A

Data Sheet

Computer: IBM Personal Computer

Manufacturer: IBM Corporation Armonk, New York

Size: 19.6" x 16.1" x 5.5"

Weight: 20.9 lb. without disk drive installed

Power Required: 63.5 watts (maximum)
110/220 volts

CPU: 8088 Microprocessor

Data Word Size: 8 bits

CPU Clock Speed: 4.77 MHz

Memory Size: 40K ROM
16K-bytes on system board
1 Mbyte directly addressable memory

Mass Storage Capability: Two disk drives internally
Two disk drives externally
160K bytes–single density
320K bytes–double density

Keyboard Size: 83 keys
256 character codes

Display: 25 lines of 40 characters, 16 colors
25 lines of 80 characters, 16 colors

Graphics Capability: 100 rows of 160 picture elements (pixels), 16 colors
200 rows of 320 pixels, 4 colors
200 rows of 640 pixels, black and white
32 special graphics characters

Input/Output: Five 62-pin expansion slots
Auxiliary power connection
Cassette connector
Detachable keyboard
$2^1/_4$ inch speaker

Standard Software: Cassette BASIC

Optional Software: PC-DOS
MS-DOS
Cassette BASIC
Advanced BASIC

B

Chip Listing

IBM PC SYSTEM BOARD CHIP LISTING

Label	Integrated Circuit	Description
U1	MC1741	General purpose operational amplifier
U2	8259	Programmable interrupt controller
U3	8088	Microprocessor
U4	8087	Numeric data processor
U5	74LS30	8-input NAND gate
U6	8288	Bus controller
U7	74LS373	Octal transparent latch
U8	74LS245	Tristate octal transceiver
U9	74LS373	Octal transparent latch
U10	74LS373	Octal transparent latch
U11	8284	Clock generator
U12	74LS245	Tristate octal transceiver
U13	74LS245	Tristate octal transceiver
U14	74LS245	Tristate octal transceiver
U15	74LS244	Tristate octal buffer
U16	74LS244	Tristate octal buffer
U17	74LS244	Tristate octal buffer
U18	74LS373	Octal transpartent latch
U19	74LS670	Tristate 4 x 4 register file
U20	RN1	4.7K ohm DIP resistor network
U21	SW1	DIP switch
U22	RN2	2K ohm DIP resistor network
U23	74LS244	Tristate octal buffer
U24	74LS322	8-bit serial/parallel-in register with sign extend
U25	SW2	DIP switch
U26	74LS175	Quad D flip-flop
U27	74LS02	Quad 2-input NOR gate
U28	empty	Spare ROM socket
U29	9264 ROM	8K x 8-bit static ROM
U30	9264 ROM	8K x 8-bit static ROM
U31	9264 ROM	8K x 8-bit static ROM
U32	9264 ROM	8K x 8-bit static ROM
U33	9264 ROM	8K x 8-bit static ROM
U34	8253	Programmable interval timer
U35	8237	DMA controller
U36	8255	Programmable peripheral interface
U37	4164 RAM	64K x 1-bit dynamic RAM
U38	4164 RAM	64K x 1-bit dynamic RAM
U39	4164 RAM	64K x 1-bit dynamic RAM
U40	4164 RAM	64K x 1-bit dynamic RAM
U41	4164 RAM	64K x 1-bit dynamic RAM
U42	4164 RAM	64K x 1-bit dynamic RAM
U43	4164 RAM	64K x 1-bit dynamic RAM
U44	4164 RAM	64K x 1-bit dynamic RAM
U45	4164 RAM	64K x 1-bit dynamic RAM
U46	74LS138	1/8 decoder/demultiplexer
U47	74LS138	1/8 decoder/demultiplexer
U48	74LS138	1/8 decoder/demultiplexer
U49	74LS08	Quad 2-input AND gate
U50	74LS02	Quad 2-input NOR gate
U51	74LS04	Hex inverter
U52	74LS00	Quad 2-input NAND gate
U53	4164 RAM	64K x 1-bit dynamic RAM
U54	4164 RAM	64K x 1-bit dynamic RAM

Label	Integrated Circuit	Description
U55	4164 RAM	64K x 1-bit dynamic RAM
U56	4164 RAM	64K x 1-bit dynamic RAM
U57	4164 RAM	64K x 1-bit dynamic RAM
U58	4164 RAM	64K x 1-bit dynamic RAM
U59	4164 RAM	64K x 1-bit dynamic RAM
U60	4164 RAM	64K x 1-bit dynamic RAM
U61	4164 RAM	64K x 1-bit dynamic RAM
U62	74LS158	Quad 2-input data selector/ multiplexer
U63	74LS38	Quad 2-input NAND buffer
U64	74LS20	Dual 4-input NAND gate
U65	74LS138	1/8 decoder/demultiplexer
U66	74LS138	1/8 decoder/demultiplexer
U67	74LS74	Dual D flip-flop
U68	RN3	4.7K ohm DIP resistor network
U69	4164 RAM	64K x 1-bit dynamic RAM
U70	4164 RAM	64K x 1-bit dynamic RAM
U71	4164 RAM	64K x 1-bit dynamic RAM
U72	4164 RAM	64K x 1-bit dynamic RAM
U73	4164 RAM	64K x 1-bit dynamic RAM
U74	4164 RAM	64K x 1-bit dynamic RAM
U75	4164 RAM	64K x 1-bit dynamic RAM
U76	4164 RAM	64K x 1-bit dynamic RAM
U77	4164 RAM	64K x 1-bit dynamic RAM
U78	RN4	30 ohm DIP resistor network
U79	74LS158	Quad 2-input data selector/ multiplexer
U80	74LS125	Quad tristate buffer
U81	74S00	Quad 2-input NAND gate
U82	74S74	Dual D flip-flop
U83	74LS04	Hex inverter
U84	74LS10	Triple 3-input NAND gate
U85	4164 RAM	64K x 1-bit dynamic RAM
U86	4164 RAM	64K x 1-bit dynamic RAM
U87	4164 RAM	64K x 1-bit dynamic RAM
U88	4164 RAM	64K x 1-bit dynamic RAM
U89	4164 RAM	64K x 1-bit dynamic RAM
U90	4164 RAM	64K x 1-bit dynamic RAM
U91	4164 RAM	64K x 1-bit dynamic RAM
U92	4164 RAM	64K x 1-bit dynamic RAM
U93	4164 RAM	64K x 1-bit dynamic RAM
U94	74LS04	Hex inverter
U95	75477	Relay driver
U96	74LS74	Dual D flip-flop
U97	74S08	Quad 2-input AND gate
U98	74LS175	Quad D flip-flop
U99	74LS04	Hex inverter

Other Components

Location	Device	Description
D1	Type FC	Silicon diode
X1	Crystal	14.31818 MHz crystal oscillator

MONOCHROME MONITOR/ PRINTER ADAPTER CHIP LISTING

Label	Integrated Circuit	Description
U1	74LS74	Dual D edge-triggered flip-flop
U2	74LS04N	Hex inverter
U3	74LS08	Quad 2-input AND gate
U4	74LS74	Dual D edge-triggered flip-flop
U6	74LS10	Triple 3-input NAND gate
U7	74LS139	1-of-8 decoder/demultiplexer
U8-U15	2114	1K x 4-bit RAM
U16-U18	74LS157	Quad 2-to-1 multiplexer
U19	74LS244	3-state octal buffer
U20,21	74LS374	3-state octal D flip-flop
U22	74LS244	3-state octal buffer
U23	74LS245	3-state octal bus transceiver
U24	74LS153	Dual 4-to-1 multiplexer
U25	74LS00	Quad 2-input NAND gate
U26	74S11	Triple 3-input AND gate
U27	74LS02	Quad 2-input NOR gate
U28	74LS393	Dual binary ripple counter
U29	74LS175	Quad D type flip-flop with reset
U30	74LS273	Octal D-type flip-flop with reset
U31	74LS273	Octal D-type flip-flop with reset
U32	74LS166	8-bit parallel-in-serial-out shift register
U33	MK36906	8k character generator ROM
U34	74LS273	Octal D-type flip-flop with reset
U35	MC6845	CRT Controller
U36	74LS125	Quad 3-state buffer
U37	74LS240	Octal 3-state inverter buffer
U38	7405	Open collector hex inverter
U39	74LS174	Hex D flip-flop with reset
U40	74LS244	Octal buffer (3-state)
U41	74LS347	Octal D flip-flop (3-state)
U42	74LS139	Dual 1-of-4 decoder/demulti-plexer
U43	74S32	Quad 2-input OR gate
U44	74LS04	Hex inverter
U45	74LS74	Dual D edge-triggered flip-flop
U46	74LS08	Quad 2-input AND gate
U47	74LS138	1-of-8 decoder/demultiplexer
U48	74LS138	1-of-8 decoder/demultiplexer
U49	74LS138	1-of-8 decoder/demultiplexer
U50	74LS138	1-of-8 decoder/ demultiplexer
U51	74LS138	1-of-8 decoder/demultiplexer
U52	74LS138	1-of-8 decoder/demultiplexer
U53	74LS00	Quad 2-input NAND gate
U54	74S86	Quad 2-input exclusive OR gate
U55	74LS174	Hex D flip-flop with reset
U56	74LS04	Hex inverter
U57	74LS02	Quad 2-input NOR gate
U58	74LS175	Quad D-type flip-flop with reset
U59	74LS125	Quad 3-state buffer
U60	74LS244	Octal buffer (3-state)
U61	74LS155	Dual 1-of-4 decoder/ demultiplexer

Label	Integrated Circuit	Description
U62	74S20	Dual 4-input NAND gate
U63	74LS157	Quad 2-to-1 multiplexer
U64	74LS244	3-state octal buffer
U100	74LS32	Quad 2-input OR gate
U101	74LS74	Dual D edge-triggered flip-flop

COLOR GRAPHICS ADAPTER CHIP LISTING

Label	Circuit	Description
U1	74S112	Dual J-K negative edge-triggered flip-flop
U2	74LS74	Dual D-type edge-triggered flip-flop
U3	74S86	Quad 2-input exclusive OR gate
U4,U5	74S174	Hex D-type flip-flop with reset
U6	74LS04	Hex inverter
U7,U8	74LS166	8-bit parallel-in-serial-out shift register
U9,U10	74153	Dual 4-to-1 multiplexer
U11	74LS74	Dual D-type edge-triggered flip-flop
U12	74LS393	Dual binary ripple counter
U13	74LS08	Quad 2-input AND gate
U14	74LS32	Quad 2-input OR gate
U15	74LS00	Quad 2-input NAND gate
U16	74LS04	Hex inverter
U17,U18, U19	74LS138	1-of-8 decoder/demultiplexer
U20	74LS04	Hex inverter
U21	74LS174	Hex D flip-flop with reset
U22	74LS51	Dual AND-OR-invert gate
U23	74LS32	Quad 2-input OR gate
U24	74LS244	Octal buffer (3-state)
U25	74LS00	Quad 2-input NAND gate
U26	74S04	Hex inverter
U27	74LS51	Dual 2-wide 2-input AND-OR -inverter gate
U28	74LS10	Triple 3-input NAND gate
U29	74S04	Hex inverter
U30	74LS32	Quad 2-input OR gate
U31	74S08	Quad 2-input AND gate
U32	74LS166	8-bit parallel-in-serial-out shift register
U33	8340 (MK36000)	8k character generator ROM
U34,U35	74LS273	Octal D-type flip-flop with reset
U36	74LS244	Octal buffer (3-state)
U37	74LS374	Octal D-type flip-flop (3-state)
U38	46505 (6845)	CRT controller
U39,U40	74LS174	Hex D-type flip-flop with reset
U41	74LS08	Quad 2-input AND gate
U42	74LS86	Quad 2-input exclusive OR gate
U43	74S74	Dual D edge-triggered flip-flop
U44	74S74	Dual D edge-triggered flip-flop
U45	74LS151	8-to-1 multiplexer
U46	74LS00	Quad 2-input NAND gate
U47,U48, U49	74LS51	Dual 2-wide 2-input AND-OR inverter gate
U50-U57	MK4516N-12 (2118-4)	16K X 1-bit RAM
U58-U61	74LS374	3-state octal D flip-flop
U63	74LS175	Quad D flip-flop with reset
U64	74LS164	8-bit serial-in-parallel-out shift register
U65	74LS02	Quad 2-input NOR gate
U66	74LS245	3-state octal bus transceiver
U67	74LS244	3-state octal buffer
U68	74LS86	Quad 2-input exclusive OR gate
U101	74S174	Hex D flip-flop with reset

C

Line Definitions

Label	Location	Definition
A0-A9	Disk drive	Address line bits 0 through 9
A0-A11	Monochrome	Address line bits 0 through 11
A0-A13	Color adapter	Address line bits 0 through 13
A15-A19	Color adapter Monochrome	Address line bits 15 through 19
A0-A19	System board	Address line bits 0 through 19
ACK	System board Monochrome	Acknowledge
AD0-AD7	System board	Buffered address/data bits 0 through 7
ADSTB	System board	Address strobe
ADDR SEL	System board	Address select
AEN	System board Color adapter Disk drive Monochrome	Address enable
AEN BRD	System board	Address enable board
ALE	System board	Address latch enable
ALPHA DOTS	Monochrome	Alpha dots
AT LATCH	Color adapter	Attribute latch
AT0-AT7	Color adapter Monochrome	Attribute bits 0 through 7
AUTO FD XT	System board Monochrome	Auto feed external lines
B(0),B(7)	Monochrome	Bits 0 and 7
BA0	Color adapter	Buffered address bit 0
BA0-BA3	Monochrome	Buffered address bits 0 through 3
BA8-BA19	System board	Buffered address lines 8 through 19
BACK-GROUND 1	Color adapter	Color background one
BD0-BD7	System board Monochrome	Buffered data lines 0 through 7
BLINK	Monochrome	Blink
BLUE	Color adapter	Color blue
BMEMR	Color adapter	Buffered memory read
BUSY	System board Monochrome	Busy
BW,BW1,BW2	Color adapter	Buffered write lines
B/W VIDEO	Monochrome	Black/white video
CA0-CA11	Color adapter	Column address lines
CACS CCLK	Monochrome	Control address chip select control clock
CAS	System board Color adapter	Column address strobe
CAS0-CAS3	System board	Column address strobe lines 0 through 3
CAS CC	Color adapter	Column address strobe closed circuit
CASS DATA IN	System board	Cassette data in
CC LATC	Color adapter	Closed circuit latch
CC0-CC7	Color adapter	Closed circuit character bits 0 through 7
	Monochrome	Character code lines
CCLK	Color adapter Monochrome	Control clock
CEROM	Monochrome	Chip enable ROM
CGB0	Monochrome	
CLK	System board Color adapter Disk drive Monochrome	Clock

Label	Location	Definition
CLK88	System board	Clock 8088
CLR	Disk drive	Clear
CLR S/R	Color adapter	Clear shift register
CLRVIDEO	Monochrome	Clear video
COLOR SEL	Color adapter	Color select
CPI	Disk drive	Clock pulse
CPU MEM SEL	Color adapter	Central processing unit memory select
CPUMSEL	Monochrome	CPU memory select
CS	Color adapter	Chip select
CS2-CS7	System board	Chip select lines 2 through 7
CURSOR	Color adapter Monochrome	Cursor select
CURSOR BLINK	Monochrome	Cursor blink
CURSOR DLY	Color adapter Monochrome	Cursor delay
CYAN	Color adapter	Color cyan
D0-D7	System board Color adapter Disk drive Monochrome	Data lines 0 through 7
DACK	Disk drive	DMA acknowledge
DACK0-DACK3	System board	DMA acknowledge lines 0 through 3
DACK0 BRD	System board	DMA acknowledge 0 board
DACK 2	Disk drive	DMA acknowledge 2
DACK & TC	Disk drive	DMA acknowledge & terminal count
DATA0-DATA7	Monochrome	Data lines 0-7
DATA GATE	Color adapter	Data gate
DATA IN	Monochrome	Data in
DATA OUT	System board	Data out
DCLK	System board	Data clock
DIR	System board	Direction
DIR (A&B)	System board	Direction (disk drive) A & B
DIR (C&D)	Disk drive	Direction (disk drive) C & D
DISPEN	Disk drive Color adapter	Display enable
DISPEN DLY	Monochrome Color adapter	Display enable delay
DMA	Monochrome Disk drive	Direct memory access
DMA AEN	System board	Direct memory access address enable
DMA CS	System board	Direct memory access chip select
DMA WAIT	System board	Direct memory access wait
DOT CLK	Color adapter Monochrome	Dot clock
DRIVE SELECT (A&B)(C&D)	Disk drive	Drive select (disk drive) A,B,C,D
DRQ0-DRQ3	System board	DMA request 0 through 3
DRQ2	Disk drive	Data request 2
DT/R	System board	Data transmit/receive
E	Color adapter Monochrome	
ENABLE BLINK	Color adapter Monochrome	Enable blink
ENABLE DRIVE (C & D)	Disk drive	Enable drive (disk drive) C, D
EN CPU CAS ADDR	Color adapter	Enable central processing unit column address strobe adder
EN CPU RAS ADDR	Color adapter	Enable central processing unit row address strobe adder
EN CRT CAS ADDR	Color adapter	Enable cathode ray tube column address strobe adder
EN CRT RAS ADDR	Color adapter	Enable cathode ray tube row address strobe adder
EN I/O CK	System board	Enable input/output check
EN I/O CLK	System board	Enable input/output clock
ENB RAM PCK	System board	Enable RAM peripheral check
ERASE	Disk drive	Erase
ERROR	System board Monochrome	Error
F(0),F(1)	Monochrome	
G	System board	Enable
GRPDCD	Monochrome	
GRPH	Color adapter	Graphics
GRPH EN	Color adapter	Graphics enable
H CLK	Color adapter	Horizontal clock
HIGH LIGHT	Monochrome	High light
HIGH RES	Color adapter	High resolution
HM	Disk drive	
HOLDA	System board	Hold access
HORIZ DRIVE	Monochrome	Horizontal drive
HORIZ SYNC	Color adapter	Horizontal synchronization
HORIZ SYNC DLY	Color adapter	Horizontal sync delay
HRES	Monochrome	High resolution
HSYNC	Monochrome	Horizontal synchronization
HSYNC DLY	Monochrome	Horizontal sync delay
I(B),I(F)	Monochrome	Intensity (blink), (full)
INDEX	Disk drive	Index (mark)
INDEX (A&B)	Disk drive	Index (disk drive) A and B
INDEX (C&D)	Disk drive	Index (disk drive) C and D
INIT	System board Disk drive Monochrome	Initialize
INT	System board	Interrupt
INTA	System board	Initialize address
INTR CS	System board	Internal chip select
INT WRT BUSY	Disk drive	Interrupt write busy
I/O CH CK	System board	Input/output channel check
I/O CH CLK	System board	Input/output channel clock
I/O CH RDY	Color adapter Monochrome	Input/output channel ready
IOR	System board Color adapter Disk drive Monochrome	Input/output read
IOW	System board Color adapter Disk drive Monochrome	Input/output write

Label	Location	Definition
IRQ	Disk drive	Interrupt request
IRQ7	Monochrome	Interrupt request 7
IRQ0-IRQ7	System board	Interrupt request lines 0 through 7
IRQEN	Monochrome	Interrupt request enable
IRQ EN	System board	Interrupt request enable
JUMPER	Monochrome	Jumper
LCC5-LCC7	Monochrome	
L CLK	Color adapter	Light clock
L PEN INPUT	Color adapter	Light pen input
L PEN STR	Color adapter	Light pen strobe
L PEN SW	Color adapter	Light pen switch
LOCK	System board	Lock
LVIDEO	Monochrome	Line video
MA0-MA6	Color adapter	Memory address lines 0 through 6
MA0-MA7	System board	Memory address lines 0 through 7
MA0-MA10	Monochrome	Memory address lines 0 through 10
MD0-MD7	System board Color adapter	Memory data lines 0 through 7
MD00-MD11	System board System board	Matrix data lines 00 through 11
MDP		Memory data parity
ME	System board	Memory enable
MEMR	System board Color adapter Monochrome	Memory read
MEMW	System board Color adapter Monochrome	Memory write
MOTOR CNTRL	System board	Motor control
MOTOR ENABLE (A&B)(C&D)	Disk drive	Motor enable (disk drive) A,B,C,D
MOTOR OFF	System board	Motor off
MOTOR ON	Disk drive	Motor on
MR	Disk drive	Memory read
MRQ DMA	System board	Memory request direct memory access
MUX A, MUX B	Color adapter	Multiplexer A, B
NMI	System board	Non-maskable interrupt
NODSPLY	Monochrome	No display
NP INSTL SW	System board	Numeric processor installation switch
NPNPI	System board	Numeric processor numeric processor interrupt
OSC	System board Color adapter	Oscillator
OUT	Disk drive	Output
OVERSCAN B	Color adapter	Overscan blue
OVERSCAN G	Color adapter	Overscan green
OVERSCAN R	Color adapter	Overscan red
OVERSCAN L	Color adapter	Overscan luminance
PB6,PB7	System board	8255 port B bits 6 and 7
PCK	System board	Peripheral check
PCLK	System board	Peripheral clock
PE	System board Monochrome	Paper end
PPICS	System board	
PWR GOOD	System board	Power good
Q1,Q2,Q3,Q4	Color adapter	Accumulator extension lines 1 through 4
Q5	Monochrome	Accumulator extension line 5
QS0,QS1	System board	Q... status bits 0 and 1
RA0-RA2	Color adapter Monochrome	Read address lines 0 through 2
RA0-RA3	System board	Row address lines 0 through 3
RAM ADDR SEL	System board	RAM address select
RAS	Color adapter	Row address strobe
RAS0-RAS3	System board	Row address strobe bits 0 through 3
RD GATE	Color adapter	Read gate
RDGATEAT	Monochrome	Read gate attribute
RDGATECC	Monochrome	Read gate character code
RDY/WAIT	System board	Ready/wait
RDY TO DMA	System board	Ready to direct memory access
READ DATA	Disk drive	Read data
READ DATA (A&B)(C&D)	Disk drive	Read data (disk drive) A,B,C,D
READY	System board	Ready
RED	Color adapter	Red
REFRESH GATE	System board	Refresh gate
REQIN	System board	Request in
REQOUT	System board	Request out
RESET	System board Disk drive Monochrome	Reset
RESET C	Color adapter	Reset control
RESET DRV	System board Color adapter Monochrome	Reset drive
RMA0-RMA9	Monochrome	Read memory address lines
ROMA 11	Monochrome	ROM address line 11
ROM ADDR SEL	System board	ROM address select
RPA	System board	Read printer data
RPB	System board	Read printer control
RPC	System board	Read printer status
RPA-RPC	Monochrome	Read printer data, control, status
RQ/GT	System board	Request/grant
RVV	Monochrome	Reverse video
S0-S2	System board	Status bits 0 through 2
S0	Disk drive	Side zero
S1	Disk drive	Side 1
SA CLOSED	System board	
S DOTS	Monochrome	Serial dots
SEEK	Disk drive	Seek
SELECT0-SELECT2	System board	Select lines 0 through 2

Label	Location	Definition
SELECT HEAD (A&B)(C&D)	Disk drive	Select head (disk drive) A,B,C,D
SEL BLUE	Color adapter	Select color blue
SEL 1	Monochrome	Select line 1
SEL1, SEL2	Color adapter	Select lines 1 and 2
SENSE A-SENSE H	System board	Sense lines A through H
SERDATA	Monochrome	Serial data
SERIAL DATA	System board	Serial data
SERIN	Monochrome	Serial in
S/L	Color adapter Monochrome	Serial/line
SLCT	System board Monochrome	Select
SLCTIN	Monochrome	Select input
SLCT IN	System board	Select input
SP/EN	System board	Slave program/enable buffer
SPKR DATA	System board	Speaker data
STATUS SEL	Color adapter Monochrome	Status select
STEP (A&B)	Disk drive	Step (disk drive) A,B
STEP (C&D)	Disk drive	Step (disk drive) C,D
STR	Color adapter	Strobe
STROBE	System board Monochrome	Strobe
T/C	System board	Terminal count
TC	System board Disk drive	Terminal count
TC CS	System board	TC chip select
TD0-TD7	Color adapter	Transceiver data lines 0 through 7
TIM2 GATE SPK	System board	Timer 2 gate speaker
TIMER/ CNTR2	System board	Timer control 2
TRACK 0	Disk drive	Trace 0
TRACK 0 (A&B)	Disk drive	Track 0 (disk drive) A and B
TRACK 0 (C&D)	Disk drive	Track 0 (disk drive) C and D
UNDERLINE	Monochrome	Underline
VCO SYNC	Disk drive	Voltage controlled oscillator sync
VERT DRIVE	Monochrome	Vertical drive
VERT SYNC	Color adapter	Vertical synchronization
VERT SYNC DLY	Color adapter	Vertical sync delay
VIDEO	Monochrome	Video
VIDEO ENABLE	Color adapter	Video enable
VSYNC	Monochrome	Vertical synchronization
VSYNC DLY	Monochrome	Vertical sync delay
WE	System board Color adapter Monochrome	Write enable
WPA	System board Monochrome	Write printer data
WPC	System board Monochrome	Write printer control
WR DATA (A&B)	Disk drive	Write data (disk drive) A and B
WR DATA (C&D)	Disk drive	Write data (disk drive) C and D
WRITE	Disk drive	Write
WRITE DATA 00	Disk drive	Write data 00
WRITE DATA 01	Disk drive	Write data 01
WRITE GATE (A&B)(C&D)	Disk drive	Write gate (disk drive) A,B,C,D
WRITE PROTECT	Disk drive	Write protect
WRITE PROTECT (A&B)(C&D)	Disk drive	Write protect (disk drive) A,B,C,D
WRT DMA PG REG	System board	Write direct memory access page register
WRT NMI REG	System board	Write non-maskable interrupt register
WRT TRAN	Disk drive	
XA0-XA12	System board	Buffered address lines
XACK	Color adapter Monochrome	Buffered acknowledge
XD0-XD7	System board	Buffered data lines
XIOR	System board Monochrome	Buffered I/O read
XIOW	System board Monochrome	Buffered I/O write
XMEMR	System board Monochrome	Buffered memory read
XMEMW	System board	Buffered memory write
YELLOW BURST	Color adapter	Yellow burst
2 MHz	Disk drive	2 MHz clock frequency
3.58 MHz	Color adapter	3.58 MHz color oscillator frequency
7 MHz	Color adapter	7 MHz oscillator frequency
14 MHz	Color adapter	14 MHz oscillator frequency
16 MHz	Disk drive	16 MHz system clock

D

Disassembly Procedures

SYSTEM UNIT DISASSEMBLY INSTRUCTIONS

These procedures apply to those repairs that require access to the internal subassemblies of the IBM PC system unit.

System Board Access

Tools and Equipment Required

No. 2 flathead screwdriver

Uncluttered workspace

Container to hold screws until reassembly

Procedure for System Board Access

1. Turn the power off.
2. Unplug the power cord and any peripherals from the rear of the computer.
3. Position the system unit so the rear is facing you.
4. Using a flathead screwdriver remove the 5 screws from the rear plate (see Fig. D-1). (The older model IBM PCs have only two screws on the back plate.)

Fig. D-1. Remove these screws to disassemble the IBM PC.

5. Position the system unit so that the front is facing you.
6. Place your hands on either side of the cover and slide the cover off of the main unit pulling towards you as shown in Fig. D-2.

Procedure for Removing System Board

1. Follow steps 1 through 6 in procedure for system board access.

2. Remove all peripheral cards from the system board.

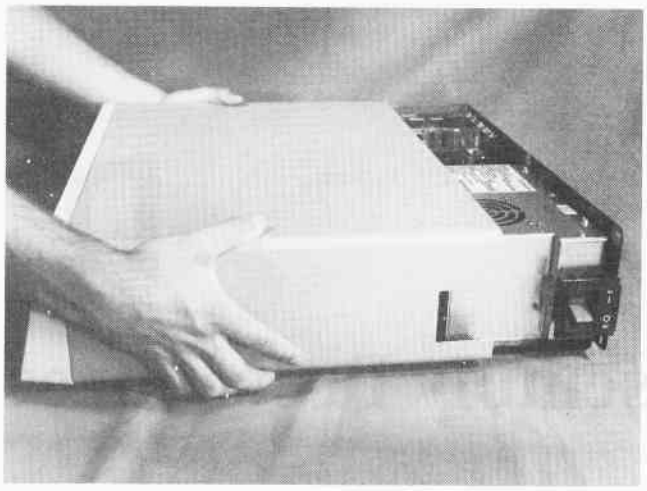

Fig. D-2. Gently slide the system unit cover forward.

3. Remove the power connector from the system board. (This is located in the back right side looking from the front.)
4. Remove the speaker cable from the connector on the lower middle section on the system board.
5. Remove the system board mounting screws as shown in Fig. D-3.
6. Slide the system unit board away from the power supply approximately 2 inches until standoffs can be lifted from their mounting slots.
7. Lift the system board from the system unit.

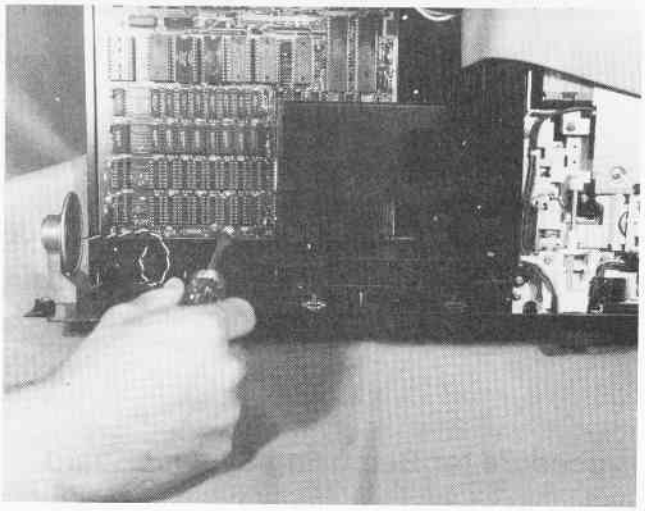

Fig. D-3. Remove the system board mounting screws.

KEYBOARD DISASSEMBLY

This section covers the proper procedures for disassembling the keyboard.

Tools and Equipment Required

Small Phillips-head screwdriver
Uncluttered workspace
Container to hold screws until reassembly

1. Turn the system unit off.
2. Remove the keyboard from the connector in the back of the system unit.
3. Turn the keyboard upside down.
4. Remove the two Phillips-head screws from the bottom of the keyboard plate.
5. Lift the top of the plate up and out of the retaining slots in the chassis of the keyboard.
6. Disconnect the cable from the keyboard assembly.
7. Lift the rear of the keyboard out of the chassis.

POWER SUPPLY REMOVAL

This section describes the steps required to remove the power supply from the chassis.

Tools and Equipment Required

No. 2 flathead screwdriver
Uncluttered workspace
Container to hold screws until reassembly

1. Turn the power off.

2. Unplug the power cord and any peripherals from the rear of the computer.
3. Position the system unit so the rear is facing you.
4. Remove the system unit cover. (See procedure for system board access.)
5. Remove the power connector from the system board. (This is located in the back right side looking from the front.)
6. If you have drives hooked to the system, disconnect the power cables going to the drive analog cards.
7. Remove the four power supply screws on the back of the chassis.
8. Push the power supply forward about $^1/_2$ inch.
9. To remove the supply, lift up and pull the power supply away from the motherboard.

E

Reassembly Procedures

SYSTEM UNIT REASSEMBLY INSTRUCTIONS

Now that the repair is complete, follow these steps to put the system back together.

Tools and Equipment Required

No. 2 flathead screwdriver
Uncluttered workspace
Container to hold screws until reassembly

REINSTALLING SYSTEM BOARD

1. Position all the standoffs hooked to the system board above the mounting holes.
2. Gently push the system board toward the power supply until you can see that the mounting screw holes line up.
3. Reinstall the mounting screws in the system board.
4. Reconnect the signal wires to the speaker.
5. Install the adapter cards.
6. Reconnect the system board power supply connectors.

REASSEMBLING SYSTEM UNIT CASE

1. Gently slide the system unit case forward over the system unit.
2. Reinstall the five flathead screws on the back of the chassis. (The older model IBM PC has only two screws on the back plate.)
3. Reconnect all peripherals and the power cord.

KEYBOARD REASSEMBLY

This section covers the proper procedures for putting the keyboard back together.

Tools and Equipment Required

Small Phillips-head screwdriver
Uncluttered workspace
Container to hold screws until reassembly

1. Position the front of the keyboard assembly into the front of the keyboard chassis.

2. Lower the back of the keyboard down into the chassis.
3. Reconnect the cable to the keyboard assembly.
4. Put the tabs on the front of the base into the slots on the front of the keyboard chassis.
5. Slowly lower the back down–don't forget to include the adjustable legs on the bottom of the keyboard.
6. Install the two Phillips-head screws into the mounting holes on the bottom of the keyboard.
7. Reconnect the cable to the system unit assembly.
8. Power up and test.

POWER SUPPLY INSTALLATION

This section describes the steps needed to reinstall a power supply in the chassis.

Tools and Equipment Required

No. 2 flathead screwdriver

Uncluttered workspace

Container to hold screws until reassembly

1. Hold the power supply unit approximately 1/2 inch from the rear of the chassis, and push the supply toward the motherboard and then back to align the screw holes in the chassis.
2. Replace the four mounting screws for the power supply.
3. Reconnect the disk drive power supply connectors.
4. Reconnect the motherboard power supply connectors.
5. Reconnect the power cord.
6. Power up and test.

> Note: Disk drive disassembly and reassembly instructions are covered in Chapter 3.

F

Replacing Surface Mounted Components

Desoldering and soldering on the IBM PC system board is not easy--the board construction is such that damage to the board traces and solder points can easily occur if you aren't extremely careful.

Caution: Proceed at your own risk.

1. Reread the section on soldering techniques found in Chapter 3.
2. Be sure you're using a temperature-controlled iron.
3. Disassemble the machine and remove the system board.
4. Place the board on its edge and locate the component to be replaced.
5. If possible, during chip removal, attach an extractor tool to the component to be replaced and use a DIP tip on your iron to heat the pins and remove the chip.
6. Or use a vacuum solder "sucker," or braided wick and the temperature controlled iron to heat the pins (start at the corners first, then desolder every other pin to avoid overheating one area of the board trace) until the component comes free.
7. Clean the solder holes using the techniques described in Chapter 3.
8. If a chip was removed, install an IC socket in its place on the system board. This lets you install a replacement chip into an already soldered connection eliminating the need to solder directly to the chip pins themselves.
9. If a transistor is being replaced, install a transistor socket in the system board connection holes.
10. If a resistor, diode, or capacitor is being replaced, solder the leads directly in the opened holes in the board.
11. Reinstall the system board in the computer's housing.
12. Reassemble the computer.
13. Reconnect the power cord.
14. Power up and test.
15. Return the computer to service (or break back down again to replace another possibly faulty component).

Note: If your efforts didn't solve the problem, and you've replaced all the suspected components with good components, you have little recourse—replace the entire system board assembly.

G

ASCII Code Chart

Hexa-decimal	ASCII	Hexa-decimal	ASCII	Hexa-decimal	ASCII	Hexa-decimal	ASCII	Hexa-decimal	ASCII	Hexa-decimal	ASCII
00	^@ (NULL)	15	^U	2B	+	40	@	56	V	6B	k
01	^A	16	^V	2C	,	41	A	57	W	6C	l
02	^B	17	^W	2D	-	42	B	58	X	6D	m
03	^C	18	^X	2E	.	43	C	59	Y	6E	n
04	^D	19	^Y	2F	/	44	D	5A	Z	6F	o
05	^E	1A	^Z	30	0	45	E	5B	[	70	p
06	^F	1B	^[(ESCAPE)	31	1	46	F	5C	\	71	q
07	^G (BELL)	1C	^\	32	2	47	G	5D	]	72	r
08	^H (BACKSPACE)	1D	^]	33	3	48	H	5E	^	73	s
09	^I (TAB)	1E	^^	34	4	49	I	5F	_	74	t
0A	^J (LINEFEED)	1F	^	35	5	4A	J	60	`	75	u
0B	^K	20	SPACE	36	6	4B	K	61	a	76	v
0C	^L	21	!	37	7	4C	L	62	b	77	w
0D	^M	22	"	38	8	4D	M	63	c	78	x
0E	^N	23	#	39	9	4E	N	64	d	79	y
0F	^O	24	$	3A	:	4F	O	65	e	7A	z
10	^P	25	%	3B	;	50	P	66	f	7B	{
11	^Q	26	&	3C	<	51	Q	67	g	7C	|
12	^R	27	'	3D	=	52	R	68	h	7D	}
13	^S	28	(	3E	>	53	S	69	i	7E	~
14	^T	29	)	3F	?	54	T	6A	j	7F	DELETE
		2A	*			55	U				

(The symbol ^ represents a control character.)

H

Hexadecimal to Decimal Conversion Chart

Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec
$00	00	$1D	29	$3A	58	$57	87	$74	116	$91	145	$AE	174	$CD	205	$EA	234
$01	01	$1E	30	$3B	59	$58	88	$75	117	$92	146	$AF	175	$CE	206	$EB	235
$02	02	$1F	31	$3C	60	$59	89	$76	118	$93	147	$B0	176	$CF	207	$EC	236
$03	03	$20	32	$3D	61	$5A	90	$77	119	$94	148	$B1	177	$D0	208	$ED	237
$04	04	$21	33	$3E	62	$5B	91	$78	120	$95	149	$B2	178	$D1	209	$EE	238
$05	05	$22	34	$3F	63	$5C	92	$79	121	$96	150	$B5	181	$D2	210	$EF	239
$06	06	$23	35	$40	64	$5D	93	$7A	122	$97	151	$B6	182	$D3	211	$F0	240
$07	07	$24	36	$41	65	$5E	94	$7B	123	$98	152	$B7	183	$D4	212	$F1	241
$08	08	$25	37	$42	66	$5F	95	$7C	124	$99	153	$B8	184	$D5	213	$F2	242
$09	09	$26	38	$43	67	$60	96	$7D	125	$9A	154	$B9	185	$D6	214	$F3	243
$0A	10	$27	39	$44	68	$61	97	$7E	126	$9B	155	$BA	186	$D7	215	$F4	244
$0B	11	$28	40	$45	69	$62	98	$7F	127	$9C	156	$BB	187	$D8	216	$F5	245
$0C	12	$29	41	$46	70	$63	99	$80	128	$9D	157	$BC	188	$D9	217	$F6	246
$0D	13	$2A	42	$47	71	$64	100	$81	129	$9E	158	$BD	189	$DA	218	$F7	247
$0E	14	$2B	43	$48	72	$65	101	$82	130	$9F	159	$BE	190	$DB	219	$F8	248
$0F	15	$2C	44	$49	73	$66	102	$83	131	$A0	160	$BF	191	$DC	220	$F9	249
$10	16	$2D	45	$4A	74	$67	103	$84	132	$A1	161	$C0	192	$DD	221	$FA	250
$11	17	$2E	46	$4B	75	$68	104	$85	133	$A2	162	$C1	193	$DE	222	$FB	251
$12	18	$2F	47	$4C	76	$69	105	$86	134	$A3	163	$C2	194	$DF	223	$FC	252
$13	19	$30	48	$4D	77	$6A	106	$87	135	$A4	164	$C3	195	$E0	224	$FD	253
$14	20	$31	49	$4E	78	$6B	107	$88	136	$A5	165	$C4	196	$E1	225	$FE	254
$15	21	$32	50	$4F	79	$6C	108	$89	137	$A6	166	$C5	197	$E2	226	$FF	255
$16	22	$33	51	$50	80	$6D	109	$8A	138	$A7	167	$C6	198	$E3	227		
$17	23	$34	52	$51	81	$6E	110	$8B	139	$A8	168	$C7	199	$E4	228		
$18	24	$35	53	$52	82	$6F	111	$8C	140	$A9	169	$C8	200	$E5	229		
$19	25	$36	54	$53	83	$70	112	$8D	141	$AA	170	$C9	201	$E6	230		
$1A	26	$37	55	$54	84	$71	113	$8E	142	$AB	171	$CA	202	$E7	231		
$1B	27	$38	56	$55	85	$72	114	$8F	143	$AC	172	$CB	203	$E8	232		
$1C	28	$39	57	$56	86	$73	115	$90	144	$AD	173	$CC	204	$E9	233		

Routine Preventive Maintenance

Preventive maintenance (PM) is one of the least used techniques for operational cost reduction, yet the savings that result can be substantial. If the equipment doesn't fail, you can't evaluate the bottom-line savings in conducting proper PM. But after the first mind-boggling repair expense, the fact will sink in. This failure might have been prevented by doing some easy, routine maintenance.

Someone once said "Time is money." Failure to take the time to do routine preventive maintenance can indeed cost money. Do your PMs!

Many manufacturers are not sure what optimum PM should be. Others prefer you don't do any PMs. (The effect is to cause more equipment repair jobs for you.) Among those who recommend PMs, they vary in recommended PM schedules for similar hardware (for example, disk drives).

The listing that follows is a consensus of recommendations of manufacturers, dealers, users, and the author's own experience.

OPTIMUM PM SCHEDULE

Modify the schedule if intermittents occur frequently.

Daily

Log Operational Time

Estimate disk drive "run-light-on" time.
Estimate printer "printing" time.
Estimate computer "power-on" time.

Monitor Humidity

This is a measure of static electricity.

Weekly

Clean Computer System Work Area

Pick up all loose trash, reshelve scattered books, restore magazines, toss out old printed paper,

toss those "bad" disks you've been saving, wipe down hardware with an antistatic, dust-absorbing cloth, wipe desk and bench space with antistatic cloth, and vacuum shelves, desk, and floor.

Clean Equipment Housings and Cases

Wipe chassis with antistatic cloth, "wash" with lightly soaped damp cloth.

Clean Display Screens

Use antistatic "dust-off" type spray or damp cloth of antistatic solution.

Clean Drive Read Head

Clean drive read head after 40 hours of "run-light-on" use.

Monthly

Some manufacturers recommend that the drive read head be demagnetized after 40 hours "run-light-on" use.

Clean Inside Computer

Disassemble according to the procedures in Appendix D.

Use soft brush and long narrow vacuum cleaner hose nozzle (it helps to spray the nozzle with antistatic first).

Clean Inside Printer

Use same technique as for cleaning inside computer.

Check Ventilation Filters in Equipment

Replace if cleaning is not practical (filter becomes worn or badly soiled).

Check Connector Contacts

Look for signs of corrosion, pitting, or discoloration.

Clean if necessary. The corrosion-removing wipes that also coat the surface with a lubricating coating to protect it from atmospheric corrosion are strongly recommended.

Every Other Month

Reseat All Socketed Chips on the Motherboard and Peripheral Cards

Disassemble according to the procedures in Appendix D.

Disconnect and Reconnect Cable and Connector Plugs

This removes corrosion buildup.

Apply Antistatic Treatment to Computer Work Area

Clean Inside Printer

Use nonmagnetic, plastic vacuum hose nozzle and soft camel hair brush. Spray or wipe nozzle with antistatic spray or solution first.

Every Six Months

Replace Vent Filters

Only if some of the equipment has filters. None are standard in the IBM PC.

Check Disk Drive Speed

Speed test programs are advertised in computer publications.

Remember the room light, strobe mark test (see Chapter 3).

Check Head Alignment

Do this only if you suspect a disk problem.

Clean Connector Contacts

If you haven't done this during earlier inspection checks, conduct this PM now. Do this PM more often if the computer system is used in a smoggy part of the country or near salty air.

Clean Disk Drive Read Head

If the system is used daily, the drive heads may need cleaning about now, but this depends very much on the kind and quality of floppy disks that are used.

Conduct Printer Routine Inspection

Do this every six months or 500,000 lines of print. Check the tightness of the screws and connectors. Conduct a printer self-test as described in the printer owner's manual.

Annually

Take Routine Maintenance Infrared Photo (optional)

Only do this if you're into this form of PM or troubleshooting.

J

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