Appendix B

BIOS Interrupts and Functions

Interrupt 13H: Hard disk

Interrupt 14H: Serial interface

Interrupt 15H: Cassette interrupt (AT only)

Interrupt 16H: Keyboard

Interrupt 10H, function 00H BIOS
Video: Set video mode

Selects and initializes a video mode and clears the screen. This function is a fast method of clearing the screen while maintaining the current video mode.

Input:

AH = 00H
AL = Video mode

0:	40x25 text mode, monochrome	(color card)
1:	40x25 text mode, color	(color card)
2:	80x25 text mode, monochrome	(mono card)
3:	80x25 text mode, color	(color card)
4:	320x200 4-color graphics	(color card)
5:	320x200 4-color graphics (colors displayed in monochrome)	(color card)
6:	640x200 2-color graphics	(color card)
7:	Internal mode	(mono card)

Output: No output

Remarks: The colors for modes 4, 5 and 6 can be set with function 11.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 01H BIOS
Video: Define cursor type

Defines the starting and ending lines of the cursor. This cursor exists independently of the current display page.

Input:

AH = 01H
CH = Starting line of the cursor
CL = Ending line of the cursor

Output: No output

Remarks: The values allowed for the cursor's starting and ending line depend on the installed video card. The following values are permitted:

Monochrome display cards:	0–13
Color display cards:	0–7

BIOS defaults to the following values:

Monochrome display cards:	11–12
Color display cards:	6–7

You can use this function to set the cursor only within the permitted ranges. Setting cursor lines outside these parameters may result in an invisible cursor or system problems.

The contents of the BX, CX, DX registers and the segment registers SS, CS and DS are not affected by this function. The contents of all the other registers may change, especially the SI and DI registers.

Interrupt 10H, function 02H — BIOS
Video: Position cursor

Repositions the cursor, which determines the screen position for character output by using one of the BIOS functions.

Input:

AH = 02H
BH = Display page number
DH = Screen line
DL = Screen column

Output: No output

Remarks: The blinking cursor moves through this function when the addressed display page is the current display page.

Values for the screen line parameter range from 0 to 24.

Values for the screen column parameter range from 0 to 79 (for an 80-column display) or from 0 to 39 (for a 40-column display), depending on the selected video mode.

You can make the cursor disappear by moving it to a nonexistent screen position (e.g., column 0, line 25).

The number of the display page parameter depends on how many display pages are available to the video card.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 03H BIOS
Video: Read cursor position

Senses the text cursor's position, starting line and ending line in a display page.

Input:
AH = 03H
BH = Display page number

Output:
DH = Screen line in which the cursor is located
DL = Screen column in which the cursor is located
CH = Starting line of the blinking cursor
CL = Ending line of the blinking cursor

Remarks:
The number of the display page parameter depends on how many display pages are available to the video card.

Line and column coordinates are related to the text coordinate system.

The contents of the BX register and the SS, CS and DS segment registers are not affected by this function. The contents of all the other registers may change, especially the SI and DI registers.

Interrupt 10H, function 04H BIOS
Video: Read lightpen position

Senses the position of the lightpen on the screen if applicable.

Input:
AH = 04H

Output:
AH = Lightpen position reading status
0: Lightpen position unreadable
1: Lightpen position readable
DH = Screen line of the lightpen (text mode)
DL = Screen column of the lightpen (text mode)
CH = Screen line of the lightpen (graphic mode)
BX = Screen column of the lightpen (graphic mode)

Remarks:
This function call must be repeated until 1 is returned in the AH register, because only then can coordinates be read from the other registers.

Coordinates indicated represent the current video mode's resolution.

Usually the coordinates of the light pen cannot be accurately sensed in the graphic mode. The Y-coordinate (line) is always a multiple of 2, so it isn't possible to determine whether the lightpen is in line 8 or 9. The X-coordinate (column) is always a multiple of 4 in 320x200 graphic mode and a multiple of 8 in the 640x200 bitmap mode.

The contents of the CL register and the SS, CS and DS segment registers are not affected by this function. The contents of all the other registers may change, especially the SI and DI registers.

Interrupt 10H, function 05H — BIOS
Video: Select current display page

Selects the current display page (text mode only) which should be displayed.

Input: AH = 05H
AL = Display page number

Output: No output

Remarks: The number of the display page depends on the number of display pages available to the video card.

On switching to a new display page, the screen cursor points to the position of the text cursor in this page.

Switching between various display pages does not affect their contents (the individual characters).

You can write characters to an inactive display page.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of the other registers, such as the SI and DI registers, may change.

Interrupt 10H, function 06H — BIOS
Video: Initialize window/scroll text upward

Clears window or scrolls a portion of the current display page up by one or more lines, depending on the input.

Input:

AH =	06H
AL =	Number of window lines to be scrolled upward (0=clear window)
CH =	Screen line of the upper left corner of the window
CL =	Screen column of the upper left corner of the window
DH =	Screen line of the lower right corner of the window
DL =	Screen column of the lower right corner of the window
BH =	Color (attribute) for blank line(s)

Output: No output

Remarks: Initializing a window (placing a 0 in the AL register) fills the window with blank spaces (ASCII code 32).

The contents of the lines scrolled out of the window are lost and cannot be restored.

Function 0 of this interrupt is better for clearing the entire screen.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 07H BIOS
Video: Initialize window/scroll text downward

Clears window or scrolls a portion of the current display page up by one or more lines, depending on the input.

Input:
AH = 07H
AL = Number of window lines to be scrolled downward (0=clear window)
CH = Screen line of the upper left corner of the window
CL = Screen column of the upper left corner of the window
DH = Screen line of the lower right corner of the window
DL = Screen column of the lower right corner of the window
BH = Color (attribute) for blank line(s)

Output: No output

Remarks: This function only affects the current display page.

Initializing a window (placing a 0 in the AL register) fills the window with blank spaces (ASCII code 32).

The contents of the lines scrolled out of the window are lost and cannot be restored.

Function 0 of this interrupt is better for clearing the entire screen.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 08H BIOS
Video: Read character/attribute

Reads the ASCII code of the character at the current cursor position and its color (attribute).

Input:
AH = 08H
BH = Display page number

Output:
AL = ASCII code of the character
AH = Color (attribute)

Remarks: The number of the display page depends on the number of display pages made available to the video card.

This function can also be called in graphic mode. The function compares the bit pattern of the character on the screen with the bit pattern of the character in character ROM of the video card and with the character patterns stored in a RAM table whose addresses appear in interrupt 1FH. If the character cannot be identified, the AL register contains the value 0 after the function call.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of the other registers may change, especially the SI and DI registers.

Interrupt 10H, function 09H — BIOS
Video: Write character/attribute

Writes a character with a certain color (attribute) to the current cursor position in a predefined display page.

Input:
AH = 09H
BH = Display page number
CX = Number of times to write the character
AL = ASCII code of the character
BL = Attribute

Output: No output

Remarks: If the character should be displayed several times (the value of the CX register is greater than 1), all characters must fit into the current screen line in the graphic mode.

The control codes (e.g., bell, carriage return) appear as normal ASCII codes.

This function can display characters in graphic mode. The patterns of the characters, with the codes from 0 to 127, are determined by a table in ROM. The patterns of the characters with the codes from 128 to 255 are determined by a RAM table that was previously installed by DOS the GRAFTABL command.

In text mode, the contents of the BL register define the attribute byte of the character. In graphic mode this register determines the color of the character. The 640x200 bitmap mode only allows the values 0 and 1 for selecting colors from the color palette. The 320x200 bitmap mode only allows the values 0 to 3 for selecting colors from the color palette.

If the graphic mode is active during character output and bit 7 of the BL register is set, an exclusive OR is performed on the character pattern and the graphic pixels behind the character pattern.

After character output, the cursor remains in the same position as the character.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0AH BIOS
Video: Write character

Writes a character to the current cursor position in a predefined display page by using the color of the character previously at this position.

Input:
AH = 0AH
BH = Display page number
CX = Number of times to write the character
AL = ASCII code of the character

Output: No output

Remarks: If the character should be displayed several times (the value of the CX register is greater than 1), all characters must fit into the current screen line in the graphic mode.

The control codes (e.g., bell, carriage return) appear as normal ASCII codes.

This function can display characters in graphic mode. The patterns of the characters with the codes from 0 to 127 are determined by a table in ROM and the patterns of the characters with the codes from 128 to 255 are determined by a RAM table previously installed by the GRAFTABL command.

In text mode, the contents of the BL register define the attribute byte of the character. In graphic mode this register determines the color of the character. The 640x200 bitmap mode only allows the values 0 and 1 for selecting colors from the color palette. The 320x200 bitmap mode only allows the values 0 to 3 for selecting colors from the color palette.

If the graphic mode is active during character output and bit 7 of the BL register is set, an exclusive OR is performed on the character pattern and the graphic pixels behind the character pattern.

The cursor remains in the same position after character output.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0BH, sub-function 0 BIOS
Video: Select palette

Selects the border and background color for graphic or text mode.

Input:
AH = 0BH
BH = 0
BL = Border/background color

Output: No output

Remarks: In graphic mode, the color value passed defines the color of both the border and background. In text mode, the background color of each character is defined individually, so the passed color value only defines the color of the screen border.

Values for the color passed can range from 0 to 15.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0BH, sub-function 1 BIOS
Video: Select color palette

Selects one of the two color palettes for the 320x200 bitmapped graphic mode.

Input:
AH = 0BH
BH = 1
BL = Color palette number

Output: No output

Remarks: Two color palettes are available. They have the numbers 0 and 1 and contain the following colors:

Palette 0: Green, red, yellow
Palette 1: Cyan, magenta, white

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0CH BIOS
Video: Write graphic pixel

Draws a color pixel at the specified coordinates in graphic mode.

Input:
AH = 0CH
AL = Pixel color value (see below)
BH = Graphics page
CX = Screen column
DX = Screen line

Output: No output

Remarks: The pixel value color parameter depends on the current graphic mode. 640x200 bitmapped mode only permits the values 0 and 1. In the 320x200 bitmapped mode, the values 0 to 3 are permitted, which generates a certain color according to the chosen color palette. 0 represents the selected background color; 1 represents the first color of the selected color palette; 2 represents the second color of the color palette, etc.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0DH BIOS
Video: Read graphic pixel

Reads the color value of a pixel at the specified coordinates in the current graphic mode.

Input:
AH = 0DH
DX = Screen line
CX = Screen column

Output: AL = Pixel color value

Remarks: The pixel color value parameter depends on the current graphic mode. 640x200 bitmapped mode permits the values 0 and 1 only. In the 320x200 bitmapped mode, the values 0 to 3 are permitted, which generates a certain color according to the color palette chosen. 0 represents the selected background color; 1 represents the first color of the selected color palette; 2 represents the second color of the color palette, etc.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0EH BIOS
Video: Write character

Writes a character at the current cursor position in the current display page. The new character uses the color of the character that was previously in this position on the screen.

Input:

AH = 0EH
AL = ASCII code of the character
BL = Foreground color of the character (graphic mode only)

Output: No output

Remarks: This function executes control codes (e.g., bell, carriage return) instead of reading them as ASCII codes. For example, the function sounds a beep instead of printing the bell character.

After this function displays a character, the cursor position increments so that the next character appears at the next position on the screen. If the function reaches the last display position, the display scrolls up one line and output continues in the first column of the last screen line.

The foreground color parameter depends on the current graphic mode. 640x200 bitmapped mode only permits the values 0 and 1. In the 320x200 bitmapped mode, the values 0 to 3 are permitted, which generates a certain color according to the chosen color palette. 0 represents the selected background color; 1 represents the first color of the selected color palette; 2 represents the second color of the color palette, etc.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 0FH BIOS
Video: Read display mode

Reads the number of the current video mode, the number of characters per line and the number of the current display page.

Input: AH = 0FH

Output: AL = Video mode

0: 40x25 text mode, monochrome (color card)
1: 40x25 text mode, color (color card)
2: 80x25 text mode, monochrome (mono card)
3: 80x25 text mode, color (color card)
4: 320x200 4-color graphics (color card)
5: 320x200 4-color graphics (color card)
(colors represented in monochrome)
6: 640x200 2-color graphics (color card)
7: Internal mode (mono card)

AH = Number of characters per line
BH = Current display page number

Remarks: The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 10H, function 13H BIOS (AT only)
Video: Write character string

Displays a character string on the screen, starting at a specified screen position on a specified display page. The characters are taken from a buffer whose address passes to the function.

Input: AH = 13H
AL = Output mode (0–3)

0: Attribute in BL, retain cursor position
1: Attribute in BL, update cursor position
2: Attribute in the buffer, retain cursor position
3: Attribute in the buffer, update cursor position

BH = Display page number
BL = Attribute byte of the character (modes 0 and 1 only)
BP = Offset address of the buffer
CX = Number of characters to be displayed
DH = display line
DL = display column
ES = segment address of the buffer

Output: No output

Remarks: Modes 1 and 3 set the cursor position following the last character of the character string. On the next call of a BIOS function for character output, the next string of characters appears following the original character string. This does not occur in the modes 0 and 2.

In modes 0 and 1, the buffer contains only the ASCII codes of the characters to be displayed. The BL register contains the color of the character string. However, in modes 2 and 3 each character has its own attribute byte when the character is stored in the buffer. The BL register doesn't have to be loaded in this mode. Even though the character string is twice as long in these modes as the number of the characters to be displayed, the CX register requires only the number of ASCII characters in the string and not the total length of the character string.

Control codes (e.g., bell) are interpreted as control codes only, and not as characters.

When the string reaches the last position on the screen, the display scrolls upward by one line and output continues in the first column of the last screen line.

The contents of the BX, CX, DX registers and the SS, CS and DS segment registers are not affected by this function. The contents of all other registers may change, especially the SI and DI registers.

Interrupt 11H — BIOS
Determine configuration

Reads the configuration of the system as recorded during the booting process.

Input: No input

Output: AX = Configuration

PC and XT:

Bit 0: 1 if the system has one or more disk drives
Bit 1: Unused
Bits 2-3: RAM available on main circuit board
- 00: 16K
- 01: 32K
- 10: 48K
- 11: 64K

Bits 4-5: Video mode after system boot
- 00: Unused
- 01: 40x25, color card
- 02: 80x25, color card
- 03: 80x25, mono card

Bits 6-7: Number of disk drives in the system if bit 0 is equal to 1
- 00: 1 disk drive
- 01: 2 disk drives
- 10: 3 disk drives
- 11: 4 disk drives

Bit 8:	0 when a DMA chip is present
Bits 9-11:	Number of RS-232 cards connected
Bit 12:	1 when system has a joystick attached
Bit 13:	Unused
Bits 14-15:	Indicates the number of printers available

AT:

Bit 0:	1 if the system has one or more disk drives
Bit 1:	1 when a math coprocessor exists in the system
Bit 2-3:	Unused
Bit 4-5:	Video mode during system boot
00:	Unused
01:	40x25, color card
02:	80x25, color card
03:	80x25, mono card
Bits 6-7:	Number of disk drives in the system if bit 0 is equal to 1
00:	1 disk drive
01:	2 disk drives
10:	3 disk drives
11:	4 disk drives
Bit 8:	Unused
Bits 9-11:	Number of RS-232 cards connected
Bit 12-13:	Unused
Bits 14-15:	Indicates the number of printers available

Remarks: The type of PC must be known (PC, XT or AT) in order to properly interpret the meanings of the individual bits of the configuration word.

The memory size indicated in bits 2 and 3 of the PC/XT configuration word refers only to the main circuit board. Interrupt 12H lets you determine the total amount of available memory.

The video mode recorded in bits 4 and 5 is the mode that was activated when the system was switched on. To determine the current video mode use function 15 of interrupt 10H.

The contents of the AX register are affected by this function.

Interrupt 12H — BIOS
Determine memory size

Input: No input

Output: AX = Memory size in kilobytes

Remarks: The PC and the XT can accept a maximum of 640K of RAM. The AT accepts up to 14 megabytes of RAM memory beyond the 1 megabyte limit. The memory size returned by this function ignores this extended memory. To determine the memory size beyond the 1 megabyte limit, use function 88H of interrupt 15H (available only on the AT).

The contents of the AX register are affected by this function.

Interrupt 13H, function 00H BIOS
Disk: Reset

Resets the disk controller and any connected disk drives. A reset should be executed after each disk operation during which an error occurred.

Input:
AH = 00H
DL = 0 or 1

Output:
Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:
The value in the DL register is unnecessary since all the disk drives execute a reset. XT and AT models use this register to determine whether a reset should be performed on the disk drives or the hard disk.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission beyond segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, unit not responding

The contents of the BX, CX, DX, SI, DI, PB registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 01H BIOS
Disk: Read status

Reads the status of the disk drive since the last disk operation.

Input:
AH = 01H
DL = 0 or 1

Output:
Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:
The value in the DL register is unnecessary, since disk drives constantly return their status. XT and AT models use this register to determine whether the status of the hard disk should be checked.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission beyond segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, unit not responding

The contents of the BX, CX, DX, SI, DI, PB registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 02H BIOS
Disk: Read disk

Reads one or more disk sectors into a buffer.

Input:

AH =	02H
AL =	Number of sectors to be read
BX =	Offset address of buffer
CH =	Track number
CL =	Sector number
DH =	Disk side number (0 or 1)
DL =	Disk drive number
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remark: The number of sectors to be read into the AL register is limited to sectors which logically follow each other on a track on one side of the disk.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on a write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission over segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, drive not responding

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all the other registers may change.

Interrupt 13H, function 03H — BIOS
Disk: Write to disk

Writes one or more sectors to a disk. The data to be transmitted are taken from a buffer.

Input:

AH = 03H
AL = Number of sectors to be written
BX = Offset address of buffer
CH = Track number
CL = Sector number
DH = Disk side number (0 or 1)
DL = Disk drive number
ES = Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remark:

The number of sectors that can be written in the AL register is limited to sectors which logically follow each other on a track on one side of the disk.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on a write protected disk
04H:	Sector not found

08H:	DMA overflow
09H:	Data transmission over segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, drive not responding

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 04H — BIOS
Disk: Verify disk sectors

Compares one or more sectors on disk with the data stored in a buffer. This can be used to verify that the data was properly saved to disk.

Input:

AH =	04H
AL =	Number of sectors to be verified
BX =	Offset address of buffer
CH =	Track number
CL =	Sector number
DH =	Disk side number (0 or 1)
DL =	Disk drive number
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The number of sectors to be verified in the AL register is limited to sectors which logically follow each other on a track on one side of the disk.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on a write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission over segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, drive not responding

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 05H BIOS
Disk: Format track

Formats a complete track on one side of a disk. A buffer which contains information about the sectors to be formatted must be passed to the function.

Input:

AH =	05H
AL =	Number of sectors to be formatted
BX =	Offset address of buffer
CH =	Track number
DH =	Disk side number (0 or 1)
DL =	Disk drive number
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remark:

The number of sectors to be formatted is limited to sectors which logically follow each other on a track on one side of the disk.

The buffer passed in ES:BX contains an entry consisting of four consecutive bytes for every sector to be formatted.

1: Track number
2: Page number
3: Logical sector number
4: Number of bytes in this sector:
  0: 128 bytes
  1: 256 bytes
  2: 512 bytes (PC standard)
  3: 1,024 bytes

The logical sector number increments continuously, but may not be the same as the physical sector number.

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on a write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission over segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, drive not responding

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all the other registers may change.

Interrupt 13H, function 15H BIOS (AT only)
Disk: Determine drive type

Senses disk change and drive type. The AT supports both the standard 320/360K drives and the 1.2 megabyte drives.

Input:

AH = 15H
DL = Disk drive number (0 or 1)

Output:

Carry flag=0: Operation completed (AH=unit type)
AH=0: Device not present
AH=1: Unit does not recognize disk change
AH=2: Unit recognizes disk change
AH=3: Hard disk (see remarks below)
Carry flag=1: Error

Remark:

The AT has a controller which selectively controls 2 disk drives and a hard disk, or one disk drive and 2 hard disks. In the latter case, the first hard disk has the number 1 and can be accessed with this function.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 16H BIOS (AT only)
Disk: Media change

Senses a disk change. The AT supports both the standard 320/360K drives and the 1.2 megabyte drives. This function reads any disk change that may have occurred since the last disk access.

Input:

AH = 16H
DL = Disk drive number (0 or 1)

Output:

AH=0: No disk change
AH=6: Disk changed since last disk access

Remarks:

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 17H BIOS (AT only)
Disk: Determine disk format

Determines the format of a disk. The AT's 1.2 megabyte disk drive can read both 320/360K disks and 1.2 megabyte disks. While the BIOS can determine disk format during a read or write access, it first must be informed of the format. Function 23 must be called on the AT before you can call function 5 (format).

Input:

AH = 17H
AL = Format
AL=1: 320/360K format on 320/360K drive
AL=2: 320/360K format on 1.2 megabyte drive
AL=3: 1.2 megabyte format on 1.2 megabyte drive

Output:

Carry flag=0: Operation completed
Carry flag=1: Error

Remark:

The following error codes can occur:

01H:	Function number not permitted
02H:	Address not found
03H:	Write attempt on a write protected disk
04H:	Sector not found
08H:	DMA overflow
09H:	Data transmission over segment border
10H:	Read error
20H:	Error in disk controller
40H:	Track not found
80H:	Time out error, drive not responding

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 00H — BIOS (XT and AT only)
Hard disk: Reset

Resets the hard disk controller and any interfaced hard disk drives. A reset should be executed after every hard disk operation during which an error was reported.

Input: AH = 00H
DL = 80H or 81H

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The value in the DL register is unnecessary since all the hard disk drives execute a reset. XT and AT models use this register to determine whether a reset should be performed on the disk drives or on the hard disk.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 01H — BIOS (XT and AT only)
Hard disk: Read disk status

Reads the status of the hard disk since the last hard disk operation.

Input: AH = 01H
DL = 80H or 81H

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The value in the DL register is unnecessary since the status is consistently returned for each disk drive. XT and AT models use this register to determine whether the status of the disk drives or hard disk should be checked.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of the other registers may change.

Interrupt 13H, function 02H BIOS (XT and AT only)
Hard disk: Read disk

Reads one or more hard disk sectors into a buffer.

Input:

AH =	02H
AL =	Number of sectors to be read (1-128)
BX =	Offset address of buffer
CH =	Cylinder number
CL =	Sector number
DH =	Read/write head number
DL =	Hard disk number (80H or 81H)
ES =	Buffer segment address

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Since the eight bits of the CH register can address only 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, which enables the addressing of up to 1,023 cylinders at a time.

If several sectors are being read and the system reaches the last sector of a cylinder, reading continues at the first sector of the next cylinder of the next read/write head. If the system reaches the last read/write head, reading continues on the first sector of the following cylinder on the first read/write head.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 03H BIOS (XT and AT only)
Hard disk: Write to disk

Writes one or more sectors to the hard disk. The data to be transmitted are taken from a buffer in the calling program.

Input:

AH =	03H
AL =	Number of sectors to be written (1-128)
BX =	Offset address of buffer
CH =	Cylinder number
CL =	Sector number
DH =	Read/write head number
DL =	Hard disk number (80H or 81H)
ES =	Buffer segment address

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Since the eight bits of the CH register can address only 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, enabling the addressing of up to 1,023 cylinders at a time.

If several sectors are being written and the system reaches the last sector of a cylinder, writing continues at the first sector of the next cylinder of the next read/write head. If the system reaches the last read/write head, writing continues on the first sector of the following cylinder on the first read/write head.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 04H BIOS (XT and AT only)
Hard disk: Verify disk sector

Verifies one or more sectors of a hard disk. Unlike the corresponding floppy disk function, the data on the hard disk are not compared with the data in memory. During data storage, four check bytes are stored for every sector; these check bytes verify the contents of a sector.

Input:

AH =	04H
AL =	Number of sectors to be verified (1-128)
BX =	Offset address of buffer
CH =	Cylinder number
CL =	Sector number
DH =	Read/write head number
DL =	Hard disk number (80H or 81H)
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Since the eight bits of the CH register can only address 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, which enables the addressing of up to 1,023 cylinders at a time.

If several sectors are being verified and the system reaches the last sector of a cylinder, verification continues at the first sector of the next cylinder of the next read/write head. If the system reaches the last read/write head, verification continues on the first sector of the following cylinder on the first read/write head.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 05H BIOS (XT and AT only)
Hard disk: Format cylinder

Formats a complete cylinder (17 sectors) of a hard disk. A buffer, which contains information about the sectors to be formatted, must be passed to the function.

Input:

AH = 05H
AL = 17
BX = Offset address of buffer
CH = Cylinder number
CL = 1
DH = Read/write head number
DL = Hard disk number (80H or 81H)
ES = Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Since the eight bits of the CH register can only address 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, which enables the addressing of up to 1,023 cylinders at a time.

Since a complete cylinder is always formatted, the first sector to be formatted in the CL register is always sector 1. For the same reason the number of sectors to be formatted in the AL register is always 17, since the average hard disk operates with 17 sectors per cylinder.

The buffer, whose address is passed in ES:BX, must always be at least 512 bytes long. Only the first 34 bytes of this buffer are used for formatting the 17 sectors of a cylinder. Two succeeding bytes contain information about the corresponding physical sector. Before the function call, the first byte isn't significant. After the function call the first byte indicates whether or not the sector could be formatted (00H) or (80H). The second byte returns the logical sector number of the physical sector and must be placed in the buffer by calling the program before the function call.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 08H BIOS (XT and AT only)
Hard disk: Check format

Conveys the formatting information found on the hard disk.

Input:

AH = 08H
CH = Cylinder number
CL = Sector number
DH = Read/write head number (0=first head)
DL = Hard disk number

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Since the eight bits of the CH register can address only 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, enabling the addressing of up to 1,023 cylinders at a time.

The total capacity of the hard disk unit in bytes can be calculated with the following formula:

```
Capacity = Heads * Cylinders * Sectors * 512
```

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 09H BIOS (XT and AT only)
Hard disk: Adapt to foreign drives

Interfaces other hard disk drives for access through BIOS functions.

Input:
AH = 09H
DL = Number of hard disk to be interfaced (80H or 81H)

Output:
Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:
The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

BIOS takes the information about the hard disk drive to be interfaced (number of units, read/write heads, etc.) from a table. The address of this table for the hard disk unit numbered 80H is stored in interrupt vector 41H, and the unit numbered 81H is stored in interrupt 46H.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC

20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 0AH BIOS (XT and AT only)
Hard disk: Extended read

Reads one or more sectors from the hard disk drive into a buffer. Besides the actual 512 bytes stored in the sector, the function also reads the four check bytes (ECC).

Input:

AH =	0AH
AL =	Number of sectors to be read (1–127)
BX =	Offset address of buffer
CH =	Cylinder number
CL =	Sector number
DH =	Read/write head number
DL =	Hard disk number (80H or 81H)
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Normally the controller computes the four check bytes. Here the buffer reads the information direct.

Since the eight bits of the CH register can only address 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, enabling the addressing of up to 1,023 cylinders at a time.

If several sectors are being read and the system reaches the last sector of a cylinder, reading continues at the first sector of the next cylinder of the next read/write head. If the system reaches the last read/write head, reading continues on the first sector of the following cylinder on the first read/write head.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset

07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 0BH BIOS (XT and AT only)
Hard disk: Extended write

Writes one or more sectors to the hard disk drive. Besides the actual 512 bytes stored in a sector, four check bytes (ECC) stored at the end of every sector are transmitted from the buffer.

Input:

AH =	0BH
AL =	Number of sectors to be read (1–127)
BX =	Offset address of buffer
CH =	Cylinder number
CL =	Sector number
DH =	Read/write head number
DL =	Hard disk number (80H or 81H)
ES =	Buffer segment address

Output:

Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks:

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

Normally the controller calculates the four check bytes. Here the system reads them direct from the buffer.

Since the eight bits of the CH register can only address 256 cylinders at a time, bits 6 and 7 of the CL register (sector number) form bits 8 and 9 of the cylinder number, enabling the addressing of up to 1,023 cylinders at a time.

If several sectors are being written and the system reaches the last sector of a cylinder, writing continues at the first sector of the next cylinder of the next read/write head. If the system reaches the last read/write head, writing continues on the first sector of the following cylinder on the first read/write head.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 0DH BIOS (XT and AT only)
Hard disk: Reset

Resets the hard disk controller and any interfaced hard disk drives. A reset should be executed after every hard disk operation during which an error was reported.

Input: AH = 0DH
DL = Hard disk drive number (80H or 81H)

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The value in the DL register is unnecessary since all the hard disk drives execute a reset. XT and AT models use this register to determine whether a reset should be performed on the disk drives or on the hard disk.

This function is identical to function 0 listed above.

The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector

20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 10H BIOS (XT and AT only)
Hard disk: Drive ready?

Determines if the drive is ready (i.e., the last operation has been completed and the drive can perform the next task).

Input: AH = 10H
DL = Hard disk drive number (80H or 81H)

Output: Carry flag=0: Drive ready (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 11H BIOS (XT and AT only)
Hard disk: Recalibrate drive

Recalibrates hard disk after an error occurs, especially after a read or write error.

Input: AH = 11H
DL = Hard disk drive number (80H or 81H)

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 14H BIOS (XT and AT only)
Hard disk: Controller diagnostic

Initializes an internal diagnostic test of the hard disk controller.

Input: AH = 14H
DL = Hard disk drive number (80H or 81H)

Output: Carry flag=0: Operation completed (AH=0)
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The following error codes can occur:

01H:	Addressed function or unit not available
02H:	Address not found
04H:	Sector not found
05H:	Error on controller reset
07H:	Error during controller initialization
09H:	DMA transmission error: Segment border exceeded
0AH:	Defective sector
10H:	Read error
11H:	Read error corrected by ECC
20H:	Controller defect
40H:	Search operation failed
80H:	Time out, unit not responding
AAH:	Unit not ready
CCH:	Write error

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 13H, function 15H BIOS (AT only)
Hard disk: Determine drive type

Determines whether or not the computer hardware assigned numbers 80H and 81H are hard disk drives. The AT contains a controller capable of controlling both hard disks and disk drives. This controller can manage either two disk drives and one hard disk, or one disk drive and two hard disks.

Input: AH = 15H
DL = Hard disk drive number (80H or 81H)

Output: Carry flag=0: Operation completed (AH=drive type)
0: Equipment not available
1: Drive does not recognize disk change
2: Drive recognizes disk change
3: Hard disk unit
Carry flag=1: Error (AH=error code)

Remarks: The first hard disk drive is assigned the number 80H, the second is assigned the number 81H.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 14H, function 00H BIOS
Serial port: Initialize

Initializes and configures a serial port. This configuration includes parameters for word length, baud rate, parity and stop bits.

Input:
AH = 00H
DX = Number of serial port (0=first serial port, 1=second serial port)
AL = Configuration parameters
Bits 0-1: Word length
10(b) = 7 bits
11(b) = 8 bits
Bit 2: Number of stop bits
00(b) = 1 stop bit
01(b) = 2 stop bits
Bits 3-4: Parity
00(b) = none
01(b) = odd
11(b) = even
Bits 5-7: Baud rate
000(b) = 110 baud
001(b) = 150 baud
010(b) = 300 baud
011(b) = 600 baud
100(b) = 1200 baud
101(b) = 2400 baud
110(b) = 4800 baud
111(b) = 9600 baud

Output:
AH = Serial port status
Bit 0: Data ready
Bit 1: Overrun error
Bit 2: Parity error
Bit 3: Framing error
Bit 4: Break discovered
Bit 5: Transmission hold register empty
Bit 6: Transmission shift register empty
Bit 7: Time out
AL = Modem status
Bit 0: Modem ready to send status change
Bit 1: Modem on status change
Bit 2: Telephone ringing status change
Bit 3: Connection to receiver status change
Bit 4: Modem ready to send
Bit 5: Modem on
Bit 6: Telephone ringing
Bit 7: Connection to receiver modem

Remarks: The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all the other registers may change.

Interrupt 14H, function 01H BIOS
Serial port: Send character

Sends a character to the serial port.

Input:
AH = 01H
DX = Number of serial port (0=first serial port, 1=second serial port)
AL = Character code to be sent

Output:
AH: Bit 7 = 0: Character transmitted
Bit 7 = 1: Error
Bit 0-6: Serial port status
Bit 0: Data ready
Bit 1: Overrun error
Bit 2: Parity error
Bit 3: Framing error
Bit 4: Break discovered
Bit 5: Transmission hold register empty
Bit 6: Transmission shift register empty

Remarks: The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 14H, function 02H BIOS
Serial port: Read character

Receives a character from the serial port.

Input:
AH = 02H
DX = Number of serial port (0=first serial port, 1=second serial port)

Output:
AH: Bit 7 = 0: Character received:
AL = Character received
Bit 7 = 1: Error:
Bit 0-6: Serial port status:
Bit 0: Data ready
Bit 1: Overrun error
Bit 2: Parity error
Bit 3: Framing error
Bit 4: Break discovered
Bit 5: Transmission hold register empty
Bit 6: Transmission shift register empty

Remarks: This function should only be called if function 3 has determined that a character is ready for reception.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 14H, function 03H BIOS
Serial port: Read status

Reads the status of the serial port.

Input: AH = 03H
DX = Number of the serial port (the first serial port has the number 0)

Output: AH = Serial port status
Bit 0: Data ready
Bit 1: Overrun error
Bit 2: Parity error
Bit 3: Framing error
Bit 4: Break discovered
Bit 5: Transmission hold register empty
Bit 6: Transmission shift register empty
AL = Modem status:
Bit 0: Modem ready to send status change
Bit 1: Modem on status change
Bit 2: Telephone ringing status change
Bit 3: Connection to receiver status change
Bit 4: Modem ready to send
Bit 5: Modem on
Bit 6: Telephone ringing
Bit 7: Connection to receiver modem

Remarks: This function should always be called before calling function 2 (read character).

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 83H BIOS (AT only)
Cassette interrupt: Set flag after time interval

Sets bit 7 of a flag to 1 after a certain amount of time in microseconds elapses.

Input: AH = 83H
ES = Segment address of the flag
BX = Offset address of the flag
CX = High word of elapsed time in microseconds
DX = Low word of elapsed time in microseconds

Output: No output

Remarks: A microsecond is a millionth of a second.

The contents of the BX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 84H, sub-function 0 BIOS (AT only)
Cassette interrupt: Read joystick switch settings

Reads the status of switches on joysticks interfaced to a PC, if game ports and joysticks are present.

Input: AH = 84H
DX = 0

Output: Carry flag=1: No game port connected
Carry flag=0: Game port present:
AL = Switch settings:
Bit 7=1: First joystick's first switch enabled
Bit 6=1: First joystick's second switch enabled
Bit 5=1: Second joystick's first switch enabled
Bit 4=1: Second joystick's second switch enabled

Remarks: Sub-function 1 reads the joystick position(s).

The contents of the BX, CX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 84H, sub-function 1 BIOS (AT only)
Cassette interrupt: Read joystick position

Reads the positions of joysticks interfaced to a PC if game ports and joysticks are present.

Input: AH = 84H
DX = 1

Output: Carry flag=1: No game port connected
Carry flag=0: Game port present:
AX = X-position of first joystick
BX = Y-position of first joystick
CX = X-position of second joystick
DX = Y-position of second joystick

Remarks: Sub-function 0 reads the joystick switch status.

The contents of the SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 85H BIOS (AT only)
Cassette interrupt: <Sys Req> key activated

Responds to pressure or release of the <Sys Req> key. The keyboard routine calls this function.

Input:
AH = 85H
AL = 0: <Sys Req> key depressed
AL = 1: <Sys Req> key released

Output: No output

Remarks: This function acts as an intermediary for application programs, so that the application program will respond appropriately when the user presses the <Sys Req> key.

Interrupt 15H, function 86H BIOS (AT only)
Cassette interrupt: Wait

Returns control to the calling program after a certain amount of time has elapsed.

Input:
AH = 86H
CX = High word of pause time in microseconds
DX = Low word of pause time in microseconds

Output: No output

Remarks: A microsecond is a millionth of a second.

The contents of the BX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 87H BIOS (AT only)
Cassette interrupt: Move memory areas

Moves areas of RAM from below the 1 megabyte limit to the range above the 1 megabyte limit, and from above the 1 megabyte limit to below the 1 megabyte limit.

Input:
AH = 87H
CX = Number of words to move
ES = Segment address of global descriptor table
SI = Offset address of global descriptor table

Output:
Carry flag=0: No error
Carry flag=1: Error:
AH=1: RAM parity error
AH=2: Incorrect GDT on function call
AH=3: Protected mode could not be initialized

Remarks: See Section 7.10.1 for more information about the global descriptor table (GDT).

Only words can be transferred; individual bytes cannot be transferred.

Maximum amount of memory allowed in a transfer is 64K. The value in the CX register cannot exceed 8000H.

All interrupts are disabled during the memory block move.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 88H BIOS (AT only)
Cassette interrupt: Determine memory size beyond 1 megabyte

Determines the amount of memory installed beyond the 1 megabyte limit.

Input: AH = 88H

Output: AX = Memory size

Remarks: The value in the AX register represents memory in kilobytes (K).

Memory size below the 1 megabyte limit can be determined using interrupt 12H.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 15H, function 89H BIOS (AT only)
Cassette interrupt: Switch to virtual mode

Switches the 80286 processor to virtual mode.

Input: AH = 89H

Output: No output

Remarks: This function should be called only if you know how virtual mode operates. Improper use of this function can easily lead to a system crash.

Interrupt 16H, function 00H BIOS
Keyboard: Read character

Reads a character from the keyboard buffer. If the buffer doesn't contain a character, the function waits until a character is entered. Then the character is read and removed from the keyboard buffer.

Input: AH = 00H

Output: AL = 0: Extended key code:
AH = Extended key code
AL>1: Normal key activated:
AL = ASCII code of key
AH = Scan code of key

Remarks: ASCII code definition occurs independent of the keyboard. Scan codes apply only to the type of keyboard attached to the PC. See Appendix J for a list of ASCII codes and Section 7.11 for a list of extended key codes.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 16H, function 01H BIOS
Keyboard: Read keyboard for character

Reads the keyboard buffer for a character ready to be entered. If a character is available, the function passes the character to the calling function. The character remains in the keyboard buffer and can be re-read when a program calls either function 0 (see above) or function 1. The function returns to the calling program immediately after the call.

Input: AH = 01H

Output: Zero flag = 1: No character in the keyboard buffer
Zero flag = 0: Character available in keyboard buffer:
AL = 0: Extended key code:
AH = Extended key code
AL>1: Normal key:
AL = ASCII code of the key
AH = Scan code of the key

Remarks: ASCII code definition occurs independent of the keyboard. Scan codes only apply to the type of keyboard attached to the PC. See Appendix J for a list of ASCII codes and Section 7.11 for a list of extended key codes.

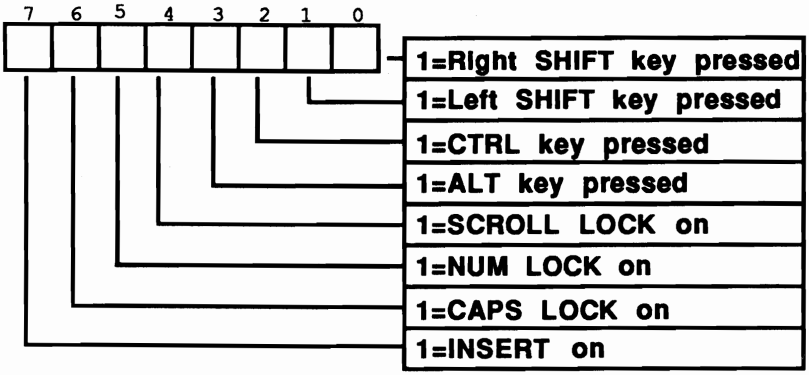
The contents of the CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 16H, function 02H BIOS
Keyboard: Read keyboard status

Reads and returns the status of certain control keys and various keyboard modes.

Input: AH = 02H

Output: AL = Keyboard status



Keyboard status

Remarks: The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 17H, function 00H BIOS
Printer: Write character

Writes a character to one of the printers interfaced to the PC.

Input: AH = 00H
AL = Character code to be printed
DX = Printer number

Output: AH = Printer status:
Bit 0=1: Time out error
Bit 1: Unused
Bit 2: Unused
Bit 3=1: Transfer error
Bit 4=0: Printer offline
Bit 4=1: Printer online
Bit 5=1: Printer out of paper
Bit 6=1: Receive mode selected
Bit 7=0: Printer busy

Remarks: Parallel port LPT1 is assigned the number 0, parallel port LPT2 is assigned the number 1 and parallel port LPT3 is assigned the number 2.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 17H, function 01H BIOS
Printer: Initialize printer

Initializes the printer interfaced to the PC. This function should be executed before executing function 0 (see above).

Input: AH = 01H
DX = Printer number

Output: AH = Printer status

Remarks: Parallel port LPT1 is assigned the number 0, parallel port LPT2 is assigned the number 1 and parallel port LPT3 is assigned the number 2.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 17H, function 02H BIOS
Printer: Read printer status

Returns the status of the printer interfaced to the PC.

Input: AH = 02H
DX = Printer number

Output: AH = Printer status

Remarks: Parallel port LPT1 is assigned the number 0, parallel port LPT2 is assigned the number 1 and parallel port LPT3 is assigned the number 2.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 18H BIOS
Call ROM BASIC

Accesses BASIC in ROM if a system disk cannot be found during the system bootstrap process.

Input: No input

Output: No output

Remarks: Very few PCs or compatibles have built-in ROM BASIC (this is a throwback from the early days of the PC). If a PC doesn't have ROM BASIC, interrupt 18H returns the system to the calling program. However, if the PC does has ROM BASIC, interrupt 18H calls BASIC. In most cases, the only way to return to DOS is by warm-starting the computer (pressing the <Ctrl><Alt><Delete> keys) or turning the computer off and on again. Some versions of ROM BASIC allow an exit to DOS by entering the SYSTEM command from BASIC.

Interrupt 19H BIOS
Boot process

Boots the computer.

Input: No input

Output: No output

Remarks: Pressing the <Ctrl><Alt><Delete> keys invokes this interrupt from the keyboard.

Interrupt 1AH, function 00H BIOS
Date and time: Read clock count

Reads the current clock count. The clock count increments 18.2 times per second. This calculates the time elapsed since the computer was switched on.

Input: AH = 00H

Output: CX = High word of the clock count
DX = Low word of the clock count
AL = 0: Less than 24 hours have elapsed since the last reading
AL<>0: More than 24 hours have elapsed since the last reading

Remarks: The AT, which has a battery powered realtime clock, sets the clock count to the current time when the computer boots. PCs (which don't have realtime clocks) set the counter to 0 during booting.

The contents of the BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 01H — BIOS
Date and time: Set clock count

Sets the contents of the current clock count, which increments 18.2 times per second. This calculates the time elapsed since the computer was switched on and sets the current time through this function.

Input:
AH = 01H
CX = High word of clock count
DX = Low word of clock count

Output:
No output

Remarks: The AT, which has a battery powered realtime clock, sets the clock count to the current time when the computer boots. PCs (which don't have realtime clocks) set the counter to 0 during booting. PC owners should use this function to set the current time.

The contents of the AX, BX, CX, DX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 02H — BIOS (AT only)
Date and time: Read realtime clock

Reads the time from the realtime clock.

Input:
AH = 02H

Output:
Carry flag = 0: O.K.:
CH = Hours
CL = Minutes
DH = Seconds
Carry flag = 1: Dead clock battery

Remarks: All time readings appear in BCD format.

The contents of the BX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 03H BIOS (AT only)
Date and time: Set realtime clock

Sets the time on the realtime clock.

Input:
AH = 03H
CH = Hours
CL = Minutes
DH = Seconds
DL = 1: Daylight Saving Time
DL = 0: Standard Time

Output: No output

Remarks: All time settings must be in BCD format.

The contents of the BX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 04H BIOS (AT only)
Date and time: Read date from realtime clock

Reads the current date from the realtime clock.

Input: AH = 04H

Output:
Carry flag = 0: O.K.:
CH = Century (19 or 20)
CL = Year
DH = Month
DL = Day
Carry flag = 1: Dead clock battery

Remarks: All date readings appear in BCD format.

The contents of the BX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 05H — BIOS (AT only)
Date and time: Set date in realtime clock

Sets the current date in the realtime clock.

Input:

AH = 05H
CH = Century (19 or 20)
CL = Year
DH = Month
DL = Day

Output:

No output

Remarks:

All date settings must be in BCD format.

The contents of the BX, CX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 06H — BIOS (AT only)
Date and time: Set alarm time

Sets alarm time for the current day. The alarm time triggers interrupt 4AH.

Input:

AH = 06H
CH = Hours
CL = Minutes
DH = Seconds

Output:

Carry flag=0: O.K.
Carry flag=1: Dead clock battery or programmed alarm time.

Remarks:

All alarm settings must be in BCD format.

During booting, interrupt 4AH points to an IRET command. If this interrupt doesn't point to a particular routine responding to the alarm, nothing will happen once the alarm time is reached.

Only one alarm time can be active at a time. If another alarm setting already exists, you must first delete it by using interrupt 26–1AH, function 7 (see below).

The contents of the BX, CX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1AH, function 07H BIOS (AT only)
Date and time: Reset alarm time

Clears an existing alarm setting created by using function 06H above.

Input: AH = 07H

Output: No output

Remarks: This function must be called when you want to change an alarm setting. Reset the alarm, then use function 06H to set the new alarm time.

The contents of the BX, CX, SI, DI, BP registers and the segment registers are not affected by this function. The contents of all other registers may change.

Interrupt 1BH BIOS/DOS
Keyboard: <Break> key pressed

Records the occurrence of a <Ctrl><Break> key combination and triggers interrupt 1BH. During the system boot, BIOS sets interrupt 1BH to an IRET command in order to prevent any reaction.

This routine sets a flag to indicate that the user has pressed <Ctrl><Break>. Following the execution of one of the DOS functions, this flag is tested for character input or output. If the system encounters <Ctrl><Break>, the current program stops. In addition, when a batch file is in process, the program asks whether the batch file should be continued or terminated.

Pressing <Ctrl><C> doesn't activate the interrupt. This key combination forces DOS to end the currently executing program. However, the DOS functions for character input/output search for this key combination.

To prevent termination of an application program, this interrupt can also be pointed to a user routine by pressing <Break> or <Ctrl><Break>.

Input: No input

Output: No output

Remarks: Before returning control to the calling program, this interrupt must restore all registers to their previous values.

Interrupt 1CH BIOS
Periodic interrupt

The timer IC calls interrupt 8H approximately 18.2 times per second. After ending its task, it calls interrupt 1CH in order to allow an application program access to the signals from the timer IC. During booting, BIOS initializes the interrupt vector of interrupt 1CH so that it points to an IRET command, which prevents any response if the interrupt is called. For example, this interrupt can be pointed to a user routine to create a constant display clock on the screen.

Input: No input

Output: No output

Remarks: This interrupt must restore all registers to their previous values before returning control to the calling program.

Interrupt 1DH BIOS
Video table

Sets a pointer to a table. The vector of this interrupt in the vector table, starting at address 0000:0074, stores the offset and segment address of this table. The table itself contains a collection of parameters used by BIOS for initializing a certain video mode. This involves the 16 memory locations on the video card, whose heart is a 6845 video processor. For this reason the table to which the vector points and which is part of the ROM-BIOS, consists of 16 consecutive bytes that indicate the contents of individual registers for a certain video mode. The first of these 16 bytes is copied into the first register of the 6845, the second byte into the second register, etc. The table in ROM contains a total of four 16-byte entries: 40x25 color mode, 80x25 color mode, 80x25 monochrome mode and one entry for the various color graphics modes.

Do not call this interrupt. If you do, the system will attempt to read the video table as executable code and will crash.

Input: No input

Output: No output

Interrupt 1EH BIOS/DOS
Drive table

Sets a pointer to a table. The vector of this interrupt in the vector table starting at address 0000:0078 stores the offset and segment address of this table. The table itself contains a collection of parameters used by BIOS in disk drive access. BIOS has a table in ROM, but deviates the interrupt vector of interrupt 30 to its own table which allows faster disk access than the BIOS table (see Section 7.7 for more information about this table).

Do not call this interrupt. If you do call it, the system will attempt to read the drive table as executable code and will crash.

Input: No input

Output: No output

Interrupt 1FH BIOS/DOS
Character table

Sets a pointer to a table. The vector of this interrupt in the vector table, starting at address 0000:007C, stores the offset and segment address of this table. The table itself contains character patterns for the characters possessing ASCII codes 128 to 255. BIOS needs this table in order to display the graphic mode characters on the screen. These characters are displayed by placing the character patterns, which are stored in this table, on the screen as individual pixels.

Since the character patterns for codes 0 to 127 are already stored in a table in ROM-BIOS, this table contains only the character patterns for codes 128 to 255. The DOS GRAFTABL command loads a table for codes 127 to 255 into RAM and points the interrupt vector of interrupt 31 to this table. A user table can be added to display on the screen, in graphic mode, certain characters that are not part of the normal PC character set. The construction of the table requires that eight consecutive bytes define the appearance of the character. The first eight bytes of the table define the appearance of ASCII code 128, the next eight bytes define ASCII code 129, etc. Each set of eight bytes represent the eight lines which denote a character in graphic mode. The eight bits of each byte indicate the eight columns of pixels for each line.

Do not call this interrupt. If you do call it, the system will attempt to read the character table as executable code and will crash.

Input: No input

Output: No output