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MPLAB® ICE 4000 IN-CIRCUIT EMULATOR USER'S GUIDE

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
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Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

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Preface

INTRODUCTION

The general information discussed here can help you when using the MPLAB ICE 4000 emulator. Items discussed in this chapter include:

- About This Guide
- Warranty Registration
- Recommended Reading
- Troubleshooting
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support

ABOUT THIS GUIDE

Document Layout

This document describes how to use MPLAB ICE 4000 as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1: Overview** – What MPLAB ICE 4000 is and how it can help you develop your application.
- **Chapter 2: Installation** – How to install MPLAB ICE 4000 hardware and MPLAB IDE v6.xx software.
- **Chapter 3: General Set Up** – Setting up MPLAB ICE 4000 for use with MPLAB IDE.
- **Chapter 4: Basic Features** – A description of the basic features of MPLAB ICE 4000, (i.e., run, halt, reset, single step, etc.).
- **Chapter 5: External Memory Usage** – A description of PIC18F8XXX external memory modes and how they are supported on the emulator.
- **Chapter 6: Complex and Internal Triggers** – A description of complex triggers and dsPIC® internal triggers. Complex trigger examples are also given.
- **Chapter 7: Code Coverage, Trace Memory, Real-Time Reads** – A description of code coverage, emulator trace and real-time reads.
- **Chapter 8: Emulator Function Summary** – A summary of emulator functions available in MPLAB IDE when MPLAB ICE 4000 is chosen as the debug tool.
- **Appendix A: Troubleshooting** – How to solve common problems with MPLAB ICE 4000 operation.
- **Appendix B: Pod Electrical Specification** – The electrical specifications and description of the emulator pod.
- **Glossary** – A glossary of terms used.

Conventions Used in this Guide

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Main Document (Arial font):		
Italic characters	Referenced books	*MPLAB IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Interface References (Arial font):		
Initial caps	A window, dialog or menu selection	Configuration Bits window, Settings dialog, Enable Programmer
Quotes	A field name in a window or dialog	"Save files before running the debugger"
Underlined, italic text with right arrow	A menu selection path	*File>Save*
Bold characters	A dialog button or tab	**OK** button, **Power** tab
Characters in angle brackets < >	A key on the keyboard	<Tab>, <Ctrl-C>
Code References (Courier font):		
Plain characters	File names and paths	`c:\autoexec.bat`
	Bit values	`0, 1`
	Sample code	`#define START`
Square brackets [ ]	Optional arguments	`mpasmwin [main.asm]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments An OR selection	`errorlevel {0|1}`
Italic characters	A variable argument; it can be either a type of data (in lower case characters) or a specific example (in uppercase characters).	`pic30-gcc` *`filename`*
Ellipses...	Replaces repeated instances of text	`list ["list_option..., "list_option"]`
0x*nnnn*	A hexadecimal number where *n* is a hexadecimal digit	`0xFFFF, 0x007A, 0x1A`
'b*nnnn*	A binary number where *n* is a digit	'b00100, 'b10

Documentation Updates

All documentation becomes dated, and this user's guide is no exception. Since Microchip tools and documentation are constantly evolving to meet customer needs, some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site to obtain the latest documentation available.

Documentation Numbering Conventions

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS Number is: DSXXXXXA;

where:

XXXXX = The document number.

A = The revision level of the document.

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in your Warranty Registration Card entitles you to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use MPLAB ICE 4000. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Readme for MPLAB ICE 4000

For the latest information on using MPLAB ICE 4000, read the "`Readme for MPLAB ICE 4000.txt`" file (an ASCII text file) in the Readmes subdirectory of the MPLAB IDE installation directory. The Readme file contains update information and known issues that may not be included in this user's guide.

Readme Files

For the latest information on using other tools, read the tool-specific Readme files in the Readmes subdirectory of the MPLAB IDE installation directory. The Readme files contain update information and known issues that may not be included in this user's guide.

MPLAB ICE 4000 Processor Module and Device Adapter Specification (DS51298)

Consult this document for information on the different processor modules and device adaptors available for use with the MPLAB ICE 4000 pod.

MPLAB ICE Transition Socket Specification (DS51194)

Consult this document for information on transition sockets available for use with MPLAB ICE 2000/4000 device adaptors.

TROUBLESHOOTING

See **Appendix A. "Troubleshooting"** for information on common problems.

THE MICROCHIP WEB SITE

Microchip provides online support on the Microchip World Wide Web (WWW) site. The web site is used by Microchip as a means to make files and information easily available to customers. To view the site, you must have access to the Internet and a web browser such as Netscape® Navigator or Microsoft® Internet Explorer.

The Microchip web site is available by using your favorite Internet browser:

www.microchip.com

The web site provides a variety of services. Users may download files for the latest development tools, data sheets, application notes, user's guides, articles and sample programs. A variety of information specific to the business of Microchip is also available, including listings of Microchip sales offices, distributors and factory representatives.

Technical Support

- Frequently Asked Questions (FAQ)
- Online Discussion Groups – Conferences for products, Development Systems, technical information and more
- Microchip Consultant Program Member Listing
- Links to other useful web sites related to Microchip products

Product/Design Support

- Design Tips
- Device Errata

Other available information

- Latest Microchip Press Releases
- Listing of seminars and events
- Job Postings
- Investor Information

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip started the customer notification service to help our customers keep current on Microchip products with the least amount of effort. Once you subscribe, you will receive email notification whenever we change, update, revise or have errata related to your specified product family or development tool of interest.

Go to the Microchip web page (www.microchip.com) and click on Customer Change Notification under Support. Follow the instructions to register.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C18 and MPLAB C30 C compilers; MPASM and MPLAB ASM30 assemblers; MPLINK and MPLAB LINK30 object linkers; and MPLIB and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB ICD 2, PRO MATE II and MPLAB PM3 device programmers and the PICSTART Plus development programmer.

CUSTOMER SUPPORT

Microchip customers can receive assistance through several channels.

Hotline

There is a Systems Information and Upgrade Line. This line provides customers a listing of the latest versions of all of Microchip's development systems software products. Plus, this line provides information on how customers can receive any currently available upgrade kits.

The Hotline Numbers are:

1-800-755-2345 for U.S. and most of Canada.

1-480-792-7302 for the rest of the world.

In The Field

Customers should call their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. See the back cover for a listing of sales offices and locations.

Corporate Applications

Corporate Applications Engineers (CAEs) may be contacted at (480) 792-7627. You will need an active internet connection to obtain a “ticket” for assistance.

NOTES:

Chapter 1. Overview

1.1 INTRODUCTION

An overview of the MPLAB ICE 4000 system is given.

1.2 HIGHLIGHTS

This chapter discusses:

- MPLAB ICE 4000 Defined
- How MPLAB ICE 4000 Helps You
- MPLAB ICE 4000 Kit Components

1.3 MPLAB ICE 4000 DEFINED

MPLAB ICE 4000 is an In-Circuit Emulator (ICE) designed to emulate PIC18X microcontroller (MCU) devices and dsPIC digital signal controller (DSC) devices. It uses the latest emulation processors to provide full-speed emulation and visibility into both the instruction and the data paths during execution.

MPLAB ICE 4000 performs basic functions such as run, halt, single step, and software breakpoints, plus advanced features such as instruction address data monitoring, instruction data trace, complex triggering and code coverage, and extended memory access.

MPLAB ICE 4000 support is integrated into MPLAB IDE v6.xx, Microchip's 32-bit Integrated Development Environment (IDE). The MPLAB IDE desktop provides an environment for developing and debugging your application.

This document covers the basic setup and operation of the MPLAB ICE 4000 emulator, but it does not cover all functions of MPLAB IDE. Refer to the *MPLAB IDE v6.xx Quick Start* (DS51281) and the on-line help for MPLAB IDE v6.xx to get a full understanding of the features and debug capabilities of the MPLAB IDE.

1.4 HOW MPLAB ICE 4000 HELPS YOU

MPLAB ICE 4000 allows you to:

- Debug your application on your own hardware in real time.
- Debug with both hardware and software breakpoints.
- Measure timing between events using the stopwatch or complex trigger.
- Set breakpoints based on internal and/or external signals.
- Monitor internal file registers.
- Emulate full speed (depending on the device).
- Select the oscillator source in software.
- Program the application clock speed.
- Trace data bus activity and time stamp events.
- Set complex triggers based on program and data bus events, and external inputs.

1.5 MPLAB ICE 4000 KIT COMPONENTS

The components of the MPLAB ICE 4000 emulator kit are listed below.

1. MPLAB IDE v6.xx Quick Start (DS51281)
2. CD-ROM with MPLAB IDE software and on-line documentation
3. USB cable to connect the emulator pod to a PC
4. Emulator pod
5. Power supply and cable
6. Emulator stand
7. Processor module flex circuit cable
8. Logic probes

Additional hardware that may be ordered separately:

1. Processor module
2. Device adapter
3. Transition socket

Chapter 2. Installation

2.1 INTRODUCTION

An overview of the MPLAB ICE 4000 system components is given, as well as an explanation of how to install the system hardware and software.

2.2 HIGHLIGHTS

This chapter contains:

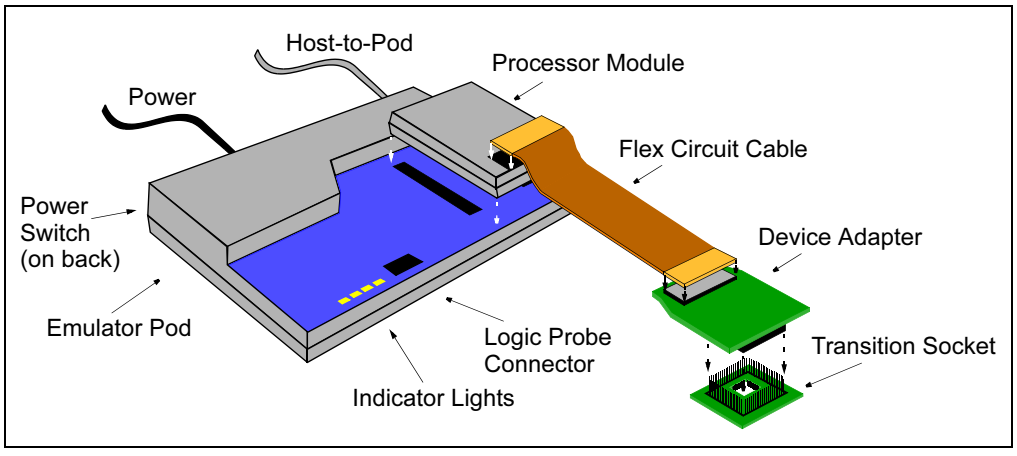
- MPLAB ICE 4000 System Components
- Driver and Software Installation
- Hardware Setup
- Applying Power to the System Components
- Applying Power to the System Components – Low Voltage Emulation
- Software Setup
- Removing Power From the System Components

2.3 MPLAB ICE 4000 SYSTEM COMPONENTS

The MPLAB ICE 4000 system consists of these items (Figure 2-1):

- Emulator pod
- Host-to-pod USB cable to connect a host PC to the emulator pod
- Power supply cable
- Processor module
- Flex circuit cable to connect the processor module to the device adapter
- Device adapter
- Transition socket to connect the device adapter to the target system
- Logic probe connector

FIGURE 2-1: MPLAB ICE 4000 EMULATOR SYSTEM



The emulator pod connects to the PC through a USB port using the provided cable. The pod contains the hardware necessary to perform the common emulator functions, such as trace, break and emulate.

The processor module inserts into two slots on top of the emulator pod. It contains the hardware necessary to emulate a specific device or family of devices. For more information on processor modules, see the *MPLAB ICE 4000 Processor Module and Device Adapter Specification* (DS51298).

The device adapter is connected to the processor module by the flex circuit cable. Device adapters are interchangeable assemblies that allow the emulator to interface to a target application system. Device adapters also have control logic that allows the target application to provide a clock source and power to the processor module. For more information on processor modules, see the *MPLAB ICE 4000 Processor Module and Device Adapter Specification* (DS51298).

The transition socket is connected to the device adapter. Transition sockets are available in various styles to allow a common device adapter to be connected to one of the supported surface mount package styles. For more information on transition sockets, see the *MPLAB ICE Transition Socket Specification* (DS51194).

The logic probes may be connected into the logic probe connector on the emulator pod.

2.4 DRIVER AND SOFTWARE INSTALLATION

CAUTION

***Do not allow Windows® OS to pick a communications driver*, i.e., the emulator will not work and you will then have to uninstall the Windows driver so you may install the proper Microchip driver.**
If you have allowed the Windows driver to install, follow the directions in the file MPUsbClean.htm found in the Drivers*nn*\ICE4k_USB subdirectory of the MPLAB IDE installation directory, where *nn* is the version of Windows OS. Then return here to install the correct driver.

1. Run the installation for the MPLAB IDE v6.xx software application on your PC. You may obtain the installation executable from the Microchip web site or from the MPLAB IDE CD-ROM available from Microchip.
2. When the MPLAB IDE installation is complete, the driver installation instructions will appear, as well as a dialog that asks you to reboot. Click **Cancel** in the dialog and follow the driver installation instructions.

   If you accidentally close these instructions, they may be found at:

   MPLAB IDE installation directory\Drivers*nn*\ICE4k_USB\Ddice4k*nn*.htm

   where *nn* represents the version of Windows OS.
3. Shut down your PC from the Start menu.

2.5 HARDWARE SETUP

CAUTION

The PC, MPLAB ICE 4000 and the target system should *NOT* be powered at this time.

1. Plug the host-to-pod USB cable into the PC and then the pod.

   Connect one end of the host-to-pod cable to the USB port on the PC chassis and connect the other end to the USB connector on the back of the MPLAB ICE 4000 pod.

2. Plug the power cord into the pod.

   Make certain that the emulator pod on/off switch is in the “O” or “off” position before completing this step.

   Note: USB cannot power the emulator pod, i.e., MPLAB ICE 4000 must be run with the supplied external power supply.

3. Plug the power cord into an outlet.
4. Plug the processor module into the emulator pod.

   Insert the processor module firmly onto the top of the MPLAB ICE 4000 pod.

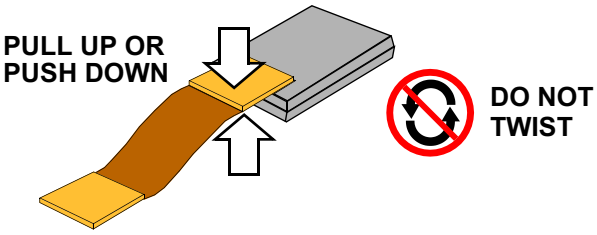
5. If a target board will be used with the MPLAB ICE 4000 system:

   a) Connect the end of the flex circuit cable marked “emulation module” to the processor module.

   b) Connect the end of the flex circuit cable marked “device adapter” to the device adapter.

CAUTION

To later remove the flex cable from either the processor module or device adapter, grip and pull up or push down on the stiffener. DO NOT twist off.



   c) Plug the device adapter into the transition socket on your target application. Make sure the target application powers the transition socket according the electrical specs for the device to be emulated.

   d) Connect the logic probes. Plug the logic probes into the logic probe connector found on the front of the emulator pod.

2.6 APPLYING POWER TO THE SYSTEM COMPONENTS

To prevent damage to any of the subsystem or target application parts, power up the system components as specified below.

CAUTION

Damage to the emulator system and/or target application may occur if these steps are not followed.

Note: When power is supplied by the target system, MPLAB ICE 4000 loads the target system with up to 150 mA. An MPLAB ICE 4000 device adapter loads the system with up to 10 mA.

See **Section 2.7 "Applying Power to the System Components – Low Voltage Emulation"** before using **low voltage emulation** if this feature is desired.

1. Apply power to the PC.
2. Apply power to the emulator pod.

CAUTION

Insert the processor module BEFORE turning on the emulator pod. DO NOT insert a processor module with power applied to the pod.

3. Apply power to the target application circuit.

2.7 APPLYING POWER TO THE SYSTEM COMPONENTS – LOW VOLTAGE EMULATION

MPLAB ICE 4000 supports low voltage emulation (2.5V). In this configuration, **power MUST BE SUPPLIED by the target system**.

Note: When power is supplied by the target system, MPLAB ICE 4000 loads the target system with up to 150 mA. An MPLAB ICE 4000 device adapter loads the system with up to 10 mA.

To prevent damage to any of the subsystem or target application parts, power up the system components as specified below.

CAUTION

Damage to the emulator system and/or target application may occur if these steps are not followed.

1. Check the limitations for your selected device. Some devices allow emulator pins to come up as output high, instead of input. Make certain you do not allow the emulated device to do this if your application cannot tolerate 5V.
2. Apply power to the PC.
3. Apply power to the emulator pod.

CAUTION

Insert the processor module BEFORE turning on the emulator pod. DO NOT insert a processor module with power applied to the pod.

4. Apply power to the target application circuit.

2.8 SOFTWARE SETUP

1. Launch MPLAB IDE v6.xx.
2. From the Configure menu, select Select Device. In this dialog, choose the device you will be emulating and click **OK**.
3. From the Debugger menu, select Select Tool and then MPLAB ICE 4000 to enable the emulator.

   Note: If you cannot select the emulator as the debug tool, please see **Appendix A. "Troubleshooting"**.

   Once you have selected MPLAB ICE 4000, debug options will appear on the Debugger menu.

   Note: It is recommended that you **not** have a programmer enabled at the same time as the emulator. See **Appendix A. "Troubleshooting"** for more information.

4. The default port setting is USB = ICEUSB-0. If you wish to change this settings, you may do so on the Port tab of the *Debugger>Settings* dialog. See **Section 3.4 "Configuring the Communications Port"** for more information.
5. MPLAB ICE 4000 allows the emulator processor module to be powered by either the emulator pod or the target system. This is set up in MPLAB IDE as follows:
   - Emulator pod: *Debugger>Settings*, **Power** tab, "Processor Power From Emulator"
   - Target system: *Debugger>Settings*, **Power** tab, "Processor Power From Target Board"

   Note: You must select "Processor Power From Target Board" when using low-voltage emulation.

   See **Section 3.5 "Selecting Processor Power"** for more information. Also, refer to the *MPLAB ICE 4000 Processor Module and Device Adapter Specification* for processor module power requirements before configuring the system for target system power.

   When connecting to a target application system, you may notice a voltage level on the target application, even though you have not yet applied power to the target application circuit. This is normal and is due to current leakage of protection diodes through V_{CC} of the Device Adapter. The current leakage will typically be less than 20 mA. However, if the target application is using a voltage regulator, it should be noted that some regulators require the use of an external shunt diode between V_{IN} and V_{OUT} for reverse-bias protection. Refer to the manufacture's data sheets for additional information.

MPLAB ICE 4000 should now be ready for you to use as an emulator. If you have had problems, please consult **Appendix A. "Troubleshooting"**. Otherwise, proceed to the next chapter for additional software setup considerations.

2.9 REMOVING POWER FROM THE SYSTEM COMPONENTS

To prevent damage to any of the subsystem or target application parts, power down the system components as specified below.

CAUTION

Damage to the emulator system and/or target application may occur if these steps are not followed.

1. Select *Debugger>None*.
2. Close MPLAB IDE v6.xx. Save any projects/work spaces when prompted.
3. Remove power from target application circuit.
4. Turn off the emulator pod.
5. Turn off the PC.

Chapter 3. General Set Up

3.1 INTRODUCTION

After installing MPLAB ICE 4000 and starting up the MPLAB IDE, MPLAB IDE must be set up to correctly emulate the selected processor.

3.2 HIGHLIGHTS

The steps needed to get started with MPLAB ICE 4000 are:

- Checking Configuration Bit Values
- Configuring the Communications Port
- Selecting Processor Power
- Setting Up the Processor Clock
- Setting Up Miscellaneous Hardware
- Using MPLAB IDE Projects and Work spaces

3.3 CHECKING CONFIGURATION BIT VALUES

To view the values of configuration bits for your selected device, open the Configuration Bits window by selecting *Configure>Configuration Bits*.

When you first select a device and start a project, default data sheet values for configuration bits are used. These may not be what you want for development, e.g., you may not want the watchdog timer enabled.

3.3.1 Watchdog Timer On/Off

Determine whether or not the Watchdog Timer (WDT) will be needed. During development, WDT is usually disabled. However, if a specific development requires the WDT to be enabled, remember to set its prescaler.

3.3.2 Processor Mode and External Memory

If a processor has a mode that supports external program memory (Microprocessor or Extended Microcontroller), select the mode here. Additional memory features are set up on the **Memory** tab of the Settings dialog.

PIC18C601/801 devices use external memory exclusively (they have no on-chip program memory), so there is no need for Processor mode selection bits. However, you may use the **Memory** tab to set up whether the external memory is provided by the emulator or the target.

3.3.3 Oscillator Settings

Select the oscillator you will use for development here and the frequency for the oscillator in *Debugger>Settings*, Clock tab (**Section 3.6 "Setting Up the Processor Clock"**). Make sure you only enter frequencies that are available for the selected oscillator.

3.4 CONFIGURING THE COMMUNICATIONS PORT

MPLAB ICE 4000 communicates with the PC via a USB port.

1. Select *Debugger>Settings* and click on the Port tab.
2. Select a communications port, where ICEUSB-x are the available USB ports. The number of available ports will depend on the configuration of individual PC's.

> **Note:** Before you change the communications port in software, make sure you have first changed it in hardware.

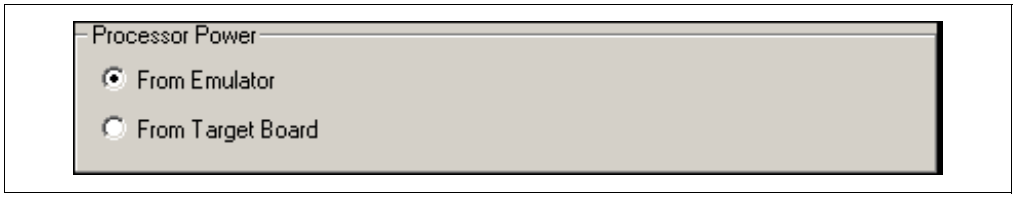
Click **Apply** to accept the setting in this tab of the Settings dialog.

3.5 SELECTING PROCESSOR POWER

MPLAB ICE 4000 allows the emulator processor chip to be powered by the emulator pod (5V) or the target system (2.5V to 5V). The emulator defaults to Processor Power from Emulator (system power) when first initialized.

For information on processor module power issues, please refer to the *MPLAB ICE 4000 Processor Module and Device Adapter Specification*.

FIGURE 3-1: SETTINGS DIALOG – POWER TAB



3.5.1 Processor Power from Emulator (System Power)

Select the **Power** tab of the *Debugger>Settings* dialog. Under Processor Power, select From Emulator and click **Apply**.

> **Note:** The emulator system cannot provide power to a target board through a device adapter. If the device adapter is plugged into an unpowered target board, it is not unusual to see a voltage level of 1-3V at VCC of the target board, caused by leakage current through VCC of the device adapter. MPLAB IDE may also have difficulty initializing the emulator when power has not yet been applied to the target board.

3.5.2 Processor Power from Target Board

Select the **Power** tab of the *Debugger>Settings* dialog. Under Processor Power, select From Target Board and click **Apply**.

Refer to the *MPLAB ICE 4000 Processor Module and Device Adapter Specification* for processor module power requirements before configuring the system for target system power.

> **Note:** If you use power from the target board, make sure it is always present or the emulator will not function properly. If the device adapter is plugged into an unpowered target board, there may still be some leakage current through VCC of the device adapter. MPLAB IDE may also have difficulty initializing the emulator when power has not yet been applied to the target board.

3.5.3 Low Voltage Emulation

MPLAB ICE 4000 also supports LOW VOLTAGE emulation down to 2.5V. The emulator system cannot provide any voltage level other than 5V to the emulator processor. In this configuration, power must be supplied by the target board (see **Section 3.5.2 "Processor Power from Target Board"**).

Before using low voltage, check the limitations for your selected device. Some devices allow emulator pins to come up as output high, instead of input. Make certain you do not allow the emulated device to do this if your application cannot tolerate 5V.

3.6 SETTING UP THE PROCESSOR CLOCK

MPLAB ICE 4000 can use the on-board clock with either emulator or target power, or it can use the target board clock with target board power.

3.6.1 Using the On-board Clock

MPLAB ICE 4000 has an on-board clock that can be programmed to a frequency between 32 kHz and 100 MHz. Refer to the specific device's data sheet to determine the supported frequency range.

1. Select an Oscillator Type (**Section 3.3.3 "Oscillator Settings"**).
2. Select the **Clock** tab on the *Debugger>Settings* dialog.
3. Select the Desired Frequency magnitude (MHz, kHz or Hz) and enter the Desired Frequency. Refer to the specific device's data sheet to determine the supported frequency range for each oscillator type.

   Note: If you enter a frequency that is out of range, your system will not operate properly.

4. Click **Apply**.

The clock will be programmed to operate as close to the entered frequency as possible. Since the generated clock frequency will be slightly different than the desired clock frequency, the Actual Frequency will be displayed. The Actual Frequency will be within 0.5% of the desired frequency.

3.6.1.1 PLL

If the Oscillator mode has a HW PLL associated with it, the run time frequency will be the desired frequency. Example: To emulate a target with a 5 MHz HS crystal while using HW PLL mode, set the desired frequency to 20 MHz.

For parts (e.g., PIC18F8680) that support SW enabled PLL, please do not enter a frequency that, when multiplied by 4, would go over the maximum speed the emulator supports.

Consult the device limitations to see how PLL is emulated for your selected device.

3.6.1.2 VERIFY FREQUENCY

To verify the clock frequency, you can set up a complex trigger and then measure the trigger output pulse width (one instruction cycle) of the TRIGOUT logic probe (**Section B.7 "Logic Probes"**) in frequency and multiply by 4.

3.6.2 Using a Target Board Clock

MPLAB ICE 4000 can use the processor clock on the target board as long as target board (external) power is being used. It can determine the frequency of the target board clock and use it for displaying timing information.

1. Select the target board Oscillator Type (**Section 3.3.3 "Oscillator Settings"**).
2. Select the **Power** tab of the *Debugger>Settings* dialog and set Processor Power to From Target Board (see **Section 3.5.2 "Processor Power from Target Board"**).
3. Select the **Clock** tab on the *Debugger>Settings* dialog. Then select Use Target Board Clock.

   Note: If MPLAB ICE 4000 is not hooked up to a target board and you click **Use Target Board Clock**, you will get a warning dialog.

   The target board clock frequency will be calculated, displayed and used for any internal time calculations. A warning is issued if the frequency is less than 32 kHz.

   Because of measurement error, the calculated frequency may not be what is desired for internal time calculations. (e.g., Your crystal oscillator has a frequency of 8 MHz ± 50 ppm, but the target frequency is shown as 7.993755.) Measurement error can range from 3.9% to a fraction of a percent.
4. Click **Apply**.

3.7 SETTING UP MISCELLANEOUS HARDWARE

In addition to the settings you have already made, there are other settings that you may or may not wish to change in the *Debugger>Settings* dialog. Depending on the device you have chosen, these tabs may or may not be available and may look different for different devices.

3.7.1 Settings Dialog, Break Options Tab

Use the Break Options tab to change the global break and trace point environment options. These include Global Hardware Break Enable (for complex trigger usage) and Freeze Peripherals on Halt. If enabled in the configuration bits (*Configure>Configuration Bits*), you may set stack and watchdog timer break options.

3.7.2 Settings Dialog, Memory Tab

Some parts allow device memory to be supplemented or replaced by off-chip (external) memory. Memory modes are selected using configuration bits (*Configure>Configuration Bits*).

Devices that support Microcontroller mode only do not have a Memory tab. Devices that support Extended Microcontroller mode and/or Microprocessor mode will display the Memory tab.

Note: There are several limitations concerning external memory, some of them device-dependent. Please see the limitations section of the on-line help file for more information.

3.7.3 Settings Dialog, Pins Tab

Set up processor pins, such as the $\overline{\text{MCLR}}$ pull-up resistor connection. Also set up the emulator operation to preserve user's external bus access method when halted.

3.7.4 Settings Dialog, Peripheral Tab

Set up peripheral functions, such a freeze on halt.

3.8 USING MPLAB IDE PROJECTS AND WORK SPACES

MPLAB IDE v5.xx and lower used projects to help you manage the files to build your application. MPLAB IDE v6.xx now uses projects and work spaces to aid in the development of complicated applications.

For general information on projects and work spaces, see the on-line help for MPLAB IDE v6.xx.