

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 pic-
ture 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
2¹/₄ inch speaker

Standard Software: Cassette BASIC

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

A

Unit Sheet

Unit Sheet

Unit Sheet

B

Chip Listing

IBM PC SYSTEM BOARD CHIP LISTING

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

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

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

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

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

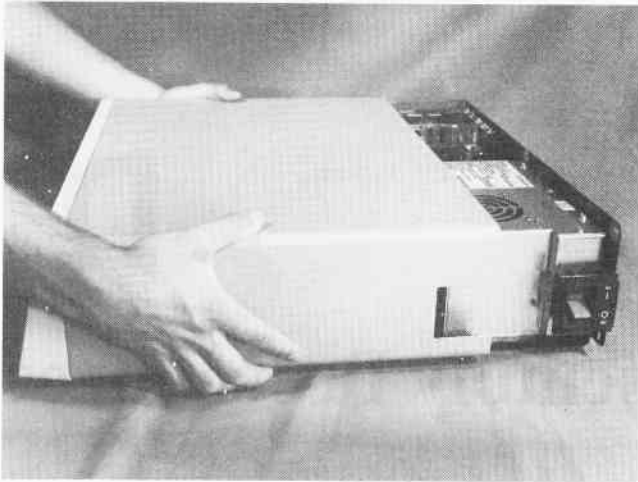


Fig. D-2. Gently slide the system unit cover forward.

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

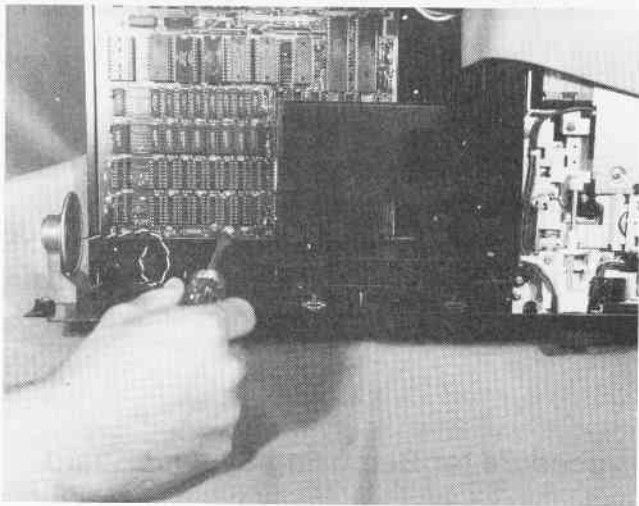


Fig. D-3. Remove the system board mounting screws.

standoffs can be lifted from their mounting slots.

7. Lift the system board from the system unit.

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 $\frac{1}{2}$ inch.
9. To remove the supply, lift up and pull the power supply away from the motherboard.

1. The first step in the process of creating a new product is to identify a market need. This involves conducting market research to determine what consumers want and what problems they are facing. Once a need is identified, the next step is to develop a concept that addresses this need. This concept should be unique and offer a solution that is better than what is currently available in the market.

2. The second step is to create a prototype of the product. This allows the company to test the concept and make any necessary adjustments before moving forward with production. The prototype should be functional and provide a clear idea of what the final product will look like and how it will be used.

3. The third step is to conduct a feasibility study. This involves assessing the technical, financial, and market viability of the product. The company should consider the costs of production, the potential for sales, and the competitive landscape. This study will help the company decide whether to proceed with the product and what resources will be needed.

4. The fourth step is to develop a business plan. This document outlines the company's strategy for marketing and selling the product. It includes information about the target market, the distribution channels, and the financial projections. The business plan is essential for securing funding and guiding the company's operations.

5. The fifth step is to produce the product. This involves sourcing materials, manufacturing the product, and packaging it for distribution. The company should ensure that the production process is efficient and that the quality of the product is consistent with the prototype.

6. The sixth step is to launch the product. This involves marketing the product to the target market and making it available for purchase. The company should use a variety of marketing channels, including social media, email, and direct sales, to reach potential customers.

7. The seventh step is to monitor the product's performance. This involves tracking sales, customer feedback, and market trends. The company should be prepared to make adjustments to the product or its marketing strategy based on this information.

8. The eighth step is to evaluate the product's success. This involves comparing the product's performance to the company's goals and the competitive landscape. The company should consider factors such as sales volume, profit margins, and customer satisfaction to determine the product's overall success.

9. The ninth step is to plan for the future. This involves identifying opportunities for growth and innovation. The company should consider ways to expand its product line, enter new markets, and improve its operational efficiency.

10. The tenth step is to celebrate the product's success. This involves recognizing the team's efforts and the company's achievements. Celebrating success can boost morale and encourage the company to continue to innovate and grow.

11. The eleventh step is to share the product's story. This involves communicating the product's benefits and the company's mission to the public. This can be done through press releases, social media, and other marketing channels.

12. The twelfth step is to maintain the product. This involves ensuring that the product remains functional and that it meets the needs of the market. The company should continue to monitor the product's performance and make any necessary updates or improvements.

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 $\frac{1}{2}$ 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.)



ASCI Core Club

ASCI Core Club is a national organization of students who are interested in chemistry and who are committed to the study of chemistry.

ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club	ASCI Core Club
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

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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