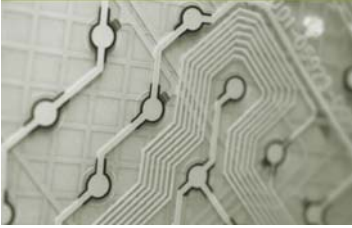


BIOS and CMOS



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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)

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The Function of BIOS

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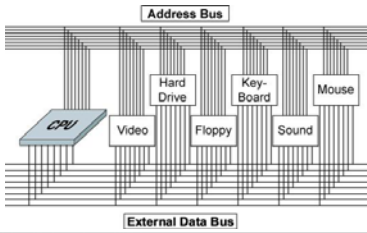
Northbridge & Southbridge

- 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**

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The Bus

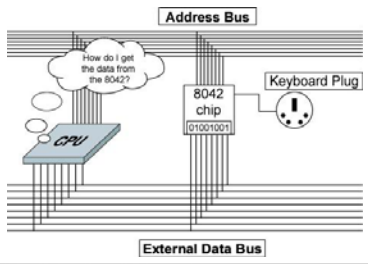
- The external data bus joins the various parts of the PC together
- The address bus also connects to various parts



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Talking to the Keyboard


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



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BIOS

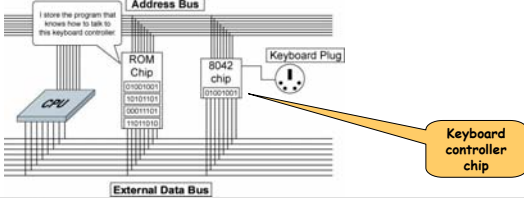
- A special kind of program is required to enable the CPU to talk to other devices
- A ROM chip stores these programs
- These programs are collectively known as the Basic Input/Output Service (BIOS)



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BIOS

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



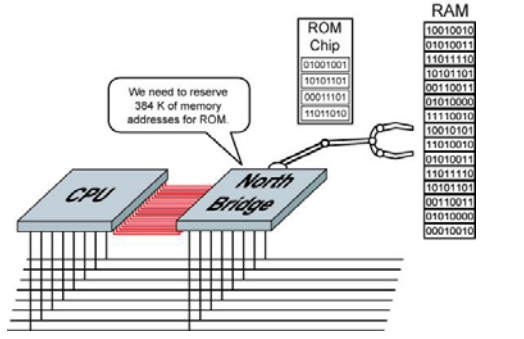
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BIOS

- **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**

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BIOS



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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.

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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.

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PC Hardware

CMOS Setup Utilities

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PC Hardware

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

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PC Hardware

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

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PC Hardware


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

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PC Hardware

CMOS Setup



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PC Hardware

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.

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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.

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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

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Soft Menu

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
!! CPU SMT MEM !!

Item	Value	Item Help
CPU Name is	Intel Pentium III MMX	
CPU Operating Speed	User Define	Menu Level >
- Ext Clock (PCI)	100MHz(1/3)	
- Multiplier Factor	x8	
- Speed Error Hold	Disabled	
CPU Power Supply	User Define	
- Core Voltage	1.00v	
Spread Spectrum	Disabled	

↑↓ ←→:Move Enter:Select +/-/PB/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Fail-Safe Defaults F7:Optimized Defaults

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Standard CMOS Features

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
Standard CMOS Features

Item	Value	Item Help
Date (mm:dd:yy)	Wed, Oct 4 2000	
Time (hh:mm:ss)	10 : 40 : 45	
> IDE Primary Master	Press Enter10263 MB	Menu Level >
> IDE Primary Slave	Press Enter13020 MB	Change the day, month, year and century
> IDE Secondary Master	Press Enter None	
> IDE Secondary Slave	Press Enter None	
Drive 0	1.44M, 3.5 in.	
Drive 1	None	
Floppy 3 Mode Support	Disabled	
Video	EGA/VGA	
Roll On	All,But Keyboard	
Base Memory	640K	
Extended Memory	113664K	
Total Memory	114304K	

↑↓ ←→:Move Enter:Select +/-/PB/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Fail-Safe Defaults F7:Optimized Defaults

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Advanced BIOS Features

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
Advanced BIOS Features

Item	Value	Item Help
Virus Warning	Disabled	
CPU Level 1 Cache	Enabled	
CPU Level 2 Cache	Enabled	
CPU L2 Cache ECC Checking	Enabled	
Processor Number Feature	Enabled	
Quick Power on Self Test	Enabled	
First Boot Device	Floppy	
Second Boot Device	HD0-0	
Third Boot Device	LS/ZIP	
Boot Other Device	Enabled	
Swap Floppy Device	Disabled	
Boot Up Floppy Seek	Disabled	
Boot Up Numlock Status	On	
Typematic Rate Setting	Enabled	
Typematic Rate (Chars/Sec)	30	
Typematic Delay (Msec)	250	
Security Option	Setup	
OS Select For DRAM >	4MB Non-DS2	
Report No FDD For Uin 95	No	

↑↓ ←→:Move Enter:Select +/-/PB/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Fail-Safe Defaults F7:Optimized Defaults

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Advanced Chipset Features

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
Advanced Chipset Features

Item	Value	Item Help
Bank 0/1 DRAM Timing	SDBRM 10ns	
Bank 2/3 DRAM Timing	SDBRM 10ns	
Bank 4/5 DRAM Timing	SDBRM 10ns	
SDBRM Cycle Length	3	
SDBRM Clock	Host CLK	
Memory Hole	Disabled	
P2C/C2P Concurrency	Enabled	
Fast S-M Turn Around	Disabled	
System BIOS Cacheable	Disabled	
Video RAM Cacheable	Disabled	
AGP Aperture Size	64K	
AGP 64 Mode	Disabled	
AGP Driving Control	Auto	
AGP Driving Value	30	
OnChip Sound	Disabled	
CPU to PCI Write Buffer	Enabled	
PCI Dynamic Bursting	Enabled	
PCI Master_0 US Write	Enabled	
PCI Delay Transaction	Enabled	

↑↓ ←→:Move Enter:Select +/-/PB/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Fail-Safe Defaults F7:Optimized Defaults

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Integrated Peripherals

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
Integrated Peripherals

Onboard IDE-1 Controller	Enabled	Item Help
- Master Drive PIO Mode	Auto	Menu Level >
- Slave Drive PIO Mode	Auto	
- Master Drive Ultra DMA	Auto	
- Slave Drive Ultra DMA	Auto	
Onboard IDE-2 Controller	Enabled	
- Master Drive PIO Mode	Auto	
- Slave Drive PIO Mode	Auto	
- Master Drive Ultra DMA	Auto	
- Slave Drive Ultra DMA	Auto	
IDE Prefetch Mode	Enabled	
Init Display First	PCI Slot	
USB Controller	Enabled	
- USB Keyboard Support	OS	
IDE HDD Block Mode	Enabled	
Onboard Floppy Controller	Enabled	
Onboard Serial Port 1	2F8/IRQ4	
Onboard Serial Port 2	2F8/IRQ4	
- UART 2 Mode	Disabled	

F1: Move Enter: Select +/-/PU/PD: Value F10: Save ESC: Exit F1: General Help
F5: Previous Values F6: Fail-Safe Defaults F7: Optimized Defaults

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Power Management Setup

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
Power Management Setup

Power Management	Press Enter	Item Help
ACPI Suspend Type	S1 (SBS)	Menu Level >
PM Control by RPM	Yes	
Video Off Option	Suspend -> Off	
Video Off Method	U/H SYNC+Blank	
MOUSE Use IRQ	NO	
Soft-Off by PWRBTN	Instant-Off	
Wake Up Events	Press Enter	

F1: Move Enter: Select +/-/PU/PD: Value F10: Save ESC: Exit F1: General Help
F5: Previous Values F6: Fail-Safe Defaults F7: Optimized Defaults

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Plug and Play Configurations

CMOS Setup Utility - Copyright (C) 1984-1999 Award Software
PnP/PCI Configurations

PnP OS Installed	No	Item Help
Reset Configuration Data	Disabled	Menu Level >
Resources Controlled By	Auto (ESDD)	Select Yes if you are using Plug and Play capable operating system. Select No if you need the BIOS to configure non-boot devices.
IRQ Resources	Press Enter	
DMA Resources	Press Enter	
PCI/MCA Palette Snoop	Disabled	
Assign IRQ For VGA	Enabled	
Assign IRQ For USB	Enabled	
INT Pin 1 Assignment	Auto	
INT Pin 2 Assignment	Auto	
INT Pin 3 Assignment	Auto	
INT Pin 4 Assignment	Auto	

F1: Move Enter: Select +/-/PU/PD: Value F10: Save ESC: Exit F1: General Help
F5: Previous Values F6: Fail-Safe Defaults F7: Optimized Defaults

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CMOS Password

CMOS Extension v1.0A
Award Software, Inc.

Master ... ST10232A
Slave ... None

Enter Password:

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Phoenix BIOS Setup

Phoenix - AwardBIOS CMOS Setup Utility
Integrated Peripherals

> OnChip IDE Device	[Press Enter]	Item Help
> OnChip PCI Device	[Press Enter]	Menu Level >
> SuperIO Device	[Press Enter]	
Init Display First	[PCI Slot]	
OnChip USB Controller	[Enabled]	
USB Keyboard Support	[Disabled]	
USB Mouse Support	[Disabled]	
Onboard RAID Device	[Enabled]	
Onboard 1394 Device	[Enabled]	
IDE HDD Block Mode	[Enabled]	

F1: Move Enter: Select +/-/PU/PD: Value F10: Save ESC: Exit F1: General Help
F5: Previous Values F6: Fail-Safe Defaults F7: Optimized Defaults

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Older Award CMOS Setup

AMIBIOS Setup, Version 2.2
(C)1995, American Megatrends, Inc.

Standard Advanced Chipset Security
Power Mgmt PCI/PnP Peripheral
Utility Defaults
Detect IDE Language Original Optimal Fail-safe
Set Chipset Features [F10]: Help

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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

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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)

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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)**



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ROM

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

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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

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BIOS and Device Drivers

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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

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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

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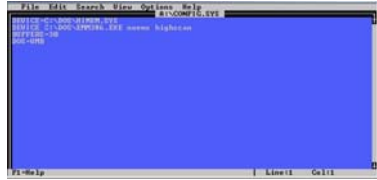
Where are the Device Drivers?

- **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

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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



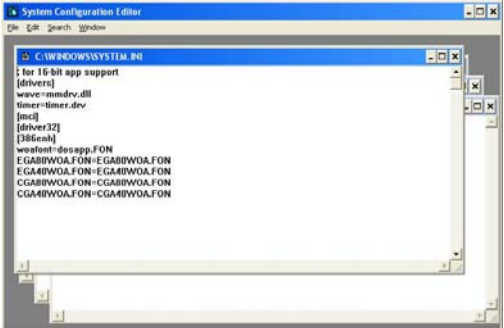
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SYSTEM.INI

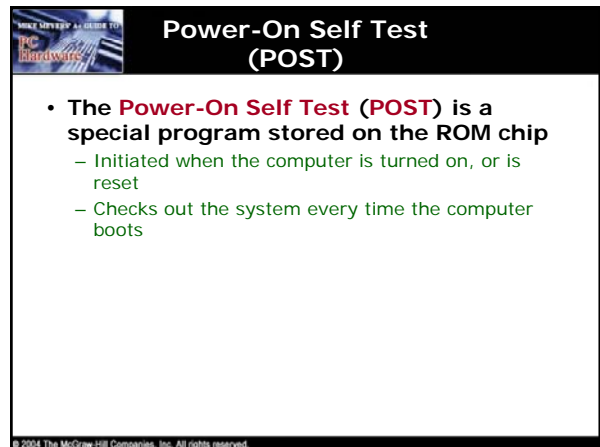
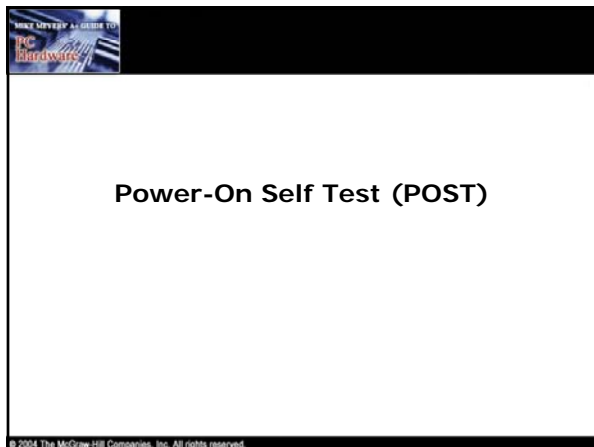
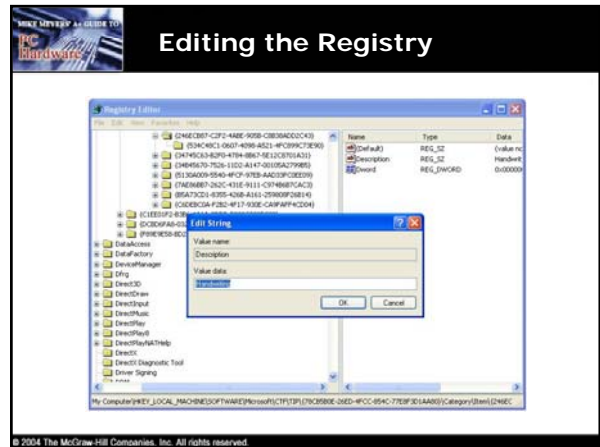
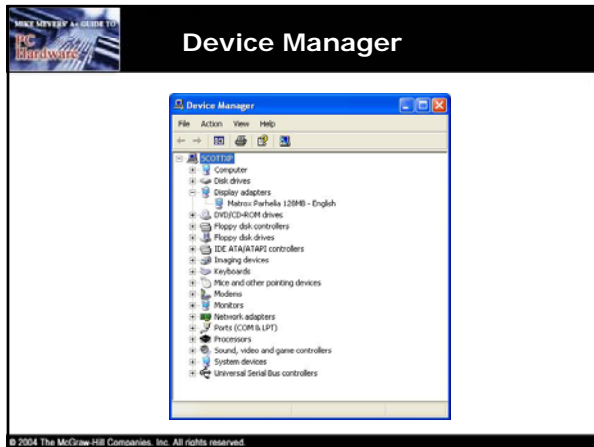
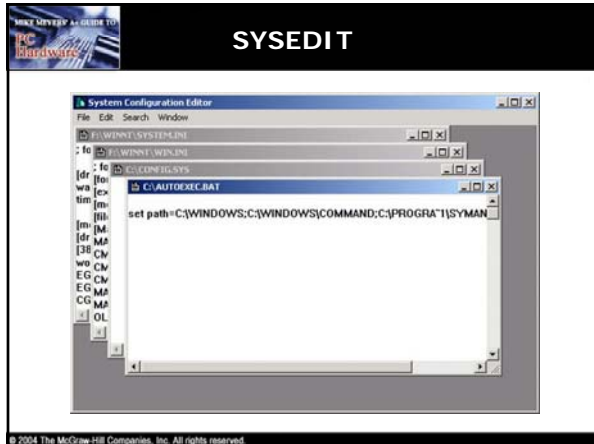
- The **SYSTEM.INI** file is located in the **\Windows** directory
 - Broken up into groups and each group is identified by the name in square brackets that starts the section
 - Standard sections are [boot], [keyboard], [boot description], [386Enh], and [drives]
 - Most drivers that load are located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

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SYSTEM.INI



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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

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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

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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

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Common Errors

Table 4.3 Common POST Beep Errors and Solutions

Problem	Solution
RAM refresh failure	(1) Reseat and clean the RAM chips.
Parity error	(2) Replace individual chips until the problem is corrected.
RAM bit error	
Base 64 K error	
8042 error	(1) Reseat and clean keyboard chip.
Gate A20 error	(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.

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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

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Text-Based Error Message

```
PhoenixBIOS 4.0 release 6.0
Copyright 1985-2000 Phoenix Technologies Ltd.
All Rights Reserved
```


```
CPU = Pentium III 500MHz
640K System RAM Passed
47M Extended RAM Passed
USB upper limit segment address: EEF0
Mouse initialized
```

```
HDD Controller Failure
Press <F1> to resume
```

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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



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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

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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

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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            NR
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
                   102B    0525  ACPI Controller         9
  
```

```

Verifying DMI Pool Data.....
Non-system disk or disk error
Replace and press any key when ready
  
```

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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

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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

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