BIOS and CMOS

Overview

- **In this chapter, you will learn to**
  - Explain the function of BIOS
  - Distinguish among various CMOS setup utility options
  - Describe BIOS and device drives
  - Troubleshoot the Power-On Self Test (POST)

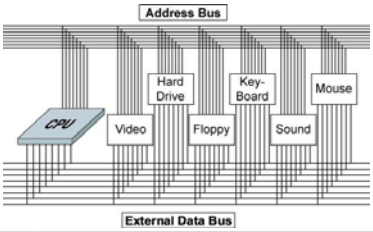
The Function of BIOS

Northbridge & Southbridge

- **Northbridge**
  - Chip or chips that connect the CPU to memory, Level 2 cache, the PCI express bus, and AGP activities
  - Northbridge chips communicate with the CPU thru the Frontside Bus
- **Southbridge**
  - Handles all of the inputs and outputs to the many devices in the PC
- **A chipset is a set of Northbridge and Southbridge chips that work together**

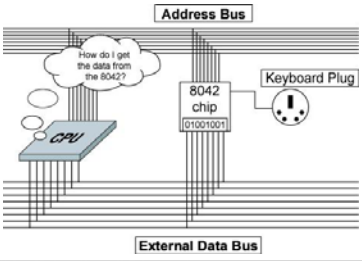
The Bus

- **The external data bus joins the various parts of the PC together**
- **The address bus also connects to various parts**



Talking to the Keyboard

- **The keyboard talks to the external data bus using the keyboard controller chip (8042)**

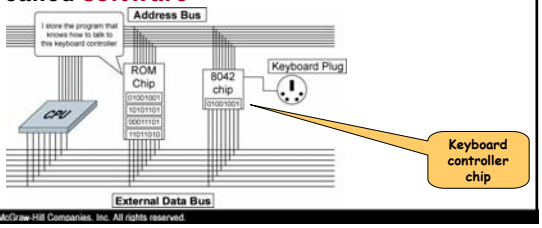


BIOS

- A special kind of program is required to enable the CPU to talk to other devices
- A ROM chip stores these programs
- These programs are collectively known as the Basic Input/Output Service (BIOS)

BIOS

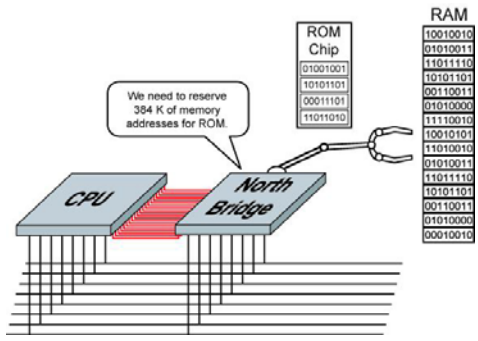
- Each program is called a service
- Programs stored on ROM chips are known as **firmware**
- Programs stored on erasable media are called **software**



BIOS

- BIOS and its relation to memory addressing:
  - The wire pattern generated by the address bus is called the address space
    - Last 65,536 reserved for system BIOS
    - Total of 384K reserved for ROM
  - The BIOS stored on the ROM chip attached to the motherboard is called the system BIOS
  - The ROM chip that stores the system BIOS is called the system ROM

BIOS



Core Group of Hardware

- Hardware that is common, necessary and never changes
  - Keyboard, speaker
- Stored on the system BIOS chip

BIOS is a group of programs.
ROM is a hardware chip used to store BIOS.

CMOS Group of Hardware

- Hardware that is common, necessary but may change
  - RAM, hard drives, floppy drives, serial and parallel ports
  - Complementary metal-oxide semiconductor
  - Programs are stored on the system BIOS chip, while the changeable data is stored on a CMOS chip

All other hardware is non-core like mice, sound cards, and CD-ROMs.

CMOS Setup Utilities

The CMOS Setup Program

- **The data on the CMOS chip can be accessed and updated via the CMOS setup program.**
- **Main manufacturers of BIOS**
  - American Megatrends (AMI)
  - Award software
  - Phoenix Technologies
- **The CMOS setup can be accessed when the system boots, but there are different ways of doing that**

Accessing the CMOS

- **AMI and Award**
  - Press DEL
- **Phoenix**
  - Press Ctrl-Alt-Esc or F2

Other possible key combinations are:
DEL, Ctrl-Alt-Ins, Ctrl-A, Ctrl-S, Ctrl-F1, F2, F10

CMOS Setup

- **The floppy drive, hard drive, and the date/time settings can be changed using the standard CMOS setup**
- **Modern computers provide extra CMOS settings for memory management, password and booting options, error handling, and power management**

CMOS Setup

CMOS Setup

- **The following CMOS setting options are available:**
  - CPU soft menu – Enables you to set the voltage and multiplier settings on the motherboard for the CPU.
  - Advanced BIOS feature – Used for selecting boot options.
  - Advanced chipset features – Deals with extremely low-level chipset functions.

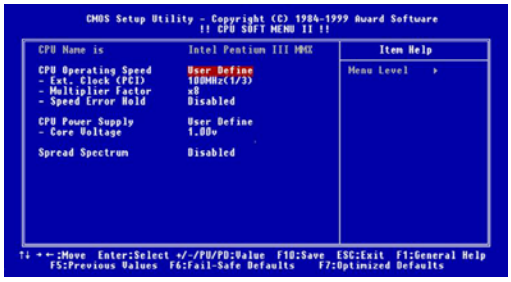
CMOS Setup

- **The following CMOS setting options are available (continued):**
  - Integrated peripherals – Allows you to configure, enable, or disable onboard ports.
  - Power management setup – Used to setup power management settings for the system.
  - PnP/PCI configurations – Used for assigning IRQs to certain resources.

CMOS Setup

- **Other options include:**
  - Load Fail-Safe Defaults: used when low-level problems occur
  - Load Optimized Defaults: sets the CMOS to the best possible speed and stability of the system
  - Set Password
  - Save and Exit Setup
  - Exit Without Saving

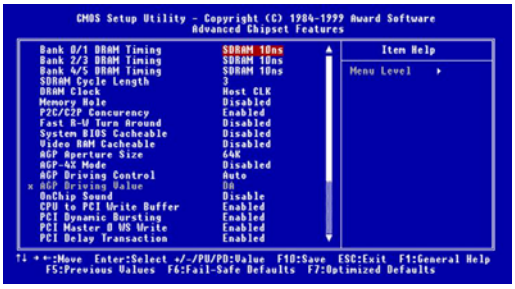
Soft Menu



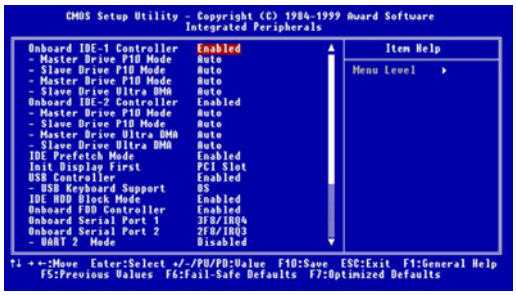
Standard CMOS Features

Advanced BIOS Features

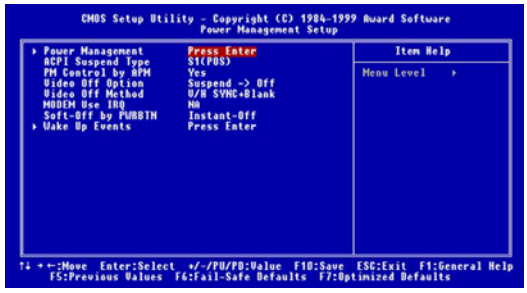
Advanced Chipset Features



Integrated Peripherals



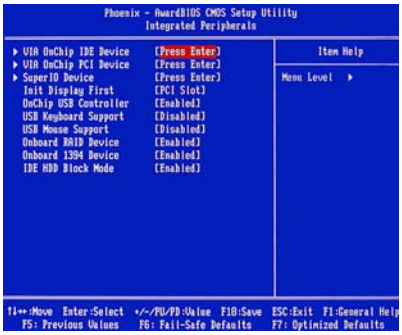
Power Management Setup



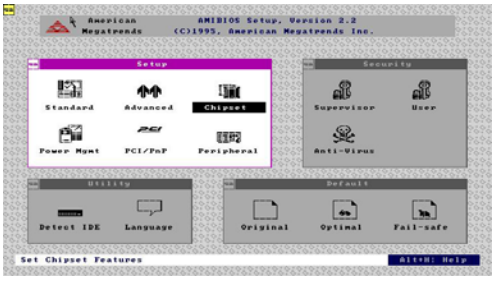
Plug and Play Configurations

CMOS Password

Phoenix BIOS Setup



Older Award CMOS Setup



CMOS Maintenance

- **Common causes of loosing CMOS data are**
  - Battery run out, dirt, faulty power supply, electrical surges, and chip creeps
  - The CMOS settings can be checked by memorizing settings, using Optimized defaults, and backing up a copy of the CMOS

To backup your CMOS to a floppy, use a third-party program such as cmossave.zip

Battery

- **Since the data stored on a CMOS chip can be saved, power is required when the computer is turned off**
- **Power is supplied by a battery on the motherboard**
- **Batteries are mounted in one of three ways:**
  - External battery (now obsolete)
  - Onboard battery
  - Built-in battery (built into the CMOS chip and very common today)

Clues to a Weak Battery

- **Clock in Windows begins to slow down**
- **System keeps losing CMOS data when you turn it off**
- **If you have an external battery, check it with a voltmeter (3.6 or 6 volts)**
- **If a built-in battery dies, replace the motherboard (seldom happens)**

ROM

- **Read Only Memory**
  - EPROM
    - Ultraviolet light erase
  - EEPROM
    - Electricity erase
    - Flash BIOS / BIOS update
  - Flash ROM

Flash ROM

- **Flash ROM is a new type of ROM chip developed by Intel**
  - Can be reprogrammed without the chip being removed
  - Running a small command line program combined with an update file can change or update the BIOS
  - In reality, CMOS no longer exists because flash ROMs (and now Non-Volatile RAM or NVRAM) now hold the system BIOS and CMOS settings – but the term is still used
  - The battery only keeps the clock running nowadays

BIOS and Device Drivers

BYOB

- **Because computer makers could not predict all the new types of hardware that may come out, ways to bring your own BIOS (BYOB) were invented:**
  - Option ROM
  - device drivers
  - Most devices with onboard BIOS use it only for internal needs (internal function) and use a device driver to talk to the CPU

Device Drivers

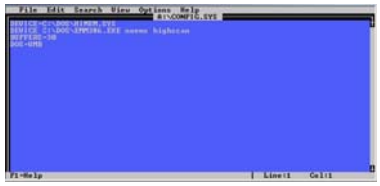
- **A device driver is a file that contains the BIOS commands necessary to communicate with the devices they support**
  - Loaded in to the RAM when the system boots
- **All devices come with their own device drivers**

Where are the Device Drivers?

- **Registry**
  - Binary file that contains the configuration settings and device driver information
- **Control Panel**
  - Applets that enable the configuration of a broad range of system devices
- **Device Manager**
  - Used for changing or removing drivers for any particular device
- **REGEDIT and REGEDIT32**
  - Enables you to access and update the Registry directly

CONFIG.SYS

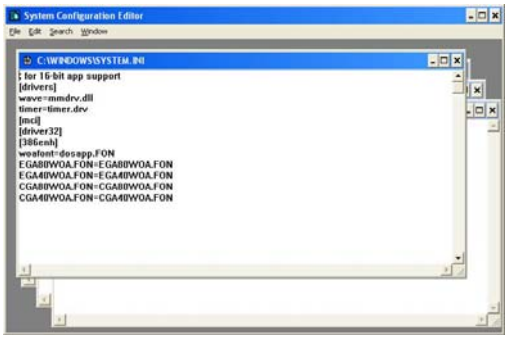
- **CONFIG.SYS is a special file through which DOS loads the device drivers**
  - Located in the root directory of the C: drive
  - The EDIT/SYSEDIT program is used for editing such files
  - Used to load extra BIOS for hardware that is not supported by the system BIOS



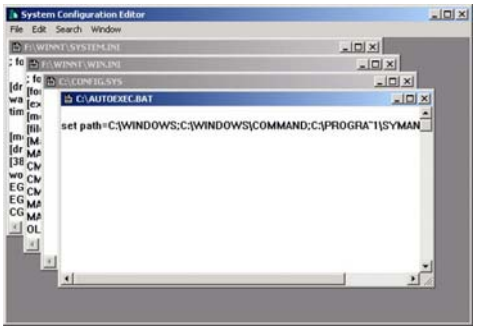
SYSTEM.INI

- **The SYSTEM.INI file is located in the \Windows directory**
  - Broken up into groups and each group is identified by the name in square brackets that starts the section
  - Standard sections are [boot], [keyboard], [boot description], [386Enh], and [drives]
  - Most drivers that load are located in the [386 Enh] section

SYSTEM.INI

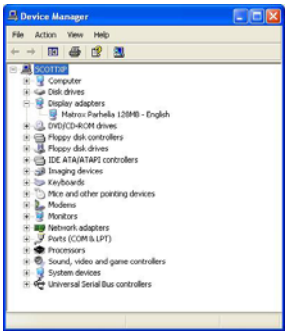


SYSEDIT

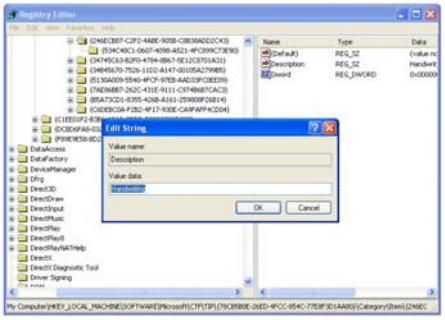


Control Panel

Device Manager



Editing the Registry



Power-On Self Test (POST)

Power-On Self Test (POST)

- **The Power-On Self Test (POST) is a special program stored on the ROM chip**
  - Initiated when the computer is turned on, or is reset
  - Checks out the system every time the computer boots

Beep Codes

- **When the computer is booted it first tests the most basic parts**
  - It generates a series of beeps if anything is wrong
- **Computers with a bad power supply generate intermittent beep codes**
  - Turn the computer on and off several times – if you get different beep codes, then it's probably the power supply

AMI Beep Codes

Table 4.1 AMI Version 8 Beep Codes

Beeps	Post Routine Description
1	Refresh failure
2	Parity error
3	Main memory read/write error
4	Timer not operational
5	Processor error
6	8042—gate A20 failure
7	Processor exception interrupt error
8	Display memory read/write failure
9	ROM checksum error
10	CMOS shutdown register read/write error
11	Cache memory bad

Phoenix Beep Codes

Table 4.2 Phoenix Beep Codes

Beeps	Post Routine Description
1-2-2-3	BIOS ROM checksum
1-3-1-1	Test DRAM refresh
1-3-1-3	Test 8742 keyboard controller
1-3-5-1	RAM failure on address line xxxx
1-3-5-3	RAM failure on data bits xxxx of low byte of memory bus
2-1-2-3	Check ROM copyright notice
2-2-3-1	Test for unexpected interrupts
1-2	Search for option ROMs; one long, two short beeps on checksum failure
1	One short beep before boot

Common Errors

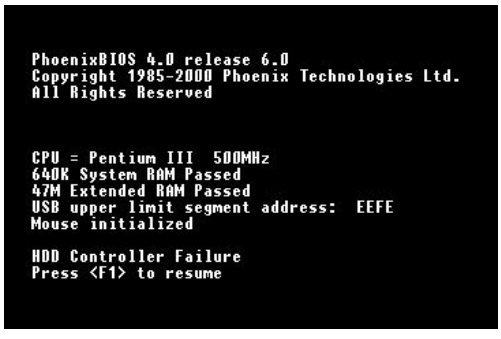
Table 4.3 Common POST Beep Errors and Solutions

Problem	Solution
RAM refresh failure Parity error RAM bit error Base 64 K error	(1) Reseat and clean the RAM chips. (2) Replace individual chips until the problem is corrected.
8042 error Gate A20 error	(1) Reseat and clean keyboard chip. (2) Replace keyboard. (3) Replace motherboard.
BIOS checksum error	(1) Reseat and clean ROM chip. (2) Replace ROM chip.
Video error	(1) Reseat video card. (2) Replace video card.
Cache memory error	(1) Shut off cache in CMOS. (2) Replace CPU.
Everything else	(1) Clean motherboard. (2) Replace motherboard.

Error Messages

- **If anything other than the most basic parts does not pass the POST, then a text message will appear on the screen:**
  - Numeric error codes
  - Text error codes

Text-Based Error Message



POST Cards

- **POST cards are devices that monitor POSTs and report on the hardware that may be causing problems**
  - Turn the PC off, plug in the card, and reboot
  - POST error codes do not fix the computer – they just tell you where to look
  - If all else fails, replace the motherboard

The Boot Process

- **The CPU is the first component that gets initialized when the computer is turned on**
- **It reads a special wire called power good once the power supply provides the proper voltage to the CPU**
- **Every CPU has a built-in memory address with the first line of the POST program on the system ROM**

The Boot Process

- **The last BIOS function called by POST is the bootstrap loader**
- **The bootstrap loader loads the operating system either from the floppy or the hard drive**
- **The bootstrap loader generates an error if it cannot find the bootable disk**

Non-System Disk Error

```
PCI device listing...
Bus No. Device No. Func No. Vendor ID Device ID Device Class              IRQ
------- --------- --------- --------- --------- ------------------------ ---
  0       7         1         8086      7111    IDE Controller           14
  0       7         2         8086      7112    Serial Bus Controller    10
  0       9         0         1102      0002    Multimedia Device        11
  0       9         1         1102      7002    Input Device             NA
  0      10         0         9904      7178    Mass Storage Controller  12
  0      11         0         8086      1229    Network Controller        5
  0      13         0         104C      8019    Serial Bus Controller     5
  1       0         0         102B      0525    Display Controller       11
                                                ACPI Controller           9


Verifying DMI Pool Data.......

Non-system disk or disk error
Replace and press any key when ready
```


The Boot Process

Boot configuration:

- The CMOS setting enables you to change the order in which the boot loader will search the devices for the operating system
- The boot order is changed to prevent hackers from inserting a bootable floppy and accessing the system

Changing the Boot Order

- **Many BIOS programs have CMOS settings that allow you to change the order in which the boot loader searches for an operating system**