
# PhoenixBIOS 4.0

## Revision 6

*User's Manual*

## Copyright

**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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# Contents

Intro

# 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 *Phoenix*BIOS. 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

Chapter

# 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 ***Phoenix*BIOS** 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]
  System Date:             [03/02/1994]
                                                    <Tab>, <Shift-Tab>, or
  Legacy Diskette A:       [1.44/1.25  MB 3½"]      <Enter> selects field
  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.

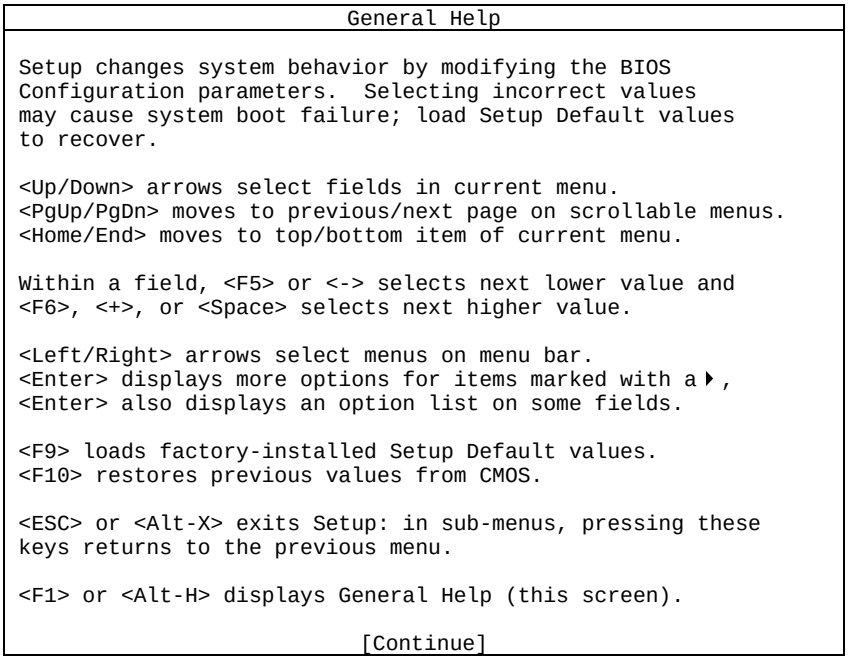
**To display a sub menu**, use the arrow keys to move the cursor to the sub menu you want. Then press **<Enter>**.
A pointer ( ▸ ) marks all sub menus.

## 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:




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<br>Diskette 2 | 360 kB, 5 ¼"<br>1.2 MB, 5 ¼"<br>720 kB, 3 ½"<br>1.44/1.25 MB, 3 ½"<br>2.88 MB, 3 ½"<br>Not installed<br>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:

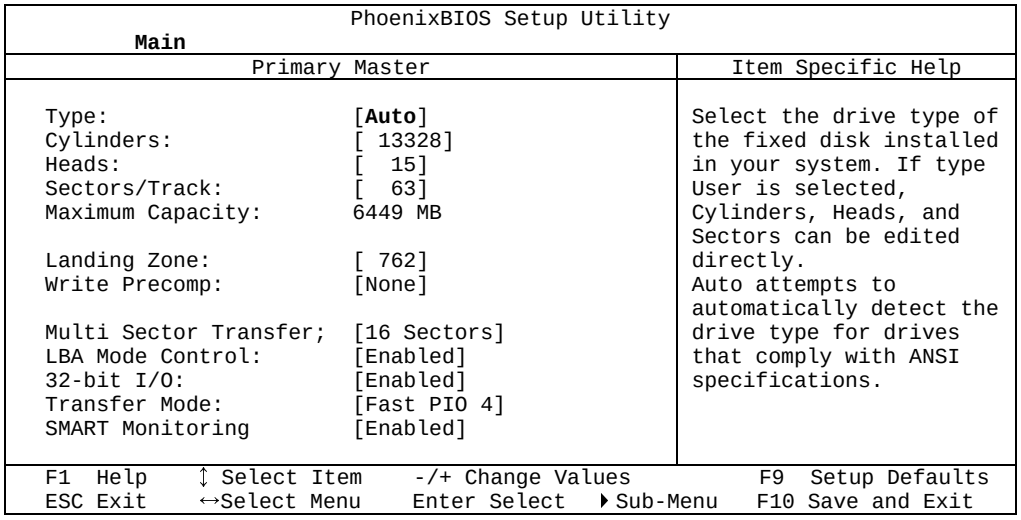
- Hard-disk drives
- Removable-disk drives such as Zip drives
- CD-ROM drives

*Phoenix*BIOS 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:




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<br>1 to 39<br>User<br>Auto<br>IDE Removable<br>CD-ROM<br>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.<br>User = You supply the hard-disk drive information in the following fields.<br>Auto = Autotyping, the drive itself supplies the correct drive information.<br>IDE Removable = Removable read-and-write media (e.g., IDE Zip drive).<br>CD-ROM = Readable CD-ROM drive.<br>ATAPI Removable = Read-and-writea 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<br>None | Number of the cylinder at which to change the write timing. |
| Multi-Sector Transfers | Disabled<br>Standard<br>2 sectors<br>4 sectors<br>8 sectors<br>16 sectors | Any selection except Disabled determines the number of sectors transferred per block. Standard is 1 sector per block. |
| LBA Mode Control | Enabled<br>Disabled | Enabling LBA causes Logical Block Addressing to be used in place of Cylinders, Heads, & Sectors. |
| 32-Bit I/O | Enabled<br>Disabled | Enables 32-bit communication between CPU and IDE card. Requires PCI or local bus. |
| Transfer Mode | Standard<br>Fast PIO 1<br>Fast PIO 2<br>Fast PIO 3<br>Fast PIO 4 | Selects the method for transferring the data between the hard disk and system memory.<br>The Setup menu only lists those options supported by the drive and platform. |
| SMART Monitoring | Enabled<br>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.

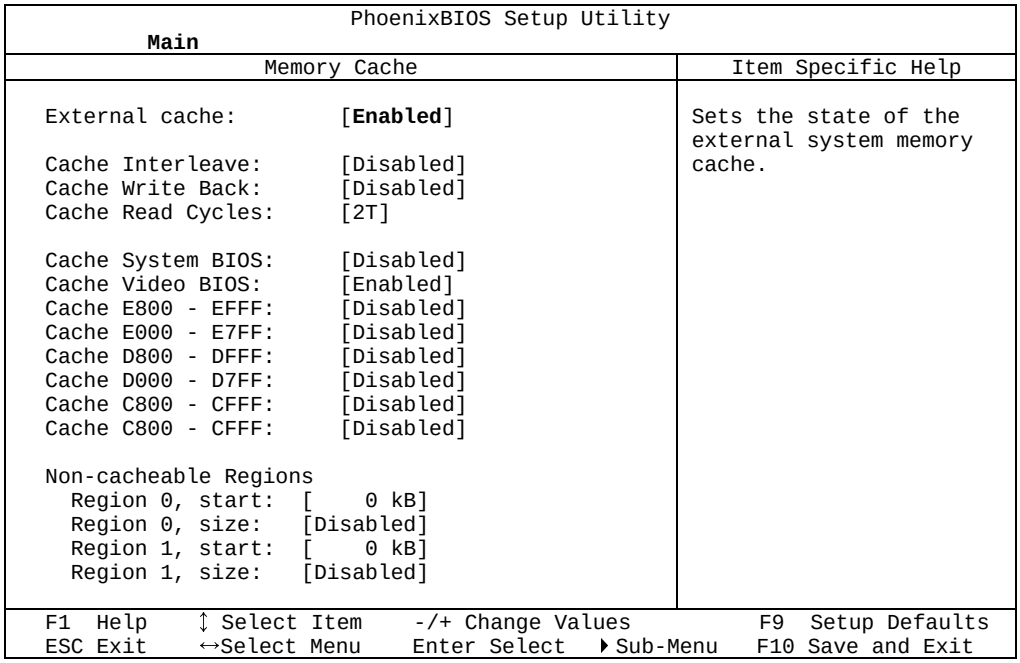
**Note**: Do not attempt to change these settings unless you have an older drive that does not support autotyping.

**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.



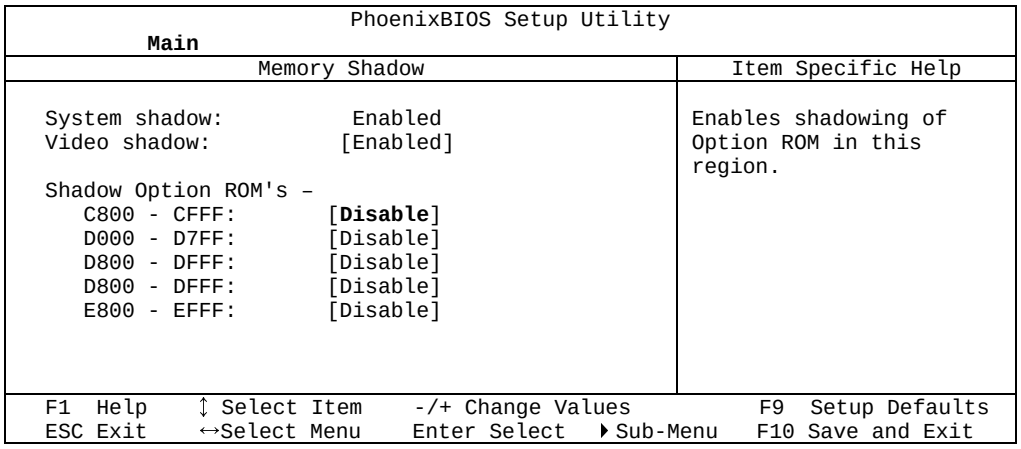

Use the legend keys listed on the bottom to make your selections and exit to the Main Menu. Use this chart to configure the memory cache.

| Feature | Options | Description |
|---|---|---|
| External Cache | Enabled<br>Disabled. | Generally enables or disables all memory caching. |
| Cache Interleave | Enabled<br>Disabled | Interleaves multiple banks of static RAM. Improves CPU access. |
| Cache Write Back | Enabled<br>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<br>Disabled | Caches the system BIOS and improves performance. |
| Cache Video BIOS | Enabled<br>Disabled | Caches the video BIOS and improves performance. |
| Cache segments, e.g., E800-EFFF | Enabled<br>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<br>Multiples of 64 | Multiples of 64 define start of non-cacheable region 0 in kilobytes. |
| Region 0, size | Disabled<br>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<br>Multiples of 64 | Multiples of 64 define start of non-cacheable region 1 in kilobytes. |
| Region 1, size | Disabled<br>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.



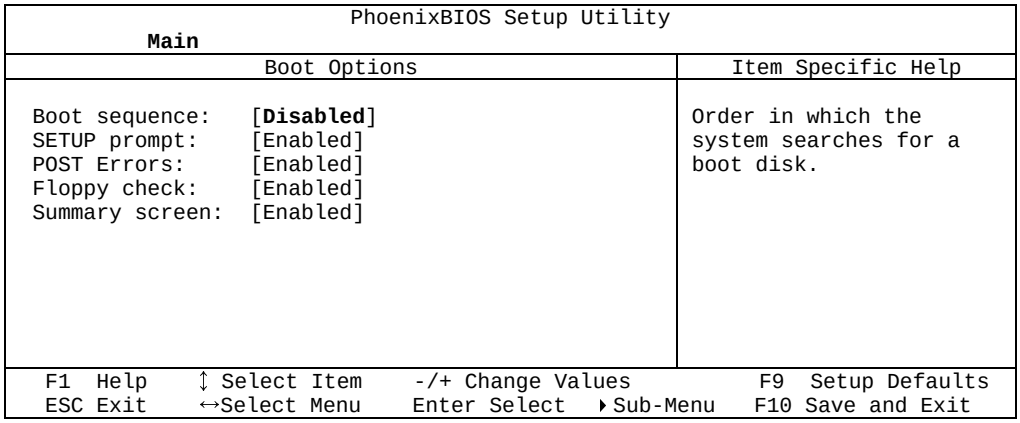

Use the legend keys to make your selections and exit to the Main Menu. Use the following chart to configure memory shadowing.

**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<br>Disabled | Shadows video BIOS and improves performance. |
| Shadow Option ROM | Enabled<br>Disabled | Shadows option ROM located in the specified segments of memory and can improve performance.<br>WARNING: Some option ROMs do not work properly when shadowed. |

# Boot Sequence

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



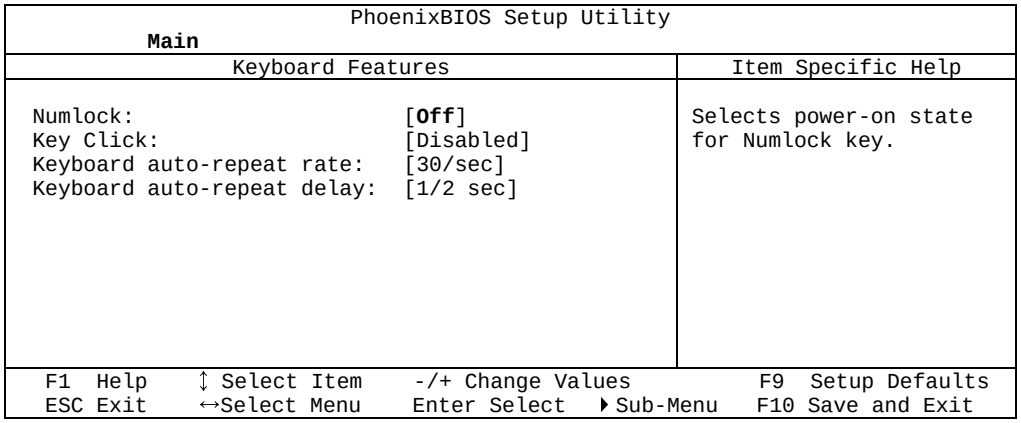

Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart to select your boot options.

| Feature | Options | Description |
|---|---|---|
| Boot sequence | A: then C;<br>C: then A:<br>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<br>Disabled | Displays "Press <F2> for Setup" during boot up. |
| POST errors | Enabled<br>Disabled | At boot error, pauses and displays "Press <F1> to resume, <F2> to Setup". |
| Floppy seek | Enabled<br>Disabled | Seeks diskette drives during boot up. Disabling speeds boot time. |
| Summary screen | Enabled<br>Disabled | Displays system summary screen during boot up. |

# Keyboard Features

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




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<br>On<br>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<br>Disabled | Turns audible key click on. |
| Keyboard auto-repeat rate | 2/sec<br>6/sec<br>10/sec<br>13.3/sec<br>21.8/sec<br>26.7/sec<br>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<br>½ sec<br>¾ sec<br>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]
Display OPROM 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.

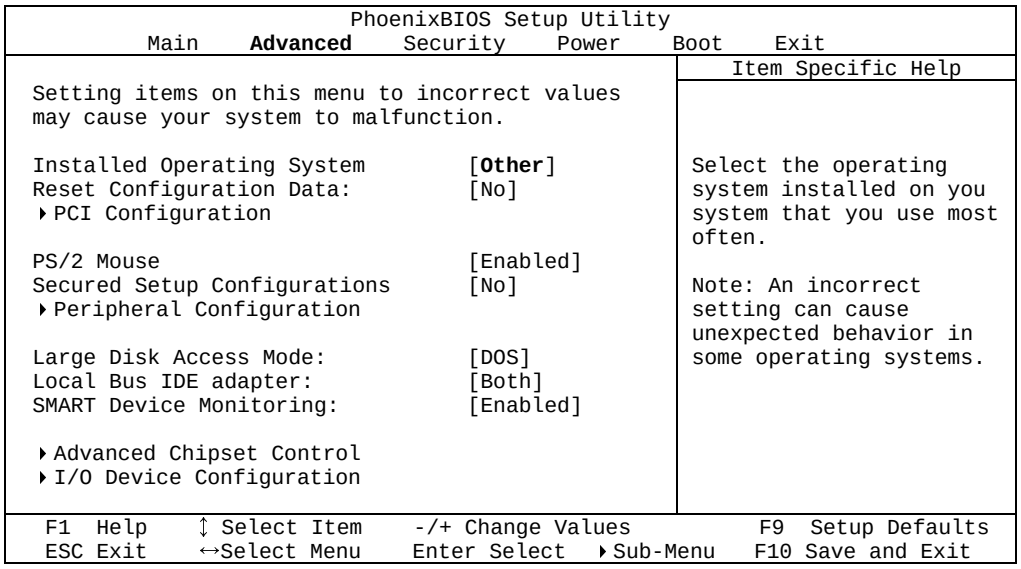
Note: Floppy drives are not managed on this menu as part of Removable Devices.

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

# The Advanced Menu

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



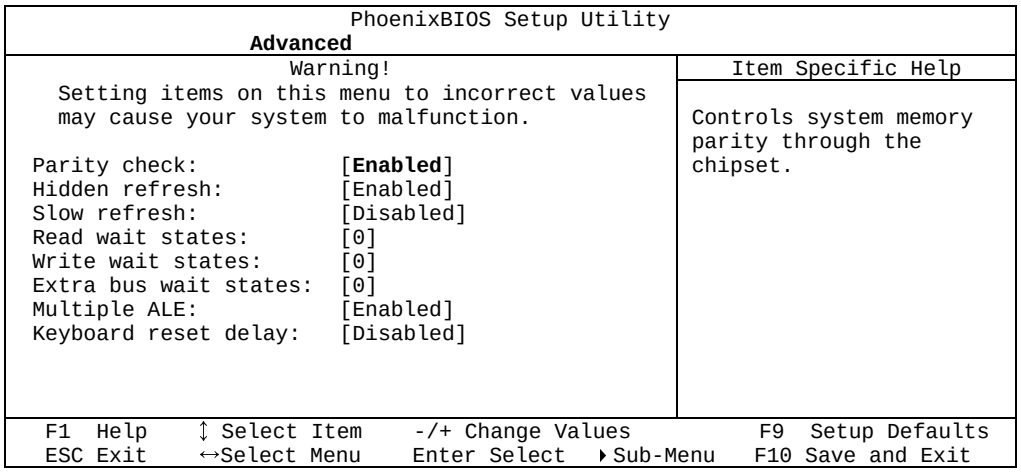

Use the legend keys to make your selections and exit to the Main Menu.

| Feature | Options | Description |
|---|---|---|
| Installed Operating System | Other<br>Win95<br>Win98/NT | Select the operating system you use most often. |
| Reset Configuration Data | Yes<br>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<br>Disabled<br>Auto<br>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<br>No | Yes prevents the Operating System from overriding selections you have made in Setup. |
| Large Disk Access Mode | DOS<br>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<br>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:




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.

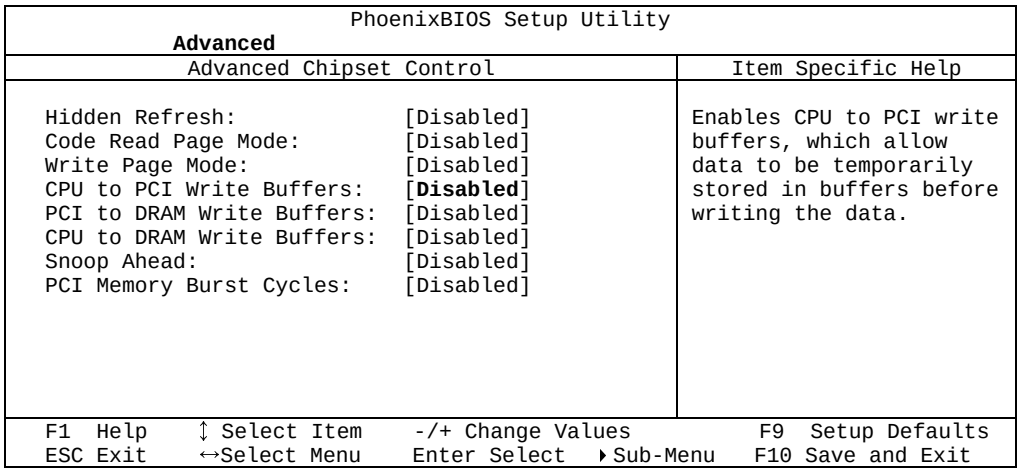
Use the following chart in configuring the chipset:

| Feature | Options | Description |
|---|---|---|
| Parity check | Enabled<br>Disabled | Controls system memory parity checking. |
| Hidden refresh | Enabled<br>Disabled | Refreshes regular memory without holding up the CPU. |
| Slow Refresh | Enabled<br>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<br>Disabled | Determines whether to use single or multiple ALEs during cycle conversion. |
| Keyboard reset delay | Enabled<br>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:




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<br>Enabled | Refreshes regular memory without holding up the CPU |
| Code Read Page Mode | Disabled<br>Enabled | Improves performance when code contains mainly sequential instructions. |
| Write Page Mode | Disabled<br>Enabled | Improves performance when data is written sequentially. |
| CPU to PCI Write Buffers | Disabled<br>Enabled | Stores CPU data in buffers before writing to PCI. |
| PCI to DRAM Write Buffers | Disabled<br>Enabled | Stores PCI data in buffers before writing to DRAM. |
| CPU to DRAM Write Buffers | Disabled<br>Enabled | Stores CPU data in buffers before writing to DRAM. |
| Snoop Ahead | Disabled<br>Enabled | Improves PCI bus master access to DRAM. |
| PCI Memory Burst Cycles | Disabled<br>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
  Option ROM Scan:                [Enabled]  expansion ROM
  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<br>Enabled | Initialize device expansion ROM. |
| Enable Master | Disabled<br>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<br>Share Two IRQs<br>Share Three IRQs<br>Auto | Share ***n*** IRQs: Forces PCI devices to use at most ***n*** IRQs.<br>Auto: Minimizes PCI IRQ Sharing. |

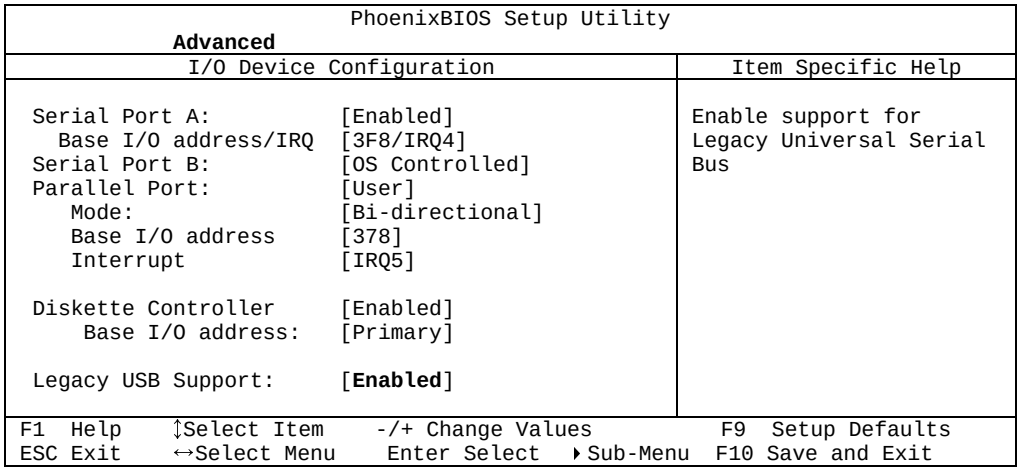
**NOTE:** The contents of this menu depend on the devices installed on your system. **Incorrect settings can cause your system to malfunction. To correct mistakes, return to Setup and restore the System Defaults (F9).**

# 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:




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

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
Set Supervisor Password    [Enter]                controls access to Setup
                                                  utility.
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.

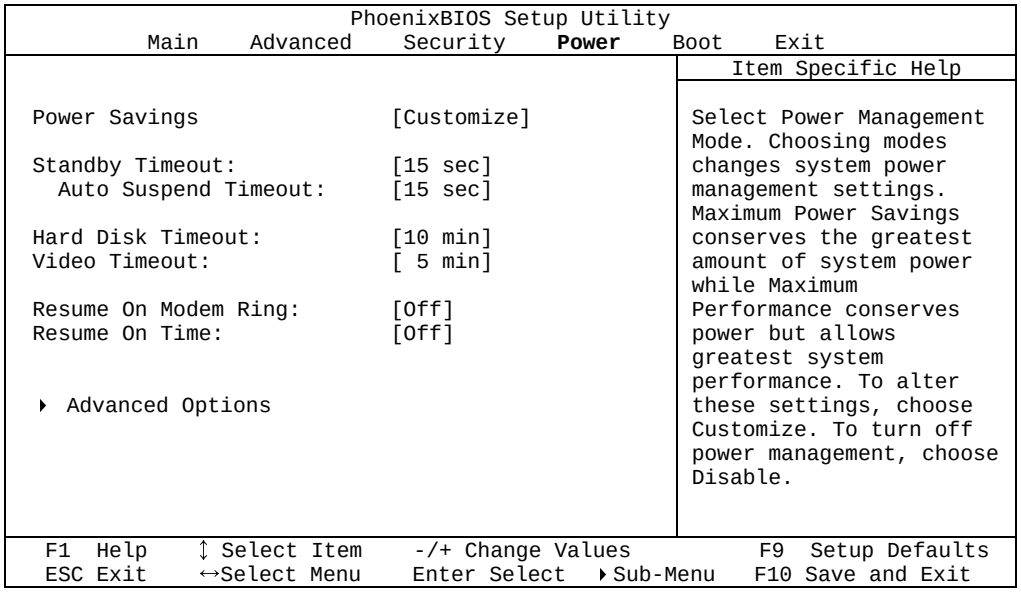
Note: In some systems, the User and Supervisor passwords are related; you cannot have a User password without first creating a Supervisor password. In other systems, you can create and use them independently.

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<br>Disabled | Enabled requires a password on boot. Requires prior setting of the Supervisor password.<br>If supervisor password is set and this option disabled, BIOS assumes user is booting. |
| Diskette access | Enabled<br>Disabled | Enabled requires a password to boot from or access the floppy disk. |
| Fixed disk boot sector | Normal<br>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<br>Virus check reminder | Disabled<br>Daily<br>Weekly<br>Monthly | Displays a message during boot up asking (Y/N) if you have backed up the system or scanned it for viruses.<br>Message returns on each boot until you respond with "Y".<br>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:




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.

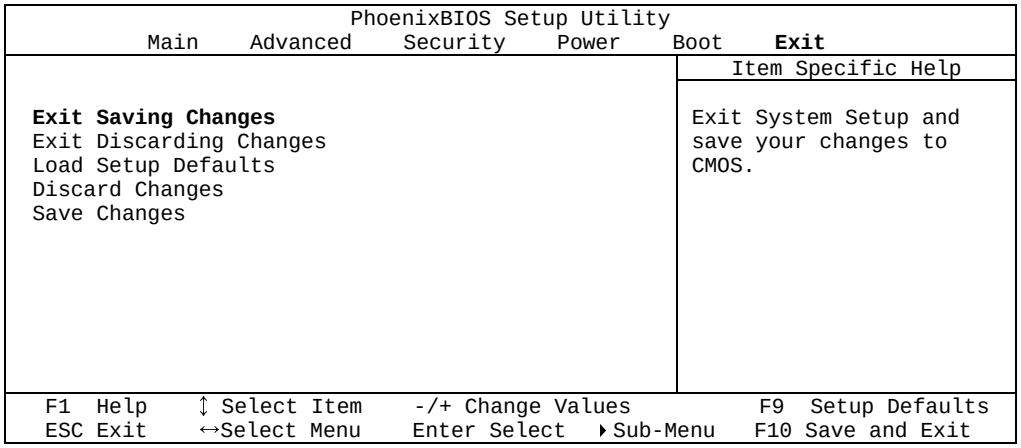
Use the Advanced Options on this menu to specify whether or not the activity of interrupts can terminate a Standby or Suspend state and restore Full On. Do not change these settings without knowing which devices use the interrupts.

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<br>Customize<br>Maximum Power Savings<br>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<br>1 min<br>2 min<br>4 min<br>6 min<br>8 min<br>12 min<br>16 min | Inactivity period required to put system in Standby (partial power shutdown). |
| Auto Suspend Timeout | Disabled<br>5 min<br>10 min<br>15 min<br>20 min<br>30 min<br>40 min<br>60 min | Inactivity period required after Standby to Suspend (maximum power shutdown). |
| Hard Disk Timeout | Disabled<br>1 min<br>2 min<br>4 min<br>8 min<br>12 min<br>16 min | Inactivity period of hard disk required before standby (motor off). |
| Video Timeout | Disabled<br>10 sec<br>15 sec<br>20 sec<br>30 sec<br>45 sec<br>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<br>On | Wakes up system when an incoming call is detected on the modem. |
| Resume On Time | Off<br>On | Wakes up system at predetermined time. |
| IRQ0...IRQ15<br>SMI<br>NMI | Disabled<br>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:




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, *Phoenix*BIOS 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 $I_2O$ 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.

# Chapter 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.

# Chapter 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:

```
phlash
```

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> <Del> to reboot the system.
3. When your system reboots, Phoenix Phlash will restore the BIOS from the diskette and successfully boot the operating system.

Chapter 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

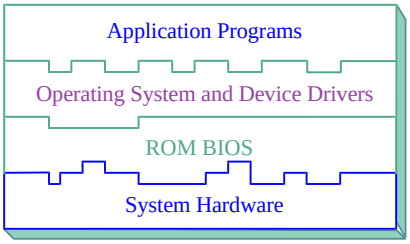
## What is a ROM BIOS?

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 *Phoenix*BIOS 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 |
|---|
| 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, *Phoenix*BIOS displays an error message describing the problem.

*Phoenix*BIOS 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 |
| AEh | | 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 (***xxxx***) 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_"<br>Offset 0 = underscore<br>Offset 1 = "3"<br>Offset 2 = "2"<br>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:<br>00h = Service corresponding to the Service Identifier is present.<br>80h = Service corresponding to the Service Identifier is not present.<br>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:<br>00 = EGA/VGA<br>01 = 40x25 CGA<br>10 = 80x25 CGA<br>11 = Monochrome |
| 6,7 | Diskette drives:<br>00 = 1 drive<br>01 = 2 drives<br>10 = 3 drives<br>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 5-¼" and 3-½" 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<br>If Carry = 1: |
| AH | 01h = Illegal BIOS command<br>02h = Bad address mark<br>03h = Write-protect occurred<br>04h = Sector not found<br>06h = Media changed<br>09h = DMA crossed 64K boundary<br>08h = DMA failed<br>0Ch = Media not found<br>10h = CRC failed<br>20h = NEC failed<br>30h = Drive does not support media sense<br>31h = No media in drive<br>32h = Drive does not support media type<br>40h = Seek failed<br>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.

**Diskette Types**

| Media | Drive | 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)
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 *Phoenix*BIOS **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)

*Continued*

*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:<br>Bits 0-3:<br>00h = No emulation<br>01h = 1.2 MB diskette<br>02h = 1.44 MB diskette<br>03h = 2.88 MB diskette<br>04h = Hard disk (drive C:)<br>Bits 05h-07h: Reserved<br>Bit 6: 01h = System has ATAPI driver<br>with 8 & 9 below describing IDE interface.<br>Bit 7: 01h = System has SCSI drivers<br>with 8 & 9 below describing SCSI interface |
| 2h | Byte | Drive number:<br>00h = Floppy image<br>80 = Bootable hard disk<br>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:<br>For SCSI:<br>Byte 8: LUN and PUN of CD drive<br>Byte 9: Bus number<br>For IDE:<br>Byte 8 LSB: 0 = Master, 1 = Slave |
| Ah-Bh | Word | User buffer segment |
| Ch-Dh | Word | Load segment (only for Int 13h 4Ch):<br>00h = 7C0h |
| Eh-Fh | Word | Virtual sector count (only for Int 13h 4Ch) |
| 10h | Byte | Low-order bits (0-7) of the cylinder count<br>(Matches returned CH of Int 13h 08h) |
| 11h | Byte | Bits 0-5: Sector count<br>Bits 6-7: High order 2 bits of cylinder count<br>(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<br>1 = System not in emulation mode |

**AH = 4Bh Terminate disk emulation**

| | |
|---|---|
| Entry: | |
| AL | 00h = Return status and terminate emulation<br>01h = Return status only, do not terminate |
| DL | Drive number to terminate<br>7Fh = Terminate all |
| DS:SI | Empty Specification Packet |
| Exit: | |
| DS:SI | Completed Specification Packet (See above) |
| AX | Exit status codes |
| CF | 0 = System released<br>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 *Phoenix*BIOS 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

*Continued*

*Interrupt 14h–Serial Services, Continued*

**AH = 04h Extended Initialize (PS/2)**

Entry:
DX 0-3 = Communications adapter
AL 00 = Break
01 = No break
BH Parity:
00 = None
01 = Odd
02 = Even
03 = Stick parity odd
04 = Stick parity even
BL Stop bits:
00 = One
01 = Two if 6,7, or 8-bit word length
One and one-half if 5-bit word length
CH Word length:
00 = 5 bits
01 = 6 bits
02 = 7 bits
03 = 8 bits
CL 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 = EDBA 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 *Phoenix*BIOS 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

*Continued*

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

The following table describes the Interrupt 15h PS/2 mouse services of *Phoenix*BIOS 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<br>01h = Enable |

**AL 01 = Reset PS/2 Mouse**

Exit:

| | |
|---|---|
| BH | Device ID |

**AL 02 = Set Sample Rate**

Entry:

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

**AL 03h = Set resolution**

Entry:

| | |
|---|---|
| BH | Resolution value:<br>00h = 1 count per millimeter<br>01h = 2 counts per millimeter<br>02h = 4 counts per millimeter<br>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 *Phoenix*BIOS 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 *Phoenix*BIOS 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 *Phoenix*BIOS 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<br>(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<br>01h = Daylight Savings |
| **AH = 03h** | **Set the real time clock** |
| Entry: | |
| CH | BCD hours |
| CL | BCD minutes |
| DH | BCD seconds |
| DL | 01h = Daylight saving<br>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<br>If Carry = 1: |
| AH | 81h = Function not supported<br>83h = Bad vendor ID<br>86h = Device not found<br>87h = Bad register number<br>88h = Set failed<br>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 staring 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 *Phoenix*BIOS 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;
struc 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;
struc 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<br>82h = The function is not supported on this system<br>83h = SMBIOS Structure number/handle passed is invalid or out of range.<br>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<br>85h = The SubFunction parameter supplied on a SMBIOS control function is not supported by the system BIOS.<br>86h = There are no changed SMBIOS structures pending notification.<br>87h = Returned when there was insufficient storage space to add the desired structure.<br>8Dh = A “Set SMBIOS Structure” request failed because one or more of the to-be-changed structure fields are read-only.<br>90h = The GPNV functions do not support locking for the specified GPNV handle.<br>91h = The GPNV lock request failed - the GPNV is already locked.<br>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.

**SMBIIOS 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 | Floppy diskette available for boot ("IPL bit") |
| | 1 | Math coprocessor installed |
| | 2 | PS/2 mouse installed |
| | 3 | Not used |
| | 4,5 | Initial video mode:<br>00 = EGA/VGA<br>01 = 40x25 CGA<br>10 = 80x25 CGA<br>11 = Monochrome |
| | 6,7 | Diskette drives:<br>00 = 1 drive<br>01 = 2 drives<br>10 = 3 drives<br>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:<br>Bit Definition<br>0 Right shift key pressed<br>1 Left shift key pressed<br>2 Control key pressed<br>3 Alt key pressed<br>4 Scroll lock on<br>5 Num lock on<br>6 Caps lock on<br>7 Insert mode on |
| 18 | 1 | Keyboard flag 1:<br>Bit Definition<br>3 Freeze state<br>4 Scroll lock pressed<br>5 Num lock pressed<br>6 Caps lock pressed<br>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**

| Offset | Size | Description |
|---|---|---|
| 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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