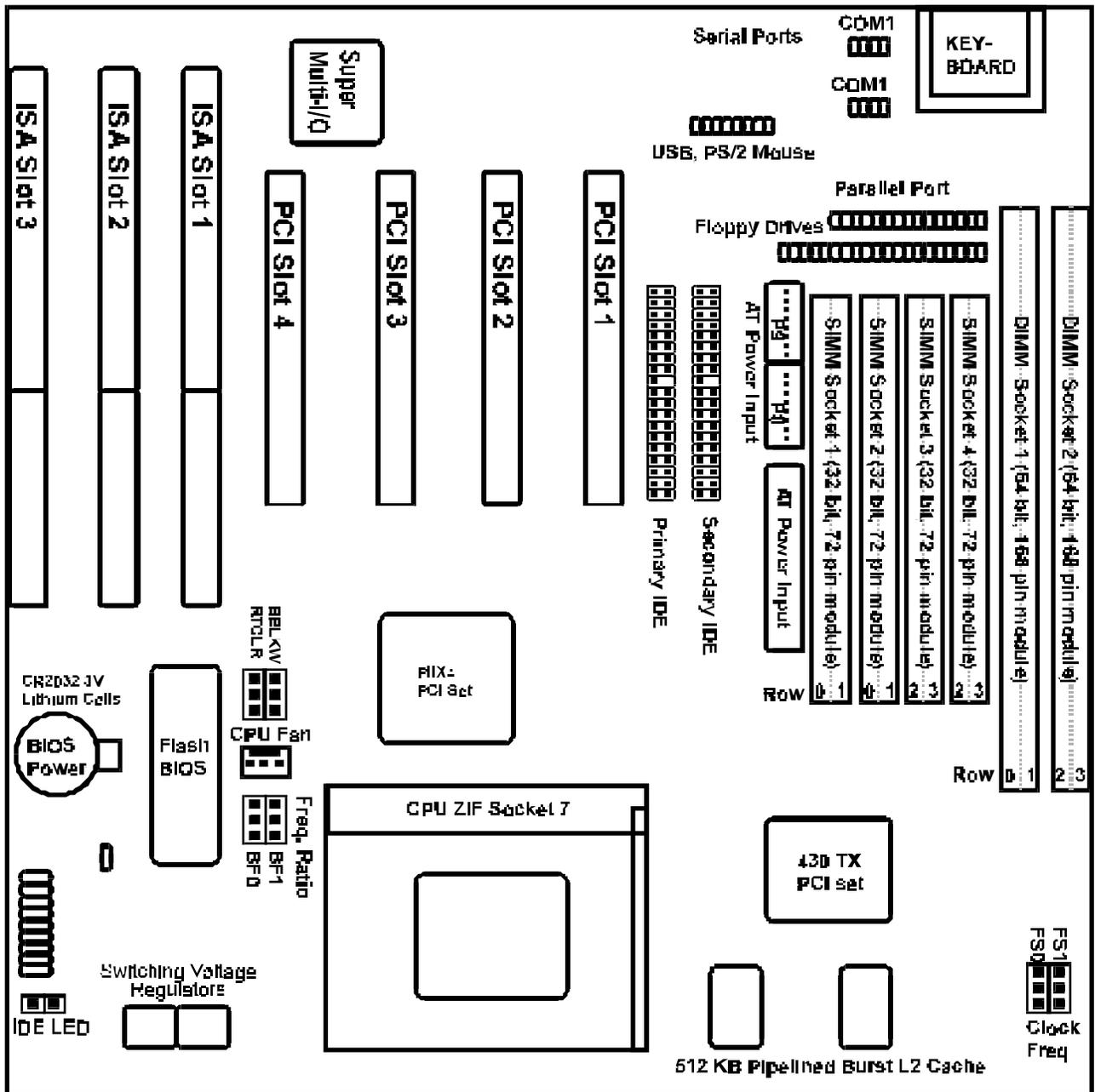
COMPETENCY OBJECTIVES

The objective of this Chapter is to make the students understand the new generation motherboards. At the end of this section, a student should be able to :-

- ❖ Install a Pentium Motherboard and understand its various features.
- ❖ Assemble a Pentium based system.
- ❖ Compatibility and upgradation of various CPUs as regards to operating speed and voltage.
- ❖ Upgrade Cache memory and know about SIMMs and DIMMs.
- ❖ Troubleshoot Motherboard.

CHAPTER - 8

PENTIUM MOTHERBOARD



Typical Motherboard Layout

MOTHERBOARD INSTALLATION STEPS

Before using the computer, you must complete the following steps:

1. Set jumpers on the motherboard.
2. Install memory modules.
3. Install the processor.
4. Install expansion cards.
5. Connect ribbon cables, cabinet wires, and power supply.
6. Set up the BIOS software.

PRECAUTIONS

Computer motherboards and components contain very delicate integrated circuit (IC) chips. To protect the motherboard and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

1. Unplug your computer before working on the inside.
2. Use a grounded wrist strap when handling computer components. If you do not have one, touch both of your hands to a safely grounded object or to a metal object, such as the power supply case.
3. Hold the components by the edges and try not to touch the IC chips, leads or circuitry.
4. Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.

TYPE OF JUMPER SETTINGS ON MOTHERBOARD (Socket 7)

1. Flash Memory Boot Block Programming (BBLKW):

This sets the operation mode of the boot block area of the programmable flash memory to allow programming in the Boot Block Write Enable position. This is required only if prompted by the Flash Memory Writer Utility. This is used to upgrade BIOS. Default value is write protect.

2. Real Time Clock (RTC) RAM (RTCLR):

The CMOS RAM is powered by the onboard button cell battery. To clear the RTC data: (I) Turn off the computer and unplug the AC power, (II) Move this jumper to "Clear CMOS", (III) Move the jumper back to "Keep CMOS", (IV) Turn on your computer, (V) Hold down <Delete> during bootup and enter BIOS setup to re-enter user preferences.

3. Voltage Regulator Output Selection (VID0):

These jumpers set the voltage supplied to the CPU. The onboard voltage regulators will automatically detect and switch between single power plane and dual power plane CPUs. A CPU is usually referred to by its Vcore voltage.

4. CPU External (Bus) Frequency Selection:

These jumpers tell the clock generator what frequency to send to the CPU. These allow the selection of the CPU's external frequency (or bus block). The bus clock times the bus ratio equals the CPU's internal frequency (the advertise CPU speed).

5. CPU to Bus Frequency Ratio (BF0, BF1):

These jumpers set the frequency ratio between the internal frequency of the CPU and the external frequency (called the bus clock) within the CPU. These must be set together with the jumpers for CPU External (Bus) Frequency Selection

Frequency	Ratio	Bus Frequency
233 MHz	3.5x	66 MHz
200 MHz	3.0x	66 MHz
166 MHz	2.5x	66 MHz
150 MHz	2.5x	60 MHz
133 MHz	2.0x	66 MHz
120 MHz	2.0x	60 MHz
100 MHz	1.5x	66 MHz
90 MHz	1.5x	60 MHz

INSTALLING MEMORY MODULES

Normally, the motherboard supports four 72-pin, 32-bit single inline memory modules (SIMMs) of 4, 8, 16, 32 or 64 MB each, to form a memory size between 8 and 256 MB. SIMMs must be installed in pairs so that each row contains 64 bits of the same size and type of chips. One side of the SIMM module (with chips) takes up half a row on the motherboard.

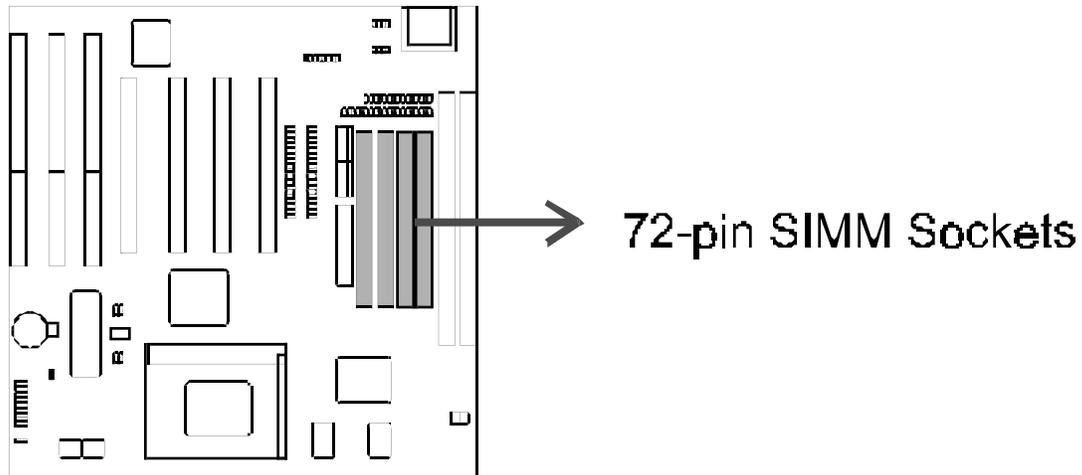
Dual inline memory modules (DIMMs) can be used when SIMMs are not used. Two sockets are available for 3.3-volt power level, unbuffered synchronous DRAMs (SDRAMs) or EDO DRAMs of either 8, 16, 32, 64 or 128 MB each to form a memory size between 8 and 256 MB. One side of the DIMM module (with chips) takes up one row on the motherboard.

Note: Set up memory speed through "Auto Configuration" in the BIOS Chips Setup of the BIOS Software. If both 60ns and 70ns memory are used, set "Auto Configuration" to 70ns. Do not use memory modules with more than 24 chips per module. Modules with more than 24 chips exceed the design specifications of the memory subsystem and will be unstable.

WARNING: Do not install both SIMMs and DIMMs at the same time or you will burn your memory. To mix SIMMs and DIMMs, you must use 5.0-volt-tolerant (signal level) memory chips.

PRACTICAL DETAILS OF SIMM MEMORY INSTALLATION

The SIMM memory modules fits in only one orientation, because of a plastic safety tab on one end of the SIMM sockets which fits the notched end of the SIMM memory modules.

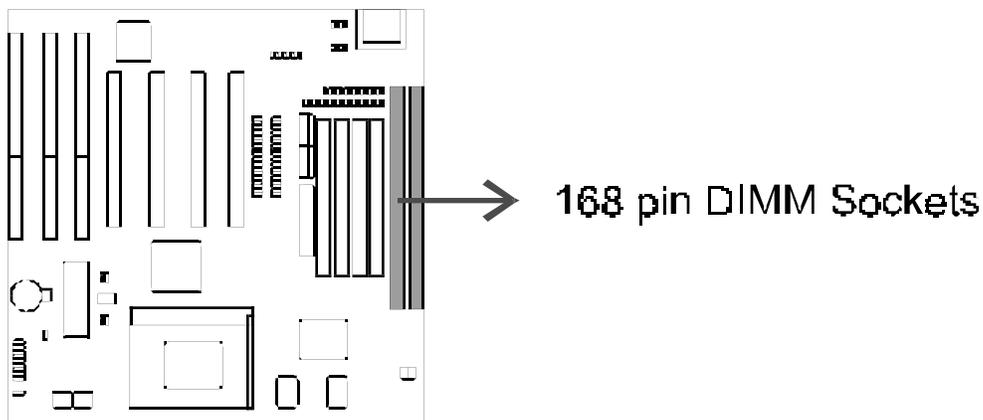


1. Press the memory module firmly into place starting from a 45-degree angle and making sure that all the contacts are aligned with the socket.
2. With your fingertips, rock the memory module into a vertical position so that it clicks into place. The plastic guides go through the two mounting holes on one side, and the metal clips snap on the other side.

To release the memory module, squeeze both metal clips outward and rock the module out of the metal clips.

DIMM MEMORY INSTALLATION

Use 3.3-volt unbuffered DIMMs, and insert the modules as shown. The modules will fit in only one orientation as shown because different numbers of pins are located between notches. The notches in the DIMM modules identify the type and also prevent the wrong type of DIMM from being inserted into the DIMM socket.



Various clock signals are supported on motherboards. Check the specification of clock speed / access time before purchasing memory modules.

INSTALL THE PROCESSOR

The motherboard provides a ZIF Socket 7 or ZIF Socket 5. The processor that came with the motherboard should have a fan attached to it to prevent overheating. If this is not the case, then purchase and install a fan before you turn on your system.

To install a processor, first turn off your system and remove its cover. Locate the ZIF socket and open it by first pulling the lever sideways away from the socket then upward to a 90-degree right angle. Insert the CPU with the correct orientation as shown. Use the notched corner of the CPU with the white dot as your guide. The white dot should point toward the end of the lever. The CPU will fit in only one orientation. Once the processor is completely inserted, close the socket's lever.

INSTALLATION OF EXPANSION CARDS

First unplug your power supply before adding or removing expansion cards or other system components, otherwise severe damage to both your motherboard and expansion cards may occur.

EXPANSION CARDS INSTALLATION PROCEDURE

1. Read the documentation for your expansion card, if necessary, set any necessary jumpers on your expansion card.
2. Remove your computer system's cover.
3. Remove the bracket on the slot you intend to use.
4. Align carefully the card's connectors and press firmly.
5. Secure the card on the slot with the screw you removed from bracket in step 3.
6. Replace back the computer system's cover.
7. Setup the BIOS if necessary (such as "IRQ xx Used by ISA: Yes" in PCI Setup")
8. Install the necessary software drivers for your expansion card.

ASSIGNING IRQS FOR EXPANSION CARDS

Some expansion cards use an IRQ (Interrupt Request) to operate. Generally an IRQ must be exclusively assigned to one use. In a standard design, 16 IRQs are available, but most of them are already in use, leaving 6 free for expansion cards.

TROUBLESHOOTING IRQ RELATED PROBLEMS

Both ISA and PCI expansion cards may require IRQs. System IRQs are available to cards installed in the ISA expansion bus first, then any remaining IRQs are available to PCI cards. Two types of ISA cards currently exist: the original (legacy) cards, and Plug and Play (PnP) cards.

Legacy (older version) ISA card designs require you to configure the cards's jumpers manually and then install the card in any available slot on the ISA bus. Microsoft's Diagnostic utility (MSD.EXE, located in the \windows directory) can display map of available and used IRQs.

In Windows 95, the Device Manager (accessed from the System selection on the Control Panel) can display the IRQ number being used by that device. Ensure that no two devices use the same IRQ, or your computer will experience problems when those two devices are in use at the same time.

PnP CONFIGURATION

Plug and Play (PnP) allows automatic system configuration whenever a PnP-compliant card is added to the system. For PnP cards, IRQs are assigned automatically from those available.

If the system has both legacy and PnP ISA cards installed, IRQs are assigned to PnP cards from those not used by legacy cards.

An IRQ number is automatically assigned to PCI expansion cards after those used by legacy and PnP ISA cards.

ASSIGNING DMA CHANNELS FOR ISA CARDS

Some ISA cards (both legacy and PnP) might also require a direct memory access (DMA) channel. DMA assignments for the motherboard are handled the same way as the IRQ assignment process. Select a DMA channel in PCI and PnP configuration section of the BIOS Setup utility.

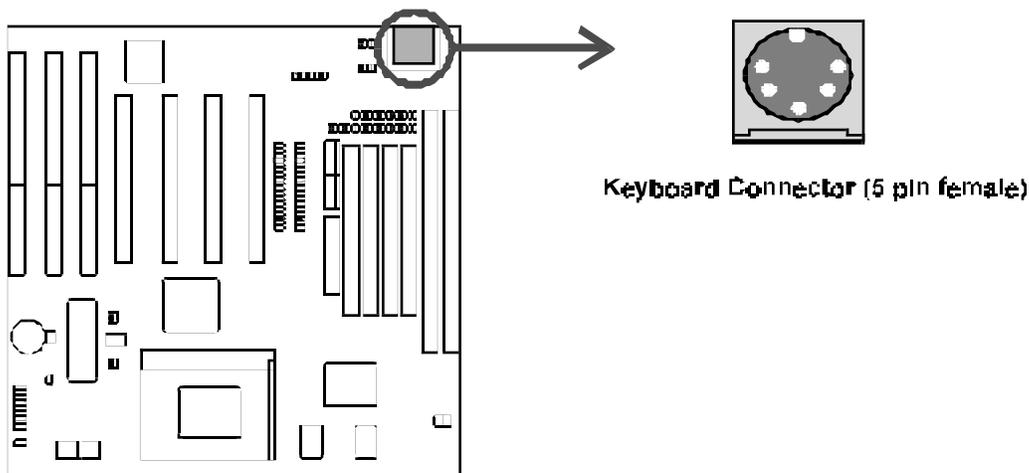
Important Note: To avoid conflicts, reserve the necessary IRQs and DMAs for legacy (old) ISA cards. (In the PnP and PCI setup section of the BIOS software, select “Yes” in “IRQxx Used by ISA” and “DMAx used by ISA” for those IRQs and DMAs you wish to give.)

Connect cables, wires and power supply

Connect ribbon cables so that the red stripe is on the Pin 1 side of the connector. The four corners of the connectors are labeled on the motherboard. Pin 1 is the side closest to the power connector on hard drives and floppy drives. IDE ribbon cable must be less than 18 in. (46cm) long, with the second drive connector no more than 6 in. (15cm) from the first connector.

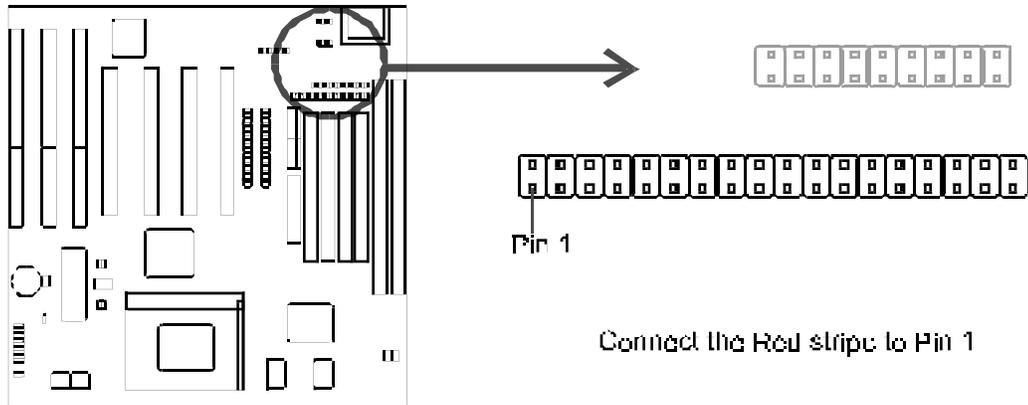
1. Keyboard Connector (5-pin female)

This connector supports a standard IBM-compatible (or “101 enhanced”) keyboard.



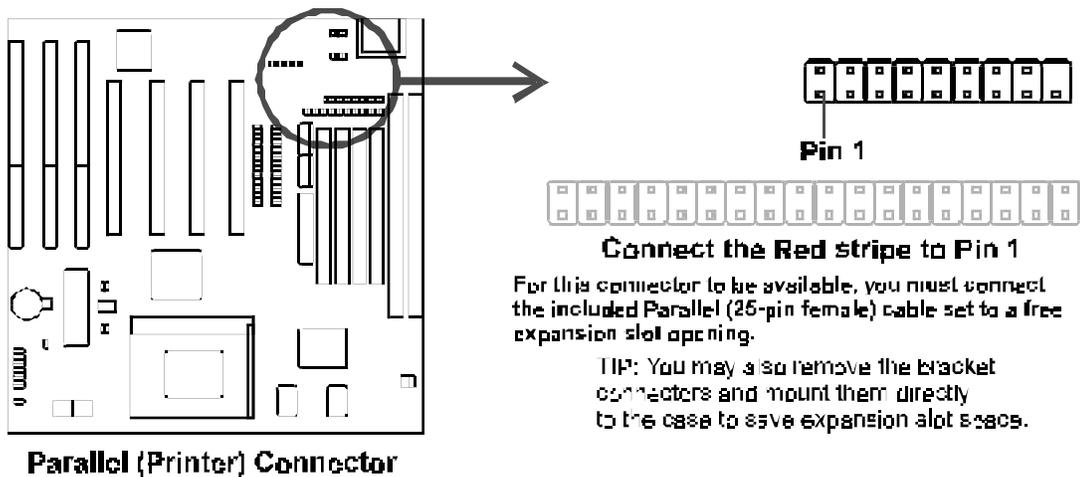
2. Floppy drive connector (34-pin block)

This connector supports the standard floppy drive ribbon cable. After connecting the single end to the board, connect the two plugs on the other end to the floppy drives. (Pin 5 is removed to prevent inserting the cable in the wrong orientation when using ribbon cables with pin 5 plugged).



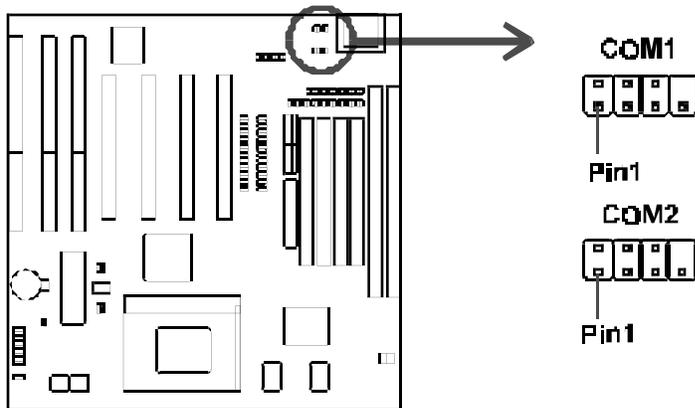
3. Parallel Printer Connector (26-pin block)

This connector supports the parallel port ribbon cable and mounting bracket. Connect the ribbon cable to this connection, and mount the bracket to the computer case on an open slot. Enable the parallel port and choose the IRQ through Onboard Parallel Port in Chipset Features of the BIOS software.



4. Serial Port COM1 and COM2 Connectors (two 10-pin blocks)

These connectors support the provided serial port ribbon cables and mounting bracket. Connect the ribbon cables to these connectors, and mount the bracket to the case on an open slot. Enable the serial port and choose the IRQ through Onboard Serial Port in Chipset Features of the BIOS software.



Onboard Serial Port Connectors

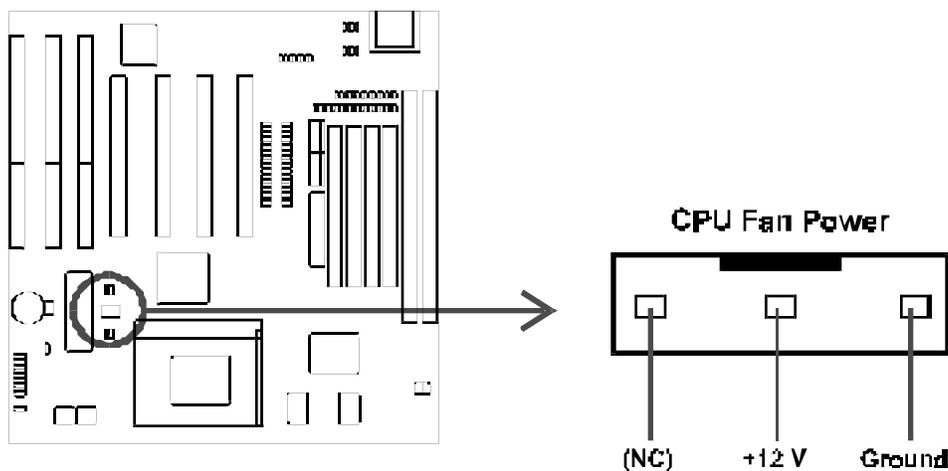
For these connectors to be available, you must connect the included serial cable set from COM1 (using the 9-pin male) & COM2 (using the 25-pin male) to a free expansion slot opening.

TIP: You may also remove the bracket connectors and mount them directly to the case to save expansion slot space.

5. CPU Cooling Fan Connector (FAN)

This connector supports a three-pin CPU cooling fan of 500 mA (6 watts) or less with a minimum of 3,500 RPM. Depending on the fan manufacturer, the wiring and plug may be different. The red wire should be positive and the black wire should be ground.

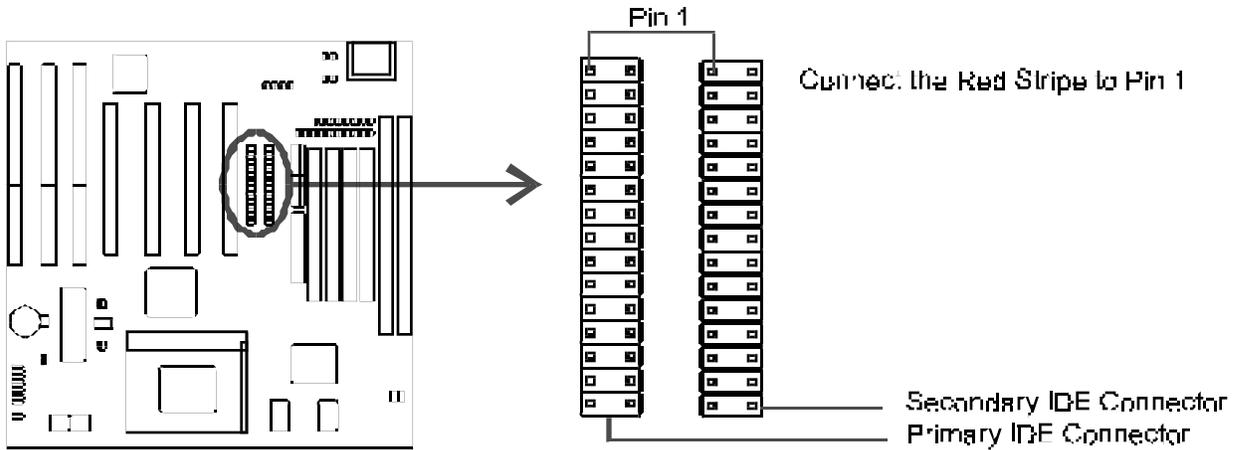
WARNING: Using these pins incorrectly can damage the motherboard and the CPU fan. These are not jumpers. Do not place jumper caps over these pins.



6. Primary / Secondary IDE connectors (two 40-pin blocks)

These connectors support the provided IDE hard disk ribbon cable. Connect the single end to the board, then connect the two plugs at the other end to your hard disk(s). If you install two hard disks, you must set the second drive to Slave mode. BIOS now supports SCSI device or IDE CD-ROM bootup (see "HDD Sequence SCSI/IDE First" and "Boot Sequence" in the BIOS Features Setup of the BIOS Software). (Pin 20 is removed to prevent inserting in the wrong orientation when using ribbon cables with pin 20 plugged).

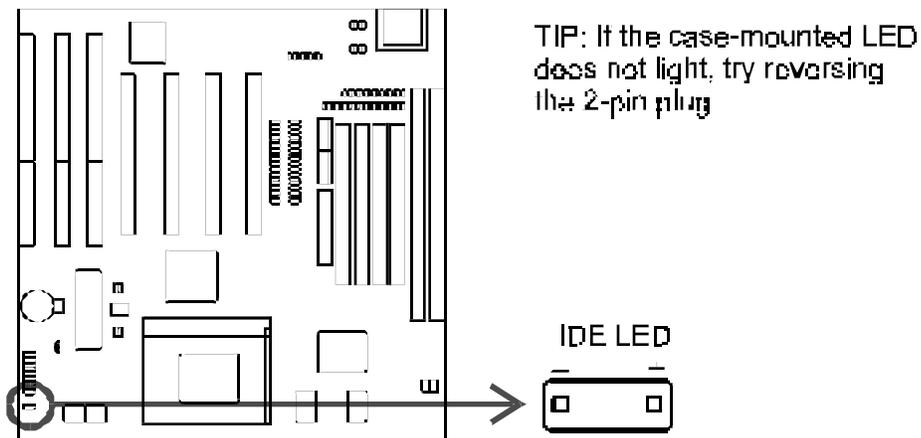
TIP: You can configure two hard disks to be both Masters using one ribbon cable on the primary IDE connector and another ribbon cable on the secondary IDE connector. You can install one operating system on an IDE drive and another on a SCSI drive, then select the boot disk through BIOS Features Setup.



IDE (Hard drive) Connectors

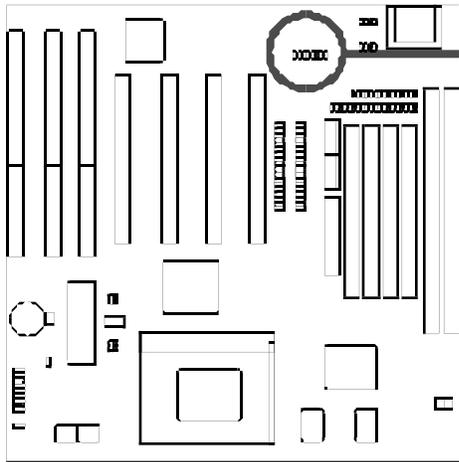
7. IDE activity LED (IDE LED)

This connector supplies power to the cabinet's IDE activity LED. Read and write activity by devices connected to the Primary or Secondary IDE connectors will cause the LED to light up.

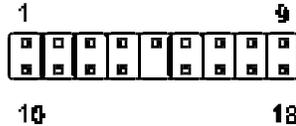


8. USB, PS/2 Mouse (18-pin block)

The external connector set connects to the 18 pin block and mount to an open slot on your computer's chassis. The system will direct IRQ12 to the PS/2 mouse if one is detected. If not detected, expansion cards can use IRQ12. See "PS/2 Mouse Control" in BIOS Features Setup and "USB Function" in PnP and PCI Setup of the BIOS SOFTWARE.



USB, PS/2 Mouse Connector



- | | |
|----------------------|----------------------|
| 1 : USB +5 V | USB +5V : 10 |
| 2 : USB Port 0 - | USB Port 1- : 11 |
| 3 : USB Port 0 + | USB Port 1 + : 12 |
| 4 : Ground | Ground : 13 |
| 5 : (no connection) | (no connection) : 14 |
| 6 : PS/2 Mouse clock | PS/2 Mouse Data : 15 |
| 7 : Ground | Ground : 16 |
| 8 : Reserved | Reserved : 17 |
| 9 : Reserved | Reserved : 18 |

9. Message LED Lead (MSG LED)

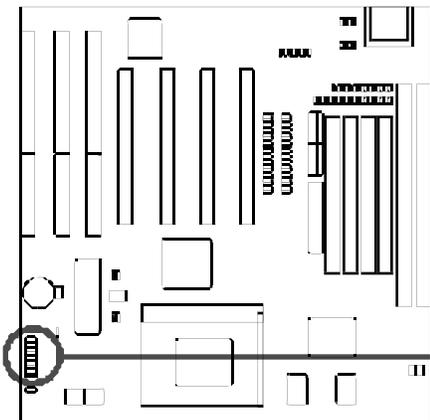
This indicates whether a message has been received from a fax/modem. The LED will remain lit when there is no signal and blink when there is data transfer or waiting in the inbox.

10. Keyboard Lock Switch Lead & System Power LED (KEYLOCK / PWR LED)

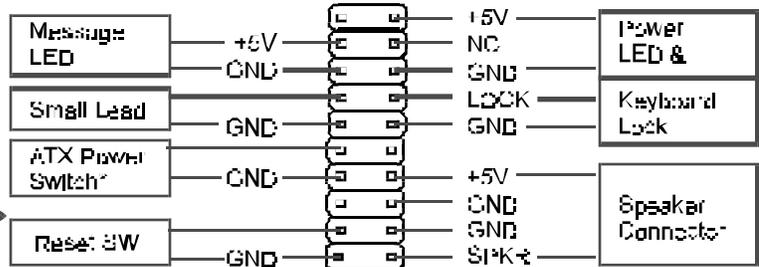
This 5-pin connector connects to the case-mounted keyboard lock switch for locking the keyboard and also to connect the system power LED. The system power LED lights when the system is powered on and blinks in sleep mode.

11. Speaker Connector (SPEAKER)

This 4-pin connector connects to the case-mounted speaker.



System Panel Connectors

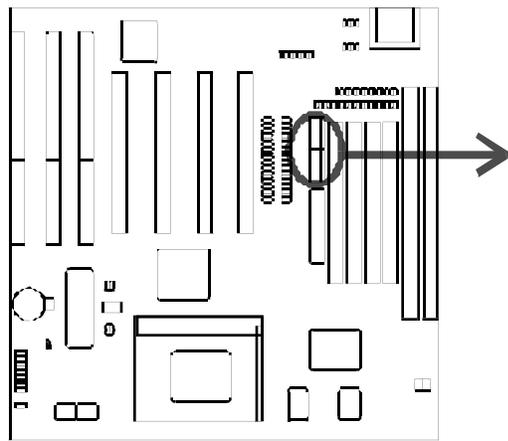


* Required with an ATX power supply

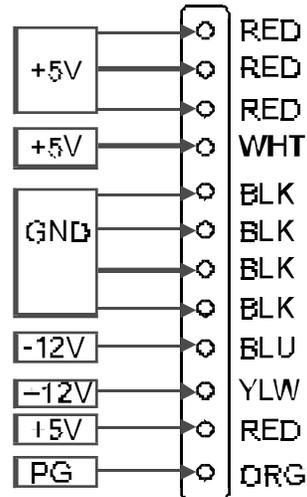
12. AT Power Connector (12-Pin block)

This connector connects to a standard 5 volt SMPS. To connect the leads from the power supply, ensure first that the power supply is not plugged. Most power supplies provide two

plugs (P8 and P9), each containing six wires, two of which are black. Orient the connectors so that the black wires are together.



AT Power Connector



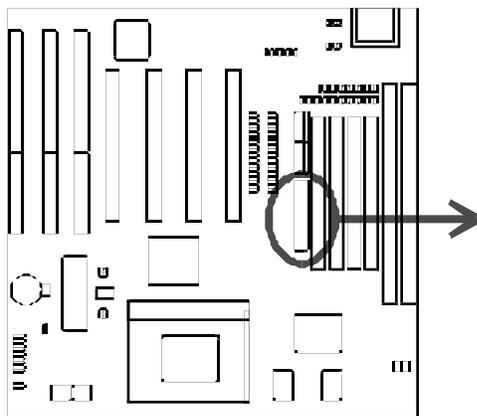
Power Connector on Motherboard

Using a slight angle, align the plastic guide pins on the lead to their receptacles on the connector. Once aligned, press the lead onto the connector until the lead locks into place.

13. ATX Power Supply Connector (20-pin block)

This connector connects to an ATX SMPS. The plug from the power supply will only insert in one orientation because of the different hole sizes. Find the proper orientation and push down firmly making sure that the pins are aligned.

IMPORTANT: Make sure that the ATX power supply can take at least 10mAmp load on the 5 Volt standby lead (5VSB). You may experience difficulty in powering on your system without this.



ATX Power Connector



POWER CONNECTION PROCEDURES

1. After all jumpers and connections are made, close the system case cover.
2. Make sure that all switches are in the off position as marked by O.
3. Connect the power supply cord into the power supply located on the back of your

- system case according to your system user's manual.
4. Connect the power cord into a power outlet that is equipped with a surge protector.
 5. You may then turn on your devices in the following order:
 6.
 - a. Monitor
 - b. System power. For ATX power supplies, you need to switch on the power supply as well as press the ATX power switch on the front of the case.
 7. During power-on, hold down the <Delete> key to enter BIOS setup.

Powering Off your computer: You must first exit or shut down your operating system before switching off the power switch. For ATX power supplies, you can press the ATX power switch after exiting or shutting down your operating system. If you use Windows 95, you can click **Shut Down** on the **Start** menu and then click **Shut down the computer?** on the Shut down Windows dialog box. The system will then give three quick beeps after about 30 seconds and power off after windows shut down. NOTE: The message **It's now safe to turn off your computer** will not be shown in Windows 95 when shutting down with ATX power supplies.

ASSIMILATION EXERCISE

1. How to install a motherboard?
2. How to install memory modules and upgrade memory?
3. How to install a processor?
4. How to assign IRQs for expansion cards?
5. How to assign DMA channel for ISA cards?
6. How to connect various cables?
7. What are the features of BIOS?

TROUBLESHOOTING AND MAINTENANCE

COMPETENCY OBJECTIVES

The objective of this Chapter is to make the students understand various types of maintenance to be done. At the end of this section, a student should be able to :-

- ❖ Do preventive maintenance for a system.
- ❖ Perform preventive maintenance for a printer.
- ❖ Perform breakdown maintenance for a system.
- ❖ Perform breakdown maintenance for a monitor and printer.

CHAPTER - 9**TROUBLESHOOTING & MAINTENANCE****8.0 TYPES OF MAINTENANCE**

Maintenance is the essential part of a Computer. The PC is a machine with electrical & electronic circuits as well as electromechanical assemblies. For reliable operation and long life, the PC should be carefully handled. The computer should be operated gently without applying force.

There are two types of Maintenance :

- a) Preventive Maintenance
- b) Breakdown Maintenance

8.0 a) Preventive Maintenance

The computer room must be kept clean and dust free. Preventive maintenance are the steps to be taken to avoid major breakdown or to run the computer smoothly. The Preventive maintenance are prescribed by manufacturer should be done periodically. One of the essential preventive maintenance is cleaning the dust prone parts.

A PC can be saved from most of the problem by proper maintenance. The general problem sources are

- 1) Dust
- 2) High temperature
- 3) Electrical noise / interface
- 4) Magnetic fields
- 5) Corrosion
- 6) Power fluctuation
- 7) Improper Handling

Drive head cleaning disk can do the floppy disk Preventive Maintenance

- 1) Turn Computer Power ON
- 2) Dampen the cleaning disk with solvent supplied.
- 3) Insert the dampened cleaning disk in the drive.
- 4) Close the drive door.
- 5) If in BASIC, reset the system. With the cleaning disk inside the drive, disk will simply spin, cleaning as it whirs along.
- 6) After 20 or 30 seconds, open drive door & remove disk.
- 7) Turn OFF the computer.
- 8) Let the drive read/write head dry thoroughly before operating the computer.

PREVENTIVE MAINTENANCE FOR PRINTER

You should clean the dust from all the Parts. Firstly remove all the easily accessible Parts. Use Vacuum Cleaner to remove dust. The moving head carriage should be provided with some oiling.

8.0.2 Breakdown Maintenance

When the PC user complains that his PC is not working, then maintenance engineer or service engineer has to attend the fault, remove the fault. This is called Breakdown Maintenance.

8.1 DISSAMBLY OF PC PROCEDURE

1. Turn OFF Power Supply.
2. Unplug the Power Cord and any Peripheral from rear of the Computer.
3. Position the system unit so the rear is facing you.
4. Using flat head screwdriver removes screws from rear plate.
5. Position the system unit so that front is facing you.
6. Place your hands on either side of cover & slide the cover off of main unit pulling towards you.
7. Remove all the peripheral cards from motherboard.
8. Remove the power connector from motherboard.
9. Remove the speaker cable from motherboard.
10. Remove the motherboard mounting screw.
11. Unscrew the Power Supply unit, Hard disk drive, Floppy disk drive, keyboard.
12. Remove it from the box.

8.2 IBM PC START UP PROBLEM

Four type of error indication can occur during the initialization or start up process; beep indication, system error code, I/O error code display; and other display problems. There are number of error codes generated. They are listed below :

8.2.1 Beep Indicators

BEEPS	MALFUNCTION
No beep	Power, Power supply.
Continuous Beep	Power Supply
Repeating short beeps	Motherboard
1 Long beep, 2 Short Beep	Display Circuit
1 Short beep, blank	Display

8.2.2 I/O Error codes

CODE	PROBLEM
199	Printer adapter Card or Printer malfunction.
432	Printer adapter Card or Printer malfunction.
7xx	System unit I/O malfunction.
9xx	System unit I/O malfunction.
901	Printer itself bad
11xx	System Unit malfunction.
12xx	System Unit malfunction.

CODE	PROBLEM
13xx	Game Control adapter card
18xx	Cable malfunction
1819, 1820	Expansion unit malfunction
20xx	System unit or communication adapter cable malfunction.

Such like this indication help in isolating a failure to a module.

Many things can cause the computer to boot improperly or not to boot at all: wrong diskette in no operating system on diskette, cable loose, adapter card not fully seated, in disk drive failure, memory chip bad, no clock pulses, or even forgotten unplugged Power Cord.

Problem 1	:	Won't Boot, No fan, Screen Blank.
Symptom Described	:	When the ON/OFF switch is to the ON Position, nothing happens. No fan sound can be heard.
Preliminary Check	:	1) Check that external Power Cable is plugged into the system unit and into Wall socket. 2) Check the fuse in Power Supply is good. 3) Check the Power Supply cables to ensure that they are properly seated.

Classical approach : 1) Remove all peripherals including disk drive adapter card. Power up & note if fan energizes. If it does turn off the system & plug each peripheral one at each time to see if any adapter card is doing malfunction.

When failure occurs, the last card plugged is bad. Check for shorts between Power and ground on failed board. If the fan does not turn on, after all peripherals are removed. Check the voltages at Power Connectors. If proper Power is present on the cable pins, turn OFF machine & replug into Motherboard. Turn on Power, check pins +5 Volts. If logic is high, check for short on the motherboard between power and ground.

Problem 2 : Won't boot, Fan works, Screen Blank.

Symptom described : No cursor, no screen display, no keyboard response, but can hear fan running in P.S.

Preliminary Check :
 1. Check cables for proper mating.
 2. Clean all edges connectors on adapter card.
 3. Visually inspect motherboard.

Classical approach : Remove all peripherals except keyboard, monitor with adapter card. Power up. Does system boot to ROM BASICS ?

If it does, turn machine off, and reinstall one adapter card at a time, testing after each installation. When the system fails, to boot to ROM BASIC with all Peripheral Card except keyboard and monitor adapter Card installed.

8.3 IBM PC Run Problems

Problem : Can't Read from One Drive
Symptom Described : An error display occurs or drive spins continuously trying to load data from disk into system Board.

Preliminary check :
 1. Check cables for continuity and Proper Connection.
 2. Try another good known good Program disk.
 3. Shift the bad drive to Position A

4. Check for disk spinning action during read sequence.
5. With system turned off, move drive head towards centre of disk, turn the system on and note it head moves to track 00.
6. Conduct the following adjustment
 - A. Speed adjustment
 - B. Radial head alignment
 - C. Track 00 adjustment
 - D. Azimuth check
7. Clean the drive Read/Write heads.
8. Check jumpers analog card

TABLE 8.4

PRINTER TROUBLE-SHOOTING

NO.	FAULT SYMPTOM	TROUBLE SOURCES	SUGGESTED ACTIONS
1.	Printer does not work; dead printer	<ol style="list-style-type: none"> 1. AC input voltage improper 2. Power supply fuse blown 3. Bad transformer 4. Power supply circuit problem 	<ol style="list-style-type: none"> 1. Check AC voltage 2. Check the fuse and replace 3. Check the resistance of primary and secondary for open and short and replace the transformer if faulty 4. Check the the components and replace
2.	Carriage does not move after power-on	<ol style="list-style-type: none"> 1. Contact problem in the cable connections between the printer electronic and printer mechanism 2. Missing or wrong voltages in the printer electronics 3. Abnormal AC voltage 	<ol style="list-style-type: none"> 1. Check the connectors and cable for loose contact, short and open connections 2. Check dc voltages in the printer electronics with a multimeter 3. Check ac voltage with a digital multimeter

4. Fault in printer electronics	4. Check the printer electronics board and trace the fault
5. Paper end switch defective	5. Check the switch
6. Carriage motor defective	6. Check resistances of carriage motor coils
7. Paper end sensor defective	7. Replace paper end sensor

TABLE 8.4
PRINTER TROUBLE-SHOOTING CONTD,..

NO.	FAULT SYMPTOM	TROUBLE SOURCES	SUGGESTED ACTIONS
3.	Carriage moves to the right	Printer mechanism	Check the printer mechanism
4.	Does not print during self-test	1. Loose connections in the print head cable 2. Loose Connection in the connector/cable between the printer electronics and printer mechanism 3. Problem in printer electronics	1. Check the print head cable 2. Check the connectors and cables 3. Debug printer electronics
5.	Missing dots during printing	1. Broken dot wire 2. Head coil open	1. Replace print head 2. Check resistance of head coil and replace print head

3. Tip of the dot wire is worn out	3. Replace print head
4. Dust around the head cable connector	4. Clean
5. Loose connections in the head cable	5. Check and connect firmly
6. Fault in printer electronics	6. Troubleshoot the printer electronics

**TABLE 8.4
PRINTER TROUBLE-SHOOTING CONTD,..**

NO.	FAULT SYMPTOM	TROUBLE SOURCES	SUGGESTED ACTIONS
6.	Non-uniform printing density and very dim colour	1. Misadjustment of the platen gap 2. Tip of the dot wire (pin) is worn out 3. Print head coil open	1. Check and adjust the gap between the platen and tip of the dot wire. 2. Replace the print head 3. Check the resistance of coil and replace print head
7.	No paper feed or non-uniform pitch or abnormal paper feed	1. Defective sprocket unit 2. Improper driving of the gear by the paper feed	1. Check the positioning of the sprocket wheel and adjust properly 2. (a) Check for broken sprocket gears and replace (b) Check for worn out sprocket gears and replace (c) Check paper feed transmission gear, platen gear, sprocket gear and sprocket transmission gear

10.	End of paper is not sensed and printing continues without paper	1. Defective paper end sensor sensor assembly	1. Verify the smooth movement of PE sensor lever and replace the PE
		2. Defective microswitch in PE sensor assembly	2. During insertion and removal of paper, verify the ON/OFF operation of the microswitch with a meter.
11.	Does not print on line	1. Signal cable to PC faulty	1. Check the signal cable and replace
		2. Interface logic in the printer electronics faulty	2. Diagnose the fault

TABLE 8.4 PRINTER TROUBLE-SHOOTING CONTD,..

NO.	FAULT SYMPTOM	TROUBLE SOURCES	SUGGESTED ACTIONS
		3. Contact problem in the signal cable connector	3. Check and rectify the contact problem
		4. System problem; fault in Print controller, CPU or software	4. Check the printer controller
12.	In power off condition, it is not possible to move the carriage to the left and the right.	1. Fault in printer electronics	1. Diagnose the fault
		2. Fault in carriage motor and replace the carriage motor.	2. Check the resistances of carriage motor coils
13.	Control panel switches (FF,LF,	1. Defective switches	1. Check the switches with multimeter and replace if faulty

ONLINE, etc) malfunction	2. Defective electronics	2. Diagnose the fault
14. No clear symptoms	1. Option switch setting wrong	1. Check and correct the option switch setting
	2. Power supply fluctuations	2. Check ac voltage variation and check stabilizer

Cautions

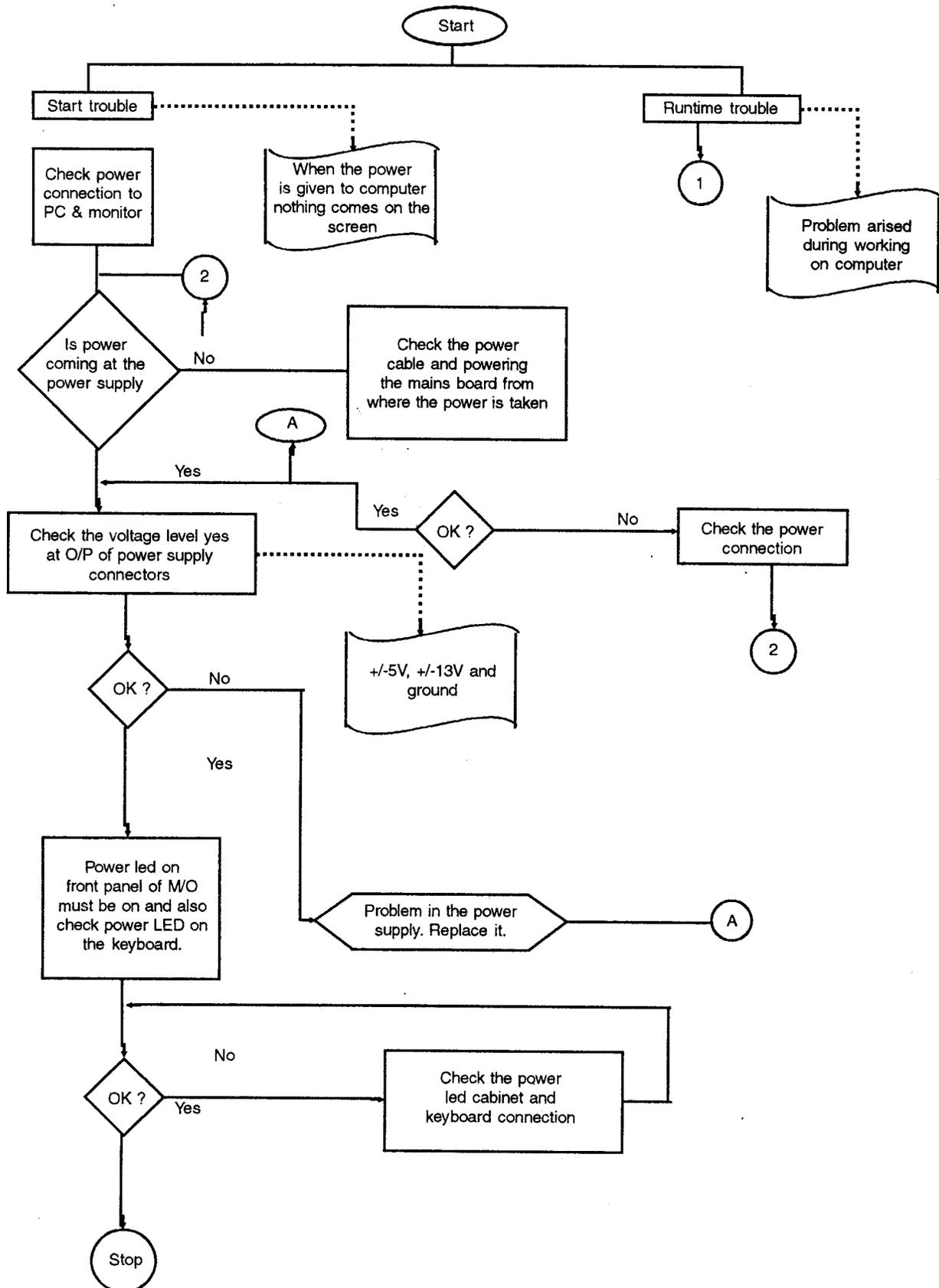
1. Do not touch the print head when the printer is powered-on or immediately after switching-off the printer. A hot printer head will burn your fingers.
2. Do not move the carriage assembly when the print head is not mounted on the carriage.

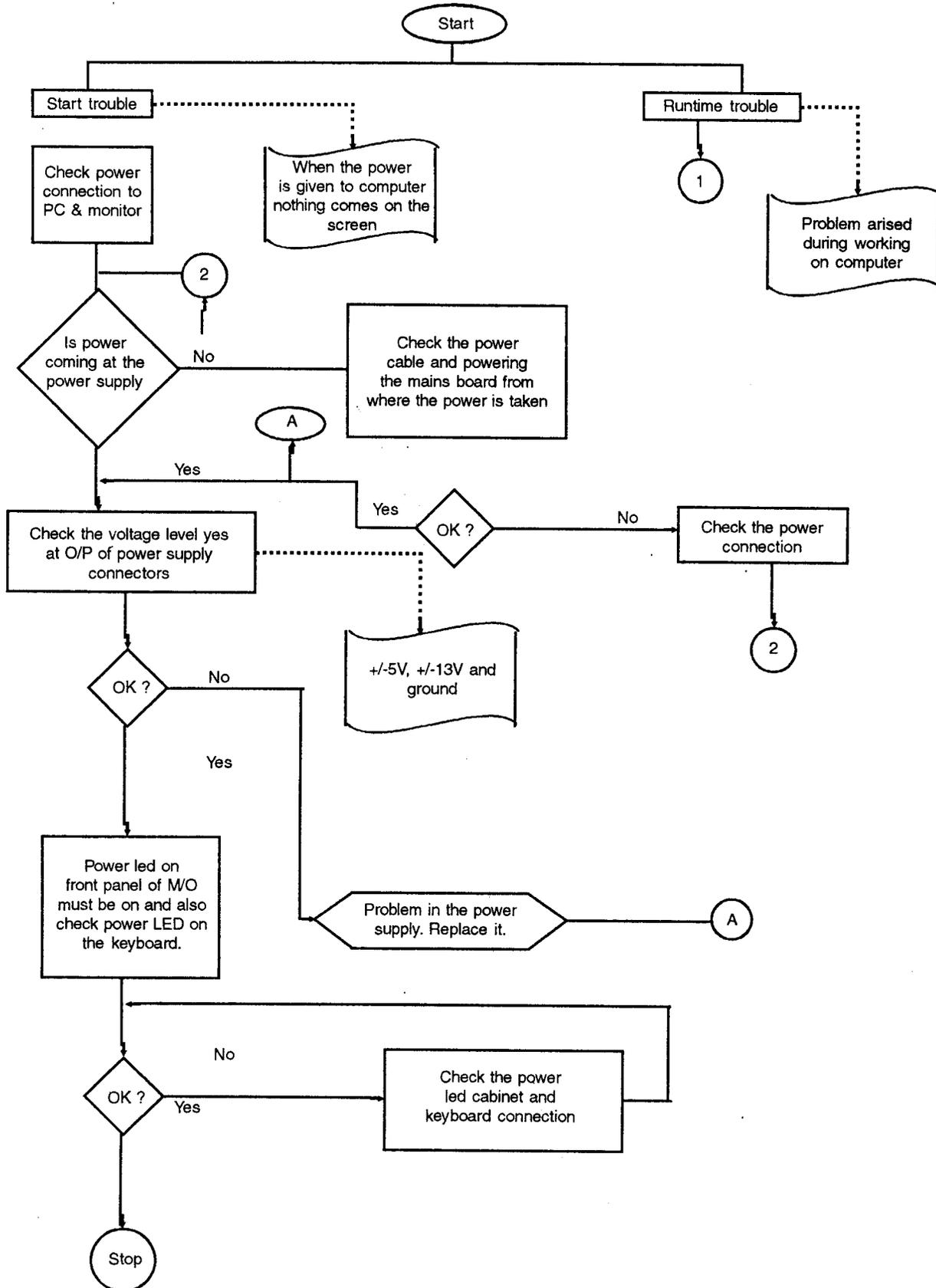
TABLE 8.5 TROUBLE-SHOOTING CRT MONITOR CONTD,..

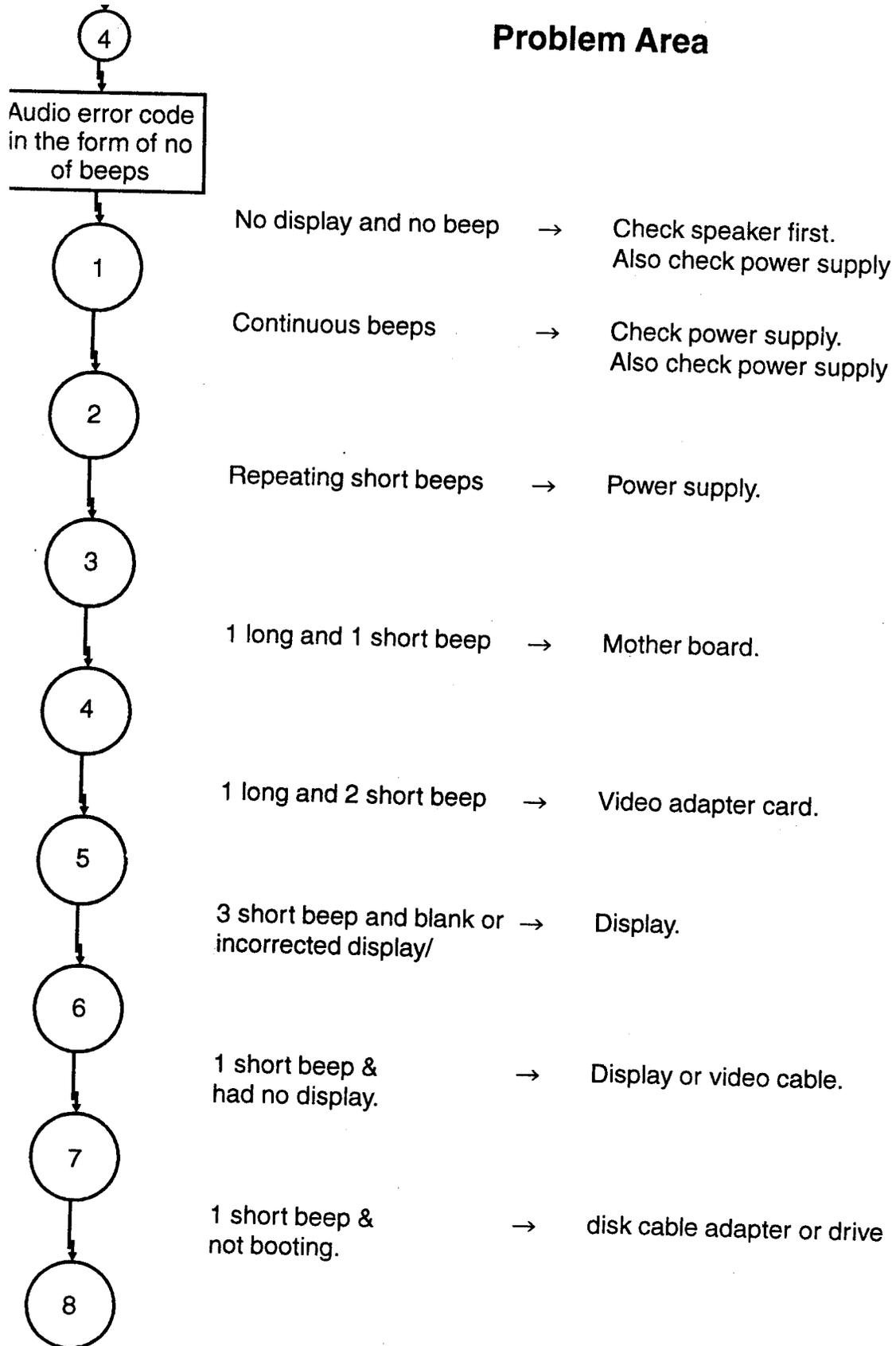
NO.	FAULT SYMPTOMS	TROUBLE SOURCES	SUGGESTED ACTIONS
1.	The display on the screen raster is not centered respect to CRT face	Misadjustment of (deflection yoke) centering (magnetic rings)	Rotate and adjust slowly the magnetic rings so as to position centre
2.	Display (Raster) is not stable; slight shaking	1. Power supply has excess ripples 2. Electro magnetic interference	1. Check with oscilloscope whether ripple is less than 10 mV peak to peak 2. Identify any source near the monitor causing alternating magnetic field.
3.	Raster present but no video	1. Video cable contact problem 2. VSYNC not received at IC input 3. HSYNC not received at IC	1. Check and insert video cable properly 2. Check the relevant capacitor 3. Check the relevant components near the IC
4.	No video but sync is present	1. +5V not present	1. Check Zener diode

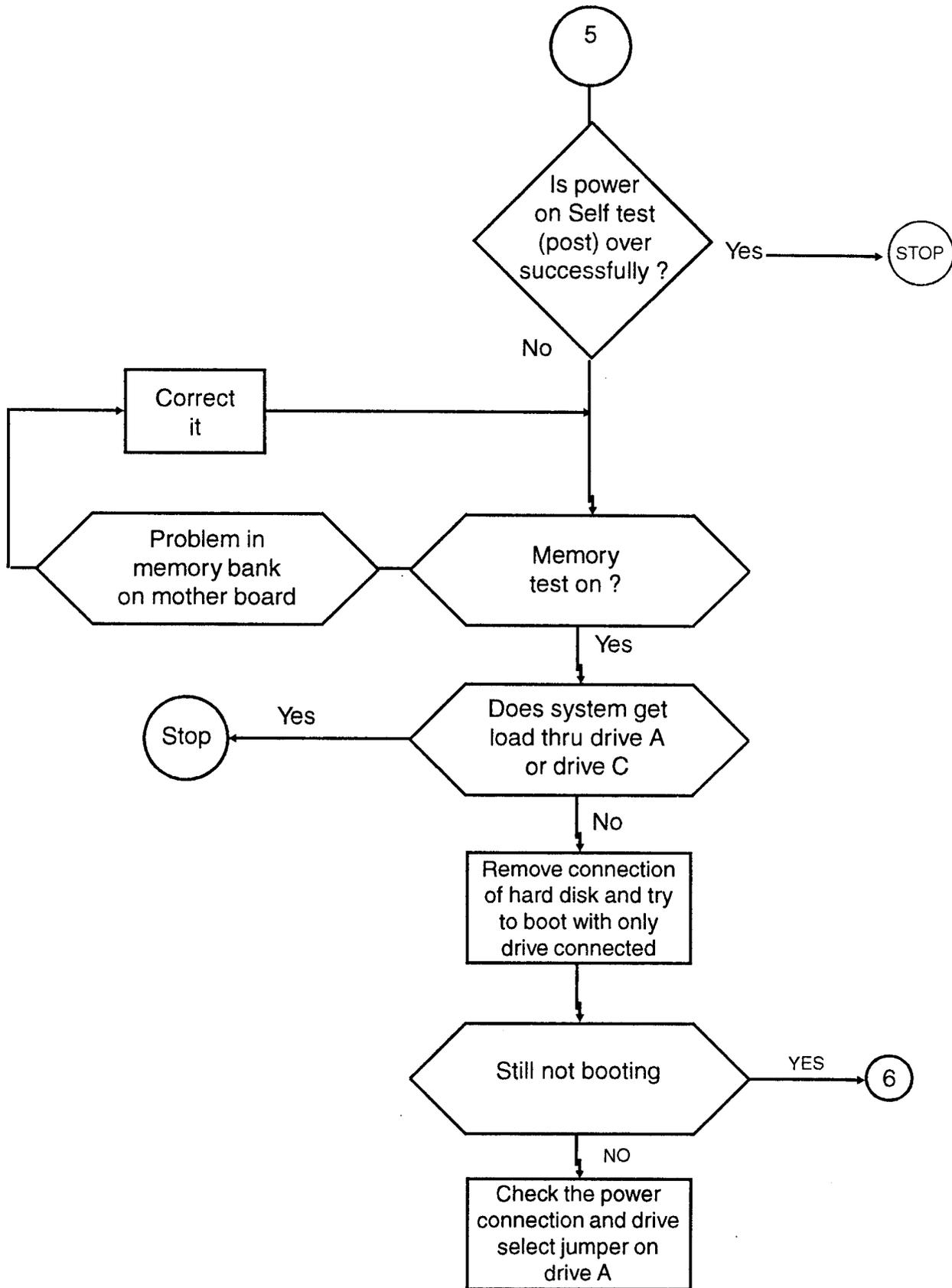
		2. Defective transistor in video amplifier section	2. Check the transistors and replace
5.	Display rolls in the vertical direction	Misadjustment of vertical hold control	Adjust the vertical hold control preset
6.	Display roll in the horizontal direction	Misadjustment of horizontal hold control	Adjust the horizontal hold control present
7.	“Fold over” in the beginning or in the end of scan line	Misadjustment of phase preset	Adjust the phase preset
8.	Poor contrast driven	Video under driven	Adjust the video drive Preset
9.	Overlapping of dots resulting in horizontal line	Video under driven	Adjust the video drive preset
10.	Defocussing of dots	Focus voltage improper	Adjust the focus preset
11.	Horizontal non-linearity from left to right in a given row	Misadjustment of linearity coil	Adjust the horizontal linearity coil
12.	Vertical non-linearity in character size from top to bottom along a column	Misadjustment of vertical linearity preset	Adjust the vertical linearity preset
13.	Vertical black bar	Unstable voltage at control grid	Check the voltage and the relevant capacitor

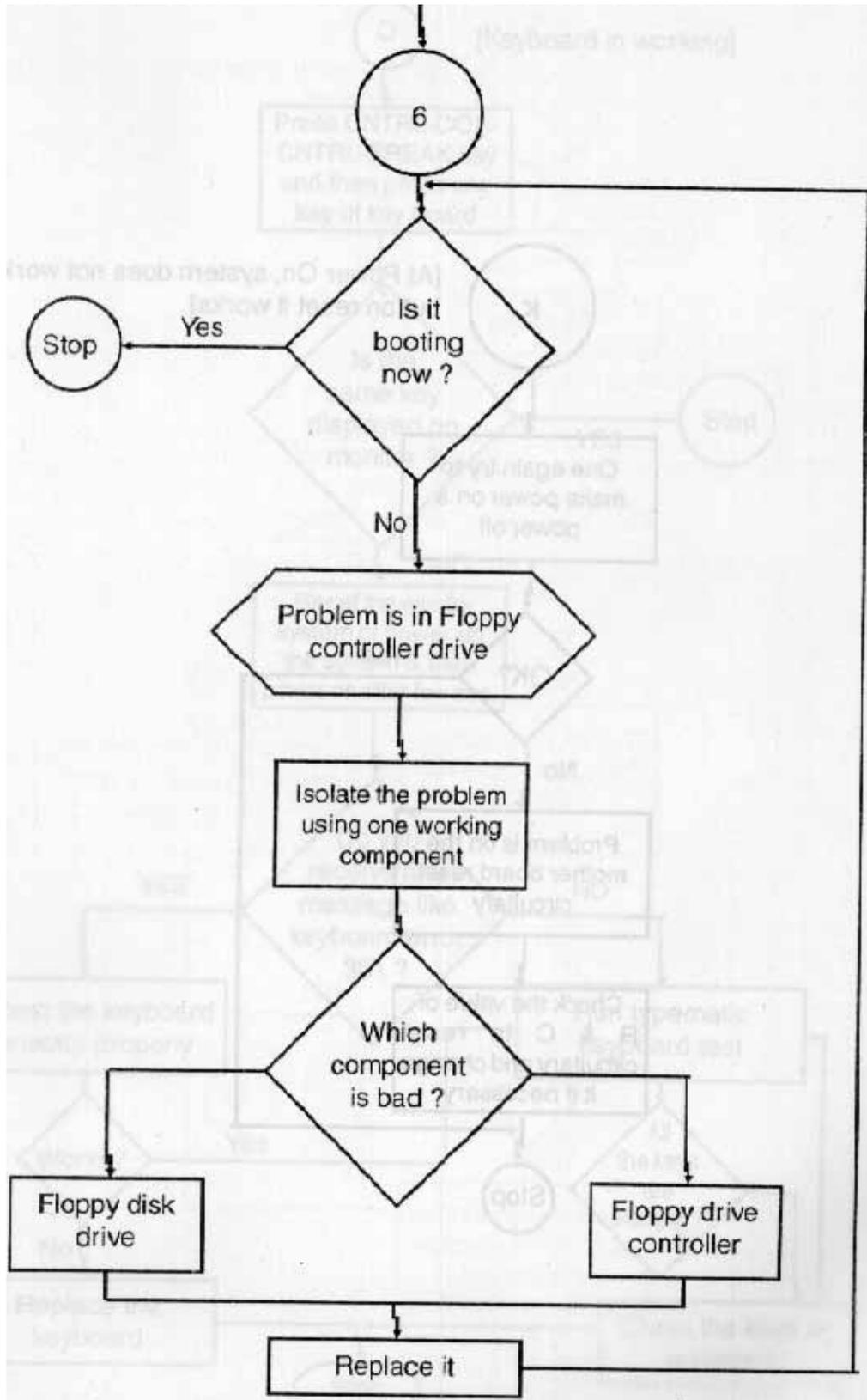
14.	Display height abnormal	Misadjustment of vertical height	Adjust the vertical height preset
15.	Display corners are not proper	Misadjustment of corner magnets	Adjust corner magnets
16.	Display suddenly vanishes and appears	1. Poor soldering in video circuit 2. Loose contact in CRT socket	1. Inspect the video circuit soldering and solder the poor points 2. Check the CRT socket
17.	Raster appears after long delay (more than 20s)	CRT deterioration	Change picture tube
18.	Noisy display problem	Grounding Wire	1. Check contact problem in grounding wire 2. Check video grounding 3. Check power supply ground
19.	Fine noise on the screen	1. Contact problem in connectors 2. Leakage in high voltage portion	1. Check connectors 2. Check high voltage portion
20.	Inclined display	Misadjustment of deflection yoke	Adjust the deflection yoke by turning
21.	Small raster size and abnormal brightness of picture	Abnormal high voltage	Check for high voltage
22.	Spot seen when powering OFF	Aging of CRT and confirm	Replace tube

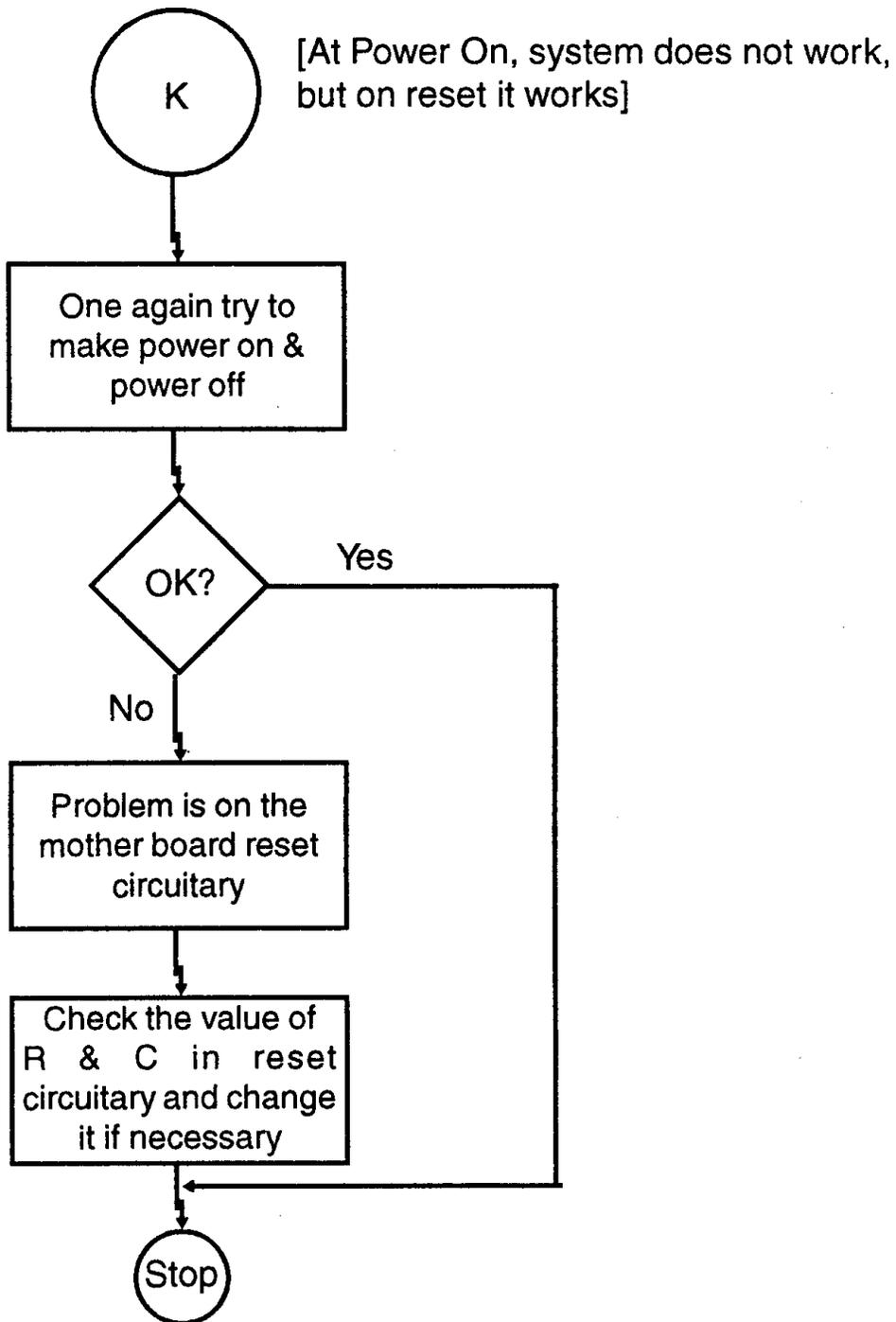


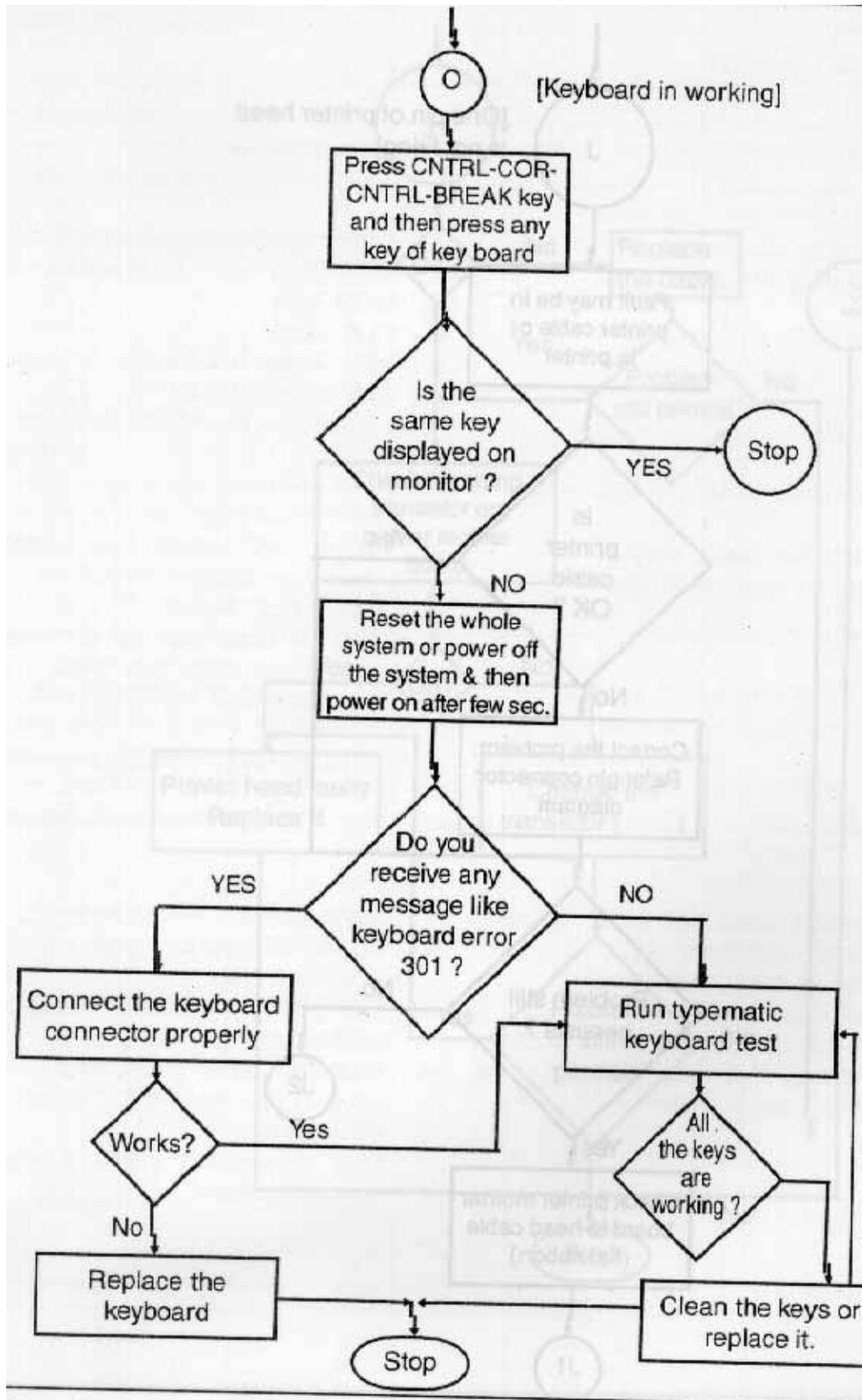


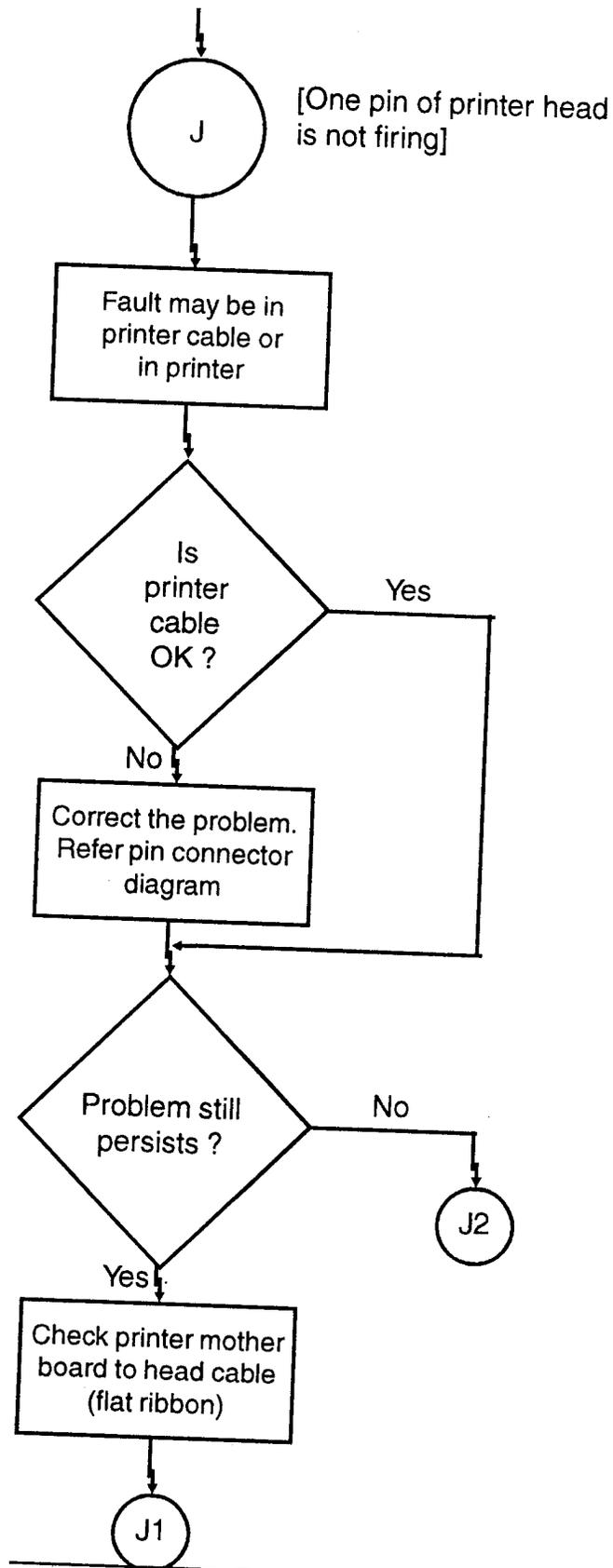


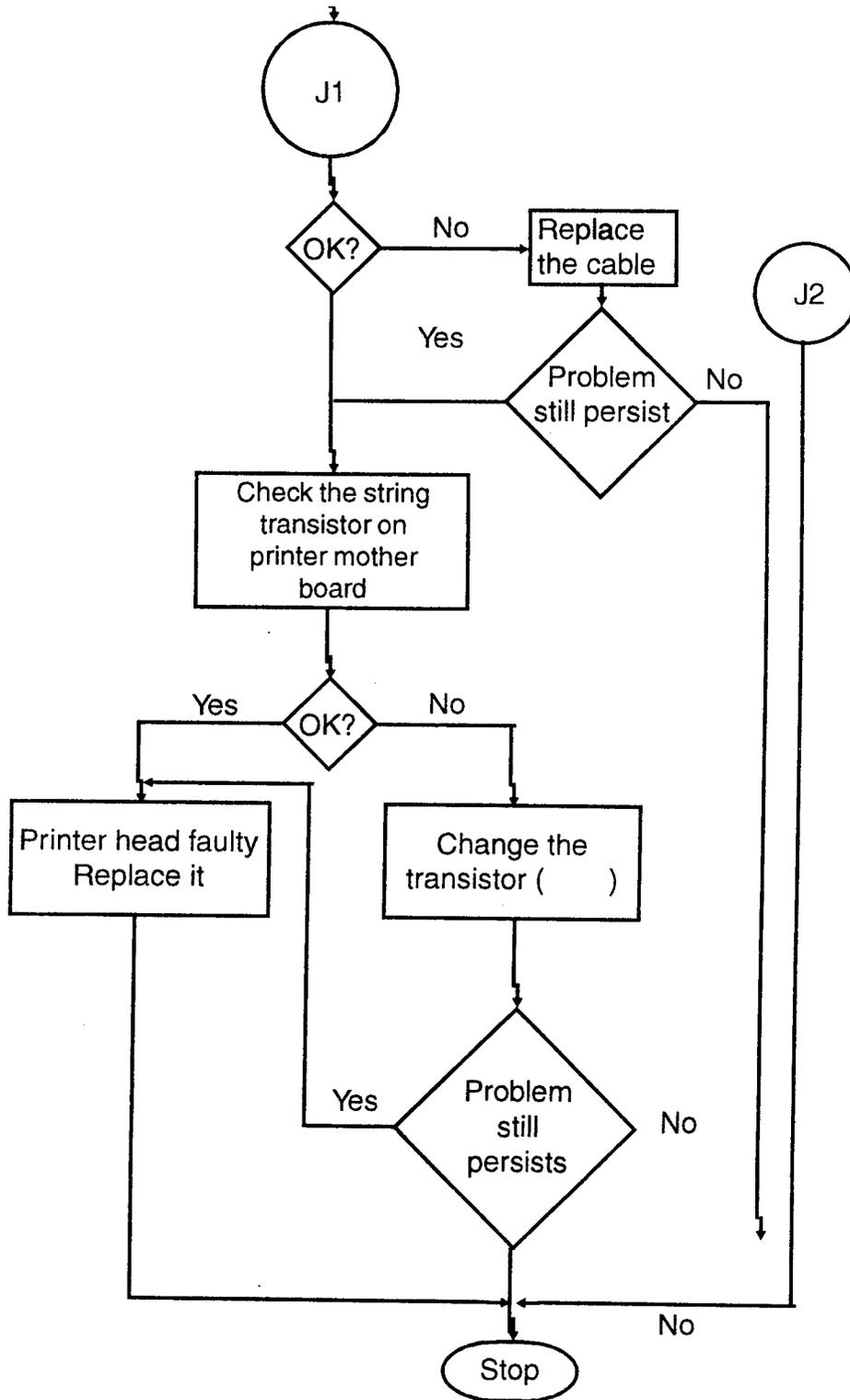












<p>5. No Display, no booting Speaker click, keyboard indicator flash are present but video display and FDD indicator inactive. Sometimes, there may be grotesque display on video screen.</p>	<ol style="list-style-type: none"> 1. Mother Board problem 2. Excessive ripple or noisy power supply 3. CGA/VGA Card problem. 4. FDD controller card problem. 5. Wrong CMOS Setup in PC-AT 6. Wrong DIP switch setting in PC-XT
<p>6. No display but successful booting</p>	<ol style="list-style-type: none"> 1. Mother Board Problem 2. Video Card Problem (e.g. CG ROM fault) 3. Video monitor fuse blown or otherwise faulty 4. Video monitor cable loose connection or broken. There may be problem with connectors.
<p>7. Mouse not working. All other functions of the PC are all right</p>	<ol style="list-style-type: none"> 1. COM 1/2 Serial port may be faulty 2. Mouse driver program got corrupted. 3. Internal Mouse circuit may be faulty. 4. Cable of the Mouse may be faulty.
<p>8. No booting from hard disk; booting from FDD O.K.</p>	<ol style="list-style-type: none"> 1. Wrong or corrupted CMOS setup 2. Boot tracks corrupted 3. Virus infection 4. Bad hard drive. 5. IDE card failure.
<p>9. Very slow disk booting and performance</p>	<ol style="list-style-type: none"> 1. Incorrect CONGIF.SYS Setup 2. Files may be fragmented. 3. Disk controller hardware fault.

ASSIMILATION EXERCISE

- Q.1 Draw complete flow chart for troubleshooting the problem given below.
If Keyboard of your system is not responding at all or wrong characters are produced.
Discuss the analysis in detail.
- Q.2 Where are the common faults write down.
- No display & no speaker beeps.
 - Abnormal Character display.
 - Bad Colour.
- Q.3 Write down step by step procedure to trouble shoot the following problem.
- Printer does not work.
 - Dead System, No Display, No Booting.
 - System hangs during Booting.
 - When we type c:\ > to a:\ then following message is displayed on Screen "INT-24" failure.
 - "Disk Boot Failure"
- Q.4 In CMOS Setup, there is LBA or Normal mode for Hard Disk. What is LBA and NORMAL mode ?
- Q.5 After completing POST where the system is transferred ?