The
BIOS Companion

Phil Croucher

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Sources

Which are gratefully acknowledged:

- Experience.
- Many conversations with technicians.
- Hundreds of motherboard manuals, not all of which were helpful!
- AMI BIOS Tech Ref manual.
- MR BIOS Tech Ref Manual. Thanks to Mike at Microid Research!
- Readers, including Mick O'Donnell, Martyn Smith, Chris Crook, Chris Nicholson, Dart Computers, Pat Tan, John Dallman, Ulf Boehlau, Rick and Tilman at ProData, Adrian Clint of Samsung, Peter Farrow, Kerry and Toni at Award Software, Chuck French at Unicore, Ali Kiafar at ECS/TTX, John Dann at ProData, Jerome Czeikus and Mike Echlin.
- **amibios.txt**, available from Jean-Paul Rodrigue in the University of Montreal, which had useful snippets, especially the explanation of Fast Decode.
- **amisetup**, a shareware program from Robert Muchsel.Copyrights, etc.

Praise For The BIOS Companion

"The computer book of the month is The Bios Companion by Phil Croucher. Long-time readers of this column will recall I have recommended his book before. This tells you everything you ought to know about the BIOS in your system. Post codes, options, upgrades, you name it. Years ago, I called an earlier edition of this invaluable and I see no reason to change my view. Recommended."

Jerry Pournelle, *Byte Magazine*

"You will find more information about your motherboard assembled here than I have ever seen."

Frank Latchford *PCCT*

"Thank! I really appreciated this. I read it and was able to adjust my BIOS settings so that my machine runs about twice as fast. Pretty impressive. Thanks again."

Tony

"This book is worth far more than is charged for it. Very well written. Probably the most-used reference book in my shop. ....a great value as the feature explanations trigger your thinking and allow you to figure out many related BIOS features in some of the newer versions."

Amazon reader

"For those who need or want to fine tune, or simply understand, the basic and advanced features of their PC's BIOS, this book is an invaluable guide. It has a very broad range and covers both fundamental and more advanced topics as well as issues specific to particular bios types (AMI, PHOENIX, etc.) and versions. This is one book you need to have as a PC technician and a valuable resource for trouble shooting and configuring your personal PC even if your not."

Amazon reader

"I found The Bios companion so useful that I "just have" to have all 3 books in the set. The extra Bios Companion is going to a friend who will gain great benefit from it. Yes I definitely want all three books. Thank you very much."

Mike Reinbolt

"I received my package today containing the BIOS Companion book and 2 CD set.... I'm really impressed with what I did receive. I already had about HALF of the information, and to get THAT much, I had to get several books and web pages. GOOD JOB!!

I had more time to go thru the book and think that you should change the word "HALF" to "FOURTH".

I commend you on the great job you did. That's a hell of a lot of work for any major company to do, let alone an individual."

Craig Stubbs

"I thoroughly enjoyed my purchase! The BIOS Companion is worth the cost just for the beep-code section alone. I am new to computers and have found the book and your site to be quite informative."

pcworker

"I thought the BIOS Companion was quite good. Just chock full of the kind of info I had been looking for. First book I've gotten that was worth the more than price I paid."

Tony

"While you are appreciative of my order, I am likewise appreciative of your efforts to make such a reference available. BIOS's are the most mysterious things in the computing world to figure out. I realize the BIOS manufactures have made great effort to provide detailed information in the BIOS help (F1) (ok, so that's a bit of sarcasm). Traditionally, I have had to piece bits of information together that I have found at various locations. Once again thanks."

Brian Presson, System Engineer

"The Bios companion is an absolute must for anyone who builds or configures PC's! It is by far worth the money you pay for it. Phil Croucher has done a superb job! He explains in great detail all of the settings that even most PC technicians have no idea of what they do or effect, and mostly some very helpful suggestions on system settings as well. An Absolute Must have!"

Larry Stark, LPG Computers
Memphis, TN

"I purchased the 2000 edition of the complete The BIOS Companion - PDF from DigiBuy today. Any way you look at it, the information contained is well worth the $15 dollar investment. I must personally thank you for publishing such a wonderful resource for techies such as myself. Thank you again for all of the hard work."

Sincerely, Boyd Stephens

"I spent two hours going through the different sections therein. Everything is there and I can only say, 'AWSOME'."

Robert, San Francisco

"Hi, Phil

The book is absolutely phenomenal !! - Congratulations ! This is exactly the kind of reference many people (including our instructors) need - everything in one place, beautifully organised, crammed full of essential, UNDERSTANDABLE, info."

Alain Hendrikse, South Africa

"Your BIOS guide I had from 1994 was one of those 'never throw it away' items that I knew I would need an update for."

Adrian Clint

Contents

1 THE BIOS

The instructions that turn a PC into a useful machine come in three stages, starting with application programs, which are loaded by an operating system, which in turn is loaded by a bootstrap loader in the BIOS (the *Basic Input/Output System*). There are several in a PC, a good example being the one on the video card that controls the interface between it and the computer. However, we are concerned with the *System BIOS*, which is a collection of assembly language routines that allow programs and the components of a PC to communicate with each other at low level. It therefore works in two directions at once and is active all the time your computer is switched on. In this way, software doesn't have to talk to a device directly, but can call a BIOS routine instead. However, the BIOS is quite an Achilles Heel and can produce many incompatibilities, so these days it is often bypassed by 32-bit software (DOS relied on it totally) - some functions have migrated to the operating system, starting with Power Management (see *ACPI*), but NT and W2K have long been replacing BIOS Code with their own *Hardware Abstraction Layer* (HAL) in the Shadowed ROM area traditionally used by the BIOS after the machine has started.

LinuxBIOS is an Open Source project aimed at replacing it with a little hardware initialization and a compressed Linux kernel that can be booted from a cold start (inside 3 seconds at last count). Linux, once bootstrapped, does not make use of BIOS calls, as it has all the low level hardware drivers itself. In addition, a "trusted BIOS" is being developed that can be included in any system that requires high assurance, such as NetTop. Some access to the Video BIOS is also allowed by some manufacturers.

For the moment, though, the System BIOS will work in conjunction with the *chipset*, which is really what manages access to system resources such as memory, cache and the data buses, and actually is the subject of this book, as all those advanced settings relate to the chipset and not the BIOS as such.

On an IBM-compatible, you will find the BIOS embedded into a ROM on the motherboard, together with hard disk utilities and a CMOS setup program, although this will depend on the manufacturer (the BIOS and CMOS are separate items). The ROM will usually occupy a 64K segment of upper memory at F000 in an ISA system, and a 128K segment starting at E000 with EISA or similar. It's on a chip so it doesn't get damaged if a disk fails, as sometimes used to happen on the Victor 9000/Sirius, which had the BIOS and system on the boot floppy.

Older machines, such as 286s, will have two ROMs, labelled *Odd* and *Even*, or *High* and *Low* (they must be in the right slots), because of the 16-bit bus, but these days there tends to be only one-look for one with a printed label (older 386s sometimes had 4). You can get away with one because BIOS code is often copied into *Shadow RAM* (explained later), and not actually executed from ROM, but from extended memory. In addition, much of the code is redundant once the machine has started, and it gets replaced by the operating system anyway. Some newer machines may actually have two single-chip BIOSes, so if one fails, the back-up kicks in. Well, in theory, anyway - there have been reports of the BIOSes flashing each other out, so later backups have become read-only.

A *Flash ROM* allows you to change BIOS code without replacing chip(s). Flash ROM, or *programmable read-only nonvolatile RAM*, if you want to be posh, is similar to the EEPROM, being a storage medium that doesn't need a continuous power source, but deals with several blocks of memory at once, rather than single bytes, making it slightly faster, but only just. Also, Flash devices can be programmed in situ, whereas EEPROMS need a special device.

Older BIOSes used EPROMs, which require ultra violet light to erase them, so were a more permanent solution. Even older BIOSes used PROMs, which can't be changed at all once programmed. All are *nonvolatile*, which means that they don't need a continuous source of power to keep information in them. Actually, this does include CMOS chips, as the power referred to is mains and not battery power, but the A+ exam might not agree.

BIOS DATA AREA

As well as ROM space, the BIOS takes 256 bytes of low memory as a *BIOS Data Area*, which contains details about the Num Lock state, keyboard buffer, etc. DOS, or whatever, loads higher than this, so it's quite safe. When power is applied, the BDA is created at memory location 0040:0000h. Here is what's in it::

Hex	Dec	Service	Size	Function
00h	0	Int 14h	2 bytes	Base I/O address for serial port 1 (COM 1)
02h	2	Int 14h	2 bytes	Base I/O address for serial port 2 (COM 2)
04h	4	Int 14h	2 bytes	Base I/O address for serial port 3 (COM 3)
06h	6	Int 14h	2 bytes	Base I/O address for serial port 4 (COM 4)
08h	8	Int 17h	2 bytes	Base I/O address for parallel port 1 (LPT 1)
0Ah	10	Int 17h	2 bytes	Base I/O address for parallel port 2 (LPT 2)
0Ch	12	Int 17h	2 bytes	Base I/O address for parallel port 3 (LPT 3)
0Eh	14	POST	2 bytes	Base I/O address for parallel port 4 (LPT 4)
10h	16	Int 11h	2 bytes	Equipment Word Bits 15-14 - parallel ports installed 00b = 1 parallel port 01b = 2 parallel ports 03b = 3 parallel ports Bits 13-12 are reserved Bits 11-9 - serial ports installed 000b = none 001b = 1 serial port 002b = 2 serial ports 003b = 3 serial ports 004b = 4 serial ports Bit 8 is reserved Bit 7-6 - floppy drives installed 0b = 1 floppy drive 1b = 2 floppy drives Bits 5-4 - video mode 00b = EGA or later 01b = color 40x25 10b = color 80x25 11b = monochrome 80x25

Hex	Dec	Service	Size	Function
				Bit 3 is reserved Bit 2 - PS/2 mouse 0b = not installed 1b = installed Bit 1 - math coprocessor 0b = not installed 1b = installed Bit 0 - boot floppy 0b = not installed 1b = installed
12h	18	POST	1 byte	Interrupt flag - Manufacturing test
13h	19	Int 12h	2 bytes	Memory size in Kb
15h	21		2 bytes	Error codes for AT+; Adapter memory size
17h	22	Int 16h	1 byte	Keyboard shift flags 1 Bit 7 - Insert 0b = Insert off 1b = Insert on Bit 6 - CapsLock 0b = CapsLock off 1b - CapsLock on Bit 5 - NumLock 0b = NumLock off 1b = NumLock on Bit 4 - ScrollLock 0b = ScrollLock off 1b = ScrollLock on Bit 3 - Alt key 0b = Alt key is up 1b = Alt key is down Bit 2 - Control key 0b = Control key is up 1b = Control key is down Bit 1 - Left Shift key 0b = Left Shift key is up 1b = Left Shift key is down Bit 0 - Right Shift key 0b = Right Shift key is up 1b = Right Shift key is down
18h	23	Int 16h	1 byte	Keyboard shift flags 2 Bit 7 - Insert key 0b = Insert key is up 1b = Insert key is down Bit 6 - CapsLock 0b = CapsLock is key is up 1b = CapsLock key is down Bit 5 - NumLock key 0b = NumLock key is up 1b = Numlock key is down Bit 4 - ScrollLock key 0b = ScrollLock key is up 1b = ScrollLock key is down Bit 3 - Pause key 0b = pause key is inactive 1b = Pause key is active Bit 2 - SysReg key 0b = SysReg key is up 1b = SysReg key is down

Hex	Dec	Service	Size	Function
				Bit 1 - Left Alt key 0b = Left Alt key is up 1b = Left Alt key is down Bit 0 - Right Alt key 0b = Right Alt key is up 1b = Right Alt key is down
19h	24	Int 09h	1 byte	Alt Numpad work area
1Ah	26	Int 16h	2 bytes	Pointer - next character in keyboard buffer
1Ch	28	Int 16h	2 bytes	Pointer - last character in keyboard buffer
1Eh	60	Int 16h	32 bytes	Keyboard buffer
3Eh	61	Int 13h	1 byte	Floppy disk drive calibration status Bits 7-4 are reserved Bit 3 = floppy drive 3 (PC, XT) Bit 2 = floppy drive 2 (PC, XT) Bit 1 = floppy drive 1 Bit 0 = floppy drive 0 0b not calibrated 1b calibrated
3Fh	62	Int 13h	1 byte	Floppy disk drive motor status Bit 7 - current operation 0b = read or verify operation 1b = write or format operation Bit 6 is not used Bit 5-4 - drive select 00b = Drive 0 01b = Drive 1 10b = Drive 2 (PC, XT) 11b = Drive 4 (PC, XT) Bit 3 - drive 3 motor 0b = motor off 1b = motor on Bit 2 - drive 2 motor 0b = motor off 1b = motor on Bit 1 - drive 0 motor 0b = motor off 1b = motor on
40h	63	Int 13h	1 byte	Floppy disk drive motor time-out
41h	64	Int 13h	1 byte	Floppy disk drive status Bit 7 - drive ready status 0b = drive ready 1b = drive not ready (time out) Bit 6 - seek status 0b = no seek error detected 1b = seek error detected Bit 5 - floppy disk controller test 0b = floppy disk controller passed 1b = floppy disk controller failed

Hex	Dec	Service	Size	Function
				Bit 4-0 error codes 00000b = no errors 00001b = illegal function requested 00010b = address mark not found 00011b = write protect error 00100b = sector not found 00110b = diskette change line active 01000b = DMA overrun 01001b = DMA boundary error 01100b = unknown media type 10000b = CRC error during read
42h	65	Int 13h	1 byte	Hard disk and floppy controller status register 0 Bit 7-6 - the interrupt code 00b = command completed normally 01b = abnormal termination 10b = abnormal termination, ready on, diskette changed 11b = seek command not completed Bit 5 - seek command 0b = seek command not completed 1b = seek command completed Bit 4 - drive fault 0b = no drive fault 1b = drive fault Bit 3 - drive ready 0b = drive ready 1b = drive not ready Bit 2 - head state when interrupt occurred 00b = drive 0 01b = drive 1 10b = drive 2 (PC, XT) 11b = drive 3 (PC, XT) Bit 1-0 indicates drive select 00b = drive 0 01b = drive 1 10b = drive 2 (PC, XT) 11b = drive 3 (PC, XT)
43h	66	Int 13h	1 byte	Floppy drive controller status register 1 Bit 7, 0b = no error 1b = access beyond last cylinder Bit 6, 0b = not used Bit 5, 1b = CRC error during read Bit 4, 1b = DMA overrun Bit 3, 0b = not used Bit 2, 1b = Sector not found or read ID fail Bit 1, 1b = medium write protected Bit 0, 1b = missing address mark
44h	67	Int 13h	1 byte	Floppy drive controller status register 2 Bit 7, 0b = not used Bit 6, 1b = deleted data address mark Bit 5, 1b = CRC error detected Bit 4, 1b = wrong cylinder Bit 3, 1b = condition of equal during verify Bit 2, 1b = sector not found during verify Bit 1, 1b = bad cylinder Bit 0, 1b = address mark not found on read
45h	68	Int 13h	1 byte	Floppy disk controller: cylinder number
46h	69	Int 13h	1 byte	Floppy disk controller: head number
47h	70	Int 13h	1 byte	Floppy disk controller: sector number

Hex	Dec	Service	Size	Function
48h	71		1 byte	Floppy disk controller: number of byte written
49h	72	Int 10h	1 byte	Active video mode setting
4Ah	74	Int 10h	2 bytes	Textcolumns per row for the active video mode
4Ch	76	Int 10h	2 bytes	Size of active video in page bytes
4Eh	78	Int 10h	2 bytes	Offset address of active video page relative to start of video RAM
50h	80	Int 10h	2 bytes	Cursor position for video page 0
52h	82	Int 10h	2 bytes	Cursor position for video page 1
54h	84	Int 10h	2 bytes	Cursor position for video page 2
56h	86	Int 10h	2 bytes	Cursor position for video page 3
58h	88	Int 10h	2 bytes	Cursor position for video page 4
5Ah	90	Int 10h	2 bytes	Cursor position for video page 5
5Ch	92	Int 10h	2 bytes	Cursor position for video page 6
5Eh	94	Int 10h	2 bytes	Cursor position for video page 7
60h	96	Int 10h	2 bytes	Cursor shape
62h	97	Int 10h	1 byte	Active video page
63h	99	Int 10h	2 bytes	I/O port address for the video display adapter
65h	100	Int 10h	1 byte	Video display adapter internal mode register Bit 7, 0b = not used Bit 6, 0b = not used Bit 5 0b = attribute bit background intensity 1b = attribute bit controls blinking Bit 4, 1b = mode 6 graphics operation Bit 3 - video signal 0b = video signal disabled 1b = video signal enabled Bit 2 - color operation 0b = color operation 1b = monochrome operation Bit 1, 1b = mode 4/5 graphics operation Bit 0, 1b = mode 2/3 test operation
66h	101	Int 10h	1 byte	Color palette Bit 7, 0b = not used Bit 6, 0b = not used Bit 5 - mode 5 foreground colors 0b = green/red/yellow 1b = cyan/magenta/white Bit 4 - background color 0b = normal background color 1b = intensified background color Bit 3 - intensified border color (mode 2) and background color (mode 5) Bit 2 - red Bit 1 - green Bit 0 - blue
67h	103		2 bytes	Adapter ROM offset address
69h	106		2 bytes	Adapter ROM segment address

Hex	Dec	Service	Size	Function
6Bh	107		1 byte	Last interrupt (not PC) Bit 7 - IRQ 7 0b = did not occur 01 = did occur Bit 6 - IRQ 6 0b = did not occur 01 = did occur Bit 5 - IRQ 5 0b = did not occur 01 = did occur Bit 4 - IRQ 4 0b = did not occur 01 = did occur Bit 3 - IRQ 3 0b = did not occur 01 = did occur Bit 2 - IRQ 2 0b = did not occur 01 = did occur Bit 1 - IRQ 1 0b = did not occur 01 = did occur Bit 0 - IRQ 0 0b = did not occur 01 = did occur
6Ch	111	Int 1Ah	4 bytes	Counter for Interrupt 1Ah
70c	112	Int 1Ah	1 byte	Timer 24 hour flag
71h	113	Int 16h	1 byte	Keyboard Ctrl-Break flag
72h	115	POST	2 bytes	Soft reset flag
74h	116	Int 13h	1 byte	Status of last hard disk operation 00h = no errors 01h = invalid function requested 02h = address mark not found 04h = sector not found 05h = reset failed 06h = removable media changed 07h = drive parameter activity failed 08h = DMA overrun 09h = DMA boundary overrun 0Ah = bad sector flag detected 0Bh = bad track detected 0Dh = invalid number of sectors on 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 failure 40h = seek operation failed 80h = timeout AAh = drive not ready BBh = undefined error occurred CCh = write fault on selected drive E0h = status error or error register is zero FFh = sense operation failed
75h	117	Int 13h	1 byte	Number of hard disk drives

Hex	Dec	Service	Size	Function
76h	118	Int 13h	1 byte	Hard disk control byte Bit 7 0b = enables retries on disk error 1b = disables retries on disk error Bit 6 0b = enables reties on disk error 1b = enables reties on disk error Bit 5, 0b = not used Bit 4, 0b = not used Bit 3 0b = drive has less than 8 heads 1b = drive has more than 8 heads Bit 2, 0b = not used Bit 1, 0b = not used Bit 0, 0b = not used
77h	119	Int 13h	1 byte	Offset address of hard disk I/O port (XT)
78h	120	Int 17h	1 byte	Parallel port 1 timeout
79h	121	Int 17h	1 byte	Parallel port 2 timeout
7Ah	122	Int 17h	1 byte	Parallel port 3 timeout
7Bh	123		1 byte	Parallel port 4 timeout (PC, XT) support for virtual DMA services (VDS) Bit 7, 0b = not used Bit 6, 0b = not used Bit 5 - virtual DMA services 0b = not supported 1b = supported Bit 4, 0b = not used Bit 3 - chaining on interrupt 4Bh 0b = not required 1b = required Bit 2, 0b = not used Bit 1, 0b = not used Bit 0, 0b = not used
7Ch	124	Int 14h	1 byte	Serial port 1 timeout
7Dh	125	Int 14h	1 byte	Serial port 2 timeout
7Eh	126	Int 14h	1 byte	Serial port 3 timeout
7Fh	127	Int 14h	1 byte	Serial port 4 timeout
80h	129	Int 16h	2 bytes	Starting address of keyboard buffer
82h	131	Int 16h	2 bytes	Ending address of keyboard buffer
84h	132	Int 10h	1 byte	Number of video rows (minus 1)
85h	134	Int 10h	2 bytes	Number of scan lines per character
87h	135	Int 10h	1 byte	Video display adapter options Bit 7 - bit 7 of last video mode 0b = clear display buffer setting mode 1b = do not clear the display buffer Bit 6-4 - memory on video adapter 000b = 64Kb 001b = 128Kb 010b = 192Kb 011b = 256Kb 100b = 512Kb 110 = 1024Kb or more Bit 3 - video subsystem 0b = not active 1b = active Bit 2 is reserved

Hex	Dec	Service	Size	Function
				Bit 1 - monitor type 0b = color 1b = monochrome Bit 0 - alphanumeric cursor emulation 0b = disabled 1b = enabled
88h	136	Int 10h	1 byte	Video display adapter switches Bit 7 - state of feature connector line 1 Bit 6 - state of feature connector line 0 Bit 5-4 not used Bit 3-0 - adapter type switch settings 0000b = MDA/color 40x25 0001b = MDA/color 80x25 0010b = MDA/high-resolution 80x25 0011b = MDA/high-res enhanced 0100b = CGA 40x25/monochrome 0101b = CGA 80x25/monochrome 0110b = color 40x25/MDA 0111b = color 80x25/MDA 1000b = high-resolution 80x25/MDA 1001b = high-res enhanced/MDA 1010b = monochrome/CGA 40x25 1011b = monochrome/CGA 80x25
89h	137	Int 10h	1 byte	VGA video flags 1 Bit 7 and 4 - scanline mode 00b = 350-line mode 01b = 400-line mode 10b = 200-line mode Bit 6 - display switch 0b = disabled 1b = enabled Bit 5 is reserved Bit 3 - default palette loading 0b = disabled 1b= enabled Bit 2 - monitor type 0b = color 1b = monochrome Bit 1 - gray scale summing 0b = disabled 1b = enabled Bit 0 - VGA active state 0b = VGA inactive 1b = VGA active
8Ah	138	Int 10h	1 byte	VGA video flags 2
8Bh	139	Int 13h	1 byte	Floppy disk configuration data Bit 7-6 - last data sent to controller 00b = 500 Kbit/sec/sec 01b = 300 Kbit/sec 10b = 250 Kbit/sec 11b = rate not set or 1 Mbit/sec Bit 5-4 - last drive steprate to controller 00b = 8ms 01b = 7ms 10b = 6ms 11b = 5ms Bit 3-2 - data rate, set at start (Bits 7-6) Bit 1-0 not used

Hex	Dec	Service	Size	Function
8Ch	140	Int 13h	1 byte	Hard disk drive controller status Bit 7 - controller state 0b = controller not busy 1b = controller busy Bit 6 indicates drive ready state 0b = drive selected not ready 1b = drive selected ready Bit 5 - write fault 0b = write fault did not occur 1b = write error occurred Bit 4 - seek state 0b = drive selected seeking 1b = drive selected seek complete Bit 3 - data request 0b = data request is inactive 1b = data request is active Bit 2 - data correction 0b = data not corrected 1b = data corrected Bit 1 - index pulse state 0b = index pulse inactive 1b = index pulse active Bit 0 - error 0b = no error 1b = error in previous command
8Dh	141	Int 13h	1 byte	Hard disk drive error Bit 7 - bad sector 0b = not used 1b = bad sector detected Bit 6 - ECC error 0b = not used 1b = uncorrectable ECC error Bit 5 - media state 0b = not used 1b = media changed Bit 4 - sector state 0b = not used 1b = ID or target sector not found Bit 3 - media change request state 0b = not used 1b = media change requested Bit 2 - command state 0b = not used 1b = command aborted Bit 1 - drive track error 0b = not used 1b = track 0 not found Bit 0 - address mark 0b = not used 1b = address mark not found
8Eh	142	Int 13h	1 byte	Hard disk drive task complete flag
8Fh	143	Int 13h	1 byte	Floppy disk drive information Bit 7 not used Bit 6 - drive 1 type determination 0b = not determined 1b = determined Bit 5 - drive 1 multirate status 0b = no 1b = yes

Hex	Dec	Service	Size	Function
				Bit 4 - diskette 1 change line detection 0b = no 1b = yes Bit 3 not used Bit 2 - drive 0 type determination 0b = not determined 1b = determined Bit 1 - drive 0 multirate status 0b = no 1b = yes Bit 0 - diskette 0 change line detection 0b = no 1b = yes
90h	144	Int 13h	1 byte	Diskette 0 media state Bit 7-6 - transfer rate 00b = 500 Kbit/sec 01b = 300 Kbit/sec 10b = 250 Kbit/sec 11b = 1 Mbit/sec Bit 5 - double stepping 0b = not required 1b = required Bit 4 - media in floppy drive 0b = unknown media 1b = known media Bit 3 not used Bit 2-0 - last access 000b = 360k media in 360K drive 001b = 360K media in 1.2M drive 010b = 1.2M media in 1.2M drive 011b = known 360K media 360K drive 100b = known 360K media in 1.2M drive 101b = known 1.2M media in 1.2M drive 110b = not used 111b = 720K media in 720K drive or 1.44M media in 1.44M drive
91h	145	Int 13h	1 byte	Diskette 1 media state As for Diskette 0
92h	146	Int 13h	1 byte	Diskette 0 operational starting state Bit 7 - data transfer rate 00b = 500 Kbit/sec 01b = 300 Kbit/sec 10b = 250 Kbit/sec 11b = 1 Mbit/sec Bits 5-3 not used Bit 2 - drive determination 0b = drive type not determined 1b = drive type determined Bit 1 - drive multirate status 0b = drive is not multirate 1b = drive is multirate Bit 0 - change line detection 0b = no change line detection 1b = change line detection
93h	147	Int 13h	1 byte	Diskette 1 operational starting status As for Diskette 0
94h	148	Int 13h	1 byte	Diskette 0 current cylinder
95h	149	Int 13h	1 byte	Diskette 1 current cylinder

Hex	Dec	Service	Size	Function
96h	150	Int 16h	1 byte	Keyboard status flags 3 Bit 7, 1b = reading 2 byte keyboard ID Bit 6, 1b = last code was first ID character Bit 5, 1b = forced Numlock on Bit 4 - 101/102 key keyboard 0b = present 1b = not present Bit 3 - right alt key active 0b = not active 1b = active Bit 2 - right control key active 0b = not active 1b = active Bit 1, 1b = last scancode was E0h Bit 0, 1b = last scancode was E1h
97h	151	Int 16h	1 byte	Keyboard status flags 4 Bit 7, 1b = keyboard transmit error Bit 6, 1b = LED update in progress Bit 5, 1b = re-send code received Bit 4, 1b = acknowledge code received Bit 3, 1b = reserved Bit 2 indicates CapsLock LED state 0b = CapsLock LED off 1b = CapsLock LED on Bit 1 indicates NumLock LED state 0b = NumLock LED off 1b = NumLock LED on Bit 0 indicates ScrollLock LED state 0b = ScrollLock LED off 1b = ScrollLock LED on
98h	155		4 bytes	Segment:Offset address of user wait flag pointer
9Ch	159		4 bytes	User wait count
A0h	160		1 byte	User wait flag Bit 7, 1b = wait time has elapsed Bit 6, 1b not used Bit 0 - wait progress 0b = no wait in progress 1b = wait in progress
A1h	167		7 bytes	Local area network (LAN) bytes
A8h	171		4 bytes	Segment:Offset address of video parameter control block
ACh	239		68 bytes	Reserved
F0h	255		16 bytes	Intra-applications communications area

There are several types of BIOS because so many computers need to be IBM-compatible; they're not allowed to copy each other, for obvious reasons. The BIOS worries about all the differences and presents a standard frontage to the operating system, which in turn provides a standard interface for application programs. PC and motherboard manufacturers used to make their own BIOSes, and many still do, but most are now based on code from third party companies, the most well-known of which are Phoenix, Award, Microid Research and American Megatrends (AMI). However, all is not what it seems! Award Software owns Unicore (aka **esupport.com**, the upgraders), which in turn owns MR, which does the customised stuff. Phoenix also owns Quadtel and has merged with Award.

WHAT HAPPENS WHEN YOU SWITCH ON

The (x86) CPU is programmed to read the address space at FFFF:0000h, the last 16 bytes of memory in the first megabyte, which is just large enough to contain a jump command (JMP) that tells the processor where to find the BIOS code it is looking for (this is the bootstrap process). Next, the *Power On Self Test* (or POST) is run, to ensure the hardware is working (see the listings for each manufacturer to see what is actually done). During the POST, the BIOS will look for a video BIOS between C000:000h and C780:000h, and test its checksum, after which it will allow the video BIOS to initialise itself and retake control afterwards (you will see the manufacturer's logo and various ID strings on the screen). Then the area between C800:000h to DF80:0000h will be searched in 2 K increments, looking for other ROMs. They, too, will be initialised after a checksum test.

The memory area at 0000:0472h contains a flag which will tell the BIOS if a cold or warm boot has occurred (a value of 1234h means it is a warm boot. Being in *little endian format*, where the least significant byte comes first, it will be in memory as 3412). A warm boot means that most of the POST can be skipped. Once the POST is over, the BIOS looks for an operating system in various locations. Traditionally, the order is the first floppy then the first hard drive, but you can change all that in the CMOS, to include CD ROM drives, Zip drives, etc.

If the floppy drive has a bootable disk in it, the BIOS will load sector 1, head 0, cylinder 0 into memory, starting at 0000:7C00h.

HOW OLD IS MY BIOS?

If you want to check how old your BIOS is, the date is on the start-up screen, usually buried in the BIOS ID String, which looks a bit like this (**121291** is the date in this AMI sample):

```
40-0201-BY6379-01101111-121291-UMCAUTO-04
```

If you don't get one, you can also use **debug**. The BIOS lives between F000:0000 and F000:FFFF, with copyright messages typically at F000:E000, F000:C000 and F000:0000.

Type:

```
debug
```

at the DOS prompt. A minus sign will appear. Press *D* followed by an address in memory to see the 128 bytes' worth of the values stored there, for example:

```
-d f000:e000
```

You can also use the *S* command to search for the word "version", although some computers, IBM and Compaq, for example, don't use version numbers. In this case, the date will be near F000:FFE0. Quit **debug** by pressing *q* at the prompt. The AMI WinBIOS has a normal date on the startup screen. Otherwise, as you can see, you don't just get the date - many manufacturers include extras that identify the state of the chipset inside. For example, with the AMI Hi-Flex BIOS, there are two more strings, displayed by pressing **Ins** during bootup, or any other key to create an error condition.

IDENTIFYING YOUR BIOS

Acer ID Strings

In the bottom left hand corner of the screen:

```
ACR89xxx-xxx-950930-R03-B6
```

The first 2 characters after ACR identify the motherboard (see table). The last few are the BIOS revision. The ones before that are the date (e.g. **950930**).

ID	Board	Product	ID	Board	Product
05	X1B	Altos 19000	4B	V55LA-2M	Acros, Power, Aspire
07	M7	Altos 900 & 9000M	5A	X3	Altos 19000 Pro 4
19	V55-2	Acros, Power	62	V65X	AcerAcros PII
1A	M3A	Altos 300	63	V58	Entra
1B	V35	Power	67	V65LA	Acros, Power
22	V50LA-N	Acros, Power	6B	A1G4	Acros
24	M9B	Altos 9000/Pro	6D	V20	AcerPower
25	V55LA	Acros, Power, Aspire	89	M5	Altos 7000P
29	V60N	AcerPower	8F	M3 (SCSI)	Altos 9000
2F	M11A	Altos 900/Pro	8F	M3-EIDE	AcerPower (590)
30	V56LA	Acros, Power, Aspire	99	A1GX, -2	Acros, Power
33	V58LA	Acros, Power, Aspire	9A	V30, -2	Acros, Power
35	V35N	Acros, Power	9C	V12LC, -2X	Acros, Power, Aspire
46	M9N	Altos 920 and 9100			

ALR (Gateway) ID Strings

BIOS ID Begins	Motherboard
SU81010A	E-1400
0AAGT	E-1000
0AAKW	PII
404CL0X0	PII
4D4KL0X0	Dual PII
4J4NB0X1	Pentium
4K4UE0X1	E-1200
4M4PB0X1	PII
4M4SG0X0	PII
4R4CB0XA	Pentium 440BX

AMI ID Strings

The release number is at the top left of the screen for AMI boards. The ID string is at the bottom left. The AMI BIOS and BIOS Plus series (1986-1990) looks like this (for example):

```
DINT-1123-04990-K8
```

Or, in other words:

```
aaaa-bbbb-mmddyy-Kc
```

where:

```
aaaa   BIOS type
bbbb   Customer Number
mmddyy Release date
Kc     Keyboard BIOS version number
```

If the first customer number (in bold above) is **1**, **2**, **8** or a **letter**, it is a non-AMI Taiwanese motherboard. If it is **3**, **4** or **5**, it is from AMI. **50** or **6** means a non-AMI US motherboard and **9** means an evaluation BIOS for a Taiwanese manufacturer. Otherwise, there can be up to three lines (from 1991 onwards) at the bottom left of the screen. The first is displayed automatically, the other two can be seen by pressing the **Insert** key. Aside from version numbers, the 1s and 0s indicate the state of the settings inside. The Hi-Flex BIOS might look like this (from 1991):

```
41-0102-zz5123-00111111-101094-AMIS123-P
```

Again, check the bold numbers in the third set for the manufacturer.

NON-AMI TAIWANESE BOARDS (1XXX, 8XXX)

Code	Manufacturer	Code	Manufacturer
1003	QDI	1514	Wuu Lin
1045	Vtech/PC Partner	1519	Epox
1101	Sunlogix	1526	Eagle
1102	Soyo	1531	Force
1103	Tidalpower	1540	BCM
1105	Autocomputer	1546	Golden Horse
1106	Dynasty	1549	CT Continental
1107	Dataexpert	1564	Random Technology
1108	Chaplet	1576	Jetta
1109	Fair Friend	1585	Gleem
1111	Paoku	1588	Boser
1112	Aquarius Systems	1593	Advantech
1113	MicroLeader	1594	Trigon
1114	Iwill	1608	Consolidated Marketing
1115	Senior Science	1612	Datavan
1116	Chicony	1617	Honotron
117	A-Trend	1618	Union Genius
1120	Unicorn	1621	New Paradise
1121	First International	1622	RPT Intergroups
1122	MicroStar/NoteStar	1628	Digital Eqpt Intl
1123	Magtron	1630	Iston
1124	Tekram	1647	Lantic
1126	Chuntex	1652	Advanced Semiconductor
1128	Chaintech	1655	Kingston Tech
1130	Pai Jung	1656	Storage System
1131	ECS (Elite Group)	1658	Macrotek
1132	Dkine	1666	Cast Technology
1133	Seritech	1671	Cordial Far East
1135	Acer	1672	Lapro

Code	Manufacturer	Code	Manufacturer
1136	Sun Electronics	1675	Advanced Scientific
1138	Win Win	1685	High Ability
1140	Angine	1691	Gain Technology
1141	Nuseed	1700	DSG Technology
1142	Firich	1707	Chaining Computer
1143	Crete	1708	E-San
1144	Vista	1719	Taiwan Turbo
1146	Taste	1720	Fantas
1147	Integrated Tech Express	1723	NTK
1150	Achitec	1727	Tripod
1151	Accos1	1737	Ay Ruey
1152	Top-Thunder	1739	Jetpro
1154	San Li	1743	Mitac
1156	Technical House	1759	Bek-Tronic
1158	Hi-Com	1762	Ansoon
1159	Twinhead	1770	Acer Incorp.
1161	Monterey Intl	1771	Toyen
1163	Softek	1774	Acer Sertek
1165	Mercury	1776	Joss
1168	Rio Works	1780	Acrosser
1169	MicroStar	1783	Efar
1170	Taiwan Igel	1788	Systex
1171	Shining Yuan	1792	U-board
1172	Giantec	1794	CMT
1175	Applied Component Tech	1796	J & J
1176	Sigma	1800	Syzygia
1177	High Tech Information	1801	Palit
1178	Clevo	1806	Interplanetary Info
1180	Paladin	1807	Expert
1181	Leo Systems (FIC)	1810	Elechands Intl
1182	Alpha-Top	1815	Powertech
1183	Mirle Automation	1820	Ovis
1184	Delta Electronics	1823	Inlog Micro
1188	Quanta	1826	Tercomputer
1190	Chips & Technologies	1827	Anpro
1192	Interlogic Industries/ICP	1828	Axiom
1193	Sercom	1840	New Union KH
1195	GNS	1845	PC Direct/Proware
1196	Universal Scientific	1846	Garnet Intl
1197	Golden Way	1847	Brain Power
1199	Gigabyte	1850	HTR Asia Pacific
1201	New Tech Intl	1853	Veridata
1203	Sunrex	1856	Smart D & M
1204	Bestek	1867	Lutron
1209	Puretek	1868	Soyo
1210	Rise	1879	Aeontech Intl
1211	DFI	1881	Manufacturing Tech
1214	Rever Computer	1888	Seal Intl
1218	Elite Computer	1889	Rock

Code	Manufacturer	Code	Manufacturer
1221	Darter tech	1906	Freedom Data
1222	Domex	1914	Aquarius Systems
1223	BioStar	1917	Source of Computer
1225	Yung Lin	1918	Lanner
1229	Dataworld Intl	1920	Ipex ITG Intl
1234	Leadman Electronics	1924	Join Corp
1235	Formosa Industrial	1926	Kou Sheng
1238	Win Tech	1927	Seahill Tech
1240	Free Computer	1928	Nexcom Intl
1241	Mustek	1929	CAM Enterprise
1242	Amptek	1931	Aaeon Techlogu
1244	Flytech	1932	Kuei Hao
1246	Cosmotech	1933	ASMT
1247	Abit	1934	Silver Bally
1248	Muse	1935	Prodisti
1251	Portwell	1936	Codegen
1252	Sono Computer	1937	Orientech
1256	Lucky Star	1938	Project Info
1258	Four Star	1939	Arbor
1259	GVC	1940	Sun Top
1260	DT Research	1941	Funtech
1262	Arima	1942	Sunflower
1266	Modula	1943	Needs System
1270	Portwell	1945	Norm Advanced
1271	Tidal	1947	Ten Yun
1272	Ultima Electronics	1948	Beneon
1273	UFO Systems	1949	National Advantage
1274	Full Yes	1950	MITS
1275	Jackson Dai Industrial	1951	Macromate
1276	Jetway	1953	Orlycon
1277	Tarng Bow	1954	Chung Yu
1281	EFA	1955	Yamashita
1283	Advance Creative	1957	High Large
1284	Lung Hwa	1958	Young Micro
1286	Askey Computer	1959	Fastfame
1291	TMC	1960	Acqutek
1292	Asustek	1961	Deson Trade
1297	DD&TT	1962	Atra Comms
1298	Trigem	1963	Dimensions Electronics
1299	Trigem	1964	Micron design
1301	Taken	1965	Cantta
1304	Dual Enterprises	1968	Khi Way
1306	Sky Computer Europe	1969	Gemlight
1309	Protronic	1970	MAT
1317	New Comm	1973	Fugutech
1318	Unitron	1974	Green Taiwan
1323	Inventec	1975	Supertone
1343	Holco	1977	AT&T
1346	Snobol	1978	Winco

Code	Manufacturer
1351	Singdak
1353	J Bond
1354	Protech
1355	Argo Systems
1357	Portwell
1367	Coxswain
1371	ADI
1373	SiS
1379	Win Technolgies
1391	Aten Intl
1392	ACC
1393	Plato Technology
1396	Tatung
1398	Spring Circle
1400	Key Win Electronics
1404	Alptech
1421	Well Join
1422	Labway
1425	Lindata
1437	Hsing Tech
1440	Great Electronics
1450	Win-Lan
1451	Ecel Systems
1452	United Hitech
1453	Kai Mei
1461	Hedonic
1462	Arche
1470	Flexus
1471	CP technology
1472	Datacom
1473	PC Chips
1484	Mitac
1490	Great Tek
1491	President Technology
1493	Artdex
1494	Pro Team
1500	Netcon/Foxen Co
1503	Up Right
1980	Teryang
1981	Nexcom
1982	China Semiconductor
1985	Top Union
1986	DMP
1988	Concierge
1989	Atherton
1990	Expentech
1994	CBR (Japan Cerebro)
1996	Ikon
1998	Chang Tseng
2100	Kapok
2292	Olivetti
6069	Ocean Tech
6081	CSS Labs
6082	Pioneer Computers
6105	Dolch
6132	Technology Power
6165	Genoa
6182	Peaktron
6214	HP
6259	Young Micro
6285	Tyan
6326	Crystal
6328	Alaris
6347	Teknor
6386	Pacific Information
6389	Super Micro
6399	Mylex
6407	Elonex
6423	American Predator
8003	QDI
8005	AVT Industrial
8031	Zida
8045	PC Partner (VTech)
8054	Pine
8078	Weal Union

NON-AMI USA BOARDS (6XXX)

Code	Manufacturer	Code	Manufacturer
105	Dolch	326	Crystal
132	Tech Power Enterprises	386	Pacific Info
156	Genoa	389	Supermicro
259	Young Micro		

ID STRING LINE 1

12_4-7_9-14_16-23_25-30_32-39_41 decodes as follows:

Byte	Description	
1	Processor Type	0 8086/8 2 80286 3 80386, 80486, Pentium
2	Size of BIOS	0 64K 1 128K
4-5	Major Version Number	
6-7	Minor Version Number	
9-14	Reference Number	
16	Halt on Post Error	Set to 1 if On
17	Initialize CMOS every boot	Set to 1 if On
18	Block pins 22 & 23 of keyboard controller	Set to 1 if On
19	Mouse support in BIOS/keyboard controller	Set to 1 if On
20	Wait for if error found	Set to 1 if On
21	Display Floppy error during POST	Set to 1 if On
22	Display Video error during POST	Set to 1 if On
23	Display Keyboard error during POST	Set to 1 if On
25-26	BIOS Date	Month (1-12)
27-28	BIOS Date	Date (1-31)
29-30	BIOS Date	Year (0-99)
32-39	Chipset Identification	BIOS Name
41	Keyboard controller version number	

ID STRING LINE 2

123 5_7-10_12-13_15-16_18-21_23-24_26-27_29-31

Byte	Description
1-2	Pin no for clock switching through keyboard controller
3	High signal on pin switches clock to High(H) or Low (L)
5	Clock switching through chipset registers 0=Off 1=On
7-10	Port address to switch clock high through special port
12-13	Data value to switch clock high through special port
15-16	Mask value to switch clock high through special port
18-21	Port Address to switch clock low through special port
23-24	Data value to switch clock low through special port
26-27	Mask value to switch clock low through special port
29-31	Turbo Sw Input Pin info (Pin no for Turbo Sw Input Pin)

ID STRING LINE 3

1-3 5 7-10 12-13 15-16 18-21 23-24 26-27 29-30 31 33

Byte	Description
1-2	Keyboard Controller Pin no for cache control
3	Keyboard Controller Pin number for cache control
5	High signal is used on the Keyboard Controller pin
7-10	Cache Control through Chipset Registers. 0= control off 1= Control on
12-13	Port Address to enable cache through special port
15-16	Data value to enable cache through special port
18-21	Mask value to enable cache through special port
23-24	Port Address to disable cache through special port
26-27	Data value to disable cache through special port
29-30	Mask value to disable cache through special port
31	Pin number for Resetting 82335 Memory controller.
33	BIOS Modified Flag; Incremented each time BIOS is modified from 1-9 then A-Z and reset to 1. If 0 BIOS has not yet been modified.

INTEL

The AMI version number looks like this when used on Intel motherboards:

```
1.00.XX.??Y
```

where:

```
XX     BIOS version number
??     Intel Motherboard model
Y      Usually 0 or 1
```

1.00.07.DH0 would be BIOS version 7 and a TC430HX (Tucson) motherboard.

AOpen ID Strings

Normally starts with **R** and found in between the model name and the date:

```
AP58 R1.00 July.21.1997
```

Award ID Strings

The date is at the front:

```
05/31/94-OPTI-596/546/82-2A5UIM200-00
```

The next bit is the chipset and the next to last the Part Number, of which characters 6 and 7 identify the manufacturer (**M2**). The first 5 letters (of the part number) refer to the chipset (here **2A5UI**) and the last 2 (**00**) are the model number. An *i* suffix means an Intel 12v Flash ROM, and *s* refers to an SST 5v (the difference is where ESCD is stored in upper memory).