

## Format Of Bios Data Segment At Segment 40h

Format of BIOS Data Segment at segment 40h:  
{items in curly braces not documented by IBM}

Offset	Size	Description
00h	WORD	Base I/O address of 1st serial I/O port, zero if none
02h	WORD	Base I/O address of 2nd serial I/O port, zero if none
04h	WORD	Base I/O address of 3rd serial I/O port, zero if none
06h	WORD	Base I/O address of 4th serial I/O port, zero if none
		Note: Above fields filled in turn by POST as it finds serial ports. POST never leaves gaps. DOS and BIOS serial device numbers may be redefined by re-assigning these fields.
08h	WORD	Base I/O address of 1st parallel I/O port, zero if none
0Ah	WORD	Base I/O address of 2nd parallel I/O port, zero if none
0Ch	WORD	Base I/O address of 3rd parallel I/O port, zero if none
0Eh	WORD	[non-PS] Base I/O address of 4th parallel I/O port, zero if none [PS] Segment of Extended BIOS Data Segment
		Note: Above fields filled in turn by POST as it finds parallel ports. POST never leaves gaps. DOS and BIOS parallel device numbers may be redefined by re-assigning these fields.
10h	WORD	Installed hardware: bits 15-14: number of parallel devices bit 13: [Conv] Internal modem bit 12: reserved bits 11- 9: number of serial devices bit 8: reserved bits 7- 6: number of diskette drives minus one bits 5- 4: Initial video mode: 00b = EGA,VGA,PGA 01b = 40 x 25 color 10b = 80 x 25 color 11b = 80 x 25 mono bit 3: reserved bit 2: [PS] =1 if pointing device [non-PS] reserved bit 1: =1 if math co-processor bit 0: =1 if diskette available for boot
12h	BYTE	[Conv] POST status {AT} {Manufacturing test initialisation flags}
13h	WORD	Base memory size in kbytes (0-640)
15h	BYTE	{AT} {Manufacturing test scratch pad}
16h	BYTE	{AT} {Manufacturing test scratch pad}
		[PS/2 Mod 30] BIOS control flags
17h	BYTE	Keyboard status flags 1: bit 7 =1 INSert active bit 6 =1 Caps Lock active bit 5 =1 Num Lock active bit 4 =1 Scroll Lock active bit 3 =1 either Alt pressed bit 2 =1 either Ctrl pressed bit 1 =1 Left Shift pressed bit 0 =1 Right Shift pressed
18h	BYTE	Keyboard status flags 2: bit 7 =1 INSert pressed bit 6 =1 Caps Lock pressed bit 5 =1 Num Lock pressed bit 4 =1 Scroll Lock pressed

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bit 3 =1 Pause state active  
bit 2 =1 Sys Req pressed  
bit 1 =1 Left Alt pressed  
bit 0 =1 Left Ctrl pressed

19h BYTE Keyboard: Alt-nmn keypad workspace  
1Ah WORD Keyboard: ptr to next character in keyboard buffer  
1Ch WORD Keyboard: ptr to first free slot in keyboard buffer  
1Eh 16 WORDs Keyboard circular buffer (but see 80h, 82h for override)  
3Eh BYTE Diskette recalibrate status:  
bit 7 =1 Diskette hardware interrupt occurred  
bits 6-4 reserved  
bit 3 =1 Recalibrate diskette 3  
bit 2 =1 Recalibrate diskette 2  
bit 1 =1 Recalibrate diskette 1  
bit 0 =1 Recalibrate diskette 0

3Fh BYTE Diskette motor status:  
bit 7 =1 current operation is write or format  
=0 current operation is read or verify  
bit 6 reserved  
bits 5-4 diskette drive number selected (0-3)  
bit 3 =1 diskette 3 motor on  
bit 2 =1 diskette 2 motor on  
bit 1 =1 diskette 1 motor on  
bit 0 =1 diskette 0 motor on

40h BYTE Diskette motor turn-off time-out count  
41h BYTE Diskette last operation status (0 = OK)  
bit 7 =1 drive not ready  
bit 6 =1 seek error  
bit 5 =1 general controller failure  
bits 4-0:  
00h no error  
01h invalid request  
02h address mark not found  
03h write-protect error  
04h sector not found  
06h diskette change line active  
08h DMA overrun  
09h DMA across 64k boundary  
0Ch media type unknown  
10h CRC error on read

42h 7 BYTES Diskette/Fixed disk status/command bytes  
49h BYTE Video current mode  
4Ah WORD Video columns on screen  
4Ch WORD Video page (regen buffer) size in bytes  
4Eh WORD Video current page start address in regen buffer  
50h 16 BYTES Video cursor position (col, row) for eight pages, 0 based  
60h WORD Video cursor type, 6845 compatible, hi=startline, lo=endline  
62h BYTE Video current page number  
63h WORD Video CRT controller base address: color=03D4h, mono=03B4h  
65h BYTE Video current setting of mode select register 03D8h/03B8h  
66h BYTE Video current setting of CGA palette register 03D9h  
67h DWORD POST real mode re-entry point after certain resets  
6Bh BYTE POST last unexpected interrupt  
6Ch DWORD Timer ticks since midnight  
70h BYTE Timer overflow, non-zero if has counted past midnight  
71h BYTE Ctrl-Break flag: bit 7=1  
72h WORD POST reset flag:  
= 1234h if to bypass memory test (warm boot)

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= 4321h [PS/2 MCA only] if to preserve memory  
= 5678h [Conv] system suspended  
= 9ABCh [Conv] manufacturing test mode  
= ABCDh [Conv] POST loop mode  
= 64h Burn-in mode

74h BYTE Fixed disk last operation status: {except ESDI drives}

- 00h no error
- 01h invalid function request
- 02h address mark not found
- 03h write protect error
- 04h sector not found
- 05h reset failed
- 07h drive parameter activity failed
- 08h DMA overrun
- 09h DMA data boundary error
- 0Ah bad sector flag detected
- 0Bh bad track detected
- 0Dh invalid number of sectors for Format
- 0Eh control data address mark detected
- 0Fh DMA arbitration level out of range
- 10h uncorrectable ECC or CRC error
- 11h ECC corrected data error
- 20h general controller failed
- 40h seek failed
- 80h time out
- AAh drive not ready
- BBh undefined error
- CCh write fault on selected drive
- E0h status error/error register is zero
- FFh sense failed

75h BYTE Fixed disk: number of fixed disk drives

76h BYTE Fixed disk: control byte {IBM document only for XT}

77h BYTE Fixed disk: I/O port offset {IBM document only for XT}

78h 3 BYTES Parallel devices 1-3 time-out counters

7Bh BYTE parallel device 4 time-out counter [non-PS]  
bit 5 set if Virtual DMA Spec supported [PS] (see INT 4B)

7Ch 4 BYTES Serial devices 1-4 time-out counters

80h WORD Keyboard buffer start as offset from segment 40h (normally 1Eh)

82h WORD Keyboard buffer end+1 as offset from segment 40h (normally 3Eh)  
[XT BIOS dated 11/08/82 ends here]

84h BYTE Video EGA/MCGA/VGA rows on screen minus one

85h WORD Video EGA/MCGA/VGA character height in scan-lines

87h BYTE Video EGA/VGA control: [MCGA: =00h]

- bit 7: =1 if not to clear RAM (see INT 10h, AH=00h)
- bits 6-5: RAM on adapter = (this field + 1) \* 64K
- bit 4: reserved
- bit 3: =0 if EGA/VGA video system active, =1 if inactive
- bit 2: =1 if to wait for display enable (what means this?)
- bit 1: =0 for color or ECD monitor, =1 for mono monitor
- bit 0: =0 alphanumeric cursor emulation enabled, =1 not.  
When enabled, text mode cursor size (INT 10,AH=01h)  
settings looking like CGA ones are translated to  
equivalent EGA/VGA ones.

88h BYTE Video EGA/VGA switches: [MCGA: reserved]

- bits 7-4: power-on state of feature connector bits 3-0
- bits 3-0: configuration switches 4-1 (=0 on, =1 off)

Values as read:

- 0h Pri MDA, Sec EGA+old color display 40 x 25

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1h Pri MDA, Sec EGA+old color display 80 x 25  
2h Pri MDA, Sec EGA+ECD normal mode (CGA emul)  
3h Pri MDA, Sec EGA+ECD enhanced mode  
4h Pri CGA 40 x 25, Sec EGA mono display  
5h Pri CGA 80 x 25, Sec EGA mono display  
6h Pri EGA+old color display 40 x 25, Sec MDA  
7h Pri EGA+old color display 80 x 25, Sec MDA  
8h Pri EGA+ECD normal mode (CGA emul), Sec MDA  
9h Pri EGA+ECD enhanced mode, Sec MDA  
Ah Pri EGA mono display, Sec CGA 40 x 25  
Bh Pri EGA mono display, Sec CGA 80 x 25  
When bit4 of 40h:89h is 0, VGA emulates 350-line EGA if this byte is x3h or x9h, otherwise emulates 200-line CGA in 400-line double scan. VGA resets this byte to x9h after the mode set.

89h BYTE Video MCGA/VGA mode-set option control:  
bits 7 and 4:  
0 0 350-line mode requested  
0 1 400-line mode at next mode set  
1 0 200-line mode requested  
1 1 reserved  
Apparently VGA BIOS mode set disregards bit 7 and uses byte 40h:88h to determine 200/350 selection when bit 4 is zero. Presumably bit 7 is a convenience for other purposes. Bit 7 is reset to zero after the mode set.  
bit 6: =1 if display switching enabled, =0 if disabled  
bit 5: reserved  
bit 4: [VGA] =1 if to use 400-line mode at next mode set  
=0 if to emulate EGA at next mode set  
This bit set to 1 after the mode set.  
[MCGA] =1 use 400-line mode at next mode set  
=0 emulate CGA, digital monitor, 200 lines,  
8 x 8 text font at next mode set  
Bit unchanged by mode set.  
bit 3: =0 if default palette loading enabled at mode set  
bit 2: =1 if mono display, =0 if color display  
bit 1: =1 if gray scale summing enabled, =0 if disabled  
bit 0: [VGA] =1 if VGA active, =0 if not  
[MCGA] reserved, zero

8Ah BYTE Video [MCGA/VGA]: index into Display Combination Code table

8Bh BYTE Diskette media control [not XT]:  
bits 7-6: Last data rate set by controller:  
00=500kbps, 01=300kbps, 10=250kbps, 11=reserved  
bits 5-4: Last diskette drive step rate selected  
bits 3-2: {Data rate at start of operation}  
bits 1-0: reserved

8Ch BYTE Fixed disk controller status [not XT]

8Dh BYTE Fixed disk controller Error Status [not XT]

8Eh BYTE Fixed disk Interrupt Control [not XT]

8Fh BYTE Diskette controller information [not XT]:  
bit 7: reserved  
bit 6: =1 drive 1 determined  
bit 5: =1 drive 1 is multi-rate, valid if drive determined  
bit 4: =1 drive 1 supports 80 tracks, always valid  
bit 3: reserved  
bit 2: =1 drive 0 determined  
bit 1: =1 drive 0 is multi-rate, valid if drive determined  
bit 0: =1 drive 0 supports 80 tracks, always valid

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90h BYTE Diskette drive 0 media state  
91h BYTE Diskette drive 1 media state  
    bits 7-6: Data rate: 00=500kbps, 01=300kbps, 10=250kbps  
    bit 5: =1 if double stepping reqd (e.g. 360kB in 1.2MB)  
    bit 4: =1 if media established  
    bit 3: reserved  
    bits 2-0: on exit from BIOS, contain:  
        000 trying 360kB in 360kB  
        001 trying 360kB in 1.2MB  
        010 trying 1.2MB in 1.2MB  
        011 360kB in 360kB established  
        100 360kB in 1.2MB established  
        101 1.2MB in 1.2MB established  
        110 reserved  
        111 all other formats/drives  
92h BYTE Diskette drive 0 media state at start of operation  
93h BYTE Diskette drive 1 media state at start of operation  
94h BYTE Diskette drive 0 current track number  
95h BYTE Diskette drive 1 current track number  
96h BYTE Keyboard status byte 3  
    bit 7 =1 read-ID in progress  
    bit 6 =1 last code read was first of two ID codes  
    bit 5 =1 force Num Lock if read-ID and enhanced keyboard  
    bit 4 =1 enhanced keyboard installed  
    bit 3 =1 Right Alt pressed  
    bit 2 =1 Right Ctrl pressed  
    bit 1 =1 last code read was E0h  
    bit 0 =1 last code read was E1h  
97h BYTE Keyboard status byte 2  
    bit 7 =1 keyboard transmit error flag  
    bit 6 =1 LED update in progress  
    bit 5 =1 RESEND received from keyboard  
    bit 4 =1 ACK received from keyboard  
    bit 3 reserved, must be zero  
    bit 2 Caps Lock LED  
    bit 1 Num Lock LED  
    bit 0 Scroll Lock LED  
98h DWORD Timer2: [AT, PS exc Mod 30] ptr to user wait-complete flag  
    (see INT 15, AX=8300h)  
9Ch DWORD Timer2: [AT, PS exc Mod 30] user wait count in microseconds  
A0h BYTE Timer2: [AT, PS exc Mod 30] Wait active flag:  
    bit 7 =1 wait time elapsed  
    bits 6-1 reserved  
    bit 0 =1 INT 15h, AH=86h has occurred  
A1h 7 BYTES reserved for network adapters (oh really?)  
A4h DWORD [PS/2 Mod 30] Saved Fixed Disk Interrupt Vector  
A8h DWORD Video: EGA/MCGA/VGA ptr to Video Save Pointer Table (see below)  
ACh-AFh reserved  
B0h DWORD ptr to 3363 Optical disk driver or BIOS entry point.  
    When 3363 BIOS present, the signature "OPTIC ",00h occurs 3  
    bytes beyond this entry point.  
    When 3363 BIOS and 3363 File System Driver present, the  
    signature "FILE SYSTEM DRIVER",00h occurs 3 bytes beyond  
    this entry point.  
B4h WORD reserved  
B6h 3 BYTES reserved for POST?  
B9h 7 BYTES ???  
C0h 14 BYTES reserved

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CEh WORD count of days since last boot?  
D0h-EFh reserved  
F0h-FFh reserved for user  
100h BYTE Print Screen Status byte

Format of Extended BIOS Data Area (see 40:0Eh for ptr) [PS only]

Offset	Size	Description
00h	BYTE	Length of EBDA in kilobytes
01h	15 BYTES	reserved
17h	BYTE	Number of entries in POST error log (0-5)
18h	5 WORDs	POST error log (each word is a POST error number)
19h-21h		reserved
22h	DWORD	Pointing Device Driver entry point
26h	BYTE	Pointing Device Flags 1 bit 7: =1 command in progress bit 6: =1 resend bit 5: =1 acknowledge bit 4: =1 error bit 3: =0 reserved bits 2-0: index count
27h	BYTE	Pointing Device Flags 2 bit 7: =1 device driver far call flag bits 6-3: reserved bits 2-0: package size
28h	7 BYTES	Pointing Device Auxilliary Device Data
2Fh	BYTE	reserved
30h	DWORD	Vector for INT 07h stored here during 80387 interrupt
34h	DWORD	Vector for INT 01h stored here during INT 07h emulation
38h	BYTE	Scratchpad for 80287/80387 interrupt code
39h	WORD	Timer3: Watchdog timer initial count
3Bh	BYTE	??? seen non-zero on Model 30
3Ch	BYTE	???
3Dh	16 BYTES	Fixed Disk parameter table for drive 0 (oh really?)
4Dh	16 BYTES	Fixed Disk parameter table for drive 1 (oh really?) Neither of above seen on any Model 30, 50, 60 yet.
5Dh-6Bh		???
6Ch	BYTE	Fixed disk: (=FFh on ESDI systems) bits 7-4: Channel number 00-0Fh bits 3-0: DMA arbitration level 00-0Eh
6Dh and up:		??? seen non-zero on Model 60
3F0h	BYTE	Fixed disk buffer (????!!!)

Format of Video Save Pointer Table [EGA/VGA/MCGA only]:

Offset	Size	Description
00h	DWORD	ptr to Video Parameter Table
04h	DWORD	ptr to Parameter Dynamic Save Area, else 0 [EGA/VGA only]
08h	DWORD	ptr to Alphanumeric Character Set Override, else 0
0Ch	DWORD	ptr to Graphics Character Set Override, else 0
10h	DWORD	[VGA only] ptr to Secondary Save Pointer Table, must be valid
14h	DWORD	reserved, zero
18h	DWORD	reserved, zero

Note: table initially in ROM, copy to RAM to alter, then update 40h:A8h.

Format of Secondary Video Save Pointer Table [VGA only]:

Offset	Size	Description
00h	WORD	Length of this table in bytes, including this word (1Ah)
02h	DWORD	ptr to Display Combination Code Table, must be valid
06h	DWORD	ptr to second Alphanumeric Character Set Override, else 0

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0Ah DWORD ptr to User Palette Profile Table, else 0  
0Eh DWORD reserved, zero  
12h DWORD reserved, zero  
16h DWORD reserved, zero

Note: table initially in ROM, copy to RAM to alter, then alter Save Ptr Table.

Format of Video Parameter Table [EGA, VGA only]:

An array of 23 [EGA] or 29 [VGA] elements, each element being 64 bytes long.

Elements appear in the order:

00h-03h Modes 00h-03h in 200-line CGA emulation mode  
04h-0Eh Modes 04h-0Eh  
0Fh-10h Modes 0Fh-10h when only 64kB RAM on adapter  
11h-12h Modes 0Fh-10h when >64kB RAM on adapter  
13h-16h Modes 00h-03h in 350-line mode  
17h VGA Modes 00h or 01h in 400-line mode  
18h VGA Modes 02h or 03h in 400-line mode  
19h VGA Mode 07h in 400-line mode  
1Ah-1Ch VGA Modes 11h-13h

Format of Video Parameter Table element [EGA, VGA only]:

Offset	Size	Description
00h	BYTE	Columns on screen (see 40h:4Ah)
01h	BYTE	Rows on screen minus one (see 40h:84h)
02h	BYTE	Height of character in scan lines (see 40h:85h)
03h	WORD	Size of video buffer (see 40h:4Ch)
05h	4 BYTES	Values for Sequencer Registers 1-4
09h	BYTE	Value for Miscellaneous Output Register
0Ah	25 BYTES	Values for CRTC Registers 00h-18h
23h	20 BYTES	Values for Attribute Controller Registers 00h-13h
37h	9 BYTES	Values for Graphics Controller Registers 00h-08h

Format of Video Parameter Table [MCGA only] {guesswork from inspection}:

- 16 triplet BYTES of R,G,B DAC info for 16 colors;
- An array of 11 elements, each element being 32 bytes long.

Elements appear in the order:

Modes 00h,01h in 200-line mode for digital displays  
Modes 00h,01h in 400-line mode for analog displays  
Modes 02h,03h in 200-line mode for digital displays  
Modes 02h,03h in 400-line mode for analog displays  
Modes 04h,05h in 200-line mode for digital displays  
Modes 04h,05h in 400-line mode for analog displays  
Mode 06h in 200-line mode for digital displays  
Mode 06h in 400-line mode for analog displays  
Mode 11h  
Mode 13h in 200-line mode for digital displays  
Mode 13h in 400-line mode for analog displays

Format of Video Parameter Table element [MCGA only]:

Offset	Size	Description
00h	BYTE	Columns on screen (see 40h:4Ah)
01h	BYTE	Rows on screen minus one (see 40h:84h)
02h	BYTE	Height of character in scan lines (see 40h:85h)
03h	WORD	Size of video buffer (see 40h:4Ch)
05h	WORD	??? always zero
07h	21 BYTES	Video data registers 00h-14h to port 3D5h indexed by 3D4h
1Ch	BYTE	PEL Mask to port 3C6h
1Dh	BYTE	CGA Mode Control to port 3D8h
1Eh	BYTE	CGA Border Control to port 3D9h

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1Fh BYTE Extended Mode Control to port 3DDh

Format of Video Parameter Dynamic Save Area [EGA, VGA only]:

Offset	Size	Description
00h	16 BYTES	Last data written to Attribute Controller Palette Registers 0-15
10h	BYTE	Last data written to Attribute Controller Overscan Register
11h-FFh		Reserved

Note: Need for table was that EGA registers were write-only.

Note: If default values (from the Video Parameter Table) are over-ridden at a mode set by the VGA User Palette Profile Table, then the Dynamic Save Area is updated with the default values, not the User Profile ones.

Format of Alphanumeric Character Set Override:

Offset	Size	Description
00h	BYTE	Length in bytes of each character in font table
01h	BYTE	Character generator RAM bank to load, 0=normal
02h	WORD	Number of characters in font table, normally 256
04h	WORD	Code of first character in font table, normally 0
06h	DWORD	ptr to font table
0Ah	BYTE	Displayable rows (FFh=use maximum calculated value)
0Bh	BYTES	Array of mode values to which this font is to pertain
	BYTE	FFh end of array

Format of Second Alphanumeric Character Set Override:

Authorities differ, some say same as first override above, but IBM say:

Offset	Size	Description
00h	BYTE	Length in bytes of each character in font table
01h	BYTE	Character generator RAM bank to load, normally non-zero
02h	BYTE	reserved
03h	DWORD	ptr to font table
07h	BYTES	Array of mode values to which this font is to pertain
	BYTE	FFh end of array

Format of Graphics Character Set Override:

Offset	Size	Description
00h	BYTE	Number of displayable character rows
01h	WORD	Length in bytes of each character in font table
03h	DWORD	ptr to font table
07h	BYTES	Array of mode values to which this font is to pertain
	BYTE	FFh end of array

Format of Display Combination Code Table [VGA only]:

Offset	Size	Description
00h	BYTE	Number of entries in the DCC table at offset 04h
01h	BYTE	Version number
02h	BYTE	Maximum display type code that can appear in DCC table
03h	BYTE	reserved
04h	ARRAY OF 2 BYTES	Each pair of bytes gives a valid display combination
		Meaning of each byte:
	00h	no display
	01h	MDA with mono display
	02h	CGA with color display
	03h	reserved
	04h	EGA with color display
	05h	EGA with mono display
	06h	Professional Graphics Controller
	07h	VGA with mono display

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08h VGA with color display  
09h reserved  
0Ah MCGA with digital color display  
0Bh MCGA with analog mono display  
0Ch MCGA with analog color display  
FFh unrecognised video system

Format of User Palette Profile Table [VGA only]:

Offset	Size	Description
00h	BYTE	Underlining: 01h=enable in all alphanumeric modes 00h=enable in monochrome alphanumeric modes only FFh=disable in all alphanumeric modes
01h	BYTE	reserved
02h	WORD	reserved
04h	WORD	Number (0-17) of Attribute Controller registers in table
06h	WORD	Index (0-16) of first Attribute Controller register in table
08h	DWORD	ptr to table of Attribute Controller registers to override Table is an array of BYTES.
0Ch	WORD	Number (0-256) of video DAC Color registers in table
0Eh	WORD	Index (0-255) of first video DAC Color register in table
10h	DWORD	ptr to table of video DAC Color registers to override Table is ??? triplets ??? of BYTES???
14h	BYTES	array of mode values to which this profile is to pertain
	BYTE	FFh end of array