Motherboard Configuration: BIOS Setup Example

1.0. Introduction
When using a motherboard for an embedded electronics project, certain processor features can be enabled or disabled. These features can have a significant impact on the power consumption and performance of your system. Setting and disabling these features is done in the motherboard System BIOS. This tutorial is meant to provide the reader with a brief overview of a motherboard BIOS and what configurations can be done for an embedded motherboard.

Warning! BIOS settings impact your system in significant ways. If you do not know what a BIOS setting does, it is NOT RECOMMENDED to modify it from its default value. Setting the values incorrectly (such as the forgetting your BIOS password) could brick your device, or, in the case of other settings such as CPU voltage or thermal protection settings, potentially damage or destroy the hardware.

1.1. Hardware Overview
For this and the other embedded motherboard tutorials, I am using an AIMB-212 mini ITX motherboard from Advantech. The board features an Intel® Atom D510 processor, 2GB onboard RAM, 1 PCI port, 6 serial ports, 8 USB ports, and a VGA port. A picture of the hardware is shown in figure 1.1.1., and a photo of the complete hardware setup can be seen in figure 1.1.2.

![Fig. 1.1.1. Advantech AIMB-212 Embedded Motherboard](http://engineering.purdue.edu/ece477)
2.0. Accessing the BIOS

With your computer system completely set up as seen in figure 1.1.2., power on your embedded system. A screen should show up that looks similar to figure 2.0.1.

Press and hold down the delete (DEL) key when this screen appears to access the BIOS setup window. After a small time delay, the screen should display a window similar to figure 2.0.2.
Fig. 2.0.2. BIOS Home Screen

The main screen provides you with the option to change the system date and time. Navigation controls for the BIOS are detailed in the field in the lower right section of the main screen.

3.0. Advanced Configuration Settings
Switch screens to the Advanced tab (one tab right of the Main screen). Your screen should now appear similar to that shown in figure 3.0.1.

Fig. 3.0.1. Advanced Settings Screen

The Advanced Settings screen provides you with some more advanced hardware configuration settings. If you don’t know exactly what a setting does, or are unsure if it applies to your system, leave the default value.

3.1. CPU Configuration
Select the **CPU Configuration** subscreen of the **Advanced Settings Tab**. Your display should look similar to figure 3.1.1.

![Advanced CPU Configuration Screen](image)

**Fig. 3.1.1. Advanced CPU Configuration Screen**

The CPU configuration tab provides a number of settings that can be enabled/disabled. These options are described below:

- **Max CPUID Value Limit**: A legacy feature for older operating systems that do not recognize virtual cores utilized in hyper-threaded processors. Leave this feature disabled.
- **Execute-Disable Bit Capability**: The Execute-Disable bit adds an extra bit to memory blocks, marking them as executable or not executable. This feature is handy for security purposes, as it can enable the operating system to prevent certain classes of viruses from executing from memory locations that are not in use. It is recommended that this option be left enabled.
- **Hyper Threading Technology**: Intel processors are capable of fetching and executing multiple instructions simultaneously (even single-core processors). Through hyperthreading, each computer processing core appears as 2 separate, virtual cores. In this way, multiple threads can be executed simultaneously, increasing instruction throughput. Hyperthreading can lead to system performance increases at the expense of a small amount of power, which may be valuable for your application.
- **Intel® SpeedStep™ tech**: For processor power management, a processor’s voltage/frequency operating parameters can be adjusted. Higher voltage/frequency generally lends itself to higher performance, while lower voltage/frequency lends itself to lower power dissipation. When switching voltage/frequency parameters, the processor is temporarily unavailable to execute instructions. SpeedStep addresses this CPU downtime problem by stepping the voltage up and down in small increments independently from system clock changes. In this way, processor downtime can be reduced, and finer processor power control is possible.

[http://engineering.purdue.edu/ece477](http://engineering.purdue.edu/ece477)
• **Intel® C-STATE Tech:** C-State Tech enables processor C states. Processor C states are a series of low-power states where certain components of the processor are disabled to save power (idle states, sleep modes, etc.). In general, it is recommended to leave C-STATE tech enabled unless your application demands extremely high performance for long durations of time.

• **Enhanced C-States:** Enhanced C-states takes the processor C-state concept further by adding in additional CPU power states for finer power control. This can be a useful power-saving feature and is generally recommended.

Select your desired options, then press F10 to save and exit.

### 3.2. Hardware Health Configuration

The **Hardware Health Configuration** screen is the next valuable screen for advanced BIOS settings, so select that. Your screen should appear similar to that shown in figure 3.2.1.

![Fig. 3.2.1. Hardware Health Configuration Screen](image)

In particular, the **Hardware Health Configuration** screen allows you to set a CPU Warning Temperature and ACPI Shutdown Temperature. These can help notify the operating system in the event of a critical temperature condition, but may cause errors on operating systems that don’t support this feature. Mac OSX, Windows, and Linux distributions include support for this feature.

### 3.3. ACPI Configuration

The **Advanced Configuration and Power Interface (ACPI)** is an industry-standard interface between the operating system and the hardware. There are a few noteworthy ACPI BIOS settings which we can configure. To do so, navigate to the **ACPI Configuration** page from the **Advanced Settings** page. When you do, your display should appear similar to figure 3.3.1.
We’re particularly interested in some of the Advanced ACPI Configuration settings, so navigate to the Advanced ACPI Configuration subscreen. Your display will appear similar to figure 3.3.2.

The feature labeled **Headless Mode** is important if we wish to run our embedded system as a server. Enabling this feature tells the operating system to operate in headless mode. In headless mode, the system runs without a monitor, keyboard, or mouse and is controlled via a network interface.

### 3.4. USB Configuration

USB is one of the primary methods of communication with most motherboards, so USB configuration in the BIOS is important. For that, go to the USB Configuration subscreen of the Advanced Settings screen. Your display will appear similar to that shown in figure 3.4.1.
There are a few important options here. The first option, *Legacy USB Support* determines whether or not support should be allowed for legacy USB devices. Leave this option enabled.

In addition, the *USB 2.0 Controller Mode* option can be important for connecting to certain devices. You have the option of setting this to HiSpeed (480 Mbps) or FullSpeed (12 Mbps). Certain peripherals, such as the Microsoft Kinect, require high speed operation, while others may be able to run acceptably only on full speed operation. Determine what speed is necessary for your peripherals and set this option as such.

### 4.0. Boot Settings

Boot settings are vital to your embedded system. If you do nothing else with your embedded system, setting the boot settings properly will go a long ways towards improving the functionality of your system. Boot settings is one of the main screens of the BIOS, so navigate there from the top level. When you do, your screen should look similar to figure 4.0.1.
In the **Boot Settings** screen, select **Boot Device Priority**. That will bring up a screen similar to figure 4.0.2.

![Boot Device Priority](image)

**Fig. 4.0.2. Boot Device Priority**

The boot device priority determines the order that the BIOS will look for to boot an operating system. In general, the internal hard drive should be the lowest priority device for booting, allowing it to be superseded by a flash drive, network boot, or a CD/DVD drive.

### 5.0. Conclusion

BIOS settings can help add additional functionality and performance to your embedded system, or enable you to strip out unnecessary features to reduce power consumption. Therefore, a good working knowledge of BIOS settings can be very helpful for your embedded system. Hopefully, you found this tutorial complete and it answered your questions. If you have additional questions or suggestions for improvement, please contact the ECE477 course staff at ece477@ecn.purdue.edu.