

**HYPERTEXT
EDITION**

PhoenixPICO™ BIOS

User's Guide

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Phoenix Technologies Ltd.

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About This Manual

This manual 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. This manual contains the following chapters:

Chapter 1 - The Setup Guide

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

Chapter 2 - Technical Reference

This chapter gives programmers a more detailed description of PhoenixPICO BIOS, which enables them to use the BIOS service calls. It contains the following sections:

- Overview
- Fixed Disk Tables
- Function Keys
- POST Errors
- BIOS Services

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The Setup Guide

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

The menus shown here are from a typical system. The actual menus displayed on your screen depend on the specific hardware and features installed in your computer.

Main Menu

To start the PhoenixPICO BIOSSetup utility:

1. Turn on or reboot your system. PhoenixPICO BIOS displays this message:

Press <F2> to enter SETUP

Chapter 1: The Setup Guide

2. Press <F2> to display the Main Menu, which looks like this:

```
Phoenix NoteBIOS 4.0 Setup - Copyright 1985-95 Phoenix Technologies Ltd.
Main   Advanced   Security   Power Savings   Exit
Item Specific Help
System Time:                [16:19:20]
System Date:   [03/02/1994]   3
Diskette A:    [1.2 MB, 5~"]
Diskette B:    [Not Installed]
> IDE Adapter 0 Master:      C: 121 Mb
> IDE Adapter 0 Slave:      None
Video System:                [EGA / VGA]
> Boot Options:
> Keyboard Features:

System Memory:                640 KB
Extended Memory:             1024 KB

F1 Help   ↑↓ Select Item   -/+ Change Values   F9 Setup Defaults
ESC Exit  ←→ Select Menu   Enter Select   > Sub-Menu   F10 Previous Values
```

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 Savings	Use this menu to configure Power Management features.
Exit	Exits the current menu.

Use the left/right "← →" arrow keys to make a selection.

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

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.
← or → 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>	Load the Previous Configuration values for this menu.
<Enter>	Execute Command or Select 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.

Field Help Window

The help window on the right side of each menu displays the help text for the currently selected field. As you move the cursor to each field, it updates the values.

General Help Window

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

```
General Help

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

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

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

<Left/Right> arrows select menus on menu bar.
<Enter> displays more options for items marked with >.

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

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

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

[Continue]
```

Chapter 1: The Setup Guide

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 A: Diskette B:	360KB, 5 ¼" 1.2MB, 5 ¼" 720KB, 3 ½" 1.44M, 3 ½" 2.88MB, 3 ½" Not installed	Select the type of floppy-disk drive installed in your system.
Video System	Monochrome EGA/VGA, CGA 40x25, CGA 80x25,	Select the default video device

Feature	Options	Description
System Memory	N/A	Displays amount of conventional memory detected during bootup
Extended Memory	N/A	Displays the amount of extended memory detected during bootup

IDE Adapters

The IDE adapters control the hard disk drives. PhoenixPICO BIOS supports up to two IDE adapters. Each adapter supports one master drive and one optional slave drive in these possible combinations:

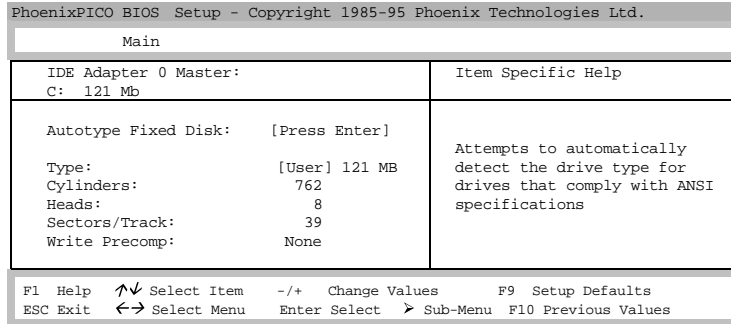
- 1 Master**
- 1 Master, 1 Slave**
- 2 Masters**
- 2 Masters, 1 Slave**
- 2 Masters, 2 Slaves**

Use a separate sub menu to configure each hard disk drive.

Advanced Hard Disk Features—Not Installed

If Advanced Hard Disk Features are not installed, selecting one of the IDE Adapter sub menus on the Main Menu displays a menu like this:

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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
Autotype Fixed Disk	N/A	Pressing <Enter> causes the system to attempt to detect the type of fixed disk. If successful, it fills in the remaining fields on this menu.
Type	1 to 39 User	1 to 39 fills in all remaining fields with values for predefined disk type. "User" prompts user to fill in remaining fields.
Cylinders	1 to 2048	Number of cylinders.
Heads	1 to 16	Number of read/write heads.
Sectors/Track	1 to 64	Number of sectors per track.
Write Precomp*	1 to 2048 None	Number of the cylinder at which to change the write timing.

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



Incorrect settings can cause your system to malfunction.

Advanced Hard Disk Features—Installed

If Advanced Hard Disk Features are installed, selecting one of the IDE Adapter sub menus on the Main Menu displays a menu like this:

PhoenixPICO BIOS Setup - Copyright 1985-95 Phoenix Technologies Ltd.	
Main	
IDE Adapter 0 Master: C: 121 Mb	Item Specific Help
Autotype Fixed Disk: [Press Enter]	Attempts to automatically detect the drive type for drives that comply with ANSI specifications
Type: [User] 121 MB	
Cylinders: 762	
Heads: 8	
Sectors/Track: 39	
Write Precomp: None	
Multi-Sector Transfers : Disabled	
LBA Control : Disabled	
32 bit I/O : Enabled	
Transfer Mode : Standard	
F1 Help ↕ Select Item -/+ Change Values F9 Setup Defaults	
ESC Exit ←→ Select Menu Enter Select > Sub-Menu F10 Previous Values	

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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 drive with Advanced Hard Disk Features:

Feature	Options	Description
Autotype Fixed Disk	N/A	Pressing <Enter> at this field attempts to read the hard disk parameters from the drive itself and sets the following options to their optimum setting. "Sets Type field to "User" and allows editing of other fields.
Type	1 to 39 User Auto	1 to 39 fills in all remaining fields with values for predefined disk type. "User" prompts user to fill in remaining fields. "Auto" autotypes at each boot, displays settings in Setup menu and does not allow editing of remaining fields.
Cylinders	1 to 16,384	Number of cylinders.
Heads	1 to 16	Number of read/write heads.
Sectors/Track	1 to 63	Number of sectors per track.
Write Precomp*	N/A	Obsolete
Multi-Sector Transfers	Auto 2 sectors 4 sectors 8 sectors 16 sectors	Auto sets the number of sectors per block at the highest number supported by the drive. This is not always the fastest option.
LBA Mode Control	Enabled Disabled	Enables Logical Block Access. Default is Disabled.

Feature	Options	Description
32-Bit I/O	Enabled Disabled	Enables 32-bit communication between CPU and IDE card. Requires PCI or local bus.
Transfer Mode	Standard Fast PIO 1 Fast PIO 2 Fast PIO 3 OR Standard Fast DMA A Fast DMA B Fast DMA F	Selects the method for transferring the data between the hard disk and system memory. The Setup menu only lists those options supported by the drive and platform.

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



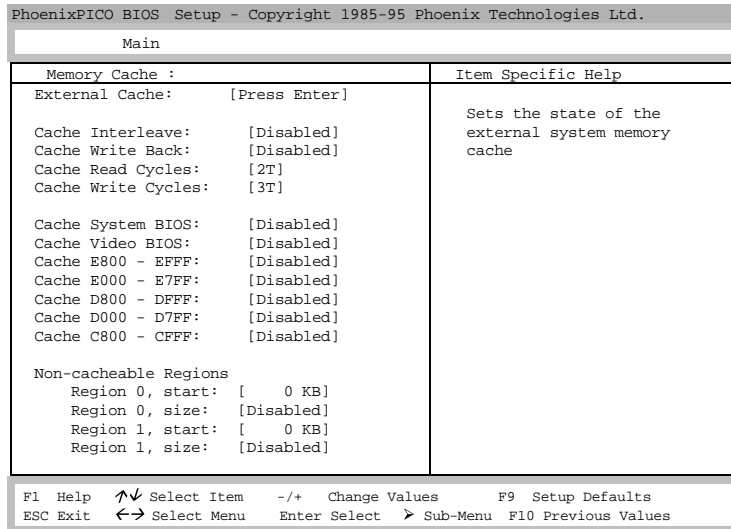
Incorrect settings can cause your system to malfunction.

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.

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Selecting "Memory Cache" from the Advanced Setup 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 the following chart to configure the memory cache.

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

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Feature	Options	Description
Region 1, start	0 Multiples of 64	Multiples of 64 define start of non-cacheable region 1 in kilobytes.
Region 1, size	Disabled Multiples of 64	Disabling makes this region available for cache. Multiples of 64 define size of non-cacheable region 1 in kilobytes.



Incorrect settings can cause your system to malfunction.

Boot Options

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

PhoenixPICO BIOS Setup - Copyright 1985-95 Phoenix Technologies Ltd.		
Main		
Boot Options	Item Specific Help	
Boot sequence: [A: then C:] SETUP prompt: [Enabled] POST Errors: [Enabled] Floppy check: [Enabled] Summary screen: [Enabled] -	Order system searches drives for a boot disk.	
F1 Help ↑↓ Select Item -/+ Change Values F9 Setup Defaults ESC Exit ←→ Select Menu Enter Select > Sub-Menu F10 Previous Values		

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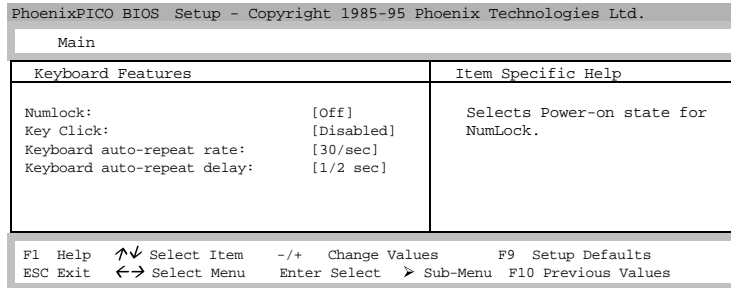
Use the legend keys to make your selections and exit to the Main Menu.

Use the following chart to select your boot options.

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

Keyboard Features

Selecting "Keyboard Features" 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:

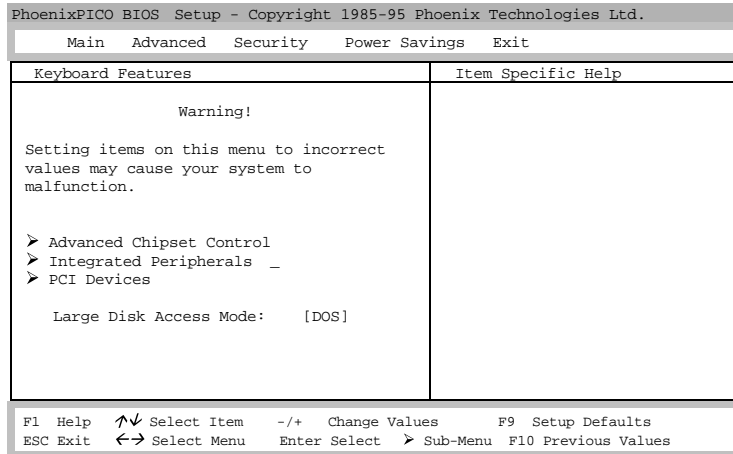
Feature	Options	Description
Numlock	On Off	On or Off turns NumLock on or off at bootup.
Key Click	Enabled Disabled	Turns audible key click on.

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Feature	Options	Description
Keyboard auto-repeat rate	2/sec 6/sec 10/sec 13.3/sec 21.8/sec 26.7/sec 30/sec	Sets the number of times a second to repeat a keystroke when you hold the key down.
Keyboard auto-lag delay	¼ sec ½ sec ¾ sec 1 sec	Sets the delay time after the key is held down before it begins to repeat the keystroke.

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. Use the following to make your selection.

Feature	Options	Description
Large Disk Mode	DOS Other	Select DOS if you have DOS. Select Other if you have another operating system such as UNIX. A large disk is one that has more than 1024 cylinders, more than 16 heads, or more than 63 tracks per sector.

Advanced Chipset Control (No PCI)

The chipset is an integrated circuit that acts as an interface between the CPU and much of the system's hardware. You can use this menu to change the values in the chipset registers and optimize your system's performance.

Use the legend keys to make your selections, display the sub menus, and exit to the Main Menu. Use the following chart in configuring the chipset:

Feature	Options	Description
Parity check	Enabled Disabled	Controls system memory parity checking.
Hidden refresh	Enabled Disabled	Refreshes regular memory without holding up the CPU.
Slow Refresh	Enabled Disabled	Slows memory refresh by a factor of 4.
Read wait states	0 to n	Sets the number of wait states added to reads from system memory. Chipset dependent.

Feature	Options	Description
Write wait states	0 to n	Sets the number of wait states added to writes to system memory. Chipset dependent.
Extra bus wait states	0 to n	Sets the number of wait states added to accesses of the AT bus. Chipset dependent.
Multiple ALE	Enabled Disabled	Determines whether to use single or multiple ALEs during cycle conversion.
Keyboard reset delay	Enabled Disabled	Enabled adds a 2 microsecond delay before resetting the system.

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

Advanced Chipset Control Menu (PCI Chipset)

The PCI chipset is a computer chip that acts as an interface between the CPU and the system's hardware. You can use this menu to optimize the performance of your computer.

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

Use the following chart in configuring the chipset:

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

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

PCI Devices Menu

PCI Devices are devices equipped for operation with a **PCI (Peripheral Component Interconnect) bus**, a standardized hardware 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:		
Enable Device	Disabled Enabled	Enable selected device (Only for devices installed on the motherboard)
Enable Master	Disabled Enabled	Enables selected device as a PCI bus master. Not every device can function as a master. Check your device documentation.
Default Latency Timer	Yes No	Default uses minimum bus master clock rate. If yes, do not set the following field.
Latency Timer	0000h to 0280h	Bus master clock rate. A high-priority, high-throughput device may benefit from a greater value.

NOTE The contents of this menu depend on the devices installed on your system. **Incorrect settings can cause your system to malfunction.**

Integrated Peripherals Menu

Most chipsets manage the connections between the CPU and the I/O ports (COM: and LPT:), the floppy disks, and the hard-drive controllers. Some systems have a separate on-board chip for handling these items. If your system has a separate on-board I/O chip selecting "Integrated Peripherals" menu on the Advanced Menu displays a menu like this:

PhoenixPICO BIOS Setup - Copyright 1985-95 Phoenix Technologies Ltd.	
Main Advanced Security Power Savings Exit	
Integrated Peripherals	Item Specific Help
COM port: [3F8, IRQ 4]	Set COM port address.
COM port: [2F8, IRQ 3]	
LPT port: [378, IRQ 7]	
Diskette controller: [Enabled]	
IDE controller: [Enabled]	
ECP: [Disabled]	
F1 Help ↕ Select Item -/+ Change Values F9 Setup Defaults	
ESC Exit ← Select Menu Enter Select > Sub-Menu F10 Previous Values	

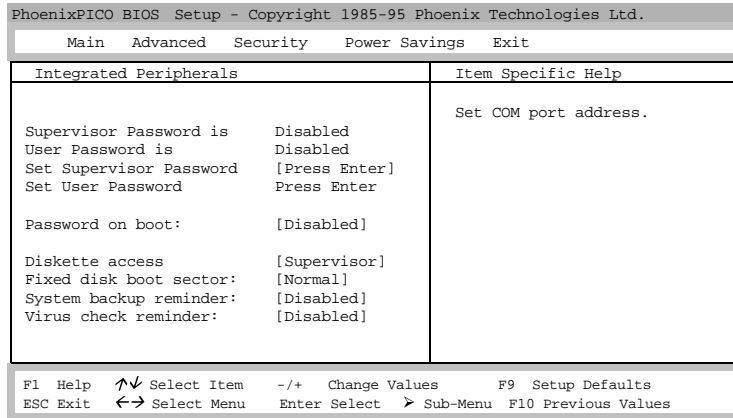
Use the legend keys to make your selections and exit to the Main Menu. Use the following chart in configuring the chipset:

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Feature	Options	Description
COM port COM port	Disabled 3F8, IRQ 4 2F8, IRQ 3 338, IRQ 4 238, IRQ 3 3E8, IRQ 4 2E8, IRQ 3 2E8, IRQ 3 2E0, IRQ 3 220, IRQ 4 228, IRQ 3 Auto	Select a unique address and interrupt request for the listed COM ports. Auto selects the next available combination.
LPT port	Disabled 3BC, IRQ 7 378, IRQ, 7 278, IRQ 5	Select a unique address and interrupt request for the LPT port. Auto selects the next available combination.
Diskette Controller	Disabled Enabled	Enables the on-board floppy disk controller.
IDE Controller	Disabled Enabled	Enables the on-board IDE controller.
ECP	Enabled Disabled	Enables Extended Capabilities Parallel port, putting the LPT port above in ECP mode.

Security Menu

Selecting "Security" from the Main Menu displays a menu that resembles this one:

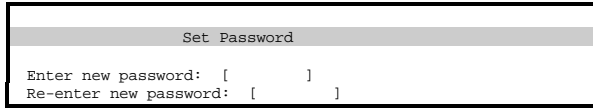


Use the legend keys to make your selections and exit to the Main Menu.

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

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



```
Set Password
Enter new password: [   ]
Re-enter new password: [   ]
```

Type the password and press <Enter>. Then, re-enter the password.

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

Feature	Options	Description
Supervisor Password	Up to seven alphanumeric characters	Pressing <Enter> displays dialog box for entering the supervisor password. This password gives full access to SETUP menus.
Set User Password	Up to seven alphanumeric characters	Pressing <Enter> displays the dialog box for entering the user password. This password gives restricted access to SETUP menus. Requires prior setting of Supervisor password.
Password on boot	Enabled Disabled	Enabled requires a password on boot. Requires prior setting of the Supervisor password. If supervisor password is set and this option disabled, BIOS assumes user is booting.
Diskette Access	Supervisor User	Supervisor restricts use of floppy drives to supervisor. Requires setting the Supervisor password.
Fixed disk boot sector	Normal Write Protected	Write protected helps prevent viruses.

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Feature	Options	Description
System backup reminder Virus check reminder	Disabled Daily Weekly Monthly	Displays a message during bootup asking (Y/N) if you have backed up the system or scanned it for viruses. Message returns on each boot until you respond with "Y". Daily displays the message on the first boot of the day, Weekly on the first boot after Sunday, and Monthly on the first boot of the month.

Power Savings Menu

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

PhoenixPICO BIOS Setup - Copyright 1985-95 Phoenix Technologies Ltd.	
Main Advanced Security Power Savings Exit	
Integrated Peripherals	Item Specific Help
Power Savings: [Maximum Battery Life]	Select Power Management Mode. Choosing modes changes system power management settings.
Hard Disk Timeout: [30 sec]	Maximum Battery Life
Medium Backlight Timeout: [15 sec]	conserves the greatest amount of system power while Maximum
Video Timeout: [1 Minute]	Performance conserves power but allows greatest system
Serial Timeout: [5 sec]	performance. To alter these settings, choose Customize.
Parallel Timeout: [5 sec]	To turn off power management, choose OFF.
Idle Mode: [On]	
Standby Timeout: [2 Minutes]	
Power Management Under AC [On]	
Suspend Mode: [Suspend]	
Auto Suspend Timeout: [5 Minutes]	
Auto Save To Disk: [Off]	
Suspend Warning Tone [Off]	
Resume On Modem Ring : [Off]	
Resume On Time : [Off]	
Resume Time : [00:00:00]	

F1 Help ↕ Select Item -/+ Change Values F9 Setup Defaults
ESC Exit ← Select Menu Enter Select > Sub-Menu F10 Previous Values

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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, an **Idle** and **Standby** state with partial power reduction, a **Suspend** state with full power reduction.

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

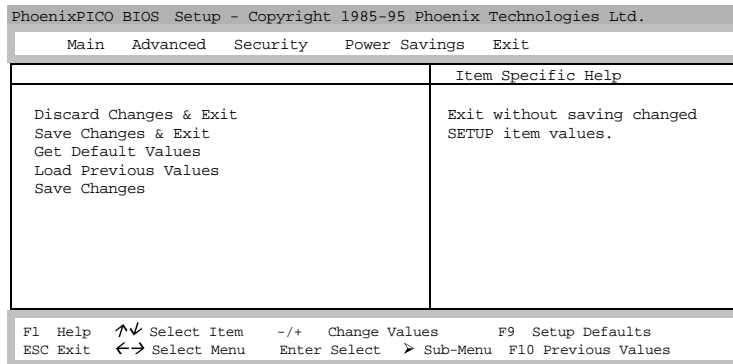
Feature	Options	Description
Power Management Mode	Off Customize Max. Battery Life Max. Performance	Max. Battery and Max. Performance set power-management options with pre-defined values. Select Customize to make your own selections from the following fields. Off turns off all power management.
Hard Disk Timeout	Off 10 seconds - 15 min	Inactivity period of hard disk required before standby (motor off).
Medium Backlight Timeout	Off 15 seconds	Inactivity period of keyboard/mouse required before dimming backlight.
Video Timeout	Off 15 seconds	Inactivity period of keyboard/mouse required before screen is turned off.
Serial Timeout	Off 1 min - 15 min	Inactivity period of serial ports required before standby.

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Feature	Options	Description
Parallel Timeout	Off 1 min - 15 min	Inactivity period of parallel ports required before standby.
Idle Mode	Off / On	Turns on/off CPU idle mode.
Feature	Options	Description
Standby Timeout	Off 1 min - 16 min	Period of system inactivity required before entering standby.
Power Management Under AC	Off / On	Turns power management on/off when system is plugged in to AC outlet.
Suspend Mode	Suspend Save To Disk	When performing Suspend, either SUSPEND (to DRAM) or Save To Disk (to hard drive).
Auto Suspend Timeout	Off 5 min - 60 min	Inactivity period required after Standby to Suspend (maximum power shutdown).
Auto Save To Disk	Off After 1 hour	Performs Save To Disk and powers system off after 1 hour of Suspend.
Suspend Warning Tone	Off / On	Sound beep when suspending system
Resume on Modem Ring	Off / On	Turn system on when an incoming call is detected.
Resume on Time	Off / On	Turn system on a specific time of day from SUSPEND mode.
Resume Time	Time of day	Time of day to turn system on from SUSPEND mode.

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.

Discard Changes and Exit 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.

Save Changes and Exit

After making your selections on the Setup menus, always select either "Save values & Exit" or "Save Current Values." 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 bootup, PhoenixPICO 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.

Get Default Values

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

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

If, during bootup, 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.

Load Previous Values

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 Load Previous Values on the Exit menu updates all the selections and displays this message:

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

Save Changes

Save Current Values saves all the selections without exiting Setup. You can return to the other menus if you want to review and change your selections.

PhoenixPICO BIOS Messages

This section explains the PhoenixPICO BIOS messages and error codes. The following table lists the messages and suggests possible solutions.

Message	Meaning
<i>nnnn</i> Cache SRAM Passed	Where <i>nnnn</i> is the amount of system cache in kilobytes successfully tested.
Diskette drive A error 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
Entering SETUP...	Starting Setup program
Extended RAM Failed at offset: <i>nnnn</i> *	Extended memory not working or not configured properly at offset <i>nnnn</i> .
Extended RAM Passed	Where <i>nnnn</i> is the amount of RAM in kilobytes successfully tested.
Failing Bits: <i>nnnn</i> *	The hex number <i>nnnn</i> is a map of the bits at the RAM address (in System, Extended, or Shadow memory) which failed the memory test. Each 1 (one) in the map indicates a failed bit.

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Message	Meaning
Fixed Disk 0 Failure Fixed Disk 1 Failure Fixed Disk Controller Failure	Fixed disk is not working or not configured properly. Check to see if fixed disk is attached properly. Run Setup to ensure that the fixed-disk type is correctly identified
Incorrect Drive A type - run SETUP	Type of floppy drive A: not correctly identified in Setup.
Incorrect Drive B type - run SETUP	Type of floppy drive B: not correctly identified in Setup.
Invalid NVRAM media type *	Problem with NVRAM (CMOS) access.
Keyboard controller error *	The keyboard controller failed test. You may have to replace keyboard or controller.
Keyboard error	Keyboard not working.
Keyboard error <i>nn</i>	BIOS discovered a stuck key and displays the scan code <i>nn</i> for the stuck key
Keyboard locked - Unlock key switch	Unlock key switch Unlock the system to proceed.
Monitor type does not match CMOS - Run SETUP	Run SETUP Monitor type not correctly identified in Setup
<i>nnnn</i> Shadow RAM Passed	Where <i>nnnn</i> is the amount of shadow RAM in kilobytes successfully tested.
Operating system not found	An 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.

Message	Meaning
Parity Check 1 <i>nnnn</i> *	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 Check 2 <i>nnnn</i> *	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	Displayed after any recoverable error message. Press <F1> to start the boot process or <F2> to enter Setup and change any settings.
Press <F2> to enter SETUP	Optional message displayed during POST. Can be turned off in Setup.
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.
Real time clock error *	Real-time clock fails BIOS test. May require board repair.
Shadow Ram Failed at offset: <i>nnnn</i> *	Shadow RAM failed at offset <i>nnnn</i> of the 64k block at which the error was detected.
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.

Message	Meaning
System BIOS shadowed	System BIOS copied to shadow RAM.
System cache error - Cache disabled *	RAM cache failed the BIOS test. BIOS disabled the cache.
System CMOS checksum bad - run SETUP	System CMOS has been corrupted or modified incorrectly, perhaps by an application program that changes data stored in CMOS. Run Setup and reconfigure the system either by getting the Default Values and/or making your own selections.
System RAM Failed at offset: <i>nnnn</i> *	System RAM failed at offset <i>nnnn</i> in the 64k block at which the error was detected.
System timer error *	The timer test failed. Requires repair of system board.
UMB upper limit segment address: <i>nnn</i>	Displays the address <i>nnn</i> of the upper limit of Upper Memory Blocks, indicating released segments of the BIOS which may be reclaimed by a virtual memory manager.
Video BIOS shadowed	Video BIOS successfully copied to shadow RAM.

* If your system displays this message, write down the message and contact your dealer. If your system fails after you made changes in the Setup menus, you may be able to correct the problem by entering Setup and restoring the original values.

2

Technical Reference

System Overview

PhoenixPICO BIOS brings to AT-compatible products a completely new level of BIOS functionality. Rapid developments in personal computers require robust software that can be easily adapted to new hardware features.

For an explanation of the Setup program, see [Chapter 1, "The Setup Guide."](#)

Basic Features

- Ultra-fast memory testing

- Speed independence (8254 PIT)
- Power-on Self Tests
- Detection of coprocessor
- Memory caching
- Selection of diskette types
- Selection of fixed-disk type
- User-defined fixed-disk types
- Selection of video display
- UMB expansion by release of part of BIOS RAM for use by memory managers after boot
- Network-server mode
- Modifiable sign-on messages
- Support for servers without keyboard and video
- Support for 2.88 MB diskettes
- Support for extended memory beyond 64 MB
- Optional suppression of error messages
- Optional control of key-click

- OEM ID in ROM
- Last Boot Failed Mode

Advanced Features

- Boot-device sequence selections:
 - A: drive followed by C: drive
 - C: drive followed by A: drive
 - C: drive only
- Integration of separately licensed video BIOS (PhoenixVIEW[™]) into system BIOS ROM
- Password control of:
 1. Bootup
 2. Access to SETUP menus
 3. Access to diskette drives
- Support of PS/2 mouse
- Power-on reminders about backup and virus scan
- NumLock control during bootup

- Automatic configuration of IDE fixed disks
- Optimal A20 control
- Selection of data transfer method for fixed disks: standard or block PIO
- Support of flash read-only memory (ROM), which allows you to erase and reprogram BIOS software without removing the ROM BIOS chip from the motherboard.
- PCI bus support:
 - INT 1Ah functions for PCI device configuration and control
 - Local-bus video
 - Palette snooping
 - Mapping of option ROMs into memory or I/O space

Chipset Features

- Shadowing of system and video BIOS
- Shadowing of option ROMs
- Advanced chipset SETUP menu for changing register values
- Automatic memory sizing for specific chipset memory configurations

- Sizing and control of cache for specific chipset cache configurations

The PhoenixPICO BIOS Software

The PhoenixPICO BIOS software performs these functions:

Configure Hardware	Using the Setup program, allocate and optimize resources (memory, interrupts, etc.) for each of the hardware components (video, disk drives, etc.).
Initialize Hardware	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 services for DOS and DOS applications.

System Hardware Requirements

PhoenixPICO BIOS requires the following hardware components on the motherboard:

System Board Requirements

1. CPU (386 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

PhoenixPICO BIOS 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.

Fixed Disk Tables					
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

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 which 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:

Code	Beeps	POST Routine Description
02		Verify Real Mode
04		Get CPU type
06		Initialize system hardware
08		Initialize chipset registers with initial POST values
09		Set in POST flag
0A		Initialize CPU registers

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Code	Beeps	POST Routine Description
0B		Enable CPU cache
0C		Initialize caches to initial POST values
0E		Initialize I/O
0F		Initialize the local bus IDE
10		Initialize Power Management
11		Load alternate registers with initial POST values
12		Restore CPU control word during warm boot
14		Initialize keyboard controller
16	1-2-2-3	BIOS ROM checksum
18		8254 timer initialization
1A		8237 DMA controller initialization
1C		Reset Programmable Interrupt Controller
20	1-3-1-1	Test DRAM refresh
22	1-3-1-3	Test 8742 Keyboard Controller
24		Set ES segment register to 4 GB
28		Autosize DRAM
2A		Clear 512K base RAM
2C	1-3-4-1	RAM failure on address line <i>xxxx</i> *
2E	1-3-4-3	RAM failure on data bits <i>xxxx</i> * of low byte of memory bus
30	1-4-1-1	RAM failure on data bits <i>xxxx</i> * of high byte of memory bus
32		Test CPU bus-clock frequency

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Code	Beeps	POST Routine Description
34		Test CMOS RAM
35		Initialize alternate chipset registers.
36		Warm start shut down
37		Reinitialize the chipset (MB only)
38		Shadow system BIOS ROM
39		Reinitialize the cache (MB only)
3A		Autosize cache
3C		Configure advanced chipset registers
3D		Load alternate registers with CMOS values
40		Set Initial CPU speed
42		Initialize interrupt vectors
44		Initialize BIOS interrupts
46	2-1-2-3	Check ROM copyright notice
47		Initialize manager for PCI Option ROMs
48		Check video configuration against CMOS
49		Initialize PCI bus and devices
4A		Initialize all video adapters in system
4B		Display QuietBoot screen
4C		Shadow video BIOS ROM
4E		Display copyright notice
50		Display CPU type and speed

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Code	Beeps	POST Routine Description
51		Initialize EISA board
52		Test keyboard
54		Set key click if enabled
56		Enable keyboard
58	2-2-3-1	Test for unexpected interrupts
5A		Display prompt "Press F2 to enter SETUP"
5C		Test RAM between 512 and 640k
60		Test extended memory
62		Test extended memory address lines
64		Jump to UserPatch1
66		Configure advanced cache registers
68		Enable external and CPU caches
6A		Display external cache size
6C		Display shadow message
6E		Display non-disposable segments
70		Display error messages
72		Check for configuration errors
74		Test real-time clock
76		Check for keyboard errors
7A		Test for key lock on
7C		Set up hardware interrupt vectors

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Code	Beeps	POST Routine Description
7E		Test coprocessor if present
80		Disable onboard I/O ports.
82		Detect and install external RS232 ports
84		Detect and install external parallel ports
85		Initialize PC-compatible PnP ISA devices
86		Re-initialize onboard I/O ports.
88		Initialize BIOS Data Area
8A		Initialize Extended BIOS Data Area
8C		Initialize floppy controller
90		Initialize hard disk controller
91		Initialize local-bus hard disk controller
92		Jump to UserPatch2
93		Build MPTABLE for multi-processor boards
94		Disable A20 address line
95		Install CD ROM for boot
96		Clear huge ES segment register
98	1-2	Search for option ROMs. One long, two short beeps on checksum failure
9A		Shadow option ROMs
9C		Set up Power Management
9E		Enable hardware interrupts

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Code	Beeps	POST Routine Description
A0		Set time of day
A2		Check key lock
A4		Initialize typematic rate
A8		Erase F2 prompt
AA		Scan for F2 key stroke
AC		Enter SETUP
AE		Clear in-POST flag
B0		Check for errors
B2		POST done - prepare to boot operating system
B4	1	One short beep before boot
B5		-
B6		Check password (optional)
B8		Clear global descriptor table
BC		Clear parity checkers
BE		Clear screen (optional)
BF		Check virus and backup reminders
C0		Try to boot with INT 19
DO		Interrupt handler error
D2		Unknown interrupt error
D4		Pending interrupt error
D6		Initialize option ROM error

Code	Beeps	POST Routine Description
D8		Shutdown error
DA		Extended Block Move
DC		Shutdown 10 error
		The following are for boot block in Flash ROM
E2		Initialize the chipset
E3		Initialize refresh counter
E4		Check for Forced Flash
E5		Check HW status of ROM
E6		BIOS ROM is OK
E7 Entry:		Do a complete RAM test
E8		Do OEM initialization
E9		Initialize interrupt controller
EA		Read in the bootstrap code
EB		Initialize all vectors
EC		Boot the Flash program
ED		Initialize the boot device
EE		Boot code was read OK

* 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 check point 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.

PhoenixPICO BIOS 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**.

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 Entry: AL	Set video mode 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 Entry: CH CL	Set cursor size Bits 4-0 = Cursor top scan line Bits 4-0 = Cursor bottom scan line
AH = 02h Entry: BH DL DH	Set cursor position Page to set cursor Character column position Character row position
AH = 03h Entry: BH	Get cursor position of page Page to return cursor

continued

Interrupt 10 Video Services(continued)	
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 pageup
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

continued

Interrupt 10 Video Services (continued)

AH = 08h	Read character and attribute
Entry:	
BH	Video page to read character
Exit:	
AL	Character
AH	Character attribute
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
	0-31 = Intense versions of colors 0-15
BL	

continued

Interrupt 10 Video Services (continued)

BH = 01 Set palette for mode 0 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

continued

Interrupt 10 Video Services (continued)

AH = 13h

Entry:
ES:BP
CX
DH
DL
BL
AL

Write string

Pointer to string
Length of string to display
Character row for display
Character column for display
Display attribute
Write string mode
0 = Chars only, no cursor update
1 = Chars only, update cursor
2 = Char, Attrib, no cursor update
3 = Char, Attrib, update cursor

Interrupt 11h—Return System Information

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

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

Interrupt 12h–Return Memory Size

Returns the amount of system memory determined during the power on diagnostics.

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

Interrupt 13h–Diskette Services

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

The following table lists the AH error codes.

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

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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 tables describe the diskette services with their entry and exit values.

Interrupt 13h Diskette Services

AH = 00h	Reset diskette system
AH = 01h	Return diskette status
Exit: AL	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 DL DH CH CL AL Exit: AL	Buffer address Drive number (0-1) Head number (0-1) Track number (0-79) Sector number (1-15) Number of sectors (1-15) Number of sectors transferred

continued

Interrupt 13h Diskette Service (continued)

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 (1-15)
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 (1-15)
AL	Number of sectors (1-15)
Exit:	
AL	Number of sectors verified

continued

Interrupt 13h Diskette Services (continued)	
AH = 05h	Format diskette track
Entry:	
ES:BX	Buffer address
DL	Drive number (0-1)
DH	Head number (0-1)
CH	Track number (0-79)
CL	Sector number (1-15)
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

continued

Interrupt 13h Diskette Services (continued)	
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 Exit: AH	Read drive type 00 = Drive not present 01 = Drive cannot detect media change 02 = Drive can detect media change 03 = Fixed disk
AH = 16h Entry: DL Exit: AH	Detect media change Drive Number (0-1) If Carry = 0: 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)

continued

Interrupt 13h Diskette Services (continued)

AH = 17h	Set diskette type
Entry: AL	Format: 00 = Not Used 01 = 360KB floppy in 360KB drive 02 = 360KB floppy in 1.2MB drive 03 = 1.2MB floppy in 1.2MB drive 04 = 1.44MB floppy in 1.44MB Drive Number (0-1)
DL	
AH = 18h	Set media type for format
Entry: CH CL	Maximum track number Diskette parameters: Bits 0-5: Maximum sector number Bits 6-7: Maximum track number Drive Number (0-1)
DL	
Exit: ES:DI	Pointer to parameter table
AH = 20h	Get media type
Entry: DL	Drive number (0-1)
Exit: AL	Type of media installed: 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 describes the errors returned by these services:

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 PhoenixPICO BIOS

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:	
AL	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 13 Standard 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

continued

Interrupt 13 Standard Fixed Disk Services (continued)

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)

continued

Interrupt 13 Standard Fixed Disk Services (continued)

AL	Number of sectors (1-80h for write) (1-79h for long write, includes ECC)
Exit:	
AL	Number of sectors formatted
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)

continued

Interrupt 13 Standard Fixed Disk Services (continued)

AH = 0Ah	Read long
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
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

continued

Interrupt 13 Standard Fixed Disk Services (continued)

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
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 PhoenixPICO 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

continued

Int 13h Extended Fixed Disk Services(continued)

DL Bits 1-7 Reserved, set to 0
 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)

continued

Int 13h Extended Fixed Disk Services (continued)

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)

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	Bits 0-3	Phoenix Proprietary
	Bits 4-7	Reserved, must be 0
6	Bits 0-3	IRQ for this drive
	Bits 4-7	Reserved, must be 0

continued

Int 13h Extended Fixed Disk Services (continued)

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
10-11	Bit 0	1 = Fast PIO access enabled
	Bit 1	1 = DMA access enabled
	Bit 2	1 = Block PIO access enabled
	Bit 3	1 = CHS translation enabled
	Bit 4	1 = LBA translation enabled
	Bit 5	1 = Removable media
	Bit 6	1 = CD ROM
	Bit 7	1 = 32-bit transfer mode
	Bit 8	1 = ATAPI Device uses Interrupt DRQ
	Bits 9-10	CHS Translation Type
	Bits 11-15	Reserved, must be 0
12-13	Byte	Reserved, must be 0
14	Byte	Extension Revision number
15	Byte	Checksum, 2s complement of the sum of bytes 0-14

Interrupt 13h-Bootable CD-ROM Services

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

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

continued

Bootable CD-ROM Specification Pack (continued)

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

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

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

The following describes the Interrupt 13 Bootable CD-ROM Services of PhoenixPICO BIOS:

Int 13 Bootable CD-ROM Services	
AH = 4Ah	Initiate disk emulation
Entry:	
AL	00
DS:SI	Pointer to Specification Packet (See above)
CF	0 = Specified drive emulating 1 = System not in emulation mode

continued

Int 13 Bootable CD-ROM Service(continued)

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

Interrupt 14h–Serial Services

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

The following describes the modem status returned by serial services.

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

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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 table describes the serial communication services of PhoenixPICO BIOS

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

continued

Interrupt 14h Serial Service(continued)	
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

continued

Interrupt 14h Serial Services (continued)	
AH = 03h	Return serial port status
Entry:	
DX	Serial port (0-3)
Exit:	
AH	Line status
AL	Modem status
AH = 03h	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

continued

Interrupt 14h Serial Services (continued)	
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 Interrupt 15h 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)

continued

Interrupt 15h System Service (continued)	
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

ES:SI

Number of words to move

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 the CPU's programmer's reference)

AH = 88h

Extended memory size

Exit:

AX

For DOS and Windows 3.x (AT Compatible):

Amount of extended memory to 64 Mb, in 1 Kb blocks

AX

For Windows NT 3.1 and OS/2 2.11 and 2.20:

Amount of extended memory to 64 Mb in 1 Kb blocks

3C00 = 15 Mb or > 64 Mb (Test further with

INT 15 E8)

AH = 89h

Enter protected mode

Entry:

ES:SI

BH

BL

Pointer to Global Descriptor

(See service 87)

Offset in IDT for IRQ 00-07

Offset in IDT for IRQ 08-0F

continued

Interrupt 15h System Services (continued)	
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)

continued

Interrupt 15h System Services (continued)

Byte 6	Feature information: Bit 0 0 = Reserved Bit 1 0 = ISA-type I/O channel Bit 2 0 = EDDBA not allocated Bit 3 0 = Wait for external event supported Bit 4 1 = Keyboard intercept (INT 154F) called by INT 09h
Bit 5 1 = Real time clock present	Bit 6 1 = Second PIC present Bit 7 0 = Fixed disk BIOS does not use DMA channel 3
Byte 7	Reserved
Byte 8	Reserved
AH = C1h	Return Extended BIOS Data Area Address
Exit:	
ES	Extended BIOS Data Area Segment Address
	If Carry = 1
AH	86 = Invalid BIOS routine call (No EBDA)

Interrupt 15h-APM Services

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

The following are the APM exit status codes:

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

The following are the Interrupt 15h APM Services of PhoenixPICO BIOS

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

continued

Interrupt 15h APM Service (continued)

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
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

continued

Interrupt 15h APM Services (continued)

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

continued

Interrupt 15h APM Services (continued)	
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

continued

Interrupt 15h APM Services (continued)

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

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

continued

Interrupt 15h APM Services (continued)

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)

continued

Interrupt 15h APM Services (continued)

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 optionally handles the calls reporting extended memory over 64 Mb.

The first function, 8Ah, only supports certain versions of UNIX.

The second function, E8h, incorporates these sub functions:

- Big memory for Windows NT 3.01 and OS/2 2.11 and 2.20–E801h (16 bit) and E881h (32 bit).
- System Memory Map–E820h

Interrupt 15h Big Memory Services	
AH = 8Ah Big Memorysize, Phoenix definition	
Entry:	(For certain versions of UNIX)
AX	Low 16-bit value
DX	High 16-bit value = memory above 1024 Kb in 1 Kb blocks
AH = E8h Big Memory size (over 64 Kb)	
AL = 01h	Big Memory Size, 16 Bit (Windows NT 3.1 and OS/2 2.11 and 2.20)
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

continued

Interrupt 15h Big Memory Service(continued)

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
	Other = Not defined, not available

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.

continued

Interrupt 15h Big Memory Services (continued)

AL = 81h Big Memory Size, 32-Bit Protected Mode (Windows NT 3.1 and OS/2 2.11 and 2.20)

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

Interrupt 15h-PS/2 Mouse Services

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

PS/2 Mouse Exit Status Codes

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

The following table describes the Interrupt 15h PS/2 mouse services of PhoenixPICO BIOS

Interrupt 15h PS/2 Mouse Services	
AH = C2h	PS/2 Mouse Support
AL Entry: BH	00 = Enable/Disable PS/2 Mouse 00h = Disable 01h = Enable
AL Exit: BH	01 = Reset PS/2 Mouse Device ID
AL Entry: BH	02 = Set Sample Rate Sample rate: 00h = 10 reports per second 01h = 20 reports per second 02h = 30 reports per second 03h = 40 reports per second 04h = 60 reports per second 04h = 80 reports per second 05h = 100 reports per second 06h = 200 reports per second

continued

Interrupt 15h PS/2 Mouse Service(continued)

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

AL **04h = Read Device Type**
Exit:
BH Device ID

AL **05h = Initialize PS/2 mouse**
Entry:
BH Data package size (01-08h, in bytes)

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:
BL If Entry BH = 00:
 Status byte 1:
 Bit 0 1 = Right button pressed
 Bit 1 0 = Reserved
 Bit 2 1 = Left button pressed
 Bit 3 0 = Reserved

continued

Interrupt 15h PS/2 Mouse Services (continued)

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

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The following are the Interrupt 15 EISA services of PhoenixPICO BIOS

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
DH	LSbyte of checksum of config file
	Number of device functions

continued

Interrupt 15h EISA Services(continued)	
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

continued

Interrupt 15h EISA Services (continued)	
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)

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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 PhoenixPICO BIOS

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

continued

Interrupt 16h Keyboard Service (continued)

AH = 03h	Set typematic rate and delay
Entry:	
AL	05 (subfunction 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:	
AL	If Carry = 1: 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-0278h, 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:	

continued

Interrupt 17h Parallel Printer Service(continued)	
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 PhoenixPICO BIOS

Interrupt 17h EPP Services

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

continued

Interrupt 17h EPP Service (continued)

**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)

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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)

continued

Interrupt 17h EPP Services (continued)

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)

AH = 05h Write address/select device

Entry:
DL EPP printer port (0-2)
AL Device address to write

continued

Interrupt 17h EPP Services (continued)

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

continued

Interrupt 17h EPP Services (continued)

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)

continued

Interrupt 17h EPP Services (continued)

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)

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

continued

Interrupt 17h EPP Services (continued)

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

continued

Interrupt 17h EPP Services (continued)

CX EPP product/Device ID
 0 = Undefined

AH = 42h Set product ID

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

AH = 50h Rescan daisy chain

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

AH = 51h Query daisy chain

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

Exit:
AL Status flags:
 Bit 0 1 = Channel locked
 Bit 1 1 = Interrupt pending
BL Currently selected device
CL Depth of daisy chain on this port
 0 = No daisy chain on this port
ES:DI Pointer to ASCII string, driver vendor ID

Interrupt 1Ah–Time of Day Services

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

Interrupt 1Ah Time-of-Day Services	
AH = 00h	Read current time
Exit:	
CX	High word of tick count
DX	Low word of tick count
AL	00h = Day rollover has not occurred (Timer count is less than 24 hours since last power on or reset)
AH = 01h	Set current time (Clear rollover bit)
Entry:	
CX	High word of tick count
DX	Low word of tick count
AH = 02h	Read real time clock
Exit:	
CH	BCD hours
CL	BCD minutes
DH	BCD seconds
DL	00 = Standard Time 01h = Daylight Savings
AH = 03h	Set the real time clock
Entry:	
CH	BCD hours

continued

Interrupt 1Ah Time-of-Day Service(continued)

CL BCD minutes
DH BCD seconds
DL 01h = Daylight saving
 00h = Otherwise

AH = 04h Read date from real time clock

Exit:
CH BCD century
CL BCD year
DH BCD month
DL BCD date

AH = 05h Set date in real time clock

Entry:
CH BCD century
CL BCD year
DH BCD month
DL BCD date

AH = 06h Set real-time alarm

Entry:
CH BCD hours to alarm
CL BCD minutes to alarm
DH BCD seconds to alarm
Exit:
C 1 = Alarm already set

AH = 07h Reset real-time alarm

Exit:
AL Value written to CMOS RAM register 0Bh

Interrupt 1Ah—General PCI Services

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

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

The following are the PCI Services:

Interrupt 1Ah General PCI Services	
AH = B1h	PCI Services
AL	01h = PCI BIOS present
Exit:	
EDX	"PCI", "P" in [DL], "C" in [DH], etc.

continued

Interrupt 1Ah General PCI Service(continued)

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

continued

Interrupt 1Ah General PCI Services (continued)

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)

continued

Interrupt 1Ah General PCI Services (continued)

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

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

continued

Interrupt 1Ah General PCI Services (continued)

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

PhoenixPICO BIOS 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

NOTE For complete instructions on using these services, consult the *Plug and Play BIOS Specification* published by Phoenix Technologies Ltd., Compaq Computer Corporation, and Intel Corporation.

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

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

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

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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 baseaddress
17h..4	OEM Device Identifier
1Bh..2	Real Mode 16-bit data segment address
1Dh..4	16-bit Protected Mode data segment baseaddress

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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 PhoenixPICO BIOS, in 'C' syntax.

PnP Runtime-Service Function Parameters

00h Get Number of Device Nodes

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

int Function;
unsigned char FAR *NumNodes;
unsigned int FAR *NodeSize;
unsigned int BiosSelector;

01h Get System Device Node

Entry:
int FAR (*entryPoint)(Function, Node, devNodeBuffer,
 Control, BiosSelector);

int Function;
unsigned char FAR *Node;
struct DEV_NODE FAR *devNodeBuffer;
unsigned int Control;
unsigned int BiosSelector;

02h Set System Device Node

Entry:
int FAR (*entryPoint)(Function, Node, devNodeBuffer,
 Control, BiosSelector);

int Function;
unsigned char Node;

continued

PnP Runtime-Service Function Parameters(continued)

```
struct DEV_NODE FAR *devNodeBuffer;  
unsigned int Control;  
unsigned int BiosSelector;
```

03h Get Event

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

04h Send Message

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

05h Get Docking Station Information

```
Entry:  
int FAR (*entryPoint)(Function, DockingStationInfo,  
BiosSelector);  
int Function;  
unsigned char FAR *DockingStationInfo;  
unsigned int BiosSelector;
```

continued

PnP Runtime-Service Function Parameters (continued)

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;

0Ah Get Statically Allocated Resources

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

int Function;
unsigned char FAR *ResourceBlock;
unsigned int BiosSelector;

continued

PnP Runtime-Service Function Parameters (continued)

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

continued

PnP Runtime-Service Function Parameters (continued)

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;
```

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	2	Com1 address
02...2	2	Com2 address
04...2	2	Com3 address
06...2	2	Com4 address
08...2	2	Lpt1 address
0A...2	2	Lpt2 address
0C...2	2	Lpt3 address
0E...2	2	LPT4/EBDA address*
10...2	2	Equipment installed:
	Bit	Definition
	0.....	Not used
	1.....	Math coprocessor installed
	2.....	PS/2 mouse installed
	3.....	Not used
	4,5.....	Initial video mode:
		00 = EGA/VGA
		01 = 40x25 CGA
		10 = 80x25 CGA
		11 = Monochrome

continued

BIOS Data Area Description(continued)

6,7..... Diskette drives:
 00 = 1 drive
 01 = 2 drives
 10 = 3 drives
 11 = 4 drives
 8..... Not used
 9-11..... Number of serial adapters
 12..... Game Adapter installed
 13..... Not used
 14,15..... Number of parallel adapters

Offset	Size	Description
12.... 1	Interrupt flag (POST)
13.... 2	Memory size (K bytes)
15.... 1	Reserved
16.... 1	Control flag

Keyboard Data Area

Offset	Size	Description
17.... 1	Keyboard flag 0:
	Bit	Definition
	0.....	Right shift key pressed
	1.....	Left shift key pressed
	2.....	Control key pressed
	3.....	Alt key pressed
	4.....	Scroll lock on
	5.....	Num lock on
	6.....	Caps lock on

continued

Keyboard Data Area(continued)	
7.....	Insert mode on
18.... 1	Keyboard flag 1:
	Bit Definition
3	Freeze state
4	Scroll lock pressed
5	Num lock pressed
6	Caps lock pressed
7	Insert mode pressed
19.... 1	Keypad input byte
1A ... 2	Key buffer head
1C ... 2	Key buffer tail
1E ... 20	Key buffer
Diskette Data Area	
3E ... 1	Seek/recalibrate status
3F ... 1	Drive motor status
40.... 1	Motor on time
41.... 1	Diskette status:
	Bit Definition
7.....	1 = Drive not ready
6.....	1 = Seek error occurred
5.....	1 = Diskette controller failed
4-0.....	Error codes:
	01h = Illegal function request
	02h = Address mark not found
	03h = Write protected error
	04h = Sector not found
	06h = Diskette change line active

continued

Diskette Data Area(continued)

- 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

continued

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

continued

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
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

continued

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	1	Size of EBDA in kbytes
01h..33	33	Reserved
21h..4	4	Pointer to device routine
25h..1	1	First byte of pointer information:
		Bit Definition
	4.....	Pointer error
	5.....	Pointer acknowledge
	6.....	Resend request
	7.....	Command in progress
26h..1	1	Second byte of pointer information
		Bit Definition
	6.....	Enable pointer device
	7.....	Pointer external device
27h..2	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	Not Supported
10	BIOS Video Interface	Supported
11	BIOS Equipment Check	Supported

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INT	Description	Status
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 - Reserved	Not Supported
75	IRQ13 - 80287 interrupt	Supported
76	IRQ14 - Fixed Disk interrupt	Supported
77	IRQ15 - Reserved	Not Supported

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