

Phoenix Technologies Ltd.



PhoenixBIOS 4.0

Revision 6

User's Manual

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PhoenixBIOS 4.0 User's Manual

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Purpose of Document

This guide explains how to configure your PC and optimize its performance using the Setup program. It also explains how to use the BIOS function calls in writing computer programs.

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About This Manual

This manual is divided into the following chapters:

Chapter 1 - The Setup Guide

This chapter describes a typical menu-driven Phoenix Setup program, which allows you to specify changes in the computer hardware (e.g. add a new diskette drive) and optimize system performance. Setup maximizes your control over your system's features and performance.

This Setup Guide is only an example. The Setup menus on your computer may be quite different. Consult the Setup manual supplied with your computer.

Chapter 2 - PhoenixBIOS Utilities

This chapter describes two new programs that give you more control over the boot process:

- Phoenix QuietBoot
- Phoenix MultiBoot

Chapter 3 - Phoenix Phlash

This chapter describes how to use the Phoenix Phlash utility for upgrading your BIOS without having to replace the BIOS ROM chip.

Chapter 4 - Programmer's Guide

This chapter gives programmers and expert PC users a detailed description of *PhoenixBIOS*. It contains the following sections:

- Overview
- Hardware Requirements
- Fixed Disk Tables
- Function Keys
- POST Errors and Beep Codes
- BIOS Services
- BIOS Data Area
- Interrupt Vector Table

1 The Setup Guide

With the **PhoenixBIOS Setup** program, you can modify BIOS settings and control the special features of your computer. The Setup program uses a number of menus for making changes and turning the special features on or off.

Note: The menus shown here are from a typical system. The actual menus displayed on your screen may be quite different and depend on the hardware and features installed in your computer. For more accurate information about your BIOS Setup program, consult your system manual or contact the manufacturer.

The Main Menu

To start the *PhoenixBIOS* Setup utility:

Turn on or reboot your system. PhoenixBIOS displays this message:

Press <F2> to enter SETUP

2. Pressing <F2> displays the Main Menu, which looks like this:

PhoenixBIOS Setup Utility				
Main	Advanced	Security	Power	Boot Exit
				Item Specific Help
System Time		[16:19:20]		<Tab>, <Shift-Tab>, or <Enter> selects field
System Date:		[03/02/1994]		
Legacy Diskette A:		[1.44/1.25 MB 3½"]		
Legacy Diskette B		[Not Installed]		
▶ Primary Master		6449 MB		
▶ Secondary Slave		None		
▶ Secondary Master		CD-ROM		
▶ Secondary Slave		None		
Numlock:		[Disabled]		
▶ Memory Cache		[Enabled]		
▶ System Shadow		[Enabled]		
▶ Video Shadow		[Enabled]		
System Memory		640 kB		
Extended Memory		31744 kB		
F1 Help	↓ Select Item	-/+ Change Values		F9 Setup Defaults
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu	F10 Save and Exit

See p. 4 for a description of the fields on this menu.

The Menu Bar

The Menu Bar at the top of the window lists these selections:

Main	Use this menu for basic system configuration.
Advanced	Use this menu to set the Advanced Features available on your system's chipset.
Security	Use this menu to set User and Supervisor Passwords and the Backup and Virus-Check reminders.
Power	Use this menu to configure Power-Management features.
Exit	Exits the current menu.

Use the left and right ↔ arrow keys to make a selection.

See the section below, "Exiting Setup," for a description on exiting the Main Menu.

The Legend Bar

Use the keys listed in the legend bar on the bottom to make your selections or exit the current menu. The chart on the following page describes the legend keys and their alternates:

Key	Function
<F1> or <Alt-H>	General Help window (See below).
<Esc>	Exit this menu.
↔ arrow keys	Select a different menu.
or ↑ ↓ arrow keys	Move cursor up and down.
<Tab> or <Shift-Tab>	Cycle cursor up and down.
<Home> or <End>	Move cursor to top or bottom of window.
<PgUp> or <PgDn>	Move cursor to next or previous page.
<F5> or <->	Select the Previous Value for the field.
<F6> or <+> or <Space>	Select the Next Value for the field.
<F9>	Load the Default Configuration values for this menu.
<F10>	Save and exit.
<Enter>	Execute Command or Select P Submenu.
<Alt-R>	Refresh screen.

To select an item, use the arrow keys to move the cursor to the field you want. Then use the plus-and-minus value keys to select a value for that field. The Save Values commands in the Exit Menu save the values currently displayed in all the menus.

To display a sub menu, use the arrow keys to move the cursor to the sub menu you want. Then press <Enter>.

A pointer (▶) marks all sub menus.

The Field Help Window

The help window on the right side of each menu displays the help text for the currently selected field. It updates as you move the cursor to each field.

The General Help Window

Pressing <F1> or <Alt-H> on any menu brings up the General Help window that describes the legend keys and their alternates:

```

General Help

Setup changes system behavior by modifying the BIOS
Configuration parameters. Selecting incorrect values
may cause system boot failure; load Setup Default values
to recover.

<Up/Down> arrows select fields in current menu.
<PgUp/PgDn> moves to previous/next page on scrollable menus.
<Home/End> moves to top/bottom item of current menu.

Within a field, <F5> or <-> selects next lower value and
<F6>, <+>, or <Space> selects next higher value.

<Left/Right> arrows select menus on menu bar.
<Enter> displays more options for items marked with a ▶,
<Enter> also displays an option list on some fields.

<F9> loads factory-installed Setup Default values.
<F10> restores previous values from CMOS.

<ESC> or <Alt-X> exits Setup: in sub-menus, pressing these
keys returns to the previous menu.

<F1> or <Alt-H> displays General Help (this screen).

[Continue]
```

The scroll bar on the right of any window indicates that there is more than one page of information in the window. Use <PgUp> and <PgDn> to display all the pages. Pressing <Home> and <End> displays the first and last page. Pressing <Enter> displays each page and then exits the window.

Press <Esc> to exit the current window.

Main Menu Selections

You can make the following selections on the Main Menu itself. Use the sub menus for other selections.

Feature	Options	Description
System Time	HH:MM:SS	Set the system time.
System Date	MM/DD/YYYY	Set the system date.
Diskette 1 Diskette 2	360 kB, 5 ¼" 1.2 MB, 5 ¼" 720 kB, 3 ½" 1.44/1.25 MB, 3 ½" 2.88 MB, 3 ½" Not installed Disabled	Select the type of floppy-disk drive installed in your system. 1.25 MB is a Japanese media format that requires a 3½" 3-Mode Diskette drive.
System Memory	N/A	Displays amount of conventional memory detected during boot up.
Extended Memory	N/A	Displays the amount of extended memory detected during boot up.

You can set the boot sequence of the bootable drives by selecting **Boot Sequence** on the Main Menu or opening the **Boot Menu**.

Master and Slave Sub-Menus

The **Master** and **Slave** sub-menus accessed from the Main Menu control these types of devices:

- Hard-disk drives
- Removable-disk drives such as Zip drives
- CD-ROM drives

PhoenixBIOS 4.0 supports up to two **IDE disk adapters**, called **primary** and **secondary** adapters. Each adapter supports one **master drive** and one optional **slave drive** in these possible combinations:

- 1 Master
- 1 Master, 1 Slave
- 2 Masters
- 2 Masters, 1 Slave
- 2 Masters, 2 Slaves

There is one IDE connector for each adapter on your machine, usually labeled "Primary IDE" and "Secondary IDE." There are usually two connectors on each ribbon cable attached to each IDE connector. When you have connected two drives to these connectors, the one on the end of the cable is the Master.

If you need to change your drive settings, selecting one of the Master or Slave drives on the Main Menu displays a sub-menu like this:

PhoenixBIOS Setup Utility		
Main		Item Specific Help
Primary Master		
Type:	[Auto]	Select the drive type of the fixed disk installed in your system. If type User is selected, Cylinders, Heads, and Sectors can be edited directly. Auto attempts to automatically detect the drive type for drives that comply with ANSI specifications.
Cylinders:	[13328]	
Heads:	[15]	
Sectors/Track:	[63]	
Maximum Capacity:	6449 MB	
Landing Zone:	[762]	
Write Precomp:	[None]	
Multi Sector Transfer:	[16 Sectors]	
LBA Mode Control:	[Enabled]	
32-bit I/O:	[Enabled]	
Transfer Mode:	[Fast PIO 4]	
SMART Monitoring	[Enabled]	
F1 Help ↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ↔ Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit		

Use the legend keys listed on the bottom to make your selections and exit to the Main Menu. Use the following chart to configure the hard disk.

Feature	Options	Description
Type	None 1 to 39 User Auto IDE Removable CD-ROM ATAPI Removable	None = Autotyping is not able to supply the drive type or end user has selected None, disabling any drive that may be installed. User = You supply the hard-disk drive information in the following fields. Auto = Autotyping, the drive itself supplies the correct drive information. IDE Removable = Removable read-and-write media (e.g., IDE Zip drive). CD-ROM = Readable CD-ROM drive. ATAPI Removable = Read-and-write media (e.g., LS120, USB Floppy, USB Zip).
Cylinders	1 to 65,536	Number of cylinders.
Heads	1 to 16	Number of read/write heads.
Sectors/Track	1 to 63	Number of sectors per track.
Landing Zone*	1 to 2048	Number of the cylinder specified as the landing zone for the read/write heads.

Feature	Options	Description
Write Precomp*	1 to 2048 None	Number of the cylinder at which to change the write timing.
Multi-Sector Transfers	Disabled Standard 2 sectors 4 sectors 8 sectors 16 sectors	Any selection except Disabled determines the number of sectors transferred per block. Standard is 1 sector per block.
LBA Mode Control	Enabled Disabled	Enabling LBA causes Logical Block Addressing to be used in place of Cylinders, Heads, & Sectors.
32-Bit I/O	Enabled Disabled	Enables 32-bit communication between CPU and IDE card. Requires PCI or local bus.
Transfer Mode	Standard Fast PIO 1 Fast PIO 2 Fast PIO 3 Fast PIO 4	Selects the method for transferring the data between the hard disk and system memory. The Setup menu only lists those options supported by the drive and platform.
SMART Monitoring	Enabled Disabled	Turn on Self-Monitoring Analysis-Reporting Technology, which monitors condition of the hard drive and reports when a catastrophic IDE failure is about to happen.

* IDE drives do not require setting Landing Zone and Write Precomp.

When you enter Setup, the Main Menu usually displays the results of **Autotyping**— information each drive provides about its own parameters (e.g., cylinders, heads, and sectors)—and how the drives are arranged as Masters or Slaves on your machine.

Some older drives, however, do not use Autotyping and require selecting type User and entering a pre-defined fixed-disk type value (e.g., 1 to 39) or specifying the drive parameters separately with the User type selected. You can find the correct parameters for hard-disk drives in the drive manual or written on the casing of the drive itself.

Note: Exiting this menu keeps your selections but loses internal autotyping information, which may not be selected. If you exit this menu and re-enter it, press <Enter> on Autotype again to restore the Autotype information.

Note: Do not attempt to change these settings unless you have an older drive that does not support autotyping.

Note: Before changing the contents of this menu, **write them down**. Once you have established correct parameters for your drive, **write them down and store them in a safe place** (e.g., tape them to the disk drive) for use in case these values are lost in CMOS or if autotyping fails. If these hard-disk parameters are not correctly entered in CMOS, you cannot access the data on your drive.

WARNING: Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the Setup Defaults with <F9> and re-enter the correct drive parameters.

Memory Cache

Enabling **cache** saves time for the CPU by holding data most recently accessed in regular memory (dynamic RAM or DRAM) in a special storage area of static RAM (SRAM), which is faster. Before accessing regular memory, the CPU first accesses the cache. If it does not find the data it is looking for there, it accesses regular memory. Selecting "Memory Cache" from the Main menu displays a menu like the one shown here. The actual features displayed depend on your system's hardware.

PhoenixBIOS Setup Utility			
Main			
Memory Cache		Item Specific Help	
External cache:	[Enabled]	Sets the state of the external system memory cache.	
Cache Interleave:	[Disabled]		
Cache Write Back:	[Disabled]		
Cache Read Cycles:	[2T]		
Cache System BIOS:	[Disabled]		
Cache Video BIOS:	[Enabled]		
Cache E800 - EFFF:	[Disabled]		
Cache E000 - E7FF:	[Disabled]		
Cache D800 - DFFF:	[Disabled]		
Cache D000 - D7FF:	[Disabled]		
Cache C800 - CFFF:	[Disabled]		
Non-cacheable Regions			
Region 0, start:	[0 kB]		
Region 0, size:	[Disabled]		
Region 1, start:	[0 kB]		
Region 1, size:	[Disabled]		
F1 Help	↓ Select Item	-/+ Change Values	F9 Setup Defaults
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu F10 Save and Exit

Use the legend keys listed on the bottom to make your selections and exit to the Main Menu. Use this chart to configure the memory cache.

Feature	Options	Description
External Cache	Enabled Disabled.	Generally enables or disables all memory caching.
Cache Interleave	Enabled Disabled	Interleaves multiple banks of static RAM. Improves CPU access.
Cache Write Back	Enabled Disabled	Enables caches to both read and write to memory. Disabled caches reads only.
Cache Read Cycles	Chipset Dependent	Sets the number of clock pulses for reading from the cache. Shorter number of pulses improves performance.
Cache Write Cycles	Chipset Dependent	Sets the number of clock pulses for writing to the cache. Shorter number of pulses improves performance.
Cache System BIOS	Enabled Disabled	Caches the system BIOS and improves performance.
Cache Video BIOS	Enabled Disabled	Caches the video BIOS and improves performance.
Cache segments, e.g., E800-EFFF	Enabled Disabled	Controls caching of individual segments of memory usually reserved for shadowing system or option ROMs
Non-cacheable regions:		Specifies areas of regular and extended memory as non-cacheable regions.
Region 0, start	0 Multiples of 64	Multiples of 64 define start of non-cacheable region 0 in kilobytes.
Region 0, size	Disabled Multiples of 64	Disabling makes this region available for cache. Multiples of 64 define size of non-cacheable region 0 in kilobytes.
Region 1, start	0 Multiples of 64	Multiples of 64 define start of non-cacheable region 1 in kilobytes.
Region 1, size	Disabled Multiples of 64	Disabling makes this region available for cache. Multiples of 64 define size of non-cacheable region 1 in kilobytes.

WARNING: Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the Setup Defaults with <F9>.

Memory Shadow

Selecting "System Shadow" or "Video Shadow" from the Main Menu displays a menu like the one shown here. The actual features displayed depend on the capabilities of your system's hardware.

PhoenixBIOS Setup Utility		
Main		
Memory Shadow		Item Specific Help
System shadow:	Enabled	Enables shadowing of Option ROM in this region.
Video shadow:	[Enabled]	
Shadow Option ROM's -		
C800 - CFFF:	[Disable]	
D000 - D7FF:	[Disable]	
D800 - DFFF:	[Disable]	
D800 - DFFF:	[Disable]	
E800 - EFFF:	[Disable]	
F1 Help ↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ← Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit		

Use the legend keys to make your selections and exit to the Main Menu. Use the following chart to configure memory shadowing.

WARNING: Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the Setup Defaults with <F9>.

Feature	Options	Description
System shadow	N/A	Usually permanently enabled.
Video shadow	Enabled Disabled	Shadows video BIOS and improves performance.
Shadow Option ROM	Enabled Disabled	Shadows option ROM located in the specified segments of memory and can improve performance. WARNING: Some option ROMs do not work properly when shadowed.

Boot Sequence

Selecting "Boot Sequence" on the Main Menu displays the Boot Options menu.

PhoenixBIOS Setup Utility	
Main	
Boot Options	Item Specific Help
Boot sequence: [Disabled] SETUP prompt: [Enabled] POST Errors: [Enabled] Floppy check: [Enabled] Summary screen: [Enabled]	Order in which the system searches for a boot disk.
F1 Help ↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ← Select Menu Enter Select → Sub-Menu F10 Save and Exit	

Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart to select your boot options.

Feature	Options	Description
Boot sequence	A: then C; C: then A; C: only	The BIOS attempts to load the operating system from the disk drives in the sequence selected here. See also the Boot Menu on p. 11.
Setup prompt	Enabled Disabled	Displays "Press <F2> for Setup" during boot up.
POST errors	Enabled Disabled	At boot error, pauses and displays "Press <F1> to resume, <F2> to Setup".
Floppy seek	Enabled Disabled	Seeks diskette drives during boot up. Disabling speeds boot time.
Summary screen	Enabled Disabled	Displays system summary screen during boot up.

Keyboard Features

Selecting "Numlock" on the Main Menu displays the Keyboard Features menu:

PhoenixBIOS Setup Utility	
Main	
Keyboard Features	Item Specific Help
Numlock: [Off] Key Click: [Disabled] Keyboard auto-repeat rate: [30/sec] Keyboard auto-repeat delay: [1/2 sec]	Selects power-on state for Numlock key.
F1 Help ↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ←Select Menu Enter Select →Sub-Menu F10 Save and Exit	

Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart to configure the keyboard features:

Feature	Options	Description
Numlock	Auto On Off	On or Off turns NumLock on or off at boot up. Auto turns NumLock on if it finds a numeric key pad.
Key Click	Enabled Disabled	Turns audible key click on.
Keyboard auto-repeat rate	2/sec 6/sec 10/sec 13.3/sec 21.8/sec 26.7/sec 30/sec	Sets the number of times a second to repeat a keystroke when you hold the key down.
Keyboard auto-lag delay	¼ sec ½ sec ¾ sec 1 sec	Sets the delay time after the key is held down before it begins to repeat the keystroke.

Boot Menu

After you turn on your computer, it will attempt to load the operating system (such as Windows 98) from the device of your choice. If it cannot find the operating system on that device, it will attempt to load it from one or more other devices in the order specified in the Boot Menu. Boot devices (i.e., with access to an operating system) can include: hard drives, floppy drives, CD ROMs, removable devices (e.g., Iomega Zip drives), and network cards.

Note: Specifying any device as a boot device on the Boot Menu requires the availability of an operating system on that device. Most PCs come with an operating system already installed on hard-drive C:.

Selecting "Boot" from the Menu Bar displays the Boot menu, which looks like this:

PhoenixBIOS Setup Utility					
Main	Advanced	Security	Power	Boot	Exit
					Item Specific Help
QuickBoot Mode:		[Enabled]		Use these keys to set the boot order in which the BIOS attempts to boot the OS: <+> or <-> moves device up or down. <Enter> expands or collapses devices marked with + or -. <Ctrl+Enter> expands all <Shift+1> enables or disables a device. <n> moves a removable device between hard or removable disk.	
Display OPRM Messages:		[Enabled]			
Preferred Video:		[AGP]			
Summary Screen:		[Enabled]			
Removable Devices					
ATAPI CD-ROM Drive					
-Hard Drive					
Primary Master					
Bootable Add-in Card					
Network Boot					
F1 Help	↓ Select Item	-/+ Change Values		F9 Setup Defaults	
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu	F10 Save and Exit	

Use this menu to arrange to specify the priority of the devices from which the BIOS will attempt to boot the Operating System. In the example above, the BIOS will attempt first to boot from the CD-ROM drive (the only Removable Device listed). Failing that, it will attempt to boot from the Primary Master hard disk, and so on down the list.

Removable Devices, Hard Drive, and Network Boot are the generic types of devices on your system from which you can boot an operating system. You may have more than one device of each type. If so, the generic type is marked with a plus or minus sign. Use the <Enter> key to expand or collapse the devices marked with <+> or <->. Press <Ctrl+Enter> to expand all such devices.

Note: Floppy drives are not managed on this menu as part of Removable Devices.

To change a device's priority on the list, first select it with the up-or-down arrows, and move it up or down using the <+> and <-> keys. Pressing <n> moves a device between the Removable Devices and Hard Drive. Pressing <Shift+1> enables or disables a device.

Feature	Options	Description
QuickBoot Mode	Enabled Disabled	Enabled skips some POST tests, speeding boot time
Display OPRM Messages	Enabled Disabled	Displays boot messages of add-on cards. Recommended for newly installed cards. May be disabled later.
Preferred Video	AGP PCI	If you have more than one video card, select one to be used at boot.
Summary Screen	Enabled Disabled	Display system configuration screen during POST.

The Advanced Menu

Selecting "Advanced" from menu bar on the Main Menu displays a menu like this:

PhoenixBIOS Setup Utility		
Main	Advanced	Security Power Boot Exit
Setting items on this menu to incorrect values may cause your system to malfunction.		Item Specific Help
Installed Operating System	[Other]	Select the operating system installed on you system that you use most often.
Reset Configuration Data: ▶ PCI Configuration	[No]	
PS/2 Mouse	[Enabled]	Note: An incorrect setting can cause unexpected behavior in some operating systems.
Secured Setup Configurations ▶ Peripheral Configuration	[No]	
Large Disk Access Mode:	[DOS]	
Local Bus IDE adapter:	[Both]	
SMART Device Monitoring:	[Enabled]	
▶ Advanced Chipset Control ▶ I/O Device Configuration		
F1 Help ↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ↔ Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit		

Use the legend keys to make your selections and exit to the Main Menu.

Feature	Options	Description
Installed Operating System	Other Win95 Win98/NT	Select the operating system you use most often.
Reset Configuration Data	Yes No	Yes erases all configuration data in a section of memory for ESCD (Extended System Configuration Data) which stores the configuration settings for non-PnP plug-in devices. Select Yes when required to restore the manufacturer's defaults.
PS/2 Mouse	Enabled Disabled Auto OS Controlled	Disabled disables any installed PS/2 mouse, but frees up IRQ 12 for use by another device. Auto lets the BIOS control the mouse. OS Controlled lets the operating system control the mouse.
Secured Setup Configurations	Yes No	Yes prevents the Operating System from overriding selections you have made in Setup.
Large Disk Access Mode	DOS Other	Select DOS if you have DOS. Select Other if you have another operating system such as UNIX. A large disk is one that has more than 1024 cylinders, more than 16 heads, or more than 63 tracks per sector.
SMART	Enabled Disabled	Enabled installs SMART (Self-Monitoring Analysis-Reporting Technology), which issues a warning if an IDE failure is imminent.

WARNING: Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the Setup Defaults with <F9>.

Advanced Chipset Control (No PCI)

In a system with no PCI, selecting "Advanced Chipset Control" from menu bar on the Advanced menu displays a menu like this:

PhoenixBIOS Setup Utility	
Advanced	
Warning! Setting items on this menu to incorrect values may cause your system to malfunction. Parity check: [Enabled] Hidden refresh: [Enabled] Slow refresh: [Disabled] Read wait states: [0] Write wait states: [0] Extra bus wait states: [0] Multiple ALE: [Enabled] Keyboard reset delay: [Disabled]	Item Specific Help Controls system memory parity through the chipset.
F1 Help	↓ Select Item -/+ Change Values F9 Setup Defaults
ESC Exit	↔ Select Menu Enter Select ▶ Sub-Menu F10 Save and Exit

The chipset consists of one or more integrated circuits that act as an interface between the CPU and much of the system's hardware. You can use this menu to change the values in the chipset registers and optimize your system's performance.

Use the legend keys to make your selections, display the sub menus, and exit to the Main Menu.

Use the following chart in configuring the chipset:

Feature	Options	Description
Parity check	Enabled Disabled	Controls system memory parity checking.
Hidden refresh	Enabled Disabled	Refreshes regular memory without holding up the CPU.
Slow Refresh	Enabled Disabled	Slows memory refresh by a factor of 4.
Read wait states	0 to n	Sets the number of wait states added to reads from system memory. Chipset dependent.
Write wait states	0 to n	Sets the number of wait states added to writes to system memory. Chipset dependent.
Extra bus wait states	0 to n	Sets the number of wait states added to accesses of the AT bus. Chipset dependent.
Multiple ALE	Enabled Disabled	Determines whether to use single or multiple ALEs during cycle conversion.
Keyboard reset delay	Enabled Disabled	Enabled adds a 2 microsecond delay before resetting the system.

NOTE: The contents of this menu depend on the chipset installed on your motherboard, and chipsets vary widely. Consult your dealer or the chipset manual before changing the items on this menu. **Incorrect settings can cause your system to malfunction.**

Advanced Chipset Control Menu (PCI BIOS)

If the system has a PCI chipset, selecting "Advanced Chipset Control" from the Advanced menu displays a menu like this:

PhoenixBIOS Setup Utility			
Advanced		Item Specific Help	
Advanced Chipset Control			
Hidden Refresh:	[Disabled]	Enables CPU to PCI write buffers, which allow data to be temporarily stored in buffers before writing the data.	
Code Read Page Mode:	[Disabled]		
Write Page Mode:	[Disabled]		
CPU to PCI Write Buffers:	[Disabled]		
PCI to DRAM Write Buffers:	[Disabled]		
CPU to DRAM Write Buffers:	[Disabled]		
Snoop Ahead:	[Disabled]		
PCI Memory Burst Cycles:	[Disabled]		
F1 Help	↓ Select Item	-/+ Change Values	F9 Setup Defaults
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu F10 Save and Exit

The chipset is one or more integrated circuits that act as an interface between the CPU and the system's hardware. It manages such things as memory access, buses, and caching. You can use this menu to optimize the performance of your computer.

Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart in configuring the chipset:

Feature	Options	Description
Hidden Refresh	Disabled Enabled	Refreshes regular memory without holding up the CPU
Code Read Page Mode	Disabled Enabled	Improves performance when code contains mainly sequential instructions.
Write Page Mode	Disabled Enabled	Improves performance when data is written sequentially.
CPU to PCI Write Buffers	Disabled Enabled	Stores CPU data in buffers before writing to PCI.
PCI to DRAM Write Buffers	Disabled Enabled	Stores PCI data in buffers before writing to DRAM.
CPU to DRAM Write Buffers	Disabled Enabled	Stores CPU data in buffers before writing to DRAM.
Snoop Ahead	Disabled Enabled	Improves PCI bus master access to DRAM.
PCI Memory Burst Cycles	Disabled Enabled	Enables PCI memory burst write cycles.

NOTE: The contents of this menu depend on the chipset installed on your motherboard, and chipsets vary widely. Consult your dealer or the computer manual before changing the items on this menu. **Incorrect settings can cause your system to malfunction.**

PCI Devices Menu

If the system has a PCI bus, selecting "PCI Devices" from menu bar on the Advanced menu displays a menu like this:

PhoenixBIOS Setup Utility			
Advanced			
PCI Devices		Item Specific Help	
PCI Device Slot #1:		Initialize device expansion ROM	
Option ROM Scan:	[Enabled]		
Enable Master:	[Disabled]		
Latency Timer:	[0040h]		
PCI Device Slot #2:			
Option ROM Scan:	[Disabled]		
Enable Master:	[Disabled]		
Latency Timer:	[0000]		
PCI Device Slot #3			
Option ROM Scan:	[Disabled]		
Enable Master:	[Disabled]		
Latency Timer:	[0000]		
Shared PCI IRQs:	[Auto]		
F1 Help	↑ Select Item	-/+ Change Values	F9 Setup Defaults
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu F10 Save and Exit

PCI Devices are devices equipped for operation with a **PCI** (Peripheral Component Interconnect) **bus**, a standardized Plug-and-Play hardware communication system that connects the CPU with other devices. Use this menu to configure the PCI devices installed on your system.

Use the legend keys to make your selections and exit to the Advanced menu. Use the following chart in configuring the PCI devices:

Feature	Options	Description
PCI Device Slots 1-n:		
Option ROM Scan	Disabled Enabled	Initialize device expansion ROM.
Enable Master	Disabled Enabled	Enables selected device as a PCI bus master. Not every device can function as a master. Check your device documentation.
Latency Timer	0000h to 0280h	Bus master clock rate. A high-priority, high-throughput device may benefit from a greater value.
Shared PCI IRQs	Share One IRQ Share Two IRQs Share Three IRQs Auto	Share <i>n</i> IRQs: Forces PCI devices to use at most <i>n</i> IRQs. Auto: Minimizes PCI IRQ Sharing.

NOTE: The contents of this menu depend on the devices installed on your system. **Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the System Defaults (F9).**

I/O Device Configuration Menu

The CPU communicates with external devices such as printers through devices called **Input/Output (I/O) ports** such as serial and parallel ports. These I/O devices require the use of system resources such as I/O addresses and interrupt lines. If these devices are Plug and Play, either the BIOS can allocate the devices during POST, or the operating system can do it. If the I/O devices are not Plug and Play, they may require manually setting them in Setup.

On some systems, the **chipset** manages the communication devices. Other systems have, instead, a separate **I/O chip** on the motherboard for configuring and managing these devices.

Many systems allow you to control the configuration settings for the I/O ports. Select "I/O Device Configuration" on the Advanced Menu to display this menu and specify how you want to configure these I/O Devices:

PhoenixBIOS Setup Utility		
Advanced		
I/O Device Configuration		Item Specific Help
Serial Port A:	[Enabled]	Set Serial Port A:
Base I/O address/IRQ	[3F8/IRQ4]	Using options:
Serial Port B:	[OS Controlled]	Disabled
Parallel Port:	[User]	[No configuration]
Mode:	[Bi-directional]	Enabled
Base I/O address	[378]	[User configuration]
Interrupt	[IRQ5]	Auto
Diskette Controller	[Enabled]	[BIOS configuration]
Base I/O address:	[Primary]	OS Controlled
		[OS configuration]
F1 Help ↑Select Item -/+ Change Values F9 Setup Defaults ESC Exit ↔Select Menu Enter Select ▶Sub-Menu F10 Save and Exit		

Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart to configure the Input/Output settings:

Feature	Options	Description
Serial port A: Serial port B:	Disabled Enabled Auto OS Controlled	Disabled turns off the port. Enabled requires you to enter the base Input/Output address and the Interrupt number on the next line. Auto makes the BIOS configure the port automatically during POST. OS Controlled lets the PnP Operating System (such as Windows 95) configure the port after POST.
Base I/O Address/IRQ	3F8, IRQ 4 2F8, IRQ 3	If you select Enabled, choose one of these combinations.
Parallel Port:	Disabled Enabled Auto OS Controlled	Disabled turns off the port. Enabled requires you to enter the base Input/Output address and the Interrupt number below. Auto makes the BIOS auto configure the port during POST. OS Controlled lets the PnP Operating System (such as Windows 95) configure the port after POST.
Mode	Output only Bi-directional	Output only is standard one-way protocol for a parallel device. Bi-directional uses two-way protocol of an Extended Capabilities Port (ECP).
Base I/O Address	378 278 3BC	If you select Enabled for the Parallel Port, choose one of these I/O addresses.
Interrupts	IRQ5 IRQ7	If you select Enabled for the Parallel Port, choose one of these interrupt options.
Diskette Controller	Disabled Enabled	Enables the on-board legacy diskette controller. Disabled turns off all legacy diskette drives.
Base I/O Address	Primary Secondary	If you select Enabled for the Diskette Controller, choose Primary for one diskette drive installed or Secondary for two diskette drives installed.

Use this menu to specify how the I/O (Input and Output) ports are configured:

Manually by you.

Automatically by the BIOS during POST (See "ROM BIOS Functions" on page 32)

Automatically by a PnP Operating System such as Windows 95 after the Operating System boots.

Warning: If you choose the same I/O address or Interrupt for more than one port, the menu displays an asterisk (*) at the conflicting settings. It also displays this message at the bottom of the menu:

* Indicates a DMA, Interrupt, I/O, or memory resource conflict with another device.

Resolve the conflict by selecting another settings for the devices.

The Security Menu

Selecting "Security" from the Main Menu displays a menu like this:

PhoenixBIOS Setup Utility				
Main	Advanced	Security	Power	Boot Exit
				Item Specific Help
Set User Password		[Enter]	Supervisor password controls access to Setup utility.	
Set Supervisor Password		[Enter]		
Virus Check Reminder:		[Disabled]		
System backup Reminder:		[Disabled]		
Password on boot:		[Disabled]		
Diskette access:		[Disabled]		
Fixed disk boot sector:		[Normal]		
F1 Help	↓ Select Item	-/+ Change Values	F9 Setup Defaults	
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu	F10 Save and Exit

Use the legend keys to make your selections and exit to the Main Menu.

Enabling "Supervisor Password" requires a password for entering Setup. The passwords are not case sensitive.

Pressing <Enter> at either Set Supervisor Password or Set User Password displays a dialog box like this:

Set Password	
Enter new password:	[]
Confirm new password:	[]
Enter: Accept	

Type the password and press <Enter>. Repeat.

Note: In some systems, the User and Supervisor passwords are related; you cannot have a User password without first creating a Supervisor password. In other systems, you can create and use them independently.

Use the following chart to configure the system-security and anti-virus options.

Feature	Options	Description
Set User Password	Up to seven alphanumeric characters	Pressing <Enter> displays the dialog box for entering the user password. In related systems, this password gives restricted access to SETUP menus.
Set Supervisor Password	Up to seven alphanumeric characters	Pressing <Enter> displays dialog box for entering the supervisor password. In related systems, this password gives full access to Setup menus.
Password on boot	Enabled Disabled	Enabled requires a password on boot. Requires prior setting of the Supervisor password. If supervisor password is set and this option disabled, BIOS assumes user is booting.
Diskette access	Enabled Disabled	Enabled requires a password to boot from or access the floppy disk.
Fixed disk boot sector	Normal Write Protect	Write protects the boot sector on the hard disk for virus protection. Requires a password to format or Fdisk the hard disk.
System backup reminder Virus check reminder	Disabled Daily Weekly Monthly	Displays a message during boot up asking (Y/N) if you have backed up the system or scanned it for viruses. Message returns on each boot until you respond with "Y". Daily displays the message on the first boot of the day, Weekly on the first boot after Sunday, and Monthly on the first boot of the month.

The Power Menu

Selecting "Power" from the menu bar displays a menu like this:

PhoenixBIOS Setup Utility				
Main	Advanced	Security	Power	Boot Exit
				Item Specific Help
Power Savings		[Customize]		Select Power Management Mode. Choosing modes changes system power management settings. Maximum Power Savings conserves the greatest amount of system power while Maximum Performance conserves power but allows greatest system performance. To alter these settings, choose Customize. To turn off power management, choose Disable.
Standby Timeout:		[15 sec]		
Auto Suspend Timeout:		[15 sec]		
Hard Disk Timeout:		[10 min]		
Video Timeout:		[5 min]		
Resume On Modem Ring:		[Off]		
Resume On Time:		[Off]		
▶ Advanced Options				
F1 Help	↓ Select Item	-/+ Change Values		F9 Setup Defaults
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu	F10 Save and Exit

Use this menu to specify your settings for Power Management. Remember that the options available depend upon the hardware installed in your system. Those shown here are from a typical system.

A power-management system reduces the amount of energy used after specified periods of inactivity. The Setup menu pictured here supports a **Full On** state, a **Standby** state with partial power reduction, and a **Suspend** state with full power reduction.

Use the Advanced Options on this menu to specify whether or not the activity of interrupts can terminate a Standby or Suspend state and restore Full On. Do not change these settings without knowing which devices use the interrupts.

Use the legend keys to make your selections and exit to the Main Menu. Use the following chart in making your selections:

Feature	Options	Description
Power Management Mode	Disabled Customize Maximum Power Savings Maximum Performance	Maximum options: pre-defined values. Select Customize to make your own selections from the following fields. Disabled turns off all power management.
Standby Timeout	Off 1 min 2 min 4 min 6 min 8 min 12 min 16 min	Inactivity period required to put system in Standby (partial power shutdown).
Auto Suspend Timeout	Disabled 5 min 10 min 15 min 20 min 30 min 40 min 60 min	Inactivity period required after Standby to Suspend (maximum power shutdown).
Hard Disk Timeout	Disabled 1 min 2 min 4 min 8 min 12 min 16 min	Inactivity period of hard disk required before standby (motor off).
Video Timeout	Disabled 10 sec 15 sec 20 sec 30 sec 45 sec 1 min to 15 min	Set inactivity period required before independently turning off monitor. Disabled turns CRT off in Standby.
Resume On Modem Ring	Off On	Wakes up system when an incoming call is detected on the modem.
Resume On Time	Off On	Wakes up system at predetermined time.
IRQ0...IRQ15 SMI NMI	Disabled Enabled	Enabling interrupt causes it to restore Full On during Standby or Suspend. SMI = System Management Interrupt. NMI = Non-Maskable Interrupt.

The Exit Menu

Selecting "Exit" from the menu bar displays this menu:

PhoenixBIOS Setup Utility				
Main	Advanced	Security	Power	Boot Exit
Exit Saving Changes Exit Discarding Changes Load Setup Defaults Discard Changes Save Changes				Item Specific Help
				Exit System Setup and save your changes to CMOS.
F1 Help	↓ Select Item	-/+ Change Values	F9 Setup Defaults	
ESC Exit	↔ Select Menu	Enter Select	▶ Sub-Menu	F10 Save and Exit

The following sections describe each of the options on this menu. Note that <Esc> does not exit this menu. You must select one of the items from the menu or menu bar to exit.

Saving Values

After making your selections on the Setup menus, always select either "Saving Values" or "Save Changes." Both procedures store the selections displayed in the menus in **CMOS** (short for "battery-backed CMOS RAM") a special section of memory that stays on after you turn your system off. The next time you boot your computer, the BIOS configures your system according to the Setup selections stored in CMOS.

After you save your selections, the program displays this message:

```
Values have been saved to CMOS!
Press <space> to continue
```

If you attempt to exit without saving, the program asks if you want to save before exiting.

During boot up, *PhoenixBIOS* attempts to load the values saved in CMOS. If those values cause the system boot to fail, reboot and press <F2> to enter Setup. In Setup, you can get the Default Values (as described below) or try to change the selections that caused the boot to fail.

Exit Discarding Changes

Use this option to exit Setup without storing in CMOS any new selections you may have made. The selections previously in effect remain in effect.

Load Setup Defaults

To display the default values for all the Setup menus, select "Load Setup Defaults" from the Main Menu. The program displays this message:

```
ROM Default values have been loaded!
Press <space> to continue
```

If, during boot up, the BIOS program detects a problem in the integrity of values stored in CMOS, it displays these messages:

```
System CMOS checksum bad - run SETUP
Press <F1> to resume, <F2> to Setup
```

The CMOS values have been corrupted or modified incorrectly, perhaps by an application program that changes data stored in CMOS.

Press <F1> to resume the boot or <F2> to run Setup with the ROM default values already loaded into the menus. You can make other changes before saving the values to CMOS.

Discard Changes

If, during a Setup Session, you change your mind about changes you have made and have not yet saved the values to CMOS, you can restore the values you previously saved to CMOS.

Selecting “Discard Changes” on the Exit menu updates all the selections and displays this message:

```
CMOS values have been loaded!  
Press <space> to continue
```

Save Changes

Selecting “Save Changes” saves all the selections without exiting Setup. You can return to the other menus if you want to review and change your selections.

PhoenixBIOS Messages

The following is a list of the messages that the BIOS can display. Most of them occur during POST. Some of them display information about a hardware device, e.g., the amount of memory installed. Others may indicate a problem with a device, such as the way it has been configured. Following the list are explanations of the messages and remedies for reported problems.

If your system displays one of the messages marked below with an asterisk (), write down the message and contact your dealer. If your system fails after you make changes in the Setup menus, reset the computer, enter Setup and install Setup defaults or correct the error.

0200 Failure Fixed Disk

Fixed disk is not working or not configured properly. Check to see if fixed disk is attached properly. Run Setup. Find out if the fixed-disk type is correctly identified.

0210 Stuck key

Stuck key on keyboard.

0211 Keyboard error

Keyboard not working.

***0212 Keyboard Controller Failed**

Keyboard controller failed test. May require replacing keyboard controller.

0213 Keyboard locked - Unlock key switch

Unlock the system to proceed.

0220 Monitor type does not match CMOS - Run SETUP

Monitor type not correctly identified in Setup

***0230 Shadow Ram Failed at offset: nnnn**

Shadow RAM failed at offset *nnnn* of the 64k block at which the error was detected.

***0231 System RAM Failed at offset: nnnn**

System RAM failed at offset *nnnn* of in the 64k block at which the error was detected.

***0232 Extended RAM Failed at offset: nnnn** Extended memory not working or not configured properly at offset *nnnn*.

0250 System battery is dead - Replace and run SETUP

The CMOS clock battery indicator shows the battery is dead. Replace the battery and run Setup to reconfigure the system.

0251 System CMOS checksum bad - Default configuration used

System CMOS has been corrupted or modified incorrectly, perhaps by an application program that changes data stored in CMOS. The BIOS installed Default Setup Values. If you do not want these values, enter Setup and enter your own values. If the error persists, check the system battery or contact your dealer.

***0260 System timer error**

The timer test failed. Requires repair of system board.

***0270 Real time clock error** Real-Time Clock fails BIOS hardware test.

May require board repair.

0271 Check date and time settings BIOS found date or time out of range and reset the Real-Time Clock. May require setting legal date (1991-2099).

0280 Previous boot incomplete - Default configuration used

Previous POST did not complete successfully. POST loads default values and offers to run Setup. If the failure was caused by incorrect values and they are not corrected, the next boot will likely fail. On systems with control of **wait states**, improper Setup settings can also terminate POST and cause this error on the next boot. Run Setup and verify that the wait-state configuration is correct. This error is cleared the next time the system is booted.

0281 Memory Size found by POST differed from CMOS

Memory size found by POST differed from CMOS.

02B0 Diskette drive A error

02B1 Diskette drive B error

Drive A: or B: is present but fails the BIOS POST diskette tests. Check to

see that the drive is defined with the proper diskette type in Setup and that the diskette drive is attached correctly.

02B2 Incorrect Drive A type - run SETUP

Type of floppy drive A: not correctly identified in Setup.

02B3 Incorrect Drive B type - run SETUP

Type of floppy drive B: not correctly identified in Setup.

02D0 System cache error - Cache disabled

RAM cache failed and BIOS disabled the cache. On older boards, check the cache jumpers. You may have to replace the cache. See your dealer. A disabled cache slows system performance considerably.

02F0: CPU ID:

CPU socket number for Multi-Processor error.

***02F4: EISA CMOS not writeable**

ServerBIOS2 test error: Cannot write to EISA CMOS.

***02F5: DMA Test Failed**

ServerBIOS2 test error: Cannot write to extended **DMA** (Direct Memory Access) registers.

***02F6: Software NMI Failed**

ServerBIOS2 test error: Cannot generate software NMI (Non-Maskable Interrupt).

***02F7: Fail-Safe Timer NMI Failed**

ServerBIOS2 test error: Fail-Safe Timer takes too long.

device Address Conflict

Address conflict for specified **device**.

Allocation Error for: device

Run ISA or EISA Configuration Utility to resolve resource conflict for the specified **device**.

CD ROM Drive

CD ROM Drive identified.

Entering SETUP ...

Starting Setup program

***Failing Bits: nnnn**

The hex number **nnnn** is a map of the bits at the RAM address which failed the memory test. Each 1 (one) in the map indicates a failed bit. See errors 230, 231, or 232 above for offset address of the failure in System, Extended, or Shadow memory.

Fixed Disk n

Fixed disk **n** (0-3) identified.

Invalid System Configuration Data

Problem with NVRAM (CMOS) data.

I/O device IRQ conflict

I/O device IRQ conflict error.

PS/2 Mouse Boot Summary Screen:

PS/2 Mouse installed.

nnnn kB Extended RAM Passed

Where **nnnn** is the amount of RAM in kilobytes successfully tested.

nnnn Cache SRAM Passed

Where **nnnn** is the amount of system cache in kilobytes successfully tested.

nnnn kB Shadow RAM Passed

Where **nnnn** is the amount of shadow RAM in kilobytes successfully tested.

nnnn kB System RAM Passed

Where **nnnn** is the amount of system RAM in kilobytes successfully tested.

One or more I2O Block Storage Devices were excluded from the Setup Boot Menu

There was not enough room in the IPL table to display all installed I2O block-storage devices.

Operating system not found

Operating system cannot be located on either drive A: or drive C:. Enter Setup and see if fixed disk and drive A: are properly identified.

***Parity Check 1 nnnn**

Parity error found in the system bus. BIOS attempts to locate the address and display it on the screen. If it cannot locate the address, it displays **????**. Parity is a method for checking errors in binary data. A parity error indicates that some data has been corrupted.

***Parity Check 2 nnnn**

Parity error found in the I/O bus. BIOS attempts to locate the address and display it on the screen. If it cannot locate the address, it displays ?????.

**Press <F1> to resume, <F2> to Setup,
<F3> for previous**

Displayed after any recoverable error message. Press <F1> to start the boot process or <F2> to enter Setup and change the settings. Press <F3> to display the previous screen (usually an initialization error of an **Option ROM**, i.e., an add-on card). Write down and follow the information shown on the screen.

Press <F2> to enter Setup

Optional message displayed during POST. Can be turned off in Setup.

PS/2 Mouse:

PS/2 mouse identified.

Run the I2O Configuration Utility

One or more unclaimed block storage devices have the Configuration Request bit set in the LCT. Run an I2O Configuration Utility (e.g. the SAC utility).

System BIOS shadowed

System BIOS copied to shadow RAM.

UMB upper limit segment address: nnnn

Displays the address *nnnn* of the upper limit of **Upper Memory Blocks**, indicating released segments of the BIOS which can be reclaimed by a virtual memory manager.

Video BIOS shadowed

Video BIOS successfully copied to shadow RAM.

2 Boot Utilities

Phoenix Boot Utilities are:
Phoenix QuietBoot™
Phoenix MultiBoot™

Phoenix QuietBoot displays a graphic illustration rather than the traditional POST messages while keeping you informed of diagnostic problems.

Phoenix MultiBoot is a boot screen that displays a selection of boot devices from which you can boot your operating system.

Phoenix QuietBoot

Right after you turn on or reset the computer, **Phoenix QuietBoot** displays the QuietBoot Screen, a graphic illustration created by the computer manufacturer instead of the text-based POST screen, which displays a number of PC diagnostic messages.

To exit the QuietBoot screen and run Setup, display the MultiBoot menu, or simply display the PC diagnostic messages, you can simply press one of the hot keys described below.

The QuietBoot Screen stays up until just before the operating system loads unless:

1. You press <Esc> to display the POST screen.
2. You press <F2> to enter Setup.
3. POST issues an error message.
4. The BIOS or an option ROM requests keyboard input.

The following explains each of these situations.

Press <ESC>

Pressing <Esc> switches to the POST screen and takes one of two actions:

1. If MultiBoot is installed, the boot process continues with the text-based POST screen until the end of POST, and then displays the **Boot First Menu**, with these options:
 - a. Load the operating system from a boot device of your choice.
 - b. Enter Setup.
 - c. Exit the Boot First Menu (with <Esc>) and load the operating system from the boot devices in the order specified in Setup.
2. If MultiBoot is not installed, the boot process continues as usual.

Press <F2>

Pressing <F2> at any time during POST switches to the POST screen (if not already displayed) and enters Setup.

POST Error

Whenever POST detects a non-fatal error, QuietBoot switches to the POST screen and displays the errors. It then displays this message:

Press <F1> to resume, <F2> to Setup

Press <F1> to continue with the boot. Press <F2> if you want to correct the error in Setup.

Keyboard Input Request

If the BIOS or an **Option ROM** (add-on card) requests keyboard input, QuietBoot switches over to the POST screen and the Option ROM displays prompts for entering the information. POST continues from there with the regular POST screen.

Phoenix MultiBoot

Phoenix MultiBoot expands your boot options by letting you choose your boot device, which could be a hard disk, floppy disk, or CD ROM. You can select your boot device in Setup, or you can choose a different device each time you boot during POST by selecting your boot device in **The Boot First Menu**.

MultiBoot consists of:

- The Setup Boot Menu
- The Boot First Menu

See the Setup Boot menu on p. 11. The following describes the Boot First Menu.

The Boot First Menu

Display the Boot First Menu by pressing <Esc> during POST. In response, the BIOS first displays the message, "Entering Boot Menu ..." and then displays the Boot Menu at the end of POST. Use the menu to select any of these options:

1. Override the existing boot sequence (for this boot only) by selecting another boot device. If the specified device does not load the operating system, the BIOS reverts to the previous boot sequence.
2. Enter Setup.
3. Press <Esc> to continue with the existing boot sequence.

```

      Boot Menu
-----
Select boot device or Setup.
Use the Up and Down arrows to
select the Boot First device,
then <Enter> or press <Esc> to
exit.

  1. Hard Drive
  2. ATAPI CD-ROM
  3. Diskette Drive
  4. Removable Devices
  5. Network Boot

      <Setup>
```

If there is more than one bootable hard drive, the first one in the Setup Boot menu is the one represented here.

3 Phoenix Phlash

Phoenix Phlash gives you the ability to update your BIOS from a floppy disk without having to install a new ROM BIOS chip.

Phoenix Phlash is a utility for "flashing" (copying) a BIOS to the Flash ROM installed on your computer from a floppy disk. A Flash ROM is a Read-Only Memory chip that you can write to using a special method called "flashing." Use Phoenix Phlash for the following tasks:

- Update the current BIOS with a new version.
- Restore a BIOS when it has become corrupted.

Installation

Phoenix Phlash is shipped on a floppy disk with your computer as a compressed file called CRISDISK.ZIP that contains the following files:

CRISDISK.BAT	Executable file for creating the Crisis Recovery Diskette.
PHLASH.EXE	Programs the flash ROM.
PLATFORM.BIN	Performs platform-dependent functions.
BIOS.ROM	Actual BIOS image to be programmed into flash ROM.
MINIDOS.SYS	Allows the system to boot in Crisis Recovery Mode.
MAKEBOOT.EXE	Creates the custom boot sector on the Crisis Recovery Diskette.

To install Phoenix Phlash on your hard disk, follow this simple procedure:

1. Insert the distribution diskette into drive A:
2. Unzip the contents of CRISDISK.ZIP into a local directory, presumably C:\PHLASH.
3. Store the distribution diskette in a safe place.

Create the Crisis Recovery Diskette

If the OEM or dealer from whom you purchased your system has not provided you with one, then you should create a **Crisis Recovery Diskette** before you use the Phlash utility. If you are unable to boot your system and successfully load the Operating System, the BIOS may have been corrupted, in which case you will have to use the Crisis Recovery Diskette to reboot your system. There are several methods that you can use to create the Crisis Recovery Diskette. Below is one recommended procedure.

1. Be sure you have successfully installed the Phlash Utility onto your hard disk.
2. Insert a clean diskette into drive A: or B:
3. From the local directory, enter the following:
CRISDISK [drive]:
where [drive] is the letter of the drive into which you inserted the diskette.
For help, type /? or /h.
CRISDISK.BAT formats the diskette, then copies MINIDOS.SYS, VGABIOS.EXE (if available), PHLASH.EXE, PLATFORM.BIN and BIOS.ROM to the diskette, and creates the required custom boot sector.

4. Write protect and label the Crisis Recovery Diskette.

NOTE: You can only supply a volume label after the Crisis Recovery Diskette has been formatted and the necessary files copied because MINIDOS.SYS must occupy the first directory entry for the diskette to boot properly.

Updating the Crisis Recovery Diskette

If the BIOS image (BIOS.ROM) changes due to an update or bug fix, you can easily update the Crisis Recovery Diskette. Simply copy the new BIOS.ROM image onto the Crisis Recovery Diskette. No further action is necessary.

Executing Phoenix Phlash

You can run Phoenix Phlash in one of two modes:

- Command Line Mode
- Crisis Recovery Mode

WARNING! For your own protection, be sure you have a Crisis Recovery Diskette ready to use before executing Phlash.

Command Line Mode

Use this mode to update or replace your current BIOS. To execute Phlash in this mode, move to the directory into which you have installed Phoenix Phlash and type the following:

```
plash
```

Phoenix Phlash will automatically update or replace the current BIOS with the one which your OEM or dealer supplies you.

Phlash may fail if your system is using memory managers, in which case the utility displays the following message:

```
Cannot flash when memory managers are present.
```

If you see this message after you execute Phlash, you must disable the memory manager on your system. To do so, follow the instructions in the following sections.

Disabling Memory Managers

To avoid failure when flashing, you must disable the memory managers that load from CONFIG.SYS and AUTOEXEC.BAT. There are two recommended procedures for disabling the memory managers. One consists of pressing the <F5> key (only if you are using DOS 5.0 or above), and the other requires the creation of a boot diskette.

DOS 5.0 (or later version)

For DOS 5.0 and later, follow the two steps below to disable any memory managers on your system. If you are not using at least DOS 5.0, then you must create a boot diskette to bypass any memory managers (See Create a Boot Diskette, below).

1. Boot DOS 5.0 or later version. (In Windows 95, at the boot option screen, choose Option 8, "Boot to a previous version of DOS.")
2. When DOS displays the "Starting MS-DOS" message, press <F5>.

After you press <F5>, DOS bypasses the CONFIG.SYS and AUTOEXEC.BAT files, and therefore does not load any memory managers.

You can now execute Phlash.

Create a Boot Diskette

To bypass memory managers in DOS versions previous to 5.0, follow this recommended procedure:

1. Insert a diskette into your A: drive.
2. Enter the following from the command line:
`Format A: /S`
3. Reboot your system from the A: drive.

Your system will now boot without loading the memory managers, and you can then execute Phlash.

NOTE: The boot diskette you create here is distinct from a *Crisis Recovery Diskette*. See page 409 for details about creating the Crisis Recovery Diskette.

Crisis Recovery Mode

You should only have to operate Phoenix Phlash in this mode only if your system does not boot the operating system when you turn on or reset your computer. In these cases, the BIOS on the Flash ROM has probably been corrupted. Boot your system with the Crisis Recovery Diskette taking these steps:

1. Insert the Crisis Recovery diskette (which your dealer supplied or one that you should have created from the instructions above) into drive A:.
2. Reset your computer, power off-on, or press <Ctrl> <Alt> to reboot the system.
3. When your system reboots, Phoenix Phlash will restore the BIOS from the diskette and successfully boot the operating system.

4 Programmer's Guide

This chapter of the User's Manual gives application developers, programmers, and expert computer users a detailed description of the BIOS.

This chapter describes the following subjects:

- What is a ROM BIOS?
- System Hardware Requirements
- Fixed-Disk Tables
- PhoenixBIOS Function Keys
- POST Errors
- Run-Time Services

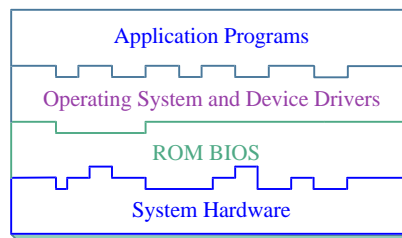
What is a ROM BIOS?

This section briefly explains the function of a BIOS in managing the special features of your system.

A **ROM BIOS (Basic Input/Output System)** is a set of programs permanently stored in a **ROM (Read-Only Memory)** chip located on the computer motherboard. These programs micro-manage the hardware devices installed on your computer. When you turn on your computer, the ROM BIOS initializes and tests these devices. During run-time, the ROM BIOS provides the Operating System and application programs with access to these devices. You can also use the BIOS **Setup** program to change your computer's hardware or behavior.

Software works best when it operates in layers, and the ROM BIOS is the bottom-most software layer in the computer. It functions as the interface between the hardware and the other layers of software, isolating them from the details of how the hardware works. This arrangement enables you to change hardware devices without having to install a new operating system.

The following diagram shows the function of the ROM BIOS as the interface between the hardware and other layers of software:



ROM BIOS Functions

The *PhoenixBIOS* software performs these functions:

The Setup Program	Using the Setup program, you can install, configure, and optimize the hardware devices on your system (clock, memory, disk drives, etc.).
Initialize Hardware at Boot	At power-on or reset, perform Power-On Self Test (POST) routines to test system resources and run the operating system.
Run-Time Routines	Basic hardware routines that can be called from DOS and Windows applications.

Initialize and Configure the computer

The first job of a ROM BIOS is to initialize and configure the computer hardware when you turn on your computer (system boot). The BIOS runs a series of complex programs called the **Power On Self Test (POST)**, which performs a number of tasks, including:

- Test Random Access Memory (RAM)
- Conduct an inventory of the hardware devices installed in the computer
- Configure hard and floppy disks, keyboard, monitor, and serial and parallel ports
- Configure other devices installed in the computer such as CD-ROM drives and sound cards
- Initialize computer hardware required for computer features such as Plug and Play and Power Management
- Run Setup if requested
- Load and run the Operating System such as DOS, OS/2, UNIX, or Windows 95 or NT.

BIOS Services

The second task of the ROM BIOS is to provide the Operating System, device drivers, and application programs with access to the system hardware. It performs this task with a set of program routines called **BIOS Services**, which are loaded into high memory at boot time.

The number of BIOS Services is always changing. The BIOS Services of PhoenixBIOS 4.05 provide precise control of hardware devices such as disk drives, which require careful management and exhaustive checking for errors. They also help manage new computer features such as Power Management, Plug and Play, and MultiBoot.

System Hardware Requirements

PhoenixBIOS 4.0 requires the following hardware components on the motherboard:

System Board Requirements
<ol style="list-style-type: none"> 1. CPU (486 or later) 2. AT-compatible and MC146818 RTC-compatible chipset. 3. AT or PS/2-compatible Keyboard controller 4. At least 1 MB of system RAM

The Power On Self Test (POST) of the BIOS initializes additional ROM BIOS extensions (Option ROMs) if they are accessible in the proper format. The requirements are:

Adapter ROM Requirements

1. The code must reside in the address space between C0000H and F0000H.
2. The code must reside on a 2K boundary.
3. The first two bytes of the code must be 55H and AAH.
4. The third byte must contain the number of 512-byte blocks.
5. The fourth byte must contain a jump to the start of the initialization code.
6. The code must checksum to zero (byte sum).

NOTE: The address space from C0000H to C8000H is reserved for external video adapters (e.g. EGA, VGA). Part of the address space from D0000H to E0000H is typically used by expanded memory (EMS).

Fixed Disk Tables

PhoenixBIOS 4.0 supports up to four fixed-disk drives. For each drive, it supports 39 pre-defined drive types and four user-defined types (40-43). Below is a table of the pre-defined drive types and their default values.

End users can modify the user-defined drive type for each fixed disk listed in Setup by using the menus of the Setup program. This feature avoids the need for customized software for non-standard drives.

NOTE: Since most hard drives are autotyped (i.e., automatically determined by the BIOS or Operating System), there is usually no need to set the drive geometry manually.

Type	Cylinders	Heads	Sectors	Wrt Pre	Landing
1	306	4	17	128	305
2	615	4	17	300	615
3	615	6	17	300	615
4	940	4	17	512	940
5	940	6	17	512	940
6	615	4	17	-1	615
7	462	8	17	256	511
8	733	5	17	-1	733
9	900	15	17	-1	901
10	820	3	17	-1	820
11	855	5	17	-1	855
12	855	7	17	-1	855
13	306	8	17	128	319
14	733	7	17	-1	733
15	Reserved				
16	612	4	17	0	633
17	977	5	17	300	977
18	977	7	17	-1	977
19	1024	7	17	512	1023
20	733	5	17	300	732
21	733	7	17	300	732
22	733	5	17	300	733
23	306	4	17	0	336
24	612	4	17	305	663
25	612	2	17	300	612
26	614	4	17	-1	614
27	820	6	17	-1	820
28	977	5	17	-1	977
29	1218	15	36	-1	1218

Type	Cylinders	Heads	Sectors	Wrt Pre	Landing
30	1224	15	17	-1	1224
31	823	10	17	512	823
32	809	6	17	128	809
33	830	7	17	-1	830
34	830	10	17	-1	830
35	1024	5	17	-1	1024
36	1024	8	17	-1	1024
37	615	8	17	128	615
38	1024	8	26	-1	1024
39	925	9	17	-1	925
40	User def.				
41	User def.				
42	User def.				
43	User def.				

PhoenixBIOS Function Keys

The following are the special PhoenixBIOS function keys:

<F2>	Enter SETUP program during POST
Ctrl-Alt-<->	Switch to slow CPU speed
Ctrl-Alt-<+>	Switch to fast CPU speed

The speed switching keys are only operational when speed switching is available.

POST Errors and Beep Codes

Recoverable POST Errors

Whenever a recoverable error occurs during POST, *PhoenixBIOS* displays an error message describing the problem.

PhoenixBIOS also issues a beep code (one long tone followed by two short tones) during POST if the video configuration fails (no card installed or faulty) or if an external ROM module does not properly checksum to zero.

An external ROM module (e.g. VGA) can also issue audible errors, usually consisting of one long tone followed by a series of short tones.

Terminal POST Errors

There are several POST routines that issue a **POST Terminal Error** and shut down the system if they fail. Before shutting down the system, the terminal-error handler issues a beep code signifying the test point error, writes the error to port 80h, attempts to initialize the video, and writes the error in the upper left corner of the screen (using both mono and color adapters).

The routine derives the beep code from the test point error as follows:

1. The 8-bit error code is broken down to four 2-bit groups (Discard the most significant group if it is 00).
2. Each group is made one-based (1 through 4) by adding 1.
3. Short beeps are generated for the number in each group.

Example:

Test point 01Ah = 00 01 10 10 = 1-2-3-3 beeps

Test Points and Beep Codes

At the beginning of each POST routine, the BIOS outputs the test point error code to I/O address 80h. Use this code during trouble shooting to establish at what point the system failed and what routine was being performed.

Some motherboards are equipped with a seven-segment LED display that displays the current value of port 80h. For production boards that do not contain the LED display, you can purchase a card that performs the same function.

If the BIOS detects a terminal error condition, it halts POST after issuing a terminal error beep code (See above) and attempting to display the error code on upper left corner of the screen and on the port 80h LED display. It attempts repeatedly to write the error to the screen. This may cause "hash" on some CGA displays.

If the system hangs before the BIOS can process the error, the value displayed at the port 80h is the last test performed. In this case, the screen does not display the error code.

The following is a list of the checkpoint codes written at the start of each test and the beep codes issued for terminal errors. Unless otherwise noted, these codes are valid for PhoenixBIOS 4.0 Release 6.x.

Code	Beeps	POST Routine Description
02h		Verify Real Mode
03h		Disable Non-Maskable Interrupt (NMI)
04h		Get CPU type
06h		Initialize system hardware
07h		Disable shadow and execute code from the ROM.
08h		Initialize chipset with initial POST values
09h		Set IN POST flag
0Ah		Initialize CPU registers
0Bh		Enable CPU cache
0Ch		Initialize caches to initial POST values
0Eh		Initialize I/O component
0Fh		Initialize the local bus IDE
10h		Initialize Power Management
11h		Load alternate registers with initial POST values
12h		Restore CPU control word during warm boot
13h		Initialize PCI Bus Mastering devices
14h		Initialize keyboard controller
16h	1-2-2-3	BIOS ROM checksum
17h		Initialize cache before memory Auto size
18h		8254 timer initialization
1Ah		8237 DMA controller initialization
1Ch		Reset Programmable Interrupt Controller
20h	1-3-1-1	Test DRAM refresh
22h	1-3-1-3	Test 8742 Keyboard Controller
24h		Set ES segment register to 4 GB
28h		Auto size DRAM
29h		Initialize POST Memory Manager
2Ah		Clear 512 kB base RAM
2Ch	1-3-4-1	RAM failure on address line xxxx *
2Eh	1-3-4-3	RAM failure on data bits xxxx * of low byte of memory bus
2Fh		Enable cache before system BIOS shadow
32h		Test CPU bus-clock frequency
33h		Initialize Phoenix Dispatch Manager
36h		Warm start shut down
38h		Shadow system BIOS ROM
3Ah		Auto size cache
3Ch		Advanced configuration of chipset registers
3Dh		Load alternate registers with CMOS values
41h		Initialize extended memory for RomPilot
42h		Initialize interrupt vectors
45h		POST device initialization

Code	Beeps	POST Routine Description
46h	2-1-2-3	Check ROM copyright notice
47h		Initialize I20 support
48h		Check video configuration against CMOS
49h		Initialize PCI bus and devices
4Ah		Initialize all video adapters in system
4Bh		QuietBoot start (optional)
4Ch		Shadow video BIOS ROM
4Eh		Display BIOS copyright notice
4Fh		Initialize MultiBoot
50h		Display CPU type and speed
51h		Initialize EISA board
52h		Test keyboard
54h		Set key click if enabled
55h		Enable USB devices
58h	2-2-3-1	Test for unexpected interrupts
59h		Initialize POST display service
5Ah		Display prompt "Press F2 to enter SETUP"
5Bh		Disable CPU cache
5Ch		Test RAM between 512 and 640 kB
60h		Test extended memory
62h		Test extended memory address lines
64h		Jump to UserPatch1
66h		Configure advanced cache registers
67h		Initialize Multi Processor APIC
68h		Enable external and CPU caches
69h		Setup System Management Mode (SMM) area
6Ah		Display external L2 cache size
6Bh		Load custom defaults (optional)
6Ch		Display shadow-area message
6Eh		Display possible high address for UMB recovery
70h		Display error messages
72h		Check for configuration errors
76h		Check for keyboard errors
7Ch		Set up hardware interrupt vectors
7Dh		Initialize Intelligent System Monitoring
7Eh		Initialize coprocessor if present
80h		Disable onboard Super I/O ports and IRQs
81h		Late POST device initialization
82h		Detect and install external RS232 ports
83h		Configure non-MCD IDE controllers
84h		Detect and install external parallel ports
85h		Initialize PC-compatible PnP ISA devices
86h		Re-initialize onboard I/O ports.
87h		Configure Motherboard Configurable Devices (optional)
88h		Initialize BIOS Data Area
89h		Enable Non-Maskable Interrupts (NMIs)
8Ah		Initialize Extended BIOS Data Area
8Bh		Test and initialize PS/2 mouse
8Ch		Initialize floppy controller
8Fh		Determine number of ATA drives (optional)
90h		Initialize hard-disk controllers
91h		Initialize local-bus hard-disk controllers
92h		Jump to UserPatch2
93h		Build MPTABLE for multi-processor boards
95h		Install CD ROM for boot
96h		Clear huge ES segment register

Code	Beeps	POST Routine Description
97h		Fix up Multi Processor table
98h	1-2	Search for option ROMs. One long, two short beeps on checksum failure
99h		Check for SMART Drive (optional)
9Ah		Shadow option ROMs
9Ch		Set up Power Management
9Dh		Initialize security engine (optional)
9Eh		Enable hardware interrupts
9Fh		Determine number of ATA and SCSI drives
A0h		Set time of day
A2h		Check key lock
A4h		Initialize typematic rate
A8h		Erase F2 prompt
AAh		Scan for F2 key stroke
ACh		Enter SETUP
A Eh		Clear Boot flag
B0h		Check for errors
B1h		Inform RomPilot about the end of POST.
B2h		POST done - prepare to boot operating system
B4h	1	One short beep before boot
B5h		Terminate QuietBoot (optional)
B6h		Check password (optional)
B7h		Initialize ACPI BIOS
B9h		Prepare Boot
BAh		Initialize SMBIOS
BBh		Initialize PnP Option ROMs
BCh		Clear parity checkers
BDh		Display MultiBoot menu
BEh		Clear screen (optional)
BFh		Check virus and backup reminders
C0h		Try to boot with INT 19
C1h		Initialize POST Error Manager (PEM)
C2h		Initialize error logging
C3h		Initialize error display function
C4h		Initialize system error handler
C5h		PnPnd dual CMOS (optional)
C6h		Initialize note dock (optional)
C7h		Initialize note dock late
C8h		Force check (optional)
C9h		Extended checksum (optional)
CAh		Redirect Int 15h to enable remote keyboard
CBh		Redirect Int 13h to Memory Technologies Devices such as ROM, RAM, PCMCIA, and serial disk
CCh		Redirect Int 10h to enable remote serial video
CDh		Re-map I/O and memory for PCMCIA
CEh		Initialize digitizer and display message
D2h		Unknown interrupt
		The following are for boot block in Flash ROM
E0h		Initialize the chipset
E1h		Initialize the bridge
E2h		Initialize the CPU
E3h		Initialize system timer
E4h		Initialize system I/O
E5h		Check force recovery boot
E6h		Checksum BIOS ROM
E7h		Go to BIOS

Code	Beeps	POST Routine Description
E8h		Set Huge Segment
E9h		Initialize Multi Processor
EAh		Initialize OEM special code
EBh		Initialize PIC and DMA
ECh		Initialize Memory type
EDh		Initialize Memory size
EEh		Shadow Boot Block
EFh		System memory test
F0h		Initialize interrupt vectors
F1h		Initialize Run Time Clock
F2h		Initialize video
F3h		Initialize System Management Manager
F4h		Output one beep
F5h		Clear Huge Segment
F6h		Boot to Mini DOS
F7h		Boot to Full DOS

* If the BIOS detects error 2C, 2E, or 30 (base 512K RAM error), it displays an additional word-bitmap (xxx) indicating the address line or bits that failed. For example, "2C 0002" means address line 1 (bit one set) has failed. "2E 1020" means data bits 12 and 5 (bits 12 and 5 set) have failed in the lower 16 bits. Note that error 30 cannot occur on 386SX systems because they have a 16 rather than 32-bit bus. The BIOS also sends the bitmap to the port-80 LED display. It first displays the checkpoint code, followed by a delay, the high-order byte, another delay, and then the low-order byte of the error. It repeats this sequence continuously.

PhoenixBIOS 4.0 Services

The ROM BIOS contains a number of useful run-time **BIOS Services** that are easily called by an outside program. As a programmer, you can execute these services, which are nothing more than subroutines, by invoking one of the BIOS interrupt routines (or, when specified, calling a protected-mode entry point and offset). Invoking a software interrupt causes the CPU to fetch an address from the **interrupt table** in low memory and execute the service routine. Some services return exit values in certain registers. All registers are preserved unless they return data or status.

Generally, a Carry flag set on exit indicates a failed service. A zero on exit in the AH register usually indicates no error; any other value is the service's **exit status code**.

BIOS32 Service Directory

While the standard BIOS services are accessed through the interrupt table, newer services are accessed by a FAR CALL to a service entry point. Programmers can determine the entry point by searching for a particular signature (such as "\$PnP") in the BIOS range and finding the entry point in the header.

The **BIOS32 Service Directory** (standard in PhoenixBIOS 4.0) provides a single entry point for all those services in the BIOS that are designed for BIOS clients running in a 32-bit code segment, such as 32-bit operating systems and 32-bit device drivers. The BIOS32 Service Directory itself is a 32-bit BIOS service that provides a single entry point for the other 32-bit services. For a full description of this service, see the **Standard BIOS 32-Bit Service Directory Proposal, Rev 0.4** published by Phoenix and available on the Phoenix Web site at:

<http://www.phoenix.com/products/specs.html>

Programs calling the 32-bit BIOS services should scan 0E0000h to 0FFFF0h on the 16-byte boundaries for the contiguous 16-byte data structure beginning with the ASCII signature "_32_".

If they do not find this data structure, then the platform does not support the BIOS32 Service Directory. The following chart describes the data structure.

Offset	Size	Description
0h	4 bytes	ASCII signature "_32_" Offset 0 = underscore Offset 1 = "3" Offset 2 = "2" Offset 3 = underscore
4h	4 bytes	Entry point for the BIOS32 Service Directory, a 32-bit physical address
8h	1 byte	Revision level. Currently 00h.
9h	1 byte	Length of this structure in 16-byte units. This structure is 16 bytes long, so the field = 01h.
0Ah	1 byte	Checksum of whole data structure. Result must be 0.
0Bh	5 bytes	Reserved. Must be zero.

Once the data structure is found and verified, the program can do a FAR CALL to the entry point specified in the above structure. The calling environment requires:

1. The CS code segment selector and the DS data segment selector must encompass the physical page of the entry point as well as the following page.
2. The SS stack segment selector must have available 1 kB of stack space.
3. Access to I/O space.

The BIOS32 Service Directory provides a single call that:

1. Determines if the called 32-bit service is available, and, if it is available,
2. Returns three values:
 - a) Physical address of the base of the BIOS service.
 - b) Length of the BIOS service.
 - c) Entry point into the BIOS service (offset of the base).

BIOS32 Service Directory

Entry:

EAX Service Identifier. Four-character string identifying the 32-bit service requested (e.g., "\$PCI").

EBX Low-order byte [BL] is the BIOS32 Service Directory Function Selector. Currently, zero supplies the values described below. Upper three bytes are reserved and must be zero on entry.

Exit:

AL Return code:

00h = Service corresponding to the Service Identifier is present.

80h = Service corresponding to the Service Identifier is not present.

81h = Function Selector specified not supported.

EBX Physical address of base of 32-bit service.

ECX Length of BIOS service.

EDX Entry point of BIOS service (offset to base in EBX).

Interrupt 10h–Video Services

The INT 10h software interrupt handles all video services. The results of some of these functions may depend on the active video mode and the particular video controller installed.

Interrupt 10 Video Services

AH = 00h	Set video mode
Entry:	
AL	Mode value (0-7):
	0 = 40x25 Black & White
	1 = 40x25 Color
	2 = 80x25 Black & White
	3 = 80x25 Color
	4 = 320x200 Color
	5 = 320x200 Black & White
	6 = 640x200 Black & White
	7 = Monochrome only
AH = 01h	Set cursor size
Entry:	
CH	Bits 4-0 = Cursor top scan line
CL	Bits 4-0 = Cursor bottom scan line
AH = 02h	Set cursor position
Entry:	
BH	Page to set cursor
DL	Character column position
DH	Character row position
AH = 03h	Get cursor position of page
Entry:	
BH	Page to return cursor
Exit:	
DL	Character column position
DH	Character row position
CL	Cursor top scan line
CH	Cursor bottom scan line
AH = 05h	Change displayed (active) page
Entry:	
AL	Page number to display
AH = 06h	Scroll active page up
Entry:	
CL	Upper left column to scroll up
CH	Upper left row to scroll up
DL	Lower right column to scroll up
DH	Lower right row to scroll up
BH	Attribute for blanked space
AL	Number of lines to scroll up
	0 = Blank screen
AH = 07h	Scroll active page down
Entry:	
CL	Upper left column to scroll down
CH	Upper left row to scroll down
DL	Lower right column to scroll down
DH	Lower right row to scroll down
BH	Attribute for blanked space
AL	Number of lines to scroll down
	0 = Blank screen
AH = 08h	Read character and attribute
Entry:	
BH	Video page to read character
Exit:	
AL	Character
AH	Character attribute

Continued

*Interrupt 10h–Video Services, Continued***AH = 09h Write character and attribute**

Entry:

AL Character to write
 BL Character attribute (alpha)
 Character color (graphics)
 BH Page to write character
 CX Count of characters to write

AH = 0Ah Write character at cursor

Entry:

BH Page to write character
 AL Character to write
 CX Count of characters to write

AH = 0Bh Set color palette

Entry:

BH = 00 Set colors:

If mode = 4 or 5, BL = background color
 If mode = 0-3, BL = border color
 If mode = 6 or 11, BL = foreground color
 BL 0-31 = Intense versions of colors 0-15

BH = 01 Set palette for mode 4 or 5

BL 00 Palette = Green (1), Red (2), Yellow (3)
 01 Palette = Cyan (1), Magenta (2), White (3)

AH = 0Ch Write graphics pixel

Entry:

AL Color value for pixel
 (XORed if bit7=1)
 CX Column to write pixel
 DX Row to write pixel

AH = 0D Read graphics pixel

Entry:

CX Column to read pixel
 DX Row to read pixel
 Exit:
 AL Value of pixel read

AH = 0E Teletype write character

Entry:

AL Character to write
 BL Foreground color (graphics only)

AH = 0F Return Current Video Parameters

Exit:

AL Current video mode
 AH Number of character columns
 BH Active page

AH = 13h Write string

Entry:

ES:BP Pointer to string
 CX Length of string to display
 DH Character row for display
 DL Character column for display
 BL Display attribute
 AL Write string mode
 0 = Chars only, no cursor update
 1 = Chars only, update cursor
 2 = Char, Attrib, no cursor update
 3 = Char, Attrib, update cursor

Interrupt 11h—Return System Information

This service returns the equipment installed as determined by the BIOS on power-up diagnostics and stored in the BIOS Data Area.

Interrupt 11 Return System Information	
Exit:	
AX	Equipment information:
Bit	Definition
0	Not used
1	Math coprocessor installed
2	PS/2 mouse installed
3	Not used
4,5	Initial video mode:
	00 = EGA/VGA
	01 = 40x25 CGA
	10 = 80x25 CGA
	11 = Monochrome
6,7	Diskette drives:
	00 = 1 drive
	01 = 2 drives
	10 = 3 drives
	11 = 4 drives
8	Not used
9-11	Number of serial adapters
12	Game Adapter installed
13	Not used
14,15	Number of parallel adapters

Interrupt 12h—Return Memory Size

Returns up to 640 kB of the amount of system memory determined by early POST diagnostics.

Interrupt 12 Return System Memory Size	
Exit:	
AX	Number of 1-kilobyte memory blocks

Interrupt 13h—Diskette Services

Interrupt 13 is the BIOS software interface for access to the 5-1/4" and 3-1/2" inch diskette drives. When there is a fixed disk in the system, the BIOS assigns Interrupt 13h to the fixed disk and routes diskette calls to Interrupt 40h.

The following table lists the AH error codes.

Int 13 Diskette Exit Status Codes	
AH	00h = No error
	If Carry = 1:
AH	01h = Illegal BIOS command
	02h = Bad address mark
	03h = Write-protect occurred
	04h = Sector not found
	06h = Media changed
	09h = DMA crossed 64K boundary
	08h = DMA failed
	0Ch = Media not found
	10h = CRC failed
	20h = NEC failed
	30h = Drive does not support media sense
	31h = No media in drive
	32h = Drive does not support media type
	40h = Seek failed
	80h = Time out occurred

The following table contains the combinations of drive types and media types supported by the INT 13 services 02h to 05h.

Media	Drive	Diskette Types	
		Sec/Trk	Tracks
360 kB	360 kB	8-9	40
360 kB	1.2 MB	8-9	40
1.2 MB	1.2 MB	15	80
720 kB	720 kB	9	80
720 kB	1.44 MB	9	80
1.44 MB	1.44 MB	18	80
720 kB	2.88 MB	9	80
1.44 MB	2.88 MB	18	90
2.88 MB	2.88 MB	36	80

The following describes the diskette services with their entry and exit values.

Interrupt 13h Diskette Services	
AH = 00h	Reset diskette system
AH = 01h	Return diskette status
Exit:	
AH	00h = No error 01h = Illegal BIOS command 02h = Address mark not found 03h = Write-protect error 04h = Sector not found 06h = Media has been changed 08h = DMA overrun 09h = DMA boundary error 0Ch = Media not found 10h = CRC error 20h = NEC error 40h = Seek error 80h = Time out occurred
AH = 02h	Read diskette sectors
Entry:	
ES:BX	Buffer address
DL	Drive number (0-1)
DH	Head number (0-1)
CH	Track number (0-79)
CL	Sector number (8-36)
AL	Number of sectors (1-15)
Exit:	
AL	Number of sectors transferred
AH = 03h	Write diskette sectors
Entry:	
ES:BX	Buffer address
DL	Drive number (0-1)
DH	Head number (0-1)
CH	Track number (0-79)
CL	Sector number (8-36)
AL	Number of sectors (1-15)
Exit:	
AL	Number of sectors transferred
AH = 04h	Verify diskette sectors
Entry:	
DL	Drive number (0-1)
DH	Head number (0-1)
CH	Track number (0-79)
CL	Sector number (8-36)
AL	Number of sectors (1-15)
Exit:	
AL	Number of sectors verified

Continued

Interrupt 13h—Diskette Services, Continued**AH = 05h Format diskette track**

Entry:
 ES:BX Buffer address
 DL Drive number (0-1)
 DH Head number (0-1)
 CH Track number (0-79)
 CL Sector number (8-36)
 AL Number of sectors (1-15)
 Exit:
 AL Number of sectors formatted

AH = 08h Read drive parameters

Entry:
 DL Drive number
 Exit:
 ES:DI Pointer to parameter table
 DH Maximum head number
 DL Number of diskette drives present
 CH Maximum track number
 CL Drive capacity:
 Bits 0-5 Maximum sector number
 Bits 6-7 Maximum track number
 BL Diskette drive type from CMOS:
 Bits 0-3:
 00 = CMOS not present or invalid
 01 = 360 kB
 02 = 1.2 MB
 03 = 720 kB
 04 = 1.44 MB
 06 = 2.88 MB
 Bits 4-7: 0

AH = 15h Read drive type

Entry:
 DL Drive number
 Exit:
 AH 00 = Drive not present
 01 = Drive cannot detect media change
 02 = Drive can detect media change
 03 = Fixed disk

AH = 16h Detect media change

Entry:
 DL Drive Number (0-1)
 Exit:
 If Carry = 0:
 AH 00 = Disk change not active
 01 = Invalid drive number
 06 = Either disk change line active or
 change line not supported
 80h = Drive not ready or no drive present:
 (timeout)

AH = 17h Set diskette type

Entry:
 AL Format:
 00 = Invalid Request
 01 = 360kB floppy in 360kB drive
 02 = 360kB floppy in 1.2MB drive
 03 = 1.2MB floppy in 1.2MB drive
 04 = 720kB floppy in 720kB (1.44MB not supported)
 DL Drive Number (0-1)

AH = 18h Set media type for format

Entry:
 CH Maximum track number
 CL Diskette parameters:
 Bits 0-5: Maximum sector number
 Bits 6-7: Maximum track number
 DL Drive Number (0-1)
 Exit:
 ES:DI Pointer to parameter table

Continued

Interrupt 13h–Diskette Services, Continued
AH = 20h Get media type
 Entry:
 DL Drive number (0-1)
 Exit:
 AL Type of media installed:
 00h = 720 kB diskette
 01h = 1.44 MB diskette
 02h = 2.88 MB diskette
 03h = 1 MB diskette
 04h = 2 MB diskette
 06h = 4 MB diskette

Interrupt 13h–Fixed Disk Services

Interrupt 13h accesses these Services:
 Standard Fixed-Disk Services, 00h-15h
 Enhanced Disk Drive Services, 41h -48h
 Bootable CD-ROM Services, 4Ah-4Dh

The following box lists the error codes:

Int 13h Fixed-Disk Exit Codes

AH 00h = No error
 If Carry = 1:
 AH 01 = Bad command or parameter
 02h = Address mark not found
 04h = Sector not found
 05h = Reset failed
 07h = Drive parameter activity failed
 0Ah = Bad sector flag detected
 10h = ECC data error
 11h = ECC data corrected
 20h = Controller failure
 40h = Seek failed
 80h = Time out occurred
 AAh = Drive not ready
 BBh = Undocumented controller error
 CCh = Controller write fault
 E0h = Unrecognized controller error

The following describes the Standard Fixed-Disk services of PhoenixBIOS 4.0:

Interrupt 13 Standard Fixed Disk Services

AH = 00 Reset diskette and fixed-disk systems
AH = 01h Read disk status
 Entry:
 DL Drive number (80h-81h)
 Exit:
 AH 001h = Bad command
 002h = Bad address mark
 004h = Record not found
 005h = Controller reset error
 007h = Drive initialization error
 00Ah = Bad sector
 010h = ECC data error
 020h = Controller failed
 040h = Seek error
 0AAh = Drive not ready
 0BBh = Invalid controller error
 0CCh = Controller write fault
 0E0h = Unrecognized controller error

Continued

Interrupt 13h—Fixed Disk Services, Continued**AH = 02h Read disk sectors**

Entry:

ES:BX Buffer address
 DL Drive number (80h-81h)
 DH Head number (0-15)
 CH Track number (0-1023)
 Put the two high-order bits (8 and 9)
 in the high-order bits of CL
 CL Sector number (1-17)
 AL Number of sectors (1-80h for read)
 (1-79h for long read, includes ECC)

Exit:

AL Number of sectors transferred

AH = 03h Write disk sectors

Entry:

ES:BX Buffer address
 DL Drive number (80H-81H)
 DH Head number (0-15)
 CH Track number (0-1023)
 Put the two high-order bits (8 and 9)
 in the high-order bits of CL
 CL Sector number (1-17)
 AL Number of sectors (1-80h for write)
 (1-79h for long write, includes ECC)

Exit:

AL Number of sectors transferred

AH = 04h Verify disk sectors

Entry:

ES:BX Buffer address
 DL Drive number (80h-81h)
 DH Head number (0-15)
 CH Track number (0-1023)
 Put the two high-order bits (8 and 9)
 in the high-order bits of CL
 CL Sector number (1-17)
 AL Number of sectors (1-80h for write)
 (1-79h for long write, includes ECC)

Exit:

AL Number of sectors verified

AH = 05h Format disk cylinder

Entry:

ES:BX Pointer to table containing the
 following byte pair for each sector
 in the track:
 Byte 0: 00h if sector is good
 80h if sector is bad
 Byte 1: Sector Number (0-255)
 DL Drive number (80H-81H)
 DH Head number (0-15)
 CH Track number (0-1023)
 Put the two high-order bits (8 and 9)
 in the high-order bits of CL
 CL Sector number (1-17)
 AL Number of sectors (1-80h for write)
 (1-79h for long write, includes ECC)

Exit:

AL Number of sectors formatted

Continued

*Interrupt 13h—Fixed Disk Services, Continued***AH = 08h Read drive parameters**

Entry:

DL Drive number (80H-81H)

Exit:

CL Maximum sector number

CH Maximum cylinder number
(High bits in CL)

DH Maximum head number

DL Number of responding drives (0-2)

If Carry - 1:

AH 07h = Invalid drive number

AL 0 = Error

CX 0 = Error

DX 0 = Error

AH = 09h Initialize drive parameters

Entry:

DL Drive number (80H-81H)

AH = 0Ah Read long sector

Entry:

ES:BX Buffer address

DL Drive number (80H-81H)

DH Head number

CH Cylinder number

CL Sector number/Cyl high

AL Number of sectors

Exit:

AL Number of sectors transferred

AH = 0Bh Write long sector

Entry:

ES:BX Buffer address

DL Drive number (80H-81H)

DH Head number

CH Cylinder number

CL Sector number/Cyl high

AL Number of sectors

Exit:

AL Number of sectors transferred

AH = 0Ch Seek drive

Entry:

ES:BX Buffer address

DL Drive number (80H-81H)

DH Head number

CH Cylinder number

CL Cylinder high

AH = 0Dh Alternate disk reset

Entry:

DL Drive number (80H-81H)

AH = 10h Test drive ready

Entry:

DL Drive number (80H-81H)

AH = 11h Recalibrate drive

Entry:

DL Drive number (80H-81H)

AH = 14h Controller diagnostic

Entry:

DL Drive number (80H-81H)

AH = 15h Read drive type

Entry:

DL Drive number (80H-81H)

Exit:

AH 00 = Drive not present

01 = Drive cannot detect media change

02 = Drive can detect media change

03 = Fixed disk

CX High word of number of 512-byte blocks

DX Low word of number of 512-byte blocks

Interrupt 13h—Extended Fixed Disk Services

The following describes the Interrupt 13h Extended Fixed Disk Services, including the *PhoenixBIOS Enhanced Disk Drive (EDD)* services:

Int 13h Extended Fixed Disk Services	
AH = 41h	Check Extensions Present
Entry:	
BX	55AAh
DL	Drive Number
Exit:	
AH	Major version number (20h)
AL	Internal use only
BX	55AAh = Extensions present
CX	Feature support map:
	Bit 0: 1 = Extended disk access
	Bit 1: 1 = Removable drive control
	Bit 2: 1 = Enhanced Disk Drive Extensions
	Bits 3-7, Reserved, must be 0
AH = 42h	Extended Read
Entry:	
DL	Drive Number
DS:SI	Disk address packet
AH = 43h	Extended Write
Entry:	
AL	Verify Bits:
	Bit 0: 0 = Write with verify off
	1 = Write with verify on
	Bits 1-7 Reserved, set to 0
DL	Drive number
DS:SI	Disk address packet
AH = 44h	Verify Sectors
Entry:	
DL	Drive number
DS:SI	Disk address packet
AH = 47h	Extended Seek
Entry:	
DL	Drive number
DS:SI	Disk address packet
AH = 48h	Get Drive Parameters
Entry:	
DL	Drive Number
DS:SI	Address of Result Buffer
Exit:	
DS:SI	Pointer to Result Buffer:
	info_size dw 30 ;size of this buffer
	flags dw ? ;info flags (See below)
	cylinders dd ? ;cylinders on disk
	heads dd ? ;heads on disk
	sec_per_track dd ? ;sectors per track
	sectors dq ? ;sectors on disk
	sector_size dw ? ;bytes per sector
	extended_table dd? ;extended table ptr
	; (See below)
	info flags:
Bit 0	0 = DMA boundary errors possible
	1 = DMA errors handled
Bit 1	0 = CHS info not supplied
	1 = CHS info valid
Bit 2	0 = Drive not removable
	1 = Drive removable
Bit 3	0 = No write with verify
	1 = Write with verify
Bit 4	0 = No change-line support
	1 = Change-line support
Bit 5	0 = Drive not lockable
	1 = Drive lockable
Bit 6	0 = CHS values for installed media
	1 = Maximum CHS values for drive (media absent)
<i>Continued</i>	

Interrupt 13h–Extended Fixed Disk Services, Continued

Extended Fixed Disk Parameter Table		
Byte	Type	Description
0-1	Word	I/O port address
2-3	Word	Control port address
4		Bit 0-3 Reserved, must be 0
		Bit 4 0 = Master, 1 = Slave
		Bit 5 Reserved, must be 0
		Bit 6 1 = LBA enabled
		Bit 7 Reserved, must be 1
5		Bits0-3 Phoenix Proprietary
		Bits 4-7 Reserved, must be 0
6		Bits 0-3 IRQ for this drive
		Bits 4-7 Reserved, must be 0
7	Byte	Sector count for multi-sectored transfers
8		Bits 0-3 DMA channel
		Bits 4-7 DMA type
9		Bits 0-3 PIO type
		Bits 1-7 Reserved, must be 0
Byte	Type	Description
10-11		Bit 0 1 = Fast PIO access enabled
		Bit 1 1 = DMA access enabled
		Bit 2 1 = Block PIO access enabled
		Bit 3 1 = CHS translation enabled
		Bit 4 1 = LBA translation enabled
		Bit 5 1 = Removable media
		Bit 6 1 = CD ROM
		Bit 7 1 = 32-bit transfer mode
		Bit 8 1 = ATAPI Device uses Interrupt DRQ
		Bits 9-10 CHS Translation Type
		Bits 11-15 Reserved, must be 0
12-13	Byte	Reserved, must be 0
14	Byte	Extension Revision number
15	Byte	Checksum, 2s complement of the sum of bytes 0-14

Interrupt 13h–Bootable CD-ROM Services

Bootable CD-ROM Services 4Ah-4Ch use a pointer to the **Specification Packet**, described here:

Bootable CD-ROM Specification Packet		
Offset	Type	Description
0h	Byte	Packet size, currently 13h
1h	Byte	Boot media type: Bits 0-3: 00h = No emulation 01h = 1.2 MB diskette 02h = 1.44 MB diskette 03h = 2.88 MB diskette 04h = Hard disk (drive C:) Bits 05h-07h: Reserved Bit 6: 01h = System has ATAPI driver with 8 & 9 below describing IDE interface. Bit 7: 01h = System has SCSI drivers with 8 & 9 below describing SCSI interface
2h	Byte	Drive number: 00h = Floppy image 80 = Bootable hard disk 81h -FFh = "Non-bootable" or "No emulation"

Continued

Interrupt 13h—Bootable CD-ROM Services, Continued

Offset	Type	Description
3h	Byte	Controller index of CD drive
4h-7h	Dword	Logical Block Address
8h-9h	Word	Device specification: For SCSI: Byte 8: LUN and PUN of CD drive Byte 9: Bus number For IDE: Byte 8 LSB: 0 = Master, 1 = Slave
Ah-Bh	Word	User buffer segment
Ch-Dh	Word	Load segment (only for Int 13h 4Ch): 00h = 7C0h
Eh-Fh	Word	Virtual sector count (only for Int 13h 4Ch)
10h	Byte	Low-order bits (0-7) of the cylinder count (Matches returned CH of Int 13h 08h)
11h	Byte	Bits 0-5: Sector count Bits 6-7: High order 2 bits of cylinder count (Matches returned CL of Int 13h 08h)
12h	Byte	Head count (Matches returned DH of Int 13h 0h)

Bootable CD-ROM Service 4Dh uses a pointer to the **Command Packet**, described here:

Bootable CD-ROM Command Packet		
Offset	Type	Description
0h	Byte	Packet size in bytes, currently 08h
1h	Byte	Count of sectors in boot catalog to transfer
2-h	Dword	Pointer to destination buffer for boot catalog
6-7h	Word	Beginning sector to transfer, relative to start of the boot catalog. Int 14 4Dh should set this value to 00h.

The following describes the Interrupt 13 Bootable CD-ROM Services of PhoenixBIOS 4.0:

Int 13 Bootable CD-ROM Services

AH = 4Ah	Initiate disk emulation
Entry:	
AL	00
DS:SI	Pointer to Specification Packet (See above)
CF	0 = Specified drive emulating 1 = System not in emulation mode
AH = 4Bh	Terminate disk emulation
Entry:	
AL	00h = Return status and terminate emulation 01h = Return status only, do not terminate
DL	Drive number to terminate 7Fh = Terminate all
DS:SI	Empty Specification Packet
Exit:	
DS:SI	Completed Specification Packet (See above)
AX	Exit status codes
CF	0 = System released 1 = System not in emulation mode
AH = 4Ch	Initiate disk emulation and boot
Entry:	
AL	00h
DS:SI	Specification Packet (See above)
AH = 4Dh	Return boot catalog
Entry :	
AL	00h
DS:SI	Point to Command Packet (See above)

Interrupt 14h—Serial Services

The INT 14 software interrupt handles serial I/O service requests. Use the AH register to specify the service to invoke. This describes the UART Modem and Line Status returned by these services. It also includes two services, 04h and 05h, that support the extended communication capabilities of PS/2.

The following describes the modem status returned by serial services.

Modem Status	
AL	Description
Bit 0	1 = Delta clear to send
Bit 1	1 = Delta data set ready
Bit 2	1 = Trailing edge ring indicator
Bit 3	1 = Delta data carrier detect
Bit 4	1 = Clear to send
Bit 5	1 = Data set ready
Bit 6	1 = Ring indicator
Bit 7	1 = Received line signal detect

The following describes the line status returned by Int 14h Serial Services.

Line Status	
AH	Description
Bit 0	1 = Data ready
Bit 1	1 = Overrun error
Bit 2	1 = Parity error
Bit 3	1 = Framing error
Bit 4	1 = Break detect
Bit 5	1 = Trans holding register empty
Bit 6	1 = Trans shift register empty
Bit 7	1 = Time out error

The following describes the serial communication services of *PhoenixBIOS 4.0*:

Interrupt 14h Serial Services	
AH = 00	Initialize Serial Adapter
Entry:	
AL	Init parameters:
Bit 1,0	10 = 7 data bits 11 = 8 data bits
Bit 2	0 = 1 stop bit 1 = 2 stop bits
Bit 4,3	00 = No parity 10 = No parity 01 = Odd parity 11 = Even parity
Bit 7-5	000 = 110 Baud- 417 divisor 001 = 150 Baud-300 divisor 010 = 300 Baud-180 divisor 011 = 600 Baud-0C0 divisor 100 = 1200 Baud-060 divisor 101 = 2400 Baud-030 divisor 110 = 4800 Baud-018 divisor 111 = 9600 Baud-00C divisor
DX	Serial port (0-3)
Exit:	
AL	Modem status
AH	Line status
AH = 01h	Send character
Entry:	
AL	Character to transmit
DX	Serial port (0-3)
Exit:	
AH	Line status
AH = 02h	Receive character
Entry:	
DX	Serial port (0-3)
Exit:	
AL	Character received
AH	Line Status
AH = 03h	Return serial port status
Entry:	
DX	Serial port (0-3)
Exit:	
AH	Line status
AL	Modem status
<i>Continued</i>	

*Interrupt 14h–Serial Services, Continued***AH = 04h Extended Initialize (PS/2)**

Entry:

DX 0-3 = Communications adapter

AL 00 = Break
01 = No breakBH Parity:
00 = None
01 = Odd
02 = Even
03 = Stick parity odd
04 = Stick parity evenBL Stop bits:
00 = One
01 = Two if 6,7, or 8-bit word length
One and one-half if 5-bit word lengthCH Word length:
00 = 5 bits
01 = 6 bits
02 = 7 bits
03 = 8 bitsCL Baud rate:
00 = 110 baud
01 = 150 baud
02 = 300 baud
03 = 600 baud
04 = 1200 baud
05 = 2400 baud
06 = 6000 baud
07 = 9600 baud
08 = 19200 baud

Exit:

AL Modem status

AH Line status

AH = 05h Extended Communications Port Control (PS/2)**AL = 00 Read modem control register**

Entry:

DX Serial port (0-3)

Exit:

BL Modem control register

AL = 01 Write modem control register

Entry:

DX Serial port (0-3)

BL Modem control register

Exit:

AL Modem status

AH Line status

Interrupt 15h–System Services

The INT 15 software interrupt handles a variety of system services:

- Multi-tasking–80h, 81h, 82h, 85h, 90h, and 91h

- Joystick support–84h

- Wait routines–83h and 86h

- Protected-mode support–87h and 89h

- Report extended memory to 64 kB–88h

- System information–C0h

- Advanced Power Management (optional)–53h

- Report extended memory above 64 kB (optional)–8Ah and E8h

- PS/2 Mouse support (optional)–C2h

- EISA Support (optional)–D8h

The first section describes the standard Interrupt 15 services, followed by separate sections describing each of the optional services.

Interrupt 15h System Services

AH = 00-03h **Cassette services**
 Entry:
 No longer supported
 Exit:
 Carry 1 = Not supported

AH = 80h **Device open**
 Entry:
 BX Device identifier
 CX Process identifier

AH = 81h **Device close**
 Entry:
 BX Device identifier
 CX Process identifier

AH = 82h **Program termination**
 Entry:
 BX Device identifier

AH = 83h **Event wait**

AL 00 = Set interval
 Entry:
 ES:BX Pointer to byte in caller's memory that will have
 bit 7 set when interval expires.
 CX Microseconds before post (high byte)
 DX Microseconds before post (low byte)
 Exit:
 AH 83h
 AL A value written to CMOS register B
 00h = Function busy

AL 01 = Cancel set interval
 Exit:
 AH 83
 AL 00

AH = 84h **Joystick support**
 Entry:
 DL 00 = Read switch settings
 Exit:
 AL Switch settings
 DL 01 Return resistive inputs
 Exit:
 AX Input bit 0 (Joystick A, x coordinate)
 BX Input bit 1 (Joystick A, y coordinate)
 CX Input bit 2 (Joystick B, x coordinate)
 DX Input bit 3 (Joystick B, y coordinate)

AH = 85h **System request key pressed**
 Entry:
 AL 00 System request key pressed
 AL 01 System request key released

AH = 86h **Wait**
 Entry:
 CX Number of microseconds to wait (high byte)
 DX Number of microseconds to wait (low byte)

Continued

*Interrupt 15h—System Services, Continued***AH = 87h Extended memory move block**

Entry:

CX Number of words to move
 ES:SI Pointer to Global Descriptor
 Byte 0-1 Bits 0-15 of Segment Limit
 Byte 2-3 Bits 0-15 of Base Address
 Byte 4 Bits 16-23 of Base Address
 Byte 5 Access Rights
 Byte 6 Bits 7-4 more Access Rights
 Bits 3-0 upper 4 bits of Segment Limit
 Byte 7 Bits 24-31 of Base Address

(See Intel programmer's reference)

AH = 88h Extended memory size

Exit:

AX Amount of Extended memory less 1 kB up to 64 MB,
 in 1 kB blocks (FFFCh implies 64 MB or greater. Use
 INT 15 Big Memory Services for further information).

AH = 89h Enter protected mode

Entry:

ES:SI Pointer to Global Descriptor (See service 87)
 BH Offset in IDT for IRQ 00-07
 BL Offset in IDT for IRQ 08-0F

AH = 90h Device busy

Entry:

AL Type code:
 00h = Fixed disk (May time out)
 01h = Diskette (May time out)
 02h = Keyboard (No time out)
 03h = Pointing device (May time out)
 80h = Network (No time out)
 FCh = Fixed disk reset (May time out)
 FDh = Diskette drive motor start (May time out)
 FEh = Printer (May time out)

ES:BX Points to request block if AL = 80h-FFh

Exit:

Carry 0 = No wait performed
 (Driver must perform own wait)
 1 = Wait performed (I/O complete or time out)

AH = 91h Interrupt complete

Entry:

AL Type code: See service 90h

AH = C0h Return system parameters

Exit:

ES:BX Pointer to System Configuration
 Bytes 1-2 Length of table in bytes (8)
 Byte 3 Model (FCh = AT)
 Byte 4 Sub model (01h = AT)
 Byte 5 BIOS revision level (0)
 Byte 6 Feature information:
 Bit 0 0 = Reserved
 Bit 1 0 = ISA-type I/O channel
 Bit 2 0 = EDDBA not allocated
 Bit 3 0 = Wait for external event
 supported
 Bit 4 1 = Keyboard intercept
 (INT 154F) called by INT 09h
 Bit 5 1 = Real time clock present
 Bit 6 1 = Second PIC present
 Bit 7 0 = Fixed disk BIOS does not
 use DMA channel 3
 Byte 7 Reserved
 Byte 8 Reserved

AH = C1h Return Extended BIOS Data Area Address

Exit:

ES Extended BIOS Data Area Segment Address
 If Carry = 1
 AH 86 = Invalid BIOS routine call (No EBDA)

Interrupt 15h–APM Services

The INT 15 software interrupt optionally handles the calls supporting APM (Advanced Power Management).

The following are the APM exit status codes:

APM Service Exit Status Codes	
AH	00h = No error
	If Carry = 1:
AH	01h = Power Management disabled
	02h = Real Mode interface already connected
	03h = Interface not connected
	05h = 16-bit protected mode interface already connected
	06h = 16-bit protected mode interface not supported
	07h = 32-bit protected mode interface already connected
	08h = 32-bit protected mode interface not supported
	09h = Unrecognized Device ID
	0Ah = Parameter value out of range
	0Bh = Interface not engaged
	60h = Unable to enter requested state
	80h = No PM events pending
	86h = No APM present

The following are the Interrupt 15 APM Services of *PhoenixBIOS 4.0*:

Interrupt 15h APM Services	
AH = 53h APM 1.0 and APM 1.1 BIOS Services	
AL = 00h Installation Check	
Entry:	
BX	0000h = Power Device ID (APM BIOS) All other values reserved
Exit:	
AH	APM major revision in BCD
AL	APM minor revision in BCD
BH	ASCII "P"
BL	ASCII "M"
CX	APM information:
Bit 0	1 = 16 bit Prot Mode supported
Bit 1	1 = 32 Bit Prot Mode supported
Bit 2	1 = CPU IDLE slows down CPU speed. Requires APM CPU Busy service
Bit 3	1 = BIOS Power Management is disabled
Bit 4	1 = APM disengaged
AL = 01h Interface Connect	
Entry:	
BX	0000h = Power Device ID (APM BIOS) All other values reserved
AL = 02h Protected-mode 16-bit interface connect	
Entry:	
BX	0000h = Power Device ID (APM BIOS) All other values reserved
Exit:	
AX	APM 16-bit code segment (real mode segment base address)
BX	Offset of entry point into the BIOS
CX	APM 16-bit data segment (real mode segment address)
SI	BIOS code segment length
DI	BIOS data segment length
<i>Continued</i>	

Interrupt 15h—APM Services, Continued**AL = 03h Protected-mode 32-bit interface connect**

Entry:

BX Power Device ID, 0000h
All other values reserved

Exit:

AX APM 32-bit code segment (real mode segment
base address)

EBX Offset of entry point into the BIOS

CX APM 16-bit data segment (real mode segment
address)DX APM data segment (real mode segment
address)

SI BIOS code segment length

DI BIOS data segment length

AL = 04h Protected-mode 32-bit interface connect

Entry:

BX 0000h = Power Device ID (APM BIOS)
All other values reserved**AL = 05h CPU Idle****AL = 06h CPU busy****AL = 07h Set Power State**

Entry:

BX Power Device ID:
0001h = All PM devices managed by the BIOS
01XXh = Display
02XXh = Secondary Storage
03XXh = Parallel Ports
04XXh = Serial Ports
05XXh = Network Adapters
06XXh = PCMCIA Sockets
E000h-EFFFh = OEM-defined power-device
IDs

where:

XXh = Unit Number (0 based)

Unit Number FFh = all units in this class

CX

Power State:

*0000h = APM enabled

0001h = Standby

0002h = Suspend

0003h = Off

**0004h = Last Request Processing

Notification

**0005h = Last Request Rejected

0006h-001Fh = Reserved system states

0020h-003Fh = OEM-defined system states

0040h-007Fh = OEM-defined device states

0080-FFFFh = Reserved device states

* Not supported for Power Device ID 0001h

**Only supported for Power Device ID 0001h

AL = 08h Enable/disable power management

Entry:

BX Power Device ID:
0001h = All PM devices controlled by the BIOS
FFFFh = All PM devices controlled by the
BIOS (For compatibility with APM 1.0)
All other values reserved

CX

Function code:

0000h = Disable power management

0001h = Enable power management

AL = 09h Restore Power-On Defaults

Entry:

BX Power Device ID:
0001h = All PM devices managed by the BIOS
FFFFh = All PM devices managed by the BIOS
(For compatibility with APM 1.0)
All other values reserved*Continued*

*Interrupt 15h-APM Services, Continued***AL = 0Ah Get Power Status**

Entry:

BX Power Device ID, 0000h = APM BIOS
All other values reserved

Exit:

BH AC line status:
00h = Off line
01h = On line
02h = On backup power
FFh = Unknown
All other values reserved

BL Battery status:

00h = High
01h = Low
02h = Critical
03h = Charging
FFh = Unknown

CL Percentage of charge remaining:

0-100 = Percentage of full charge
FFh = Unknown
All other values reserved

AL = 0Bh Get PM Event

Exit:

BX PM event code**AL = 0Ch Get Power State**

Entry:

BX Power Device ID:
0001h = All PM devices managed by the BIOS
01XXh = Display
02XXh = Secondary Storage
03XXh = Parallel Ports
04XXh = Serial Ports
05XXh = Network Adapters
06XXh = PCMCIA Sockets
E000h-EFFFh = OEM-defined power-device IDs
All other values reserved
where:
XXh = Unit Number (0 based)

AH = 53h APM 1.1 BIOS Services**AL = 0Dh Enable/Disable power management
(APM 1.1 only)**

Entry:

BX Power Device ID:
0001h = All PM devices managed by the BIOS
01XXh = Display
02XXh = Secondary Storage
03XXh = Parallel Ports
04XXh = Serial Ports
05XXh = Network Adapters
06XXh = PCMCIA Sockets
E000h-EFFFh = OEM-defined power-device IDs
All other values reserved
where:
XXh = Unit Number (0 based)

**AL = 0Eh APM Driver Version
(APM 1.1 only)**

Entry:

BX 0000h = BIOS device
CH APM Driver major version number (BCD)
CL APM Driver minor version number (BCD)

Exit:

AH APM Connection major version number (BCD)
AL APM Connection minor version number (BCD)

Continued

Interrupt 15h—APM Services, Continued**AL = 0Fh Engage/disengage power management (APM 1.1 only)**

Entry:

BX Power Device ID:
 0001h = All PM devices managed by the BIOS
 01XXh = Display
 02XXh = Secondary Storage
 03XXh = Parallel Ports
 04XXh = Serial Ports
 05XXh = Network Adapters
 06XXh = PCMCIA Sockets
 E000h-EFFFh = OEM-defined power-device IDs

All other values reserved

where:

XXh = Unit Number (0 based)

Unit Number FFh = all devices in this class

CX

Function code:

0000h = Disengage power management

0100h = Engage power management

Interrupt 15h—Big Memory Services

The INT 15 software interrupt is an installable option that handles the calls reporting extended memory over 64 MB.

Interrupt 15h Big Memory Services**AH = 8Ah Big Memory size, Phoenix definition**

Entry:

AX Low 16-bit value**DX** High 16-bit value

= amount of memory above 64 MB in 1 kB blocks

AH = E8h Big Memory size**AL = 01h Big Memory Size, 16 Bit**

Exit:

Carry 0 = E801 Supported

AX Memory 1 MB to 16 MB, in 1 kB blocks**BX** Memory above 16 MB, in 64 kB blocks**CX** Configured memory 1 MB to 16 MB, in 1 kB blocks**DX** Configured memory above 16 MB, in 64 kB blocks**AL = 20h System Memory Map**

Entry:

EBX Continuation value**ES:DI** Address of Address Range Descriptor**ECX** Length of Address Range Descriptor
(=> 20 bytes)**EDX** "SMAP" signature

Exit:

Carry 0 = E820 Supported

EAX "SMAP" signature**ES:DI** Same value as entry**ECX** Length of actual reported information in bytes**EBX** Continuation value

Structure of Address Range Descriptor:

Bytes 0-3 Low 32 bits of Base Address

Bytes 4-7 High 32 bits of Base Address

Bytes 8-11 Low 32 bits of Length in bytes

Bytes 12-15 High 32 bits of Length in bytes

Bytes 16-20 Type of Address Range:

1 = AddressRangeMemory, available to OS**2** = AddressRangeReserved, not available**3** = AddressRangeACPI, available to OS**4** = AddressRangeNVS, not available to OS**Other** = Not defined, not available*Continued*

Interrupt 15h–Big Memory Services, Continued

NOTE: Each call of this service defines a descriptor buffer and requests the memory status of the address range specified by the continuation value, where zero = first address range. The function fills the buffer and returns the continuation value for the next address range, where zero = last address range.

AL = 81h Big Memory Size, 32-Bit Protected Mode

Exit:
 Carry 0 = E881 supported
 EAX Memory 1 MB to 16 MB, 1 kB blocks
 EBX Memory above 16 MB, 64 kB blocks
 ECX Configured memory 1 MB to 16 MB, 1 kB blocks
 EDX Configured memory above 16 MB, 64 kB blocks

Interrupt 15h–PS/2 Mouse Services

The INT 15 software interrupt optionally supports systems with the PS/2 mouse or similar devices installed on the motherboard. The following table describes the exit status codes:

PS/2 Mouse Exit Status Codes

AH 00h = No error
 01h = Invalid function call
 02h = Invalid input value
 03h = Interface error
 04h = Request for resend received from 8042
 05h = No driver installed (i.e., Function C207 has not been called)

The following table describes the Interrupt 15h PS/2 mouse services of PhoenixBIOS 4.0:

Interrupt 15h PS/2 Mouse Services

AH = C2h PS/2 Mouse Support

AL 00 = Enable/Disable PS/2 Mouse

Entry:
 BH 00h = Disable
 01h = Enable

AL 01 = Reset PS/2 Mouse

Exit:
 BH Device ID

AL 02 = Set Sample Rate

Entry:
 BH Sample rate:
 00h = 10 reports per second
 01h = 20 reports per second
 02h = 30 reports per second
 03h = 40 reports per second
 04h = 60 reports per second
 04h = 80 reports per second
 05h = 100 reports per second
 06h = 200 reports per second

AL 03h = Set resolution

Entry:
 BH Resolution value:
 00h = 1 count per millimeter
 01h = 2 counts per millimeter
 02h = 4 counts per millimeter
 03h = 8 counts per millimeter

AL 04h = Read Device Type

Exit:
 BH Device ID

AL 05h = Initialize PS/2 mouse

Entry:
 BH Data package size (01-08h, in bytes)

Continued

*Interrupt 15h-PS/2 Mouse Services, continued***AL 06h = Set Scaling or Get Status**

Entry:

BH 00 = Return status (See Exit Status below)
 01 = Set Scaling Factor to 1:1
 02 = Set Scaling Factor to 2:1

Exit:

If Entry BH = 00:
 BL Status byte 1:
 Bit 0 1 = Right button pressed
 Bit 1 0 = Reserved
 Bit 2 1 = Left button pressed
 Bit 3 0 = Reserved
 Bit 4 0 = 1:1 Scaling
 1 = 2:1 Scaling
 Bit 5 0 = Disable
 1 = Enable
 Bit 6 0 = Stream mode
 1 = Remote mode
 Bit 7 0 = Reserved

CL Status byte 2:
 00h = 1 count per millimeter
 01h = 2 counts per millimeter
 02h = 4 counts per millimeter
 03h = 8 counts per millimeter

DL Status byte 3:
 0Ah = 10 reports per second
 14h = 20 reports per second
 28h = 40 reports per second
 3Ch = 60 reports per second
 50h = 80 reports per second
 64h = 100 reports per second
 C8h = 200 reports per second

AL 07 = Set PS/2 mouse driver address

Entry:

ES:BX Pointer to mouse driver

Interrupt 15h–EISA Services

The INT 15 software interrupt optionally supports systems with EISA (Extended Industry Standard Architecture) with these services:

Read slot configuration information–D800h, D880h

Read function configuration information–D801h, D881h

Clear EISA CMOS–D802h , D882h

Write slot configuration information to EISA CMOS–D803h, D883h

Read physical slot information–D804, D884h

The EISA BIOS services accommodate real and protected mode and 16 and 32-bit addressing. See the EISA specifications for descriptions of these services.

The following are the exit status codes for the Int 15 EISA services:

Int 15 EISA Exit Status Codes

AH 00h = No error
 If Carry = 1
 AH 80h = Invalid slot number
 81h = Invalid function number
 82h = Extended CMOS corrupted
 83h = Empty slot specified
 84h = Error writing to CMOS
 85h = CMOS is full
 86h = Invalid BIOS routine call
 87h = Invalid system configuration
 88h = Configuration utility not supported

The following are the Interrupt 15 EISA services of *PhoenixBIOS 4.0*:

Interrupt 15h EISA Services

AH = D8h Access EISA System Information

AL 00h = Read slot config information
80h = Read slot config information, 32 bit

Entry:

CL Slot number (0-63)

Exit:

AL Vendor information byte:
 Bits 3-0 Duplicate ID number:
 0000 = No duplicate ID
 0001 = First duplicate ID
 Bits 5-4 Slot type:
 00 = Expansion slot
 01 = Embedded device
 10 = Virtual device
 11 = Reserved
 Bit 6 Product ID:
 00 = Readable
 01 = Not readable
 Bit 7 Duplicate ID:
 00 = No duplicate ID
 01 = Duplicate IDs

BH Major revision level of config utility

BL Minor revision level of config utility

CH MSbyte of checksum of config file

LSbyte of checksum of config file

DH Number of device functions

DL Combined function information byte:

Bit 7 Reserved
 Bit 6 Slot has free-form data entries
 Bit 5 Slot has port initialization entries
 Bit 4 Slot has port range entries
 Bit 3 Slot has DMA entries
 Bit 2 Slot has IRQ entries
 Bit 1 Slot has memory entries
 Bit 0 Slot has function type entries

DI First word of compressed device ID

SI Second word of compressed device ID
 (See "Read physical slot information" below)

AL 01h = Read function config information
81h = Read function config information, 32 bit

Entry:

CH Function number (0 to n-1)

CL Slot number (0-63)

DS:SI Pointer to output data buffer

Exit:

DS Segment for return data buffer

SI Offset to return data buffer (16 bit)

ESI Offset to return data buffer (32 bit)

AL 02h = Clear EISA CMOS configuration
82h = Clear EISA CMOS configuration 32 bit

Entry:

BH Configuration utility major revision level

BL Configuration utility minor revision level

AL 03h = Write slot config information
83h = Write slot config information, 32 bit

Entry:

CX Length of data structure in bytes

DS Segment of data table

SI Offset of data table (16-bit call)

ESI Offset of data table (32-bit call)

Continued

*Interrupt 15h–EISA Services, Continued***AL 04h = Read board ID registers****84h = Read board ID registers, 32 bit**

Entry:

CL Slot number (0-63)

Exit:

DI First word of compressed ID:

Byte 0:

Bits 1-0 2nd character of manufacturer code

Bits 6-2 1st character of manufacturer code

Bit 7 Reserved

Byte 1:

Bits 4-0 3rd character of manufacturer code

Bits 5-7 2nd character of manufacture code, cont.

SI Second word of compressed ID:

Byte 0:

Bits 3-0 2nd hex digit of product number

Bits 7-4 1st hex digit of product number

Byte 1:

Bits 3-0 Hex digit of revision number

Bits 7-4 3rd hex digit of product number

If Carry = 1:

Interrupt 16h–Keyboard Services

The INT 16 software interrupt handles keyboard I/O services. The following describes the keyboard services of *PhoenixBIOS 4.0*:

Interrupt 16h Keyboard Services**AH = 00h Read keyboard input**

Exit:

AL ASCII keystroke pressed

AH Scan code of key

AH = 01h Return keyboard status

Exit:

AL ASCII keystroke pressed

AH Scan code of key

ZF No keystroke available

NZ Keystroke in buffer

AH = 02h Return shift-flag status

Exit:

AL Current shift status

AH = 03h Set typematic rate and delay.

Entry:

AL 05 (sub function number)

BL 00H through 1FH, typematic rate
(30 chars/sec to 2 char/sec)

BH Delay rate:

00h = 250 ms

01h = 500 ms

02h = 750 ms

03h = 1000 ms

04h to 07h = Reserved

AH = 05h Add key to Keyboard buffer.

Entry:

CL ASCII code

CH Scan code

Exit:

If Carry = 1:

AL Keyboard buffer full

AH = 10h Read extended character from buffer.

Exit:

AL ASCII keystroke pressed

AH Scan code of key

Continued

*Interrupt 16h–Keyboard Services, Continued***AH = 11h Return extended buffer status.**

Exit:

AL ASCII keystroke pressed
 AH Scan code of key
 ZF No keystroke available
 NZ Keystroke in buffer

AH = 12h Return extended shift status.

Exit:

AL Shift status:
 Bit 7 1 = Sys Req pressed
 Bit 6 1 = Caps Lock active
 Bit 5 1 = Num Lock active
 Bit 4 1 = Scroll Lock active
 Bit 3 1 = Right Alt active
 Bit 2 1 = Right Ctrl active
 Bit 1 1 = Left Alt active
 Bit 0 1 = Left Ctrl active
 AH Extended shift status:
 Bit 7 1 = Insert active
 Bit 6 1 = Caps Lock active
 Bit 5 1 = Num Lock active
 Bit 4 1 = Scroll Lock active
 Bit 3 1 = Alt pressed
 Bit 2 1 = Ctrl pressed
 Bit 1 1 = Left Shift pressed
 Bit 0 1 = Right Shift pressed

Interrupt 17h–Parallel Printer Services

The INT 17 software interrupt supports up to 4 parallel adapters. The BIOS stores the standard base addresses for three parallel adapters in the BIOS Data Area at 3FCh, 378h, and 278h. These services use the I/O ports 0278h-027Ah, 0378h-037Ah, and 03BCh-03BEh.

Interrupt 17h Parallel Printer Services**AH = 00h Print character**

Entry:

AL Character to print
 DX Printer port (0-3)

Exit:

AH Printer Status (see below)

AH = 01h Initialize printer port

Entry:

DX Printer port (0-3)

Exit:

AH Printer Status (see below)

AH = 02h Return printer status

Entry:

DX Printer port (0-3)

Exit:

AH Printer Status:
 Bit 0 1 = Time-out error
 Bit 1 Reserved
 Bit 2 Reserved
 Bit 3 1 = I/O error
 Bit 4 1 = Printer selected
 Bit 5 1 = Out of paper
 Bit 6 1 = Acknowledgment from printer
 Bit 7 1 = Printer not busy

Interrupt 17h–EPP Services

Use Interrupt 17h 02h to obtain the BIOS entry point (also called the EPP Vector) to Enhanced Parallel Printer (EPP) Services. To use the other EPP services, load AH with an appropriate function value and Far call the EPP Vector.

The following are the EPP exit status codes:

EPP Services Exit Status Codes

AH 00h = No error
 01h = Failed I/O function
 02h = Invalid function
 03h = EPP not supported
 04h = Not an EPP port
 20h = Multiplexor not present
 40h = Multiplexor already locked

The following are the Int 17 EPP services of *PhoenixBIOS 4.0*:

Interrupt 17h EPP Service**AH = 02h EPP Installation check****Entry:**

DX EPP printer port (0-2)
 AL 0
 CH 45h = "E"
 BL 50h = "P"
 BH 50h = "P"

Exit:

AL 45h
 CX 5050h
 DX:BX EPP BIOS entry point

Vectored EPP Services**(Call entry point)****AH = 00h Query EPP port configuration****Entry:**

DL EPP printer port (0-2)

Exit:

AL Interrupt level of EPP port (00-15h)
 FFh = Interrupts not supported
 BH EPP BIOS revision (MMMMnnnn or M.n)
 BL I/O capabilities:
 Bit 0 Multiplexor present
 Bit 1 PS/2 bi-directional capable
 Bit 2 Daisy chain present
 Bit 3 ECP capable
 CX SPP I/O base address
 ES:DI FAR pointer to EPP BIOS manufacturer's
 info/version text string, zero terminated

AH = 01h Set mode**Entry:**

DL EPP printer port (0-2)

AL Modes:

Bit 0 Set compatibility mode
 Bit 1 Set Bi-directional mode
 Bit 2 Set EPP mode
 Bit 3 Set ECP mode
 Bit 4 Set EPP software emulation (via
 standard parallel port)

AH = 02h Get mode**Entry:**

DL EPP printer port (0-2)

Exit:**AL Modes:**

Bit 0 In compatibility mode
 Bit 1 In Bi-directional mode
 Bit 2 In EPP mode
 Bit 3 In ECP mode
 Bit 4 In EPP software-emulation mode
 Bit 7 EPP port interrupts enabled

AH = 03h Interrupt control**Entry:**

DL EPP printer port (0-2)

AL

0 = Disable EPP port interrupts

1 = Enable EPP port interrupts

AH = 04h Reset EPP port**Entry:**

DL EPP printer port (0-2)

Continued

Interrupt 17h—EPP Services, Continued

AH = 05h Write address/select device
 Entry:
 DL EPP printer port (0-2)
 AL Device address to write

AH = 06h Read address
 Entry:
 DL EPP printer port (0-2)
 AL Device address to write
 Exit:
 AL Address/device data returned

AH = 07 Write byte
 Entry:
 DL EPP printer port (0-2)
 AL Data byte

AH = 08 Write block
 Entry:
 DL EPP printer port (0-2)
 CX Number of bytes to write (0 = 64k)
 ES:SI Client buffer w/data
 Exit:
 CX Bytes not transferred (0 = no error)

AH = 09h Read byte
 Entry:
 DL EPP printer port (0-2)
 Exit:
 AL Data byte returned

AH = 0Ah Read block
 Entry:
 DL EPP printer port (0-2)
 CX Number of bytes to read (0 = 64k)
 ES:DI Client buffer for returned data
 Exit:
 CX Bytes not transferred (0 = no error)

AH = 0Bh Write address, read byte
 Entry:
 DL EPP printer port (0-2)
 AL Device address
 Exit:
 AL Data byte returned

AH = 0Ch Write address, write byte
 Entry:
 DL EPP printer port (0-2)
 AL Device address
 DH Data byte to write

AH = 0Dh Write address, read block
 Entry:
 DL EPP printer port (0-2)
 AL Device address
 CX Number of bytes to read (0 = 64k)
 ES:DI Client buffer for data
 Exit:
 AL Returned byte data
 CX Bytes not transferred (0 = no error)

AH = 0Eh Write address, write block
 Entry:
 DL EPP printer port (0-2)
 AL Device address
 CX Number of bytes to write
 ES:SI Client buffer w/data
 Exit:
 CX Bytes not transferred (0 = no error)

AH = 0Fh Lock port
 Entry:
 DL EPP printer port (0-2)
 BL Port address:
 Bits 7-4 Daisy chain port number (1-8)
 Bits 3-0 Mux device port number (1-8)
 0 = No multiplexor

AH = 10h Unlock port
 Entry:
 DL EPP printer port (0-2)

Continued

*Interrupt 17h–EPP Services, Continued***AH = 11h Device interrupt**

Entry:

DL EPP printer port (0-2)
 BL The multiplexor device port (1-8)
 0 = No multiplexor
 AL 0 = Disable device interrupts
 1 = Enable device interrupts
 ES:DI Far pointer to interrupt-event handler

AH = 12h Real time mode

Entry:

AL 0 = Query if any real-time device present
 1 = Add (advertise) real-time device
 2 = Remove real-time device

Exit:

AL 0 = No real-time devices present
 1 = One or more real-time devices present

AH = 40h Query multiplexor

Entry:

DL EPP printer port (0-2)

Exit:

AL Bit 0 1 = Channel locked
 Bit 1 1 = Interrupt pending

BL Currently selected port

AH = 41h Query multiplexor device port

Entry:

DL EPP printer port (0-2)
 BL The multiplexor device port (1-8)
 0 = No multiplexor

Exit:

AL Status flags:
 Bit 0 1 = Port selected
 Bit 1 1 = Port locked
 Bit 2 1 = Interrupts enabled
 Bit 3 1 = Interrupt pending

CX EPP product/Device ID
 0 = Undefined

AH = 42h Set product ID

Entry:

DL EPP printer port (0-2)
 AL Mapped EPP Mux device port (1-8)
 CX EPP Product ID

AH = 50h Rescan daisy chain

Entry:

DL EPP printer port (0-2)
 BL The multiplexor device port (1-8)
 0 = No multiplexor

AH = 51h Query daisy chain

Entry:

DL EPP printer port (0-2)
 BL The multiplexor device port (1-8)
 0 = No multiplexor

Exit:

AL Status flags:
 Bit 0 1 = Channel locked
 Bit 1 1 = Interrupt pending
 BL Currently selected device
 CL Depth of daisy chain on this port
 0 = No daisy chain on this port

ES:DI Pointer to ASCII string, driver vendor ID

Interrupt 1Ah–Time of Day Services

The INT 1Ah software interrupt handles the time of day I/O services. A Carry flag set on exit may indicate the clock is not operating.

Interrupt 1Ah Time-of-Day Services	
AH = 00h	Read current time
Exit:	
CX	High word of tick count
DX	Low word of tick count
AL	00h = Day rollover has not occurred (Timer count is less than 24 hours since last power on or reset)
AH = 01h	Set current time (Clear rollover bit)
Entry:	
CX	High word of tick count
DX	Low word of tick count
AH = 02h	Read real time clock
Exit:	
CH	BCD hours
CL	BCD minutes
DH	BCD seconds
DL	00 = Standard Time 01h = Daylight Savings
AH = 03h	Set the real time clock
Entry:	
CH	BCD hours
CL	BCD minutes
DH	BCD seconds
DL	01h = Daylight saving 00h = Otherwise
AH = 04h	Read date from real time clock
Exit:	
CH	BCD century
CL	BCD year
DH	BCD month
DL	BCD date
AH = 05h	Set date in real time clock
Entry:	
CH	BCD century
CL	BCD year
DH	BCD month
DL	BCD date
AH = 06h	Set real-time alarm
Entry:	
CH	BCD hours to alarm
CL	BCD minutes to alarm
DH	BCD seconds to alarm
Exit:	
C	1 = Alarm already set
AH = 07h	Reset real-time alarm
Exit:	
AL	Value written to CMOS RAM register 0Bh

Interrupt 1Ah–General PCI Services

PhoenixBIOS 4.0 optionally supports General PCI Interrupt 1Ah Services. The following are the exit status codes:

PCI Services Exit Status Codes	
AH	00h = Successful
	If Carry = 1:
AH	81h = Function not supported
	83h = Bad vendor ID
	86h = Device not found
	87h = Bad register number
	88h = Set failed
	89h = Buffer too small

The following are the PCI Services:

Interrupt 1Ah General PCI Services**AH = B1h PCI Services****AL 01h = PCI BIOS present**

Exit:

EDX "PCI", "P" in [DL], "C" in [DH], etc.

AL Hardware mechanism:

Bit Description

5 Spec. Cycle-Config Mechanism #2 support

4 Spec. Cycle-Config Mechanism #1 support

1 Config Mechanism #2 support

0 Config Mechanism #1 support

BH Interface level major version

BL Interface level minor version

CL Number of last PCI bus

AL 02h = Find PCI Device

Entry:

CX Device ID (0-65535)

DX Vendor ID (0-65534)

SI Index (0-n)

Exit:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

AL 03h = Find PCI class code

Entry:

ECX Class code in lower three bytes

SI Index (0-n)

Exit:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

AL 06h = Generate special cycle

Entry:

BH Bus number (0-255)

EDX Special cycle data

AL 08h = Read configuration byte

Entry:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

DI Register number (0-255)

Exit:

CL Byte read

AL 09h = Read configuration word

Entry:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

DI Register number (0, 2, 4,...254)

Exit:

CX Word read

AL 0Ah = Read configuration Dword

Entry:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

DI Register number (0, 4, 8,...252)

Exit:

ECX Dword read

AL 0Bh = Write configuration byte

Entry:

BH Bus number (0-255)

BL Bits 7-3 Device number

Bits 2-0 Function number

DI Register number (0-255)

CL Byte value to write

Continued

*Interrupt 1Ah—General PCI Services, Continued***AL 0Ch = Write configuration word**

Entry:

BH Bus number (0-255)
 BL Bits 7-3 Device number
 Bits 2-0 Function number
 DI Register number (0, 2, 4,...254)
 CX Word value to write

AL 0Dh = Write configuration Dword

Entry:

BH Bus number (0-255)
 BL Bits 7-3 Device number
 Bits 2-0 Function number
 DI Register number (0, 4, 8,...252)
 ECX Dword value to write

AL 0Eh = Get PCI IRQ routing options

Entry:

DS Segment or Selector for BIOS data
 ES Segment or Selector for Route Buffer parameter
 DI 16-bit offset for Route Buffer parameter
 EDI 32-bit offset for Route Buffer parameter

Exit:

BX Exclusive-PCI IRQ data map:
 Bit 0 1 = IRQ0 PCI only
 Bit 1 1 = IRQ1 PCI only
 ...
 Bit 15 1 = IRQ15 PCI only

AL 0Fh = Set PCI hardware interrupt

Entry:

BH Bus number (0-255)
 BL Bits 7-3 Device number
 Bits 2-0 Function number
 CL PCI interrupt pin (0Ah...0Dh)
 CH IRQ number (0-15)
 DS Segment or Selector for BIOS data

PnP Run-Time Services

Plug and Play automatically configures PC hardware and attached devices without requiring you to manually configure the device with jumpers or in Setup. You can install a new device such as sound or fax card ("plug it in") and start working ("begin playing").

To work properly, however, Plug-and-Play must be supported in the hardware and software, including the BIOS, the operating system (such as Microsoft Windows 95), and the hardware drivers.

Each Plug and Play device must have all of the following capabilities:

1. It must be uniquely identified
2. It must state the services it provides and the resources it requires
3. It must allow software to configure it.

Note: To register a new unique vendor ID or manufacturer ID for Plug and Play hardware, please send e-mail to pnpid@microsoft.com.

NOTE: There are a variety of Plug and Play technologies, including BIOS, ISA, SCSI, IDE, CD-ROM, LPT, COM, PCMCIA, and drivers. For complete instructions on using the PnP BIOS Services, consult the *Plug and Play BIOS Specification V. 1.0a*. You can download this specification and other PnP specifications from this Microsoft Web site:

<http://www.microsoft.com/hwdev/specs/pnpspecs.htm>

PhoenixBIOS 4.0 optionally supports PnP (Plug and Play) Runtime Services in Real and Protected Mode in with the following routines:

PnP Run-Time Services	
00h	Get Number of Device Nodes
01h	Get Device Node
02h	Set Device Node
03h	Get Event
04h	Send Message
05h	Get Docking Station Information
09h	Set Statically Allocated Resources
0Ah	Get Statically Allocated Resources
0Bh	Get APM 1.1 ID Table
40h	Get ISA Configuration Structure
41h	Get ESCD Information
42h	Read ESCD Data Image
43h	Write ESCD Data Image

The following are the exit status codes for the PnP Runtime Services

PnP Runtime Service Exit Status Codes	
AH	00h = No error
	If Carry = 1:
AH	7Fh = Device not set statically
	81h = Unknown or invalid function
	82h = Function not supported
	83h = Handle for Device Node invalid or out of range
	84h = Bad resource descriptors
	85h = Set Device Node function failed
	86h = No events pending
	87h = System currently not docked
	88h = No ISA PnP cards installed
	89h = Cannot determine docking station capabilities
	8Ah = Undocking failed: no battery
	8Bh = Docking failed: conflict with primary boot device
	8Ch = Caller's memory buffer too small
	8Dh = Use ESCD support function instead
	8Eh = Send Message 04h function not supported
	8Fh = Hardware error

To find the PnP entry points, search for the **PnP BIOS Support Installation Check** structure by searching for the "\$PnP" signature in system memory starting from F0000h to FFFFFh at every 16-byte boundary. Check the validity of the structure by adding the values of *Length* bytes, including the *Checksum* field, into a 8-bit value. Zero indicates a valid checksum.

The following describes the support structure:

PnP Support Installation Check		
Offset	Size	Description
00h	4	ASCII "\$PnP" signature
04h	1	Version (10h)
05h	1	Length (21h)
06h	2	Control field
08h	1	Checksum
09h	4	Event-notification flag address
0Dh	2	Real Mode 16-bit offset to entry point
0Fh	2	Real Mode 16-bit code segment address
11h	2	16-bit Protected Mode offset to entry point
13h	4	16-bit Protected Mode code segment base address
17h	4	OEM Device Identifier
1Bh	2	Real Mode 16-bit data segment address
1Dh	4	16-bit Protected Mode data segment base address

Call each service by loading the function parameters on the stack and FAR calling the appropriate entry point. The following are the Runtime Services of *PhoenixBIOS 4.0*, in 'C' syntax.

PnP Runtime-Service Function Parameters**00h Get Number of Device Nodes**

Entry:
 int FAR (*entryPoint)(Function, NumNodes, NodeSize,
 BiosSelector);
 int Function;
 unsigned char FAR *NumNodes;
 unsigned int FAR *NodeSize;
 unsigned int BiosSelector;

01h Get System Device Node

Entry:
 int FAR (*entryPoint)(Function, Node, devNodeBuffer,
 Control, BiosSelector);
 int Function;
 unsigned char FAR *Node;
 struct DEV_NODE FAR *devNodeBuffer;
 unsigned int Control;
 unsigned int BiosSelector;

02h Set System Device Node

Entry:
 int FAR (*entryPoint)(Function, Node, devNodeBuffer,
 Control, BiosSelector);
 int Function;
 unsigned char Node;
 struct DEV_NODE FAR *devNodeBuffer;
 unsigned int Control;
 unsigned int BiosSelector;

03h Get Event

Entry:
 int FAR (*entryPoint)(Function, Message, BiosSelector);
 int Function;
 unsigned int FAR *Message;
 unsigned int BiosSelector;

04h Send Message

Entry:
 int FAR (*entryPoint)(Function, Message, BiosSelector);
 int Function;
 unsigned int Message;
 unsigned int BiosSelector;

05h Get Docking Station Information

Entry:
 int FAR (*entryPoint)(Function, DockingStationInfo,
 BiosSelector);
 int Function;
 unsigned char FAR *DockingStationInfo;
 unsigned int BiosSelector;
 Exit:
 Docking station info buffer:
 Offset 00h Docking station location identifier
 Offset 04h Serial Number
 Offset 08h Docking Capabilities:
 Bits 2-1:
 00 = Cold Docking
 01 = Warm Docking
 10 = Hot Docking
 Bit 0:
 0 = Surprise-style docking
 1 = VCR-style docking

09h Set Statically Allocated Resources

Entry:
 int FAR (*entryPoint)(Function, Resource Block,
 BiosSelector);
 int Function;
 unsigned char FAR *ResourceBlock;
 unsigned int BiosSelector;

Continued

*PnP Run-Time Services, Continued***0Ah Get Statically Allocated Resources**

Entry:
 int FAR (*entryPoint)(Function, Resource Block,
 BiosSelector);
 int Function;
 unsigned char FAR *ResourceBlock;
 unsigned int BiosSelector;

0Bh Get APM ID Table (For APM 1.1 only)

Entry:
 int FAR (*entryPoint)(Function, BufSize, APMIdTABLE
 BiosSelector);
 int Function;
 unsigned int FAR *BufSize;
 unsigned char FAR *APMIdTable;
 unsigned int BiosSelector;

Exit:

APM ID table:

Length	Description
Dword	Device identifier
Word	APM 1.1 identifier

40h Get PnP ISA Configuration Structure

Entry:
 int FAR (*entryPoint)(Function, Configuration, BiosSelector);
 int Function;
 unsigned char FAR *Configuration;
 unsigned int BIOS Selector;

Exit:

PnP ISA Configuration structure:

Offset	Description
00h	Structure revision
01h	Number of Card Select Numbers assigned
02h	ISA Read Data port
04h	Reserved

41h Get Extended System Configuration Data (ESCD)

Entry:
 int FAR (*entryPoint)(Function, MinESCDWriteSize,
 ESCDSize, NVStorageBase, BiosSelector);
 int Function;
 unsigned int FAR *MinESCDWriteSize;
 unsigned int FAR *ESCDSize;
 unsigned long FAR *NVStorageBase;
 unsigned int BiosSelector;

42h Read Extended System Configuration Data

Entry:
 int FAR (*entryPoint)(Function, ESCDBuffer, ESCDSelector,
 BiosSelector);
 int Function;
 char FAR *ESCDBuffer;
 unsigned int ESCDSelector;
 unsigned int BiosSelector;

43h Write Extended System Configuration Data (ESCD)

Entry:
 int FAR (*entryPoint)(Function, ESCDBuffer, ESCDSelector,
 BiosSelector);
 int Function;
 char FAR *ESCDBuffer;
 unsigned int ESCDSelector;
 unsigned int BiosSelector;

SMBIOS Services

The **System Management BIOS (SMBIOS)**, one of the components of the Desktop Management Interface (DMI), is a method for managing PCs in an enterprise. Using SMBIOS, a Manager of Information Systems can access up-to-date information about the hardware and software installed on every computer on a network.

NOTE: For complete instructions on using these services, see the **System Management BIOS Reference Specification** available at the Phoenix Web site: <http://www.phoenix.com/products/specs-smbios.pdf>

For descriptions of the DMI architecture, see the Web site of the **Desktop Management Task Force** at: <http://www.dmtf.org>

The SMBIOS Services are functions 50h through 5Fh of the PnP Run Time Services. See "PnP Run-Time Services" above for a description of how to find the PnP entry points to these SMBIOS Services. The following are the SMBIOS services supported in PhoenixBIOS 4.0:

SMBIOS Services	
50h	Get SMBIOS Information
51h	Get SMBIOS Structure
52h	Set SMBIOS Structure
55h	Get GPNV Information
56h	Read GPNV Information
57h	Write GPNV Data

The following are the exit status codes for the SMBIOS Services:

SMBIOS Services Exit Status Codes	
AX	00h = Function Completed Successfully
AX	81h = Unknown, or invalid, function number passed
	82h = The function is not supported on this system
	83h = SMBIOS Structure number/handle passed is invalid or out of range.
	84h = The function detected invalid parameter or, in the case of a "Set SMBIOS Structure" request, detected an invalid value for a to-be-changed structure field
	85h = The SubFunction parameter supplied on a SMBIOS control function is not supported by the system BIOS.
	86h = There are no changed SMBIOS structures pending notification.
	87h = Returned when there was insufficient storage space to add the desired structure.
	8Dh = A "Set SMBIOS Structure" request failed because one or more of the to-be-changed structure fields are read-only.
	90h = The GPNV functions do not support locking for the specified GPNV handle.
	91h = The GPNV lock request failed - the GPNV is already locked.
	92h = The caller has failed to present the predefined GPNVLock value which is expected by the BIOS for access of the GPNV area.

Call each service by loading the function parameters on the stack and FAR calling the appropriate entry point. The following are the SMBIOS Services in 'C' syntax.

SMBIOS Function Parameters**50h Get SMBIOS Information**

Entry:

```
short FAR (*entryPoint)(short Function,
    unsigned char FAR *dmiBIOSRevision,
    unsigned short FAR *NumStructures,
    unsigned short FAR *StructureSize,
    unsigned long FAR *dmiStorageBase,
    unsigned short FAR *dmiStorageSize,
    unsigned short *BiosSelector );
```

51h Get SMBIOS Structure

Entry:

```
short FAR (*entryPoint) (
    short Function;
    unsigned short FAR *Structure;
    unsigned char FAR *dmiStrucBuffer;
    unsigned short dmiSelector;
    unsigned short BiosSelector);
```

52h Set SMBIOS Structure

Entry:

```
short FAR (*entryPoint) (
    short Function;
    unsigned char FAR *dmiDataBuffer,;
    unsigned char FAR *dmiWorkBuffer,
    unsigned char Control,
    unsigned short dmiSelector;
    unsigned short BiosSelector);
```

55h Get General-Purpose NonVolatile Information

Entry:

```
short FAR (*entryPoint) (
    short Function;
    unsigned short FAR *Handle,
    unsigned short FAR *MinGPNVRWSize,
    unsigned short FAR *GPNVSize,
    unsigned long FAR *NVStorageBase,
    unsigned short BiosSelector);
```

56h Read General-Purpose NonVolatile Data

Entry:

```
short FAR (*entryPoint) (
    short Function;
    unsigned short Handle,
    unsigned char FAR *GPNVBuffer,
    short FAR *GPNVLock,
    unsigned short GPNVSelector,
    unsigned short BiosSelector);
```

57h Write General-Purpose NonVolatile Data

Entry:

```
short FAR (*entryPoint)(
    short Function,
    unsigned short Handle,
    unsigned char FAR *GPNVBuffer,
    short GPNVLock,
    unsigned short GPNVSelector,
    unsigned short BiosSelector );
```

MultiBoot III Run-Time Services

An OS or application program can access the features of PhoenixBIOS MultiBoot II during run-time by using the following MultiBoot III Run-Time Services. You can use these services to query the number and type of Initial Program Load (IPL) devices in the system or display an IPL device menu for specifying the boot priority on the next system restart.

MultiBoot II Run-Time Services are extensions to the Plug and Play run-time functions that implement the *BIOS Boot Specification Ver. 1.01*. You can access this specification in Acrobat format from the Phoenix Web site at:

<http://www.phoenix.com/desktop/bbs101.pdf>

PnP functions 60h through 6Fh are reserved for the BIOS Boot Specification. See Appendix C of the *Plug and Play BIOS Specification* mentioned above for the details of the calling conventions. These functions are available in Real Mode and 16-bit Protected Mode.

MultiBoot III Run-Time Services

60h Get Version and Installation Check

Entry:
short FAR (* entryPoint) (Function, Version, BiosSelector);
short Function;
unsigned short FAR *Version;
unsigned short BiosSelector;

61h Get Device Count

Entry:
short FAR (* entryPoint) (Function, Switch, Count, MaxCount, StructSize, BiosSelector);
short Function;
short Switch;
unsigned short FAR *Count;
unsigned short FAR *MaxCount;
unsigned short FAR *StructSize;
unsigned short BiosSelector;

62h Get Priority and Table

Entry:
short FAR (* entryPoint) (Function, Switch, Priority, Table, BiosSelector);
short Function;
short Switch;
unsigned char FAR *Priority;
unsigned char FAR *Table;
unsigned short BiosSelector;

63h Set Priority

Entry:
short FAR (* entryPoint) (Function, Switch, Priority, BiosSelector);
short Function;
short Switch;
unsigned byte FAR *Priority;
unsigned short BiosSelector;

64h Get IPL Device from Last Boot

Entry:
short FAR (* entryPoint) (Function, IPLEntry, BiosSelector);
short Function;
unsigned short FAR *IPLEntry;
unsigned short BiosSelector;

BIOS Data Area

The BIOS keeps information about the current operating environment of the AT system in the BIOS Data Area. The normal way to access this information is by means of the BIOS Services, described above. The BIOS Data Area is located from physical address 400h to 501h.

BIOS Data Area Description		
Offset	Size	Description
00	2	Com1 address
02	2	Com2 address
04	2	Com3 address
06	2	Com4 address
08	2	Lpt1 address
0A	2	Lpt2 address
0C	2	Lpt3 address
0E	2	LPT4/EBDA address*
10	2	Equipment installed:
	Bit	Definition
	0	Not used
	1	Math coprocessor installed
	2	PS/2 mouse installed
	3	Not used
	4,5	Initial video mode: 00 = EGA/VGA 01 = 40x25 CGA 10 = 80x25 CGA 11 = Monochrome
	6,7	Diskette drives: 00 = 1 drive 01 = 2 drives 10 = 3 drives 11 = 4 drives
	8	Not used
	9-11	Number of serial adapters
	12	Game Adapter installed
	13	Not used
	14,15	Number of parallel adapters
Offset	Size	Description
12	1	Interrupt flag (POST)
13	2	Memory size (K bytes)
15	1	Reserved
16	1	Control flag
Keyboard Data Area		
Offset	Size	Description
17	1	Keyboard flag 0:
	Bit	Definition
	0	Right shift key pressed
	1	Left shift key pressed
	2	Control key pressed
	3	Alt key pressed
	4	Scroll lock on
	5	Num lock on
	6	Caps lock on
	7	Insert mode on
18	1	Keyboard flag 1:
	Bit	Definition
	3	Freeze state
	4	Scroll lock pressed
	5	Num lock pressed
	6	Caps lock pressed
	7	Insert mode pressed
19	1	Keypad input byte
1A	2	Key buffer head
1C	2	Key buffer tail
1E	20	Key buffer

Continued

*BIOS Data Area, Continued***Diskette Data Area**

3E	1	Seek/recalibrate status
3F	1	Drive motor status
40	1	Motor on time
41	1	Diskette status:
	Bit	Definition
	7	1 = Drive not ready
	6	1 = Seek error occurred
	5	1 = Diskette controller failed
	4-0	Error codes:
		01h = Illegal function request
		02h = Address mark not found
		03h = Write protected error
		04h = Sector not found
		06h = Diskette change line active
		08h = DMA overrun on operation
		09h = Data-boundary error (64k)
		0Ch = Media type not found
		10h = Uncorrectable ECC or CRC error
		20h = General controller failure
		40h = Seek operation failed
		80h = Device did not respond
42	7	Controller status

Video Data Area

Offset	Size	Description
49	1	Video mode
4A	2	Video columns
4C	2	Video length
4E	2	Video start
50	10	Cursor locations
60	2	Cursor size
62	1	Active page
63	2	6845 address
65	1	Mode register value
66	1	Video palette

Extended Work Area

67	4	ROM check address
6B	1	CPU rate control

Timer Data Area

6C	2	Timer count low word
6E	2	Timer count high word
70	1	Timer overflow byte

System Data Area

71	1	Break pressed flag
72	2	Soft reset flag

Fixed Disk Data Area

74	1	Fdisk status
75	1	Number of fixed disks
76	1	Fixed disk control
77	1	Reserved

Serial and Parallel Timeout Counters

78	4	Lpt1-4 time-out values
7C	4	Com1-4 time-out values

Extended Keyboard Data Area

80	2	Key buffer start
82	2	Key buffer end

EGA/VGA Data Area

84	1	Number of video rows
85	2	Bytes per character
87	1	EGA Status A
88	1	EGA Status B
89	1	VGA Status A
8A	1	Display Combination Code index

Extended Diskette Area

8B	1	Last diskette data rate
----	---	-------------------------

Continued

*BIOS Data Area, Continued***Extended Fixed Disk Area**

8C	1	FDisk status
8D	1	FDisk error value
8E	1	FDisk interrupt flag

Additional Extended Diskette Area**Offset Size Description**

8F	1	Floppy info nibbles
90	4	Floppy state information
94	2	Floppy cylinder number

Additional Extended Keyboard Data Area

96	1	Keyboard control
97	1	Keyboard flag 2:

Bit Definition

0	Scroll LED on
1	Num lock LED on
2	Caps lock LED on
4	Ack code received
5	Resend received
6	LED being updated
7	Keyboard error

Real Time Clock Area**Offset Size Description**

98	4	RTC user flag
9C	2	RTC time low word
9E	2	RTC time high word
A0	1	RTC wait flag

Network Data Area

A1	7	Network work area
----	---	-------------------

Extended EGA/VGA Data Area

A8	4	EGA/VGA environment pointer
----	---	-----------------------------

Miscellaneous

AC-FF		Reserved
100	1	Print screen flag

* If the BIOS supports the Extended BIOS Data Area, it uses the LPT4 address in the BIOS data area (Offset 0E) for the Extended BIOS Data Area segment.

Extended BIOS Data Area

The Extended BIOS Data Area (EBDA), located in the top 1k of system RAM, contains information about the pointing device (PS/2 mouse).

INT 15h AH = C1h returns the segment starting address of this table.

Extended BIOS Data Area**Offset Size Description**

00h	1	Size of EBDA in kbytes
01h	33	Reserved
21h	4	Pointer to device routine
25h	1	First byte of pointer information:
		Bit Definition
	4	Pointer error
	5	Pointer acknowledge
	6	Resend request
	7	Command in progress
26h	1	Second byte of pointer information
		Bit Definition
	6	Enable pointer device
	7	Pointer external device
27h	2	Pointer data package

Interrupt Vectors

The following table describes the AT system interrupt vectors. Status indicates whether the BIOS supports the interrupt.

INT	Description	Status
00	Divide by zero	Not Supported
01	Single step	Not Supported
02	Non-Maskable interrupt	Supported
03	Breakpoint	Not Supported
04	Overflow	Not Supported
05	Print Screen Interrupt	Supported
06	286 LoadAll Handler	Supported
07	Reserved	Not Supported
08	IRQ0 - System Timer Interrupt	Supported
09	IRQ1 - Keyboard Interrupt	Supported
0A	IRQ2 - Reserved	Not Supported
0B	IRQ3 - COM2: Interrupt	Supported
0C	IRQ4 - COM1: Interrupt	Supported
0D	IRQ5 - LPT2: Interrupt	Supported
0E	IRQ6 - Floppy Disk Interrupt	Supported
0F	IRQ7 - LPT1: Interrupt	Supported
10	BIOS Video Interface	Supported
11	BIOS Equipment Check	Supported
12	BIOS Memory Request	Supported
13	BIOS Fixed Disk/Diskette Interface	Supported
14	BIOS Serial Interface	Supported
15	BIOS System Functions Interface	Supported
16	BIOS Keyboard Interface	Supported
17	BIOS Parallel Printer Interface	Supported
18	BIOS Secondary Boot Request	Supported
19	BIOS Primary Boot Request	Supported
1A	BIOS System Timer Interface	Supported
1B	BIOS Control Break Interrupt	Supported
1C	BIOS User System Timer Interrupt	Supported
1D	BIOS Video Init Parameters	Supported
1E	BIOS Diskette Parameters	Supported
1F	BIOS Video Graphic Characters	Supported
40	BIOS Diskette (when fixed disk present)	Supported
41	BIOS Fixed disk 0 parameters	Supported
46	BIOS Fixed disk 1 parameters	Supported
70	IRQ8 - Real time clock interrupt	Supported
71	IRQ9 - IRQ2 redirection	Supported
72	IRQ10 - Reserved	Not Supported
73	IRQ11 - Reserved	Not Supported
74	IRQ12 - Available/PS/2 Mouse	Supported
75	IRQ13 - Math coprocessor	Supported
76	IRQ14 - Primary IDE HDD	Supported
77	IRQ15 - Available/Secondary IDE HDD	Supported

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