

# Chapter 1

## What Is the BIOS?

The **BIOS** is short for **Basic Input/Output System**. By definition, it is the interface between software and hardware that allows software and hardware to communicate and interact with each other.

The BIOS is made up of everything that allows software and hardware to interact with each other. While you may think that the BIOS only exists in the form of the motherboard BIOS, it is actually the combination of the motherboard BIOS, the BIOS of all add-on cards in the system, as well as their device drivers.

### How Does the BIOS Work?

Most people never think about what actually goes on when they do something on the computer. To most people, whenever they command the computer to do something, it just does it. No questions asked.

It isn't as simple as that. Behind the facade of the user-friendly **GUI (Graphical User Interface)**, many things have to be done by the system for the command to be carried out.

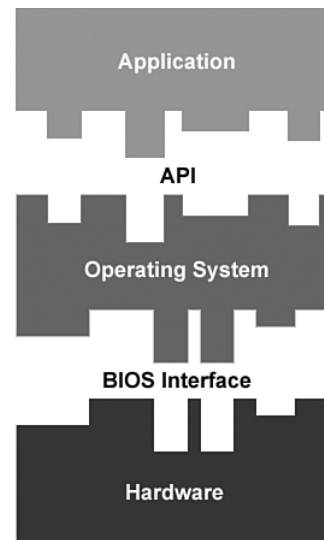
Let's visualize the computer system as three separate layers that communicate with each other through different interfaces. The diagram to the right is of that layered division:

In our layered system, the application is the highest level. It cannot directly interact with the hardware. It can only communicate with the operating system through the **API** or **Application Program Interface**.

The API is a set of common functions that the application calls upon to get the operating system to do what it wants. Because the API is operating system-specific, it differs from operating system to operating system.

However, irrespective of the operating system, the API allows the application to get the job done without knowing how the operating system does it. The application doesn't need to know anything about the computer's hardware.

The operating system then communicates to the BIOS what it needs to carry out the application's request. The operating system never communicates directly with the hardware.



*The different layers and interfaces.*

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The BIOS layer allows the operating system to support all manners of hardware. Each piece of hardware comes with its own BIOS and/or driver, which become part of the system's BIOS.

Therefore, the BIOS layer is dynamic and changes to match the computer's hardware configuration. It serves to mask the differences between different hardware by presenting a common interface to the operating system.

The operating system only needs to know how to communicate with the BIOS layer. It is up to the BIOS layer to translate the operating system commands into action by the hardware.

Without the BIOS layer, there's no way the operating system can access the hardware layer. The BIOS layer is the operating system's key to the hardware layer. That's how important the BIOS layer is in the computer system.

### The Motherboard BIOS

Although, by definition, the BIOS consists of the motherboard BIOS, the BIOS of all add-on cards in the system, as well as their drivers, we will be concentrating on the motherboard BIOS in this book.

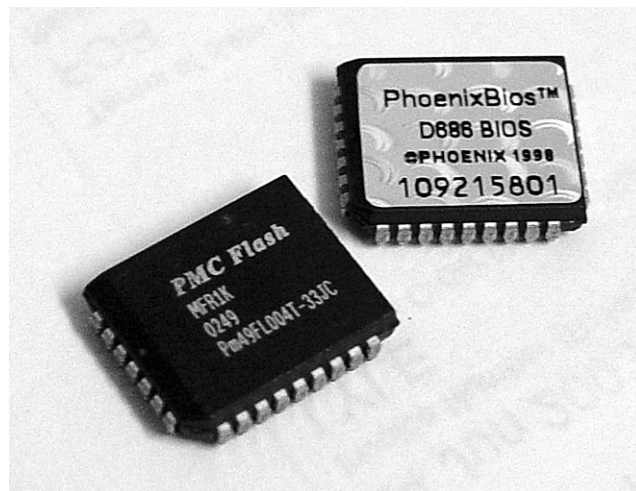
The motherboard BIOS is the most important component of the BIOS layer. This is because it contains all the software needed to get the computer started. It also comes with basic diagnostics and configuration utilities.

### The BIOS Chip

The motherboard BIOS is stored in a chip on the motherboard. The BIOS chip normally comes in the form of a rectangular **DIP (Dual In-line Package)** or a square **PLCC (Plastic Leaded Chip Carrier)** package.

The capacity of BIOS chips is measured in Megabits (Mb). Most BIOS chips these days are 2Mb (256KB) in size. These higher capacity chips allow the manufacturer to offer more features than is possible with the smaller 1Mb chips.

However, please note that the size of the BIOS chip has nothing to do with its performance. The choice of type and size of the BIOS chip is a matter of economics and requirements, rather than performance.



*PLCC-type BIOS chips.  
(Photo by author.)*

## What Does It Do?

Here is a breakdown of what the motherboard BIOS actually consists of:

- Power-on diagnostic tests
- System configuration utility
- Bootstrap loader
- BIOS interface

When you boot up the computer, it initiates the **POST (Power-On Diagnostic Test)**. The POST serves as a quick-and-dirty way to make sure that all the critical components are functioning.

After the POST sequence completes, you are given the opportunity to access the system configuration utility. This utility allows you to configure and modify a range of features. These BIOS features show you just how important the BIOS is.

These BIOS features control every aspect of the computer, from the speed at which the processor runs to the transfer mode of the hard disk. It goes without saying that these BIOS features are the reason why I'm writing this book. We go into details later in Chapter 4.

After the short delay, the BIOS starts the bootstrap loader routine, which scans for a valid master boot sector on all available drives. This can be anything from a hard disk to a CD-ROM drive. The master boot sector is just a predetermined area containing code that initiates the loading of the operating system.

When executed, the master boot sector turns over the booting process to the operating system by loading the operating system's boot sector. The operating system then starts loading up its core files.

In most cases, this is where the BIOS' role ends because current operating systems employ their own 32-bit or 64-bit drivers, which offer far superior functionality and performance to the BIOS' basic drivers. However, the BIOS' core drivers still have some importance.

Even modern operating systems like Microsoft Windows still need to use the BIOS' basic drivers, albeit only in their troubleshooting or "safe" modes. This is because the core BIOS drivers have been standardized a long time ago, and every piece of hardware made since then is backward-compatible with them.

While these core BIOS drivers may be slow and primitive, they are guaranteed to work with any hardware designed for the PC. That's why they are still an integral part of every PC.

## Why Optimize the BIOS?

Although the BIOS only functions from the time you press the Power On button until the operating system takes over, its effects last as long as the computer is operational. Whatever you set in the BIOS greatly determines your computing experience.

If the BIOS is not configured properly, you may be able to boot up the operating system and run it for a while. However, the system will become unstable and eventually crash. This will go on and on, ad nauseum.

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You may send it back to your computer dealer and, more likely than not, the technician will simply reset the BIOS to its fail-safe settings and send it back to you. However, is that the best solution?

Most definitely not! An unoptimized BIOS means an unoptimized system. Not only will it take longer to boot up or initialize devices, it will also slow down the entire computer. It's like knee-capping someone before sending him out to do the long jump!

BIOS optimization is critical not only to the optimal performance of the computer, but also to the proper functioning of the system's components. Computers these days are made up of a hodge-podge of different components from different manufacturers. This presents a real problem when it comes to getting them all to work together.

Because of the variety of components that make up any one computer, it is impossible for manufacturers to optimize their motherboards for any particular configuration. That's why all motherboards come with configurable BIOS.

The BIOS allows the OEM (Original Equipment Manufacturer), as well as the end-user, to modify settings and timings to support different configurations. Without them, manufacturers would be forced to use the most conservative settings, which would greatly degrade performance.

### How Do I Optimize the BIOS?

The key to optimizing the BIOS lies in its built-in system configuration utility. As mentioned earlier, this is where you can configure or modify a variety of BIOS features and options.

These BIOS features show you just how important the BIOS is. They control every aspect of the computer, from the speed at which the processor runs to the transfer mode of the hard disk.

This book teaches you how to optimize your BIOS for proper operation and maximum performance. Let's turn that snail into a road hog!

### BIOS Updates

First of all, you should know that the BIOS that ships with your motherboard is not necessarily the latest version or the most stable version. Reputable motherboard manufacturers constantly improve on their motherboard BIOS and regularly release BIOS updates.

These BIOS updates are important because they correct bugs and sometimes provide additional capabilities. You can think of them as driver updates or software patches. You should always keep the motherboard BIOS up to date.

In the following figure, you can see the list of changes in two BIOS updates for the ABIT NF7-S motherboard.

NF7-S	
<b>nf719.exe</b>	<b>Bios Issue Date: 2003/05/13</b>
<ol style="list-style-type: none"> <li>1. Please use AWDFLASH 8.23D or later to update NF7 series BIOS. With incorrect AWDFLASH version, the GUID will be erased, and leads to IEEE1394 peer to peer function failure. AWDFLASH 8.23K is included in this BIOS package.</li> <li>2. Fixed CPU temperature too high issue.</li> <li>3. Raised highest CPU FSB up to 300 MHz for "user define mode" in SoftMenu.</li> <li>4. Fixed SATA RAID-0 data corruption issue by adding a new option "EXT-P2P's Discard Time" in "Integrated Peripherals". The default setting is "30 us" ; which is recommended by NVIDIA. In case the problem is still there, try "1 ms" please.</li> <li>5. BIOS Compile Date: 5/13/2003.</li> </ol>	
<b>nf719.exe</b>	<b>Bios Issue Date: 2003/04/10</b>
<ol style="list-style-type: none"> <li>1. Please use AWDFLASH 8.23D or later to update NF7 series BIOS. With incorrect AWDFLASH version, the GUID will be erased, and leads to IEEE1394 peer to peer function failed. AWDFLASH 8.23K is included in this BIOS package.</li> <li>2. Changed SSID of NF7-M and NF7 to "1C01" and "1C02" respectively.</li> <li>3. Changed default setting of "Floppy A" to "1.44M, 3.5in." after fail-safe default loaded.</li> <li>4. Adds auto-detect function of "Dual Channel DDR". The DDR modules should be installed in DIMM-3 and DIMM-2.</li> <li>5. Fixed system instability issue when a PCI card installed in PCI-4 and in Windows 2000 environment.</li> <li>6. BIOS Compile Date: 4/10/2003</li> </ol>	

*Details of BIOS updates for the ABIT NF7-S motherboard.  
(Courtesy of ABIT Computer Corporation. Used with permission.)*

As you can see, the bug fixes and feature enhancements are both numerous and important. It really pays to keep your BIOS updated!

## How Do I Update the BIOS?

The process of updating the BIOS can be summarized in the following steps:

1. Determine your BIOS version.
2. Obtain the appropriate BIOS update.
3. Prepare a BIOS flash disk.
4. Flash the motherboard BIOS.

Now let's go through the process step by step.

### Note

The term **flash** or **flashing** is used to describe the act of updating the BIOS.

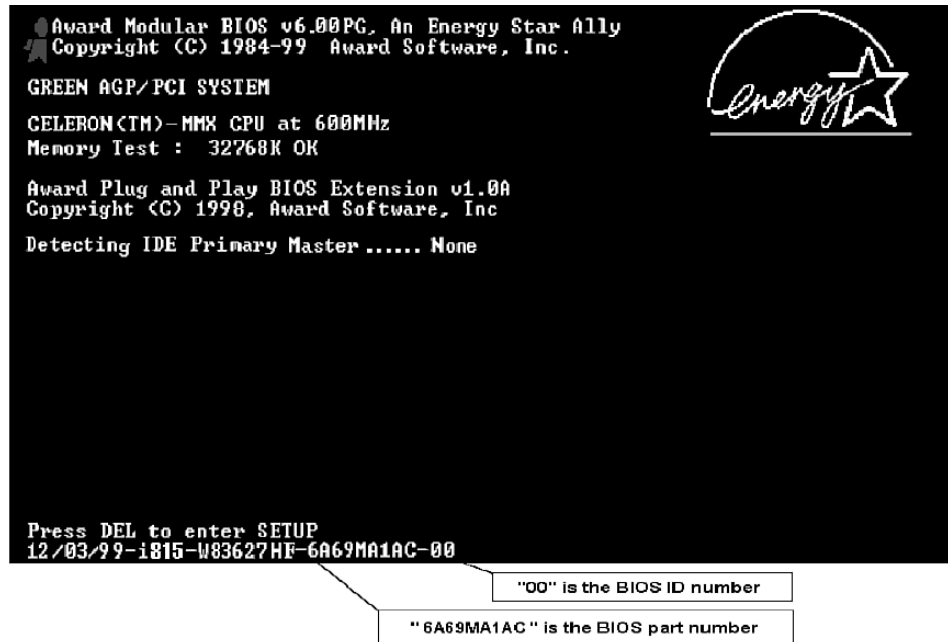
## Determining the BIOS Version

Before you update your BIOS, it's best to find out what version of BIOS you are currently using. If you already have the latest version, then there's no point in going through the process.

The display of the BIOS version number or ID varies from manufacturer to manufacturer.

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However, it is most commonly the last two or four digits or letters at the end of the string that appears when you boot up the computer.



*Determining the BIOS ID.*

*(Courtesy of ABIT Computer Corporation. Used with permission.)*

Your motherboard manufacturer may use numbers or letters to represent the BIOS version or ID. The following is an example of the BIOS version or ID.

Because this string only appears for a few seconds when you start up the computer, you might want to turn on your monitor a few seconds before you start up your computer because some monitors take some time to initialize.

You can also use the Pause key to freeze the screen so that you can search for and identify the BIOS ID. Pressing any key after that will unfreeze the screen and allow the booting process to continue.

In the preceding example, the BIOS ID is a two-digit number (00). Other motherboards may use four digits or even letters instead of digits. Some even use a mix of letters and digits.

If the BIOS ID does not appear as it does in the example, please check the manual that came with your motherboard. Your motherboard manufacturer may have chosen to show the BIOS ID somewhere else.

### Obtaining the BIOS Update

Now that you know your BIOS ID, it's time to check whether your motherboard manufacturer has a BIOS update for you.

BIOS updates are best obtained directly from the manufacturer's website instead of other distribution points like hardware sites and unofficial mirrors. This ensures that you have the very latest BIOS update available and reduces the risk of downloading a virus-infected copy.

So, head over to your motherboard manufacturer's website. The BIOS updates are usually listed in the Downloads or Support section of the website.

Please note that while different motherboard models may appear to have the same BIOS ID, you must download only the BIOS that was specifically meant for your motherboard. Flashing a BIOS update that was meant for another motherboard will likely cause your motherboard to fail.

After you have found the page listing the BIOS updates for your motherboard, there may be a long list of BIOS updates. For example, the adjacent figure shows a few of the BIOS updates for the ABIT KT7A-RAID-motherboard.

Although the number of BIOS updates may be confusing, don't worry! You don't have to download and flash all of them. All you need to do is download and flash the *latest* version.

However, you must first determine whether there is an update for your BIOS. Remember the BIOS ID? Compare it against the list of BIOS IDs.

Irrespective of how the BIOS ID appears, motherboard manufacturers always progressively label BIOS updates.

If your BIOS ID is a number, larger numbers always denote a newer BIOS. For example, a BIOS with an ID of 01 is newer than a BIOS with an ID of 00 but older than a BIOS with an ID of 02.

If the BIOS ID is made up of letters, letters lower in alphabetical order always denote a newer BIOS. For example, a BIOS with an ID of AB is newer than a BIOS with an ID of AA but older than a BIOS with an ID of AC.

The same goes even if your BIOS ID is a mix of letters and numbers, just like in the preceding KT7A-RAID example.

KT7A-RAID		
<b>kt7a9.exe</b>	<b>Bios</b>	<b>Issue Date:</b> 2002/07/11
<b>BIOS ID: A9</b>		
<ol style="list-style-type: none"> <li>1. Fix nVidia GeForce4 TI 4x00 AGP card compatible issue with Windows XP.</li> <li>2. HPT 37x BIOS version 1.11.0402. The RAID function is for KT7A-RAID only. This BIOS version is also for non-RAID boards and HPT BIOS will be automatically disabled while RAID controller chip not detected.</li> <li>3. BIOS Compile Date: 7/11/2002.</li> </ol>		
<b>kt77n.exe</b>	<b>Bios</b>	<b>Issue Date:</b> 2002/01/31
<b>BIOS ID: 7N</b>		
<ol style="list-style-type: none"> <li>1. Support up to 137GB HDD and above.</li> <li>2. HPT 370 RAID BIOS version 1.11.0402. The RAID function is for KT7-RAID / KT7A-RAID only. This BIOS version is also for non RAID boards and HPT BIOS will be automatically disabled while RAID controller chip not detected.</li> </ol>		
<b>kt764.exe</b>	<b>Bios</b>	<b>Issue Date:</b> 2001/11/07
<b>BIOS ID: 64</b>		
<ol style="list-style-type: none"> <li>1. Fine tune the register value of CPU driving strength to enhance the system stability.</li> <li>2. HPT 370 RAID BIOS version 1.11.0402. The RAID function is for KT7-RAID / KT7A-RAID only. This BIOS version is also for non RAID boards and HPT BIOS will be automatically disabled while RAID controller chip not detected.</li> </ol>		
<b>kt74a.exe</b>	<b>Bios</b>	<b>Issue Date:</b> 2001/08/24
<b>BIOS ID: 4A</b>		
<ol style="list-style-type: none"> <li>1. Support AMD 1.4GHz(133)CPU. (The bios is for both KT7 and KT7A series, but this enhancement is for KT7A/KT7A-RAID series only)</li> <li>2. HPT 370 RAID BIOS version 1.11.0402.</li> </ol>		

*List of BIOS updates for the ABIT KT7A-RAID motherboard. (Courtesy of ABIT Computer Corporation. Used with permission.)*

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If your BIOS ID is the latest BIOS ID, then there's no need to proceed further with the BIOS flash. You already have the latest version. Just make sure you check back once in a while.

If there's a newer BIOS ID than your current BIOS ID, download the new BIOS image. It usually comes prepackaged with the flash utility in the form of a compressed ZIP file or a self-extracting compressed file.

### Preparing a BIOS Flash Disk

Now that you have the compressed file containing the BIOS update, it's time to prepare a clean DOS boot disk. This is because most flash utilities require the use of real mode DOS. Also, to prevent conflicts, nothing other than the necessary boot files should be loaded into this boot disk.

You can easily create a clean boot disk in Windows. Even Windows XP, which does not support DOS, comes with a utility that allows you to create your own DOS boot disk. Just remember to use a reliable floppy disk. A defective disk may cause the BIOS update to be corrupted.

In Windows XP, all you need to do is bring up the floppy format utility. Just right-click on your floppy drive in Windows Explorer and click on **Format**. The Format 3 1/2 screen appears.

Among the format options, there is an option called **Create an MS-DOS startup disk**. Check this option and click **Start** to format the floppy disk. Windows XP will then format your floppy disk, make it bootable and copy all the necessary files for it to boot up into real mode DOS.

After you have a clean DOS boot disk, all you need to do is extract the BIOS update file and the flash utility and copy them into the boot disk.

The BIOS update file or image usually has a *.bin* extension. Some come with a *.rom* extension. However, they are all the same; they are just BIOS image files. Write down the name of the BIOS image file. It will come in handy later.



*Creating a boot disk in Windows XP.*

### Flashing the Motherboard BIOS

There are actually a few ways you can flash your BIOS. The traditional way is by a DOS boot disk. However these days, manufacturers are implementing newer methods.

For example, many BIOS now come with their own flash utility. Some manufacturers even provide you with a utility that allows you to flash the BIOS online!

For simplicity's sake, we will only touch on the common DOS flashing method using the AwardFlash software.

The AwardFlash software is probably the most common flash utility around. It is used to flash the BIOS of motherboards using the AwardBIOS. Please note that the AwardFlash utility is DOS-based. It cannot be used in a Windows-based environment. You must boot up using a DOS boot disk before using this utility.

The following is a screen capture of the available commands of the 8.23K version of the AwardFlash utility:

```

AwardFlash v8.23K (03/21) (C)Phoenix Technologies Ltd. 2003 All Rights Reserved
Usage:  AWDFLASH [FileName1] [FileName2] [/<su>[/<su>...]]
        FileName1 : New BIOS Name For Flash Programming
        FileName2 : BIOS File For Backing-up the Original BIOS
<Switches>  ?: Show Help Messages
py: Program Flash Memory                pn: No Flash Programming
sy: Backup Original BIOS To Disk File    sn: No Original BIOS Backup
sh: Skip BootBlock programming          wb: Always Programming BootBlock
cd: Clear DMI Data After Programming     cc: Clear CMOS Data After Programming
cp: Clear PnP(ESCD) Data After Programming
ld: Destroy CMOS Checksum And No System Halt For First Reboot
    After Programming                    tiny: Occupy lesser memory
ql: Qualify flash part number with source file
e: Return to DOS After Programming      R: RESET System After Programming
F: Use Flash Routines in Original BIOS For Flash Programming
cks: Show update Binfile checksum      cksXXXXX: Compare Binfile CheckSum with XXXX

NUMAC:XXXXXXXXXXXXXXXXX                NUGUID:XXXXXXXXXXXXXXXXX
        Support nForce Input MAC,GUID Function,with "/wb" to update MAC and GUID.
Example: AWDFLASH 6A69R000.bin /py/sn/nvmac:xxxxxxxxxxxx/wb
  
```

*AwardFlash utility commands.*

As you can see, the utility is quite versatile. It provides numerous options. Of course, most of them are not necessary for our use. The manufacturer of our reference motherboard, ABIT, recommends the following parameters:

```
A:\>awdf flash bios.bin /cc /cd /cp /py /sn /cks /r
```

This essentially tells the AwardFlash utility to do the following:

1. Skip back up of original BIOS image.
2. Show the bios.bin BIOS image file's checksum.
3. Program the Flash BIOS with the bios.bin BIOS image file.
4. Clear CMOS data after programming the Flash BIOS.
5. Clear DMI data after programming the Flash BIOS.
6. Clear PnP (ESCD) data after programming the Flash BIOS.
7. Automatically reset the computer after programming is complete.

Please consult your motherboard manufacturer for its recommended parameters. Different manufacturers may recommend different parameters even if they are all using the same AwardFlash utility.

If you run this command after booting up in DOS, the AwardFlash utility automatically updates the motherboard's Flash BIOS with the new BIOS image and clears the CMOS, DMI, and ESCD data before resetting the computer for the changes to take effect.

After the computer is rebooted, the new BIOS takes effect. Remember, because the CMOS data has been cleared during the flash process, the BIOS reverts to default settings. You should access the BIOS setup utility to set up the various parameters as well as optimize it.

## Accessing the BIOS Setup Utility

The BIOS setup utility is only available for a few short seconds when you boot up your computer. If your operating system has already loaded up, you must reboot your computer before you can access the BIOS setup utility.

In motherboards using the AwardBIOS, the BIOS flashes the following message for a few seconds during the booting up process:

### Press Del To Enter Setup

When you see that message, quickly press the **Del** (Delete) key. This halts the booting process and brings up the BIOS setup menu.

Please note that not all BIOS software use the **Del** key for access to the setup menu. Different BIOS vendors have different trigger keys. Alternatives to the Del key include:

- **Esc** (Escape) key
- **F2** key
- **Ctrl-Alt-Esc** key combination

Please consult your motherboard manual on the trigger key for your motherboard's BIOS setup utility.

## The BIOS Setup Utility

The BIOS setup utility varies from motherboard to motherboard. Some have a graphical appearance while others have a simple menu system. The most common is the basic menu system. The top figure on the opposite page is an example of that menu system.

This is what greets you when you press the trigger key to access the BIOS setup utility. As you can see, the screen consists of nothing more than a list of available sub-menus on the left and some commands on the right.

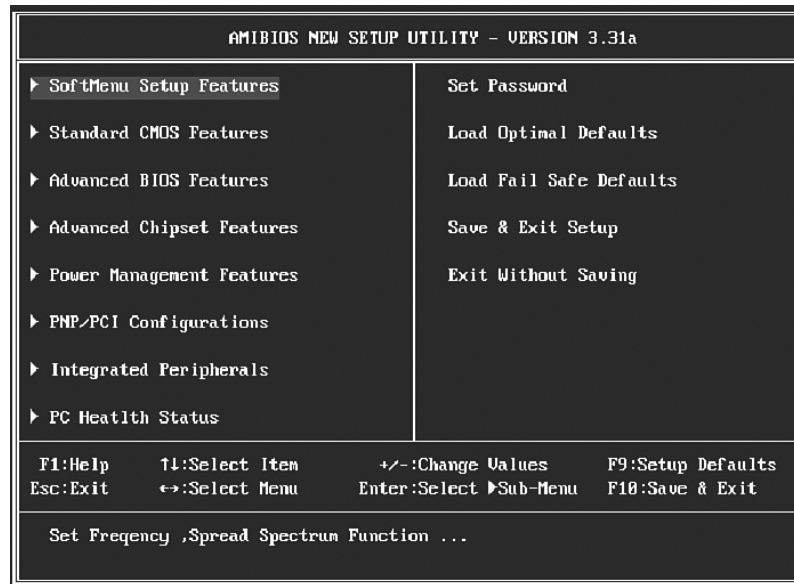
The keyboard's cursor keys are used to navigate this menu system. Pressing the **Enter** key performs actions like opening up a sub-menu or activating one of the commands on the left menu. Open up a sub-menu and the bottom figure on the opposite page is what you may see.

This sub-menu (**Advanced Chipset Features**) displays a list of available BIOS options or features. You can browse through the list using the cursor keys.

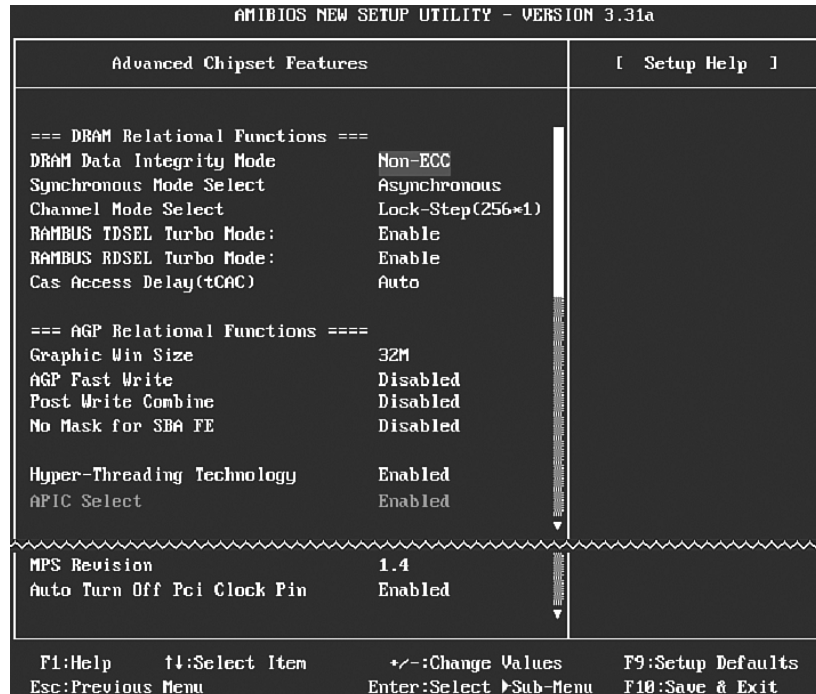
The values of those BIOS options can be modified using the + (plus) or - (minus) key in this BIOS. In other BIOS, you may use the **Page Up** and **Page Down** keys instead.

## Optimizing the BIOS

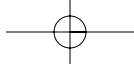
This brings us to the crux of this book. Optimizing the BIOS is what this book is all about. Chapters 3 and 4 concentrate entirely on the numerous BIOS options you may encounter in your motherboard's BIOS setup utility.



The ABIT SI7 BIOS setup utility.  
 (Courtesy of ABIT Computer Corporation. Used with permission.)



A sub-menu in the ABIT SI7 BIOS setup utility.  
 (Courtesy of ABIT Computer Corporation. Used with permission.)



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Chapters 3 and 4 offer two different levels of detail. Chapter 3 offers a quick guide to the various BIOS options and optimization recommendations. Chapter 4, on the other hand, delves into each BIOS option with much greater detail.

I hope you enjoy reading about the different BIOS options as much as I enjoyed researching and writing about them.

But before you head over to those chapters, be sure to read Chapter 2, which teaches you how to get out of trouble when something goes wrong during the optimization process. Remember to flip to Chapter 2 if you ever run into trouble!

Now, let's go optimize your BIOS!

