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**MPLAB<sup>®</sup> REAL ICE<sup>™</sup>**  
**In-Circuit Emulator**  
**User's Guide**

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# MPLAB® REAL ICE™ IN-CIRCUIT EMULATOR USER'S GUIDE

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# MPLAB® REAL ICE™ IN-CIRCUIT EMULATOR USER'S GUIDE

## Preface

### NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site ([www.microchip.com](http://www.microchip.com)) to obtain the latest documentation available.

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 "DSXXXXA", where "XXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MPLAB REAL ICE in-circuit emulator. Items discussed include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support

## DOCUMENT LAYOUT

This document describes how to use the MPLAB REAL ICE in-circuit emulator as a development tool to emulate and debug firmware on a target board, as well as how to program devices. The document is organized as follows:

- **Chapter 1: Overview** – What the MPLAB REAL ICE in-circuit emulator is, and how it can help you develop your application.
- **Chapter 2: Operation** – The theory of MPLAB REAL ICE in-circuit emulator operation.
- **Chapter 3: Installation** – How to install the emulator software and hardware.
- **Chapter 4: General Setup** – How to get started using the emulator.
- **Chapter 5: Using the Emulator as a Debugger** – A description of emulator functions available in MPLAB IDE when the MPLAB REAL ICE in-circuit emulator is chosen as the debug tool.
- **Chapter 6: Using the Emulator as a Programmer** – A description of emulator functions available in MPLAB IDE when the MPLAB REAL ICE in-circuit emulator is chosen as the programming tool.

# MPLAB® REAL ICE™ In-Circuit Emulator User's Guide

- **Chapter 7: Hardware Specification** – The hardware and electrical specifications of the emulator system.

## CONVENTIONS USED IN THIS GUIDE

The following conventions may appear in this documentation:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u><i>File</i></u> >Save
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> tab
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
<b>Courier font:</b>		
Plain Courier	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
Italic Courier	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets [ ]	Optional arguments	mpasmwin [options] <i>file</i> [options]
Curly brackets and pipe character: {   }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses...	Replaces repeated text	var_name [, var_name...]
	Represents code supplied by user	void main (void) { ... }

## 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 document describes how to use the MPLAB REAL ICE in-circuit emulator. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

### **Readme for MPLAB REAL ICE In-Circuit Emulator**

For the latest information on using the MPLAB REAL ICE in-circuit emulator, read the "Readme for MPLAB REAL ICE Emulator.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.

### **MPLAB REAL ICE In-Circuit Emulator Setup (DS51615)**

A mini-poster showing you how to hook up the hardware and install the software for the MPLAB REAL ICE in-circuit emulator using standard communications and the Explorer 16 demo board.

### **MPLAB REAL ICE In-Circuit Emulator On-line Help File**

A comprehensive help file for the emulator. Usage, troubleshooting and hardware specifications are included.

### **Header Board Specification (DS51292)**

A booklet describing how to install and use MPLAB REAL ICE in-circuit emulator headers. Headers are used to better debug selected devices using special -ICE device versions, without the loss of pins or resources.

### **Transition Socket Specification (DS51194)**

Consult this document for information on transition sockets available for use with MPLAB ICE 2000/4000 device adaptors, MPLAB ICD 2 headers and MPLAB REAL ICE in-circuit emulator headers.



## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://www.microchip.com). This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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To register, access the Microchip web site at [www.microchip.com](http://www.microchip.com), click on Customer Change Notification and follow the registration instructions.

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 REAL ICE in-circuit emulator, MPLAB ICE 2000 and MPLAB ICE 4000 emulators.
- **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 IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus and PICkit™ 1 and 2 development programmers.

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: <http://support.microchip.com>

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NOTES:



# MPLAB® REAL ICE™ IN-CIRCUIT EMULATOR USER'S GUIDE

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## Chapter 1. Overview

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### 1.1 INTRODUCTION

An overview of the MPLAB REAL ICE in-circuit emulator system is given.

- MPLAB REAL ICE In-Circuit Emulator Defined
- How the MPLAB REAL ICE In-Circuit Emulator Helps You
- MPLAB REAL ICE In-Circuit Emulator Kit Components

### 1.2 MPLAB REAL ICE IN-CIRCUIT EMULATOR DEFINED

MPLAB REAL ICE in-circuit emulator is an in-circuit emulator that is controlled by a PC running MPLAB IDE software on a Windows® platform. The MPLAB REAL ICE in-circuit emulator is an integral part of the development engineer's toolsuite. The application usage can vary from software development to hardware integration to manufacturing test to field service.

The MPLAB REAL ICE in-circuit emulator is a modern emulator system that supports hardware and software development for selected Microchip PICmicro® microcontrollers (MCUs) and dsPIC® Digital Signal Controllers (DSCs) that are based on In-Circuit Serial Programming™ (ICSP™) programming capability and Standard DUT Programming (STDP) 2-wire serial interfaces.

The emulator system will execute code like an actual device because it uses a device with built-in emulation circuitry, instead of a special emulator chip, for emulation. All available features of a given device are accessible interactively, and can be set and modified by the MPLAB IDE interface.

The MPLAB REAL ICE emulation concept was developed for emulating complex processors that differ from conventional system processors in several aspects:

- Processors run at maximum speeds
- Capability to incorporate I/O port data input
- Instrumented Trace (MPLAB IDE and Compiler Assisted)

In addition to emulator functions, the MPLAB REAL ICE in-circuit emulator system also may be used as a development programmer.

### 1.3 HOW THE MPLAB REAL ICE IN-CIRCUIT EMULATOR HELPS YOU

The MPLAB REAL ICE in-circuit emulator system allows you to:

- Debug your application on your own hardware in real time
- Debug with hardware breakpoints
- Debug with software breakpoints (future)
- Set breakpoints based on internal and/or external signals
- Monitor internal file registers
- Emulate full speed
- Program your device
- Trace lines of code or log variable/expression values

## 1.4 MPLAB REAL ICE IN-CIRCUIT EMULATOR KIT COMPONENTS

The components of the MPLAB REAL ICE in-circuit emulator system kit are listed below.

1. MPLAB IDE Quick Start Guide (DS51281)
2. CD-ROM with MPLAB IDE software and on-line documentation
3. Emulator pod
4. USB cable to provide communications between the emulator and a PC and to provide power to the emulator
5. Standard driver board (MPLAB ICD 2 compatible) and cable to connect the emulator pod to a header module or target board
6. Logic probes
7. Self-Test board

Additional hardware that may be ordered separately:

8. Processor Extension Pack: High-speed driver board, ICE header/receiver board and cables to connect the emulator pod to a target board
9. Performance Pack: High-speed driver board, high-speed receiver board and cables to connect the emulator pod to a target board
10. High-speed to standard converter board
11. Transition socket

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## Chapter 2. Operation

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### 2.1 INTRODUCTION

A simplified description of how the MPLAB REAL ICE in-circuit emulator system works is provided here. It is intended to provide enough information so a target board can be designed that is compatible with the emulator for both emulation and programming operations. The basic theory of in-circuit emulation and programming is described so that problems, if encountered, are quickly resolved.

- MPLAB REAL ICE In-Circuit Emulator vs. MPLAB ICE 2000/4000 Emulators
- MPLAB REAL ICE In-Circuit Emulator vs. MPLAB ICD 2 Debugger
- System Configurations
- Communication Connections
- Debug Mode
- Requirements For Debug Mode
- Program Mode
- Resources Used by the MPLAB REAL ICE In-Circuit Emulator

### 2.2 MPLAB REAL ICE IN-CIRCUIT EMULATOR VS. MPLAB ICE 2000/4000 EMULATORS

The MPLAB REAL ICE in-circuit emulator system is a next generation In-Circuit Emulator (ICE) system. It differs from classical in-circuit emulator systems (e.g., MPLAB ICE 2000/4000) in a single, but important way: the production device and emulation device are the same. This means that the actual device/emulated device differences are all but eliminated. For example, speed bottlenecks caused by bringing internal busses off-chip and using external memories on classical emulator systems are eliminated by using the actual device for emulation.

Another significant benefit is that there is no time lag from when the device is released to when an emulator module to support the device can be released. If a header board is required, it can be developed to coincide with the device release, or lag it by a small amount, which is a great improvement over the longer processor module development times.

### 2.3 MPLAB REAL ICE IN-CIRCUIT EMULATOR VS. MPLAB ICD 2 DEBUGGER

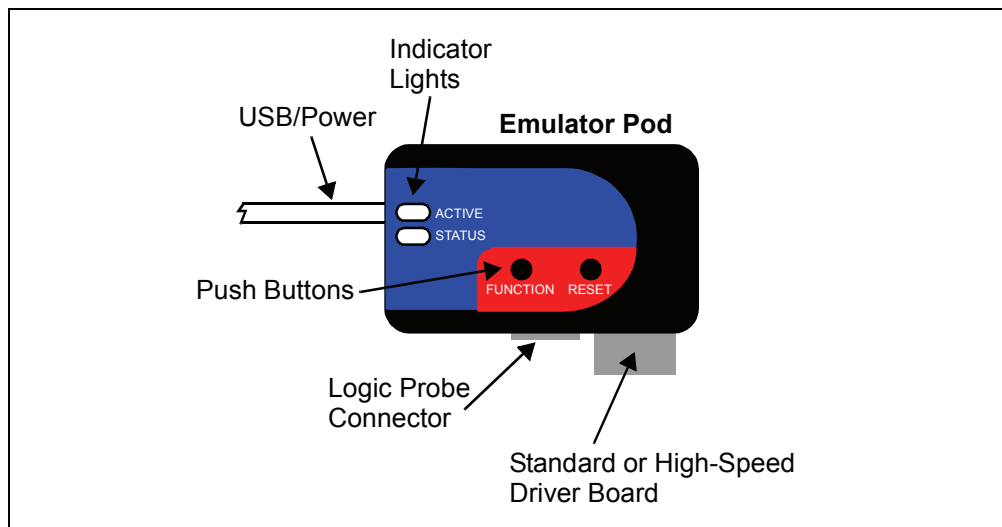
The MPLAB REAL ICE in-circuit emulator system is similar to the MPLAB ICD 2 in-circuit debugger system, but surpasses it in speed and functionality. Even with standard communication, the MPLAB REAL ICE in-circuit emulator is faster than the MPLAB ICD 2. With the high-speed communication option, it is much faster. Also, in addition to basic debug functions, the MPLAB REAL ICE in-circuit emulator incorporates “emulation” functions, such as trace.

## 2.4 SYSTEM CONFIGURATIONS

The MPLAB REAL ICE in-circuit emulator system consists of these basic items:

- Emulator pod with indicator lights, push buttons and a logic probe connector
- USB cable to connect a PC to the emulator pod and power the pod
- Driver board and modular cable(s) to connect the emulator pod to an ICE header or target board

**FIGURE 2-1: BASIC EMULATOR SYSTEM**



The emulator system configurations are discussed in the following sections.

### CAUTION

**Do not connect the hardware before installing the software and USB drivers, or whenever the pod or target is powered.**

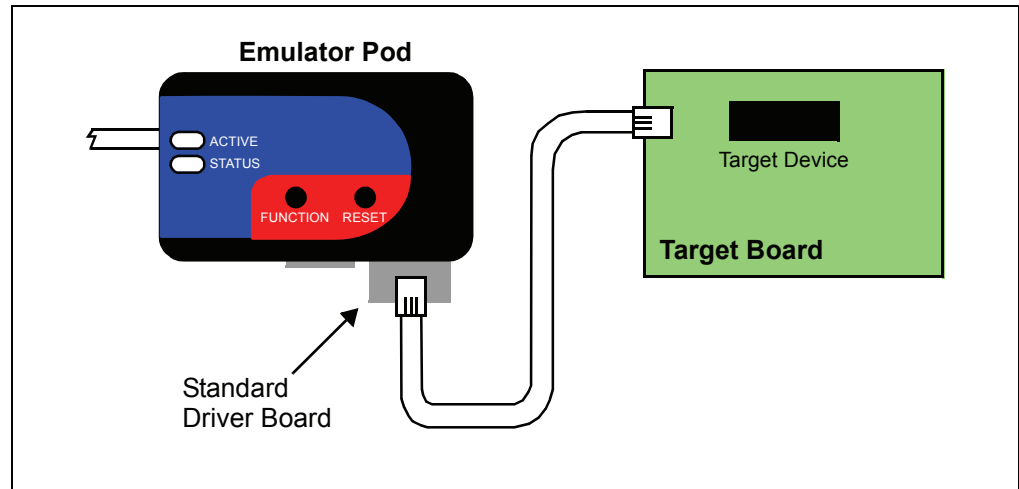
#### 2.4.1 Standard Communication

The emulator system can be configured to use standard communication for both programming and debugging functions. This 6-pin connection is the same one used by the MPLAB ICD 2 in-circuit debugger, and provides the same amount of functionality.

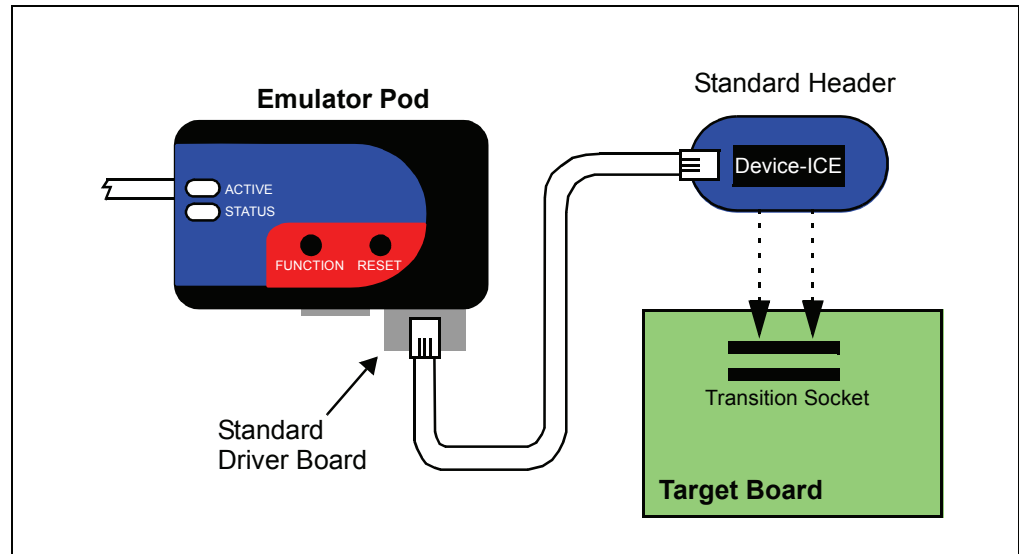
The standard driver board is plugged into the emulator pod to configure the system for this type of communication with the target. The modular cable can be either (1) inserted into a matching socket at the target, where the target device is on the target board (Figure 2-2), or (2) inserted into a header board, which is then plugged into the target board (Figure 2-3).

For more on standard communication, see **Chapter 7. "Hardware Specification"**.

**FIGURE 2-2: STANDARD EMULATOR SYSTEM – DEVICE WITH ON-BOARD ICE CIRCUITRY**



**FIGURE 2-3: STANDARD EMULATOR SYSTEM – ICE DEVICE**





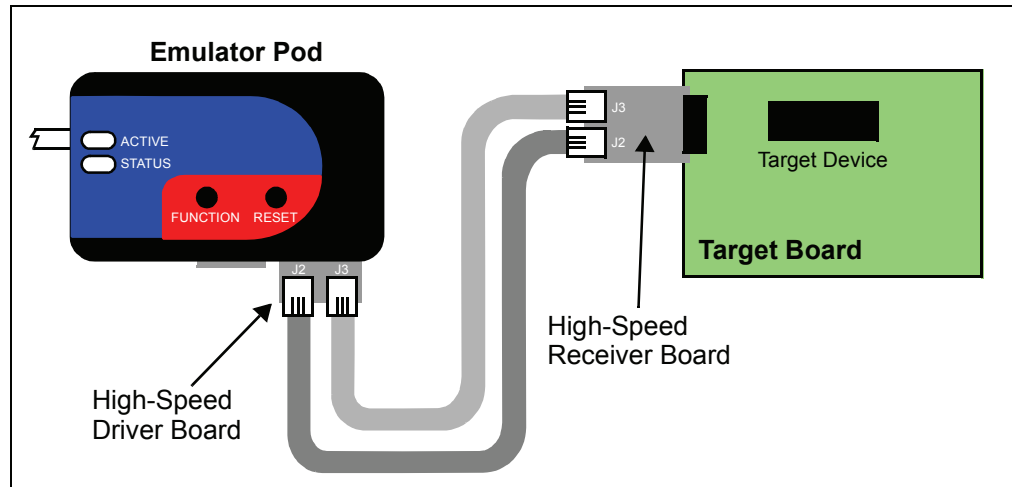
## 2.4.2 High-Speed Communication

The emulator system can be configured to use high-speed communication for both programming and debugging functions. This connection allows for high-speed operations, a longer distance between the emulator and target and additional tracing functionality over a standard connection.

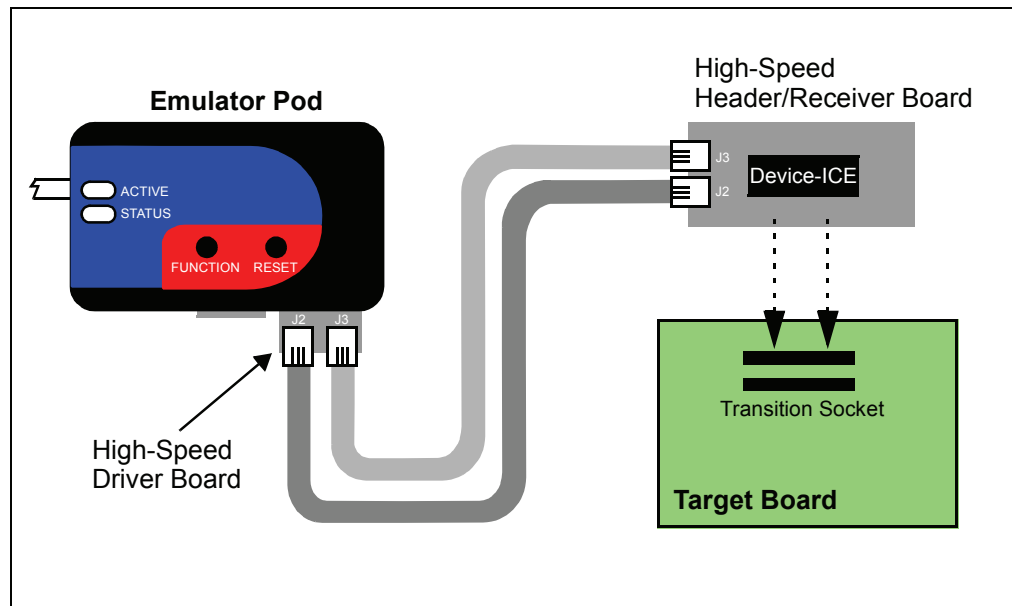
The high-speed driver board is plugged into the emulator pod to configure the system for this type of communication with the target. The modular cables can be inserted into matching sockets either (1) at the high-speed receiver board, which is plugged into the target board, with an on-board target device, via an 8-pin connector (Figure 2-4), or (2) at the header/receiver board, which is then plugged into the target board (Figure 2-5).

For more on high-speed communication, see **Chapter 7. "Hardware Specification"**.

**FIGURE 2-4: HIGH-SPEED EMULATOR SYSTEM – DEVICE WITH ON-BOARD ICE CIRCUITRY**



**FIGURE 2-5: HIGH-SPEED EMULATOR SYSTEM – ICE DEVICE**



## 2.4.3 Hybrid Communication (Future)

The emulator system can be configured to use high speed to standard communication via a converter. If you need to use high-speed to facilitate emulator/target communication over a large distance, but do not need the additional debug features, then this configuration can be useful.

To configure the system for this type of communication, plug the high-speed driver board into the emulator and then attach the modular cables. Plug these cables into the sockets on the converter board. Plug one end of the standard cable into the socket on the converter board. Plug the other end of the standard cable into either the target board or header board, as shown in **Section 2.4.1 “Standard Communication”**.

## 2.5 COMMUNICATION CONNECTIONS

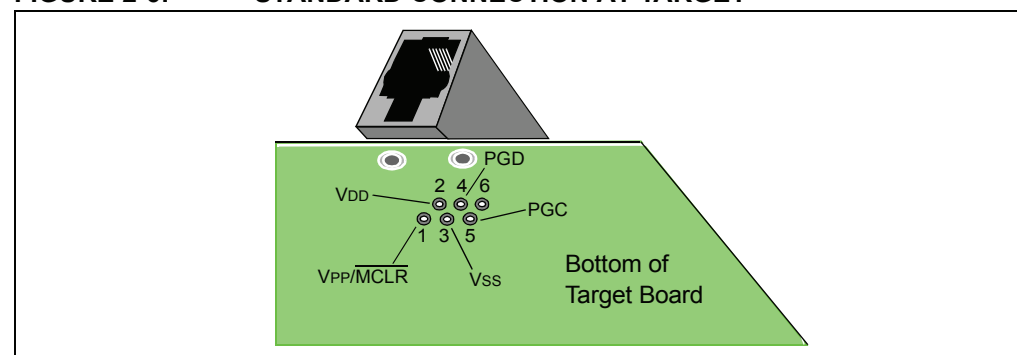
There are two driver boards available to closely match most application requirements. The standard driver board (MPLAB ICD 2 compatible) can be used to connect to the myriad of demo boards and applications that contain the RJ11 connector. The high-speed driver/receiver board combination can be used for high-speed applications, for additional trace features, for large (several feet) emulator-to-target distances and for noisy environments.

### 2.5.1 Standard Communications Target Connection

Using the standard driver board, the MPLAB REAL ICE in-circuit emulator is connected to the target device with the modular interface (six-conductor) cable. The pin numbering for the connector is shown from the bottom of the target PC board in Figure 2-6.

**Note:** Cable connections at the emulator and target are mirror images of each other, i.e., pin 1 on one end of the cable is connected to pin 1 on the other end of the cable.

**FIGURE 2-6: STANDARD CONNECTION AT TARGET**

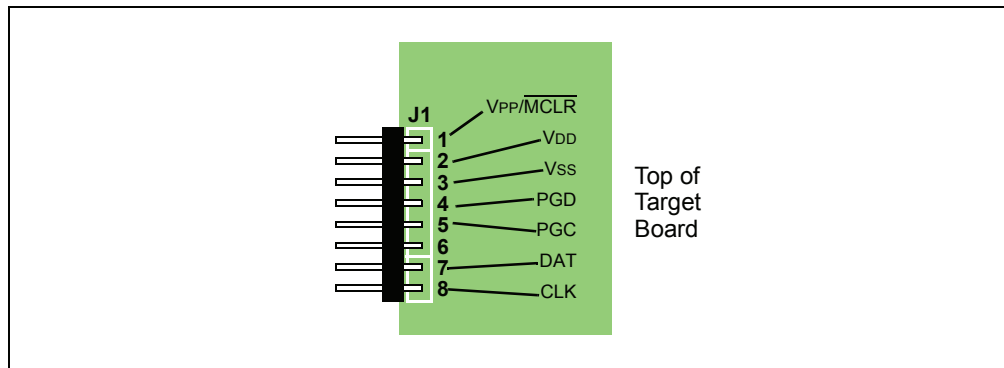


## 2.5.2 High-Speed Communications Target Connection

Using the high-speed driver/receiver board combination, the MPLAB REAL ICE in-circuit emulator is connected to the target device with an 8-pin interface. The pin numbering for the connector is shown from the top of the target PC board in Figure 2-7.

**Note:** Connections at the emulator and target are mirror images of each other, i.e., pin 1 on the receiver board is connected to pin 1 on the target board.

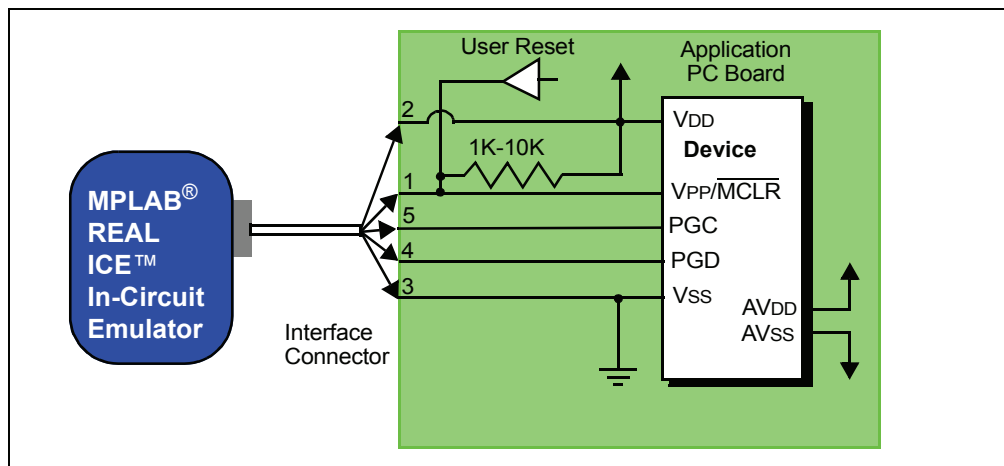
**FIGURE 2-7: HIGH-SPEED CONNECTION AT TARGET**



## 2.5.3 Target Connection Circuitry

Figure 2-8 shows the interconnections of the MPLAB REAL ICE in-circuit emulator to the connector on the target board. The diagram also shows the wiring from the connector to a device on the target PC board. A pull-up resistor (usually around 10 kΩ) is recommended to be connected from the VPP/MCLR line to VDD so that the line may be strobed low to reset the device.

**FIGURE 2-8: STANDARD CONNECTION TARGET CIRCUITRY**



In the following descriptions, only three lines are active and relevant to core emulator operation: pins 1 (VPP/MCLR), 5 (PGC) and 4 (PGD). Pins 2 (VDD) and 3 (VSS) are shown on the above diagram for completeness, but are only sensed, not provided or controlled, by the emulator.

Be aware that the target VDD is sensed by the emulator to allow level translation for target low-voltage operation. If the emulator does not sense voltage on its VDD line (pin 2 of the interface connector), it will not operate.

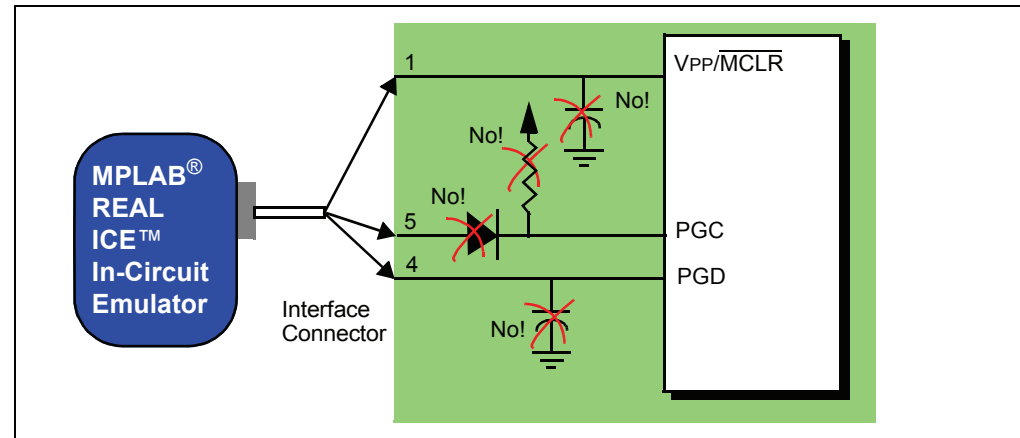
Not all devices have the AVDD and AVSS lines, but if they are present on the target device, all must be connected to the appropriate levels in order for the emulator to operate.

The interconnection is very simple; any problems experienced are often caused by other connections or components on these critical lines that interfere with the operation of the MPLAB REAL ICE in-circuit emulator system, as discussed in the next section.

## 2.5.4 Circuits That Will Prevent the Emulator From Functioning

Figure 2-9 shows the active emulator lines with some components that will prevent the MPLAB REAL ICE in-circuit emulator system from functioning.

**FIGURE 2-9: IMPROPER CIRCUIT COMPONENTS**



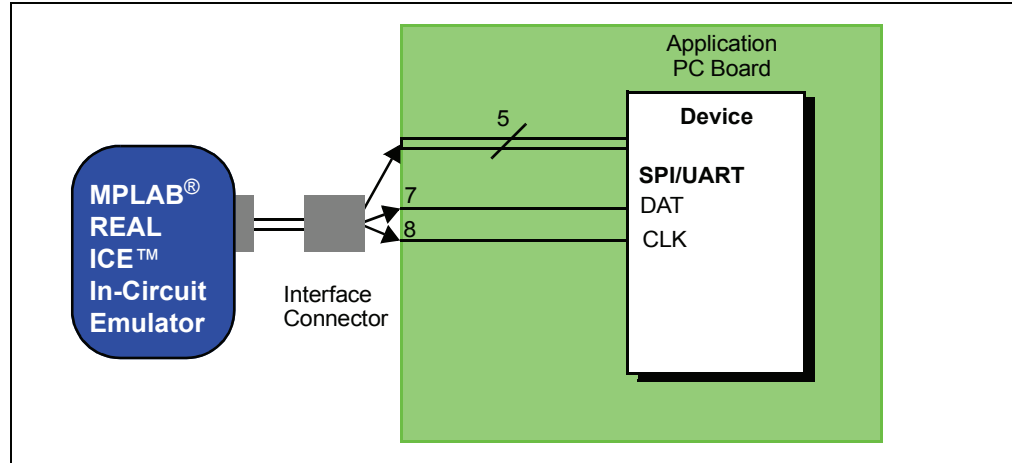
Specifically, these guidelines must be followed:

- No pull-ups on PGC/PGD – they will divide the voltage levels, since these lines have 4.7 k $\Omega$  pull-down resistors in the emulator.
- No capacitors on PGC/PGD – they will prevent fast transitions on data and clock lines during programming and debug communications.
- No capacitors on MCLR – they will prevent fast transitions of VPP. A simple pull-up resistor is generally sufficient.
- No diodes on PGC/PGD – they will prevent bidirectional communication between the emulator and the target device.

## 2.5.5 SPI/UART Trace Connections (Future)

When using high-speed communications, streaming serial trace is possible using the device SPI/UART and pins 7 (DAT) and 8 (CLK). Figure 2-10 shows these additional connections. As with pins 4 (PBD) and 5 (PGC) (**Section 2.5.4 “Circuits That Will Prevent the Emulator From Functioning”**), do not use pull-ups, capacitors or diodes.

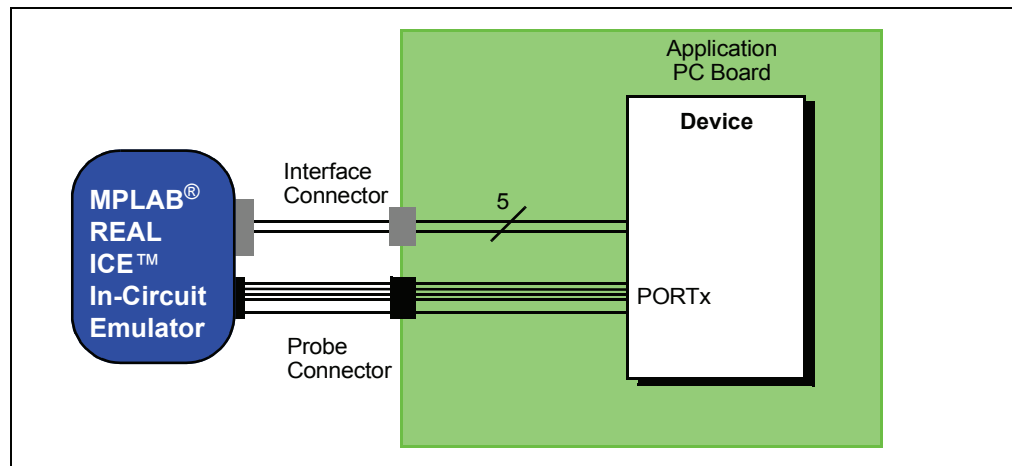
FIGURE 2-10: SERIAL TRACE CONNECTIONS



## 2.5.6 I/O Port Trace Connections

Streaming parallel trace is possible using a device I/O port and the emulator logic probe connector. This provides greater trace speed and data quantity, but limits emulator-to-target distance by the length of the parallel cable. Figure 2-11 shows these additional connections.

FIGURE 2-11: PARALLEL TRACE CONNECTIONS



For this trace configuration, seven (7) lines of data and one (1) line for clock are transmitted (see **Section 7.5.4 “Logic Probe/External Trigger Interface”**.)

As with pins 4 (PBD) and 5 (PGC) (**Section 2.5.4 “Circuits That Will Prevent the Emulator From Functioning”**), do not use pull-ups, capacitors or diodes. However, to use probe pins as inputs, you must provide the circuitry to drive them. Unused pins should either be pulled up or grounded. Floating pins may produce false triggers.

For more on this type of trace, see **Section 5.5.2 “I/O Port Trace”**.

## 2.6 DEBUG MODE

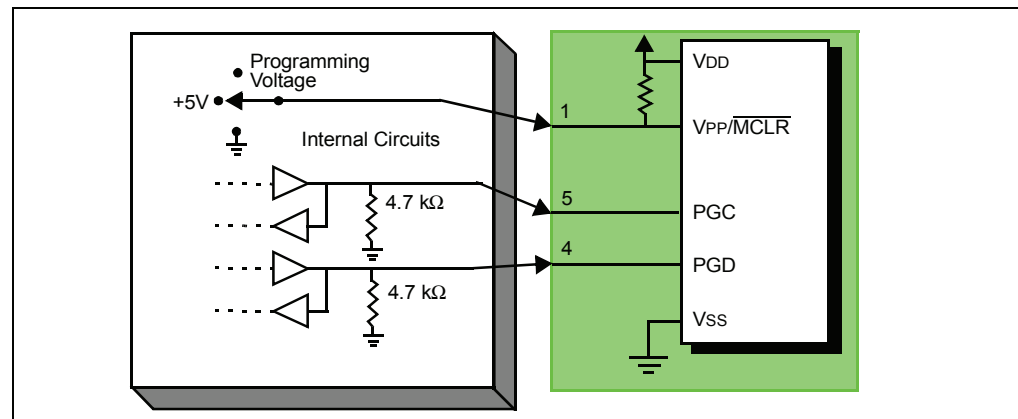
There are two steps to using the MPLAB REAL ICE in-circuit emulator system as a debugger. The first requires that an application be programmed into the target device. The second uses the internal in-circuit debug hardware of the target Flash device to run and test the application program. These two steps are directly related to the MPLAB IDE operations:

1. Programming the code into the target and activating special debug functions (see the next section for details).
2. Using the emulator to set breakpoints and run.

If the target device cannot be programmed correctly, the MPLAB REAL ICE in-circuit emulator will not be able to debug.

Figure 2-12 shows the basic interconnections required for programming. Note that this is the same as Figure 2-8, but for the sake of clarity, the VDD and VSS lines from the emulator are not shown.

**FIGURE 2-12: PROPER CONNECTIONS FOR PROGRAMMING**



A simplified diagram of some of the internal interface circuitry of the MPLAB REAL ICE in-circuit emulator pod is shown. For programming, no clock is needed on the target device, but power must be supplied. When programming, the emulator puts programming levels on VPP, sends clock pulses on PGC and serial data via PGD. To verify that the part has been programmed correctly, clocks are sent to PGC and data is read back from PGD. This conforms to the ICSP protocol of the device under development.

## 2.7 REQUIREMENTS FOR DEBUG MODE

To debug (set breakpoints, see registers, etc.) with the MPLAB REAL ICE in-circuit emulator system, there are critical elements that must be working correctly:

- The emulator must be connected to a PC. It must be powered by the PC via the USB cable, and it must be communicating with MPLAB IDE software via the USB cable. See **Chapter 3. "Installation"** for details.
- The emulator must be connected as shown to the VPP, PGC and PGD pins of the target device with the modular interface cable (or equivalent). VSS and VDD are also required to be connected between the emulator and target device.
- The target device must have power and a functional, running oscillator. If the target device does not run, for whatever reason, the MPLAB REAL ICE in-circuit emulator cannot debug.

- The target device must have its configuration words programmed correctly:
  - The oscillator Configuration bits should correspond to RC, XT, etc., depending upon the target design.
  - For some devices, the Watchdog Timer is enabled by default and needs to be disabled.
  - The target device must not have code protection enabled.
  - The target device must not have table read protection enabled.

Once the above conditions are met, you may proceed to the following:

- Sequence of Operations Leading to Debug Mode
- Debug Mode Details

## 2.7.1 Sequence of Operations Leading to Debug Mode

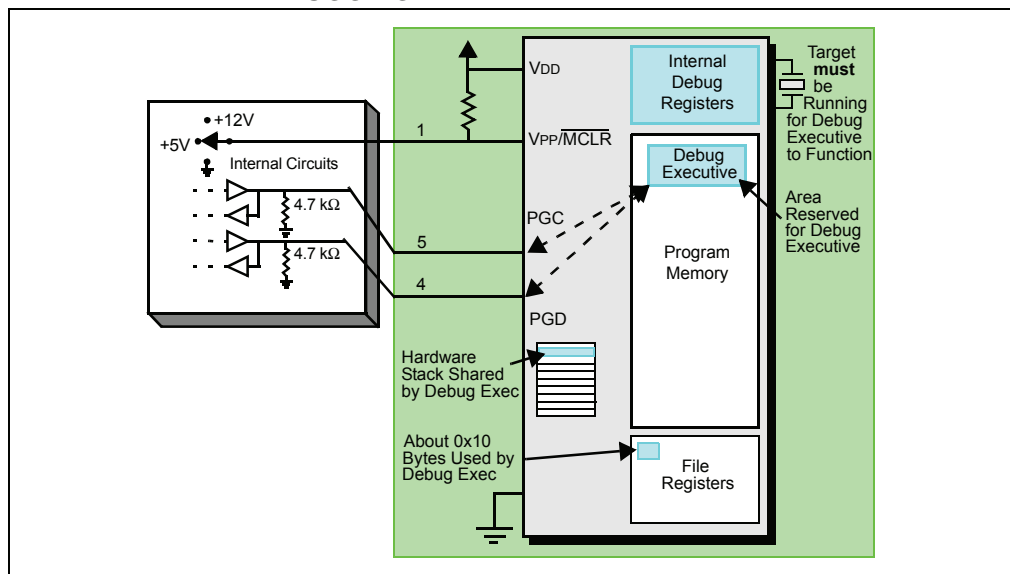
Given that the Requirements For Debug Mode are met, these actions can be performed when the MPLAB REAL ICE in-circuit emulator is set as the current debugger (*Debugger>Select Tool*):

- When *Debugger>Program* is selected, the application code is programmed into the device's memory via the ICSP protocol as described above.
- A small "debug executive" program is loaded into the high area of program memory of the target device. Since the debug executive must reside in program memory, the application program must not use this reserved space. The debug executive typically needs about 0x120 words of program memory. Some devices have special memory areas dedicated to the debug executive. Check your device data sheet for details.
- Special "in-circuit debug" registers in the target device are enabled. These allow the debug executive to be activated by the emulator.
- The target device is held in Reset by keeping the  $\overline{VPP/MCLR}$  line low.

## 2.7.2 Debug Mode Details

Figure 2-13 illustrates the MPLAB REAL ICE in-circuit emulator system when it is ready for debugging.

**FIGURE 2-13: MPLAB<sup>®</sup> REAL ICE<sup>™</sup> IN-CIRCUIT EMULATOR READY FOR DEBUGGING**



Typically, in order to find out if an application program will run correctly, a breakpoint is set early in the program code. When a breakpoint is set from the user interface of MPLAB IDE, the address of the breakpoint is stored in the special internal debug registers of the target device. Commands on PGC and PGD communicate directly to these registers to set the breakpoint address.

Next, the *Debugger>Run* function or the Run icon (forward arrow) is usually pressed from MPLAB IDE. The emulator will raise the VPP/MCLR line to allow the target to run, the target will start from the Reset vector and execute until the Program Counter reaches the breakpoint address previously stored in the internal debug registers.

After the instruction at the breakpoint address is executed, the in-circuit debug mechanism of the target device “fires” and transfers the device’s Program Counter to the debug executive (much like an interrupt) and the user’s application is effectively halted. The emulator communicates with the debug executive via PGC and PGD, gets the breakpoint status information and sends it back to MPLAB IDE. MPLAB IDE then sends a series of queries to the emulator to get information about the target device, such as file register contents and the state of the CPU. These queries are ultimately performed by the debug executive.

The debug executive runs just like an application in program memory. It uses some locations on the stack (usually just one or two) and, typically, about fourteen file registers for its temporary variables. If the device does not run, for whatever reason, such as no oscillator, a faulty power supply connection, shorts on the target board, etc., then the debug executive cannot communicate to the MPLAB REAL ICE in-circuit emulator and MPLAB IDE will issue an error message.

Another way to get a breakpoint is to press the MPLAB IDE’s **Halt** button (the “pause” symbol to the right of the Run arrow). This toggles the PGC and PGD lines so that the in-circuit debug mechanism of the target device switches the Program Counter from the user’s code in program memory to the debug executive. Again, the target application program is effectively halted, and MPLAB IDE uses the emulator communications with the debug executive to interrogate the state of the target device.

## 2.8 PROGRAM MODE

When using the *Programmer>Program* selection to program a device, MPLAB IDE will disable the in-circuit debug registers so the MPLAB REAL ICE in-circuit emulator will program only the target application code and the Configuration bits (and EEPROM data, if available and selected) into the target device. The debug executive will not be loaded. In this mode the emulator can only toggle the MCLR line to reset and start the target. A breakpoint cannot be set, and register contents cannot be seen or altered.

The MPLAB REAL ICE in-circuit emulator system programs the target using ICSP. No clock is required while programming, and all modes of the processor can be programmed, including code protect, Watchdog Timer enabled and table read protect.

**Note:** A header board is required to debug some devices. These parts can be programmed without the header by connecting the VPP, PGC and PGD lines as described previously.



## 2.9 RESOURCES USED BY THE MPLAB REAL ICE IN-CIRCUIT EMULATOR

The MPLAB REAL ICE in-circuit emulator may use on-chip resources when debugging, depending on the device.

### 2.9.1 dsPIC DSC/PIC24 Devices

The emulator device (*Device-ICE*) and header board may be used with the emulator for debugging functions without loss of pins. For more information, see the "*Header Board Specification*" (DS51292).

#### General Resources Used

- $\overline{\text{MCLR}}/\text{VPP}$  shared for programming

#### Program/Data Memory Used

In MPLAB IDE, program memory and/or data memory (file register) displays marked with an "R" represent reserved registers.

Device	Program Memory Used	File Registers Used
dsPIC DSC/PIC24 ( <i>device-ICE</i> )	None*	0x800-0x822

\* No user program memory space used for debug.



## Chapter 3. Installation

### 3.1 INTRODUCTION

How to install the MPLAB REAL ICE in-circuit emulator system is discussed.

- Installing the Software
- Installing the USB Device Drivers
- Selecting Target Communications
- Connecting the Logic Probes
- Connecting and Powering the Emulator
- Connecting and Powering the Target

### 3.2 INSTALLING THE SOFTWARE

To install the MPLAB IDE software, first acquire the latest MPLAB IDE installation executable (*MPxxxxxx.exe*, where *xxxxxx* represents the version of MPLAB IDE) from either the Microchip web site ([www.microchip.com](http://www.microchip.com)) or the MPLAB IDE CD-ROM (DS51123). Then run the executable and follow the screens to install MPLAB IDE.

**Note:** MPLAB IDE v7.43 or greater is required for MPLAB REAL ICE in-circuit emulator functionality.

### 3.3 INSTALLING THE USB DEVICE DRIVERS

MPLAB REAL ICE in-circuit emulator USB device drivers must be installed before the emulator can use USB communications. Follow the html instructions found at the location below to install the drivers:

*MPLAB IDE installation directory\REAL ICE\Drivers\ddri.htm*

**Note:** If you change USB ports/hubs, you will need to reinstall the drivers.

### 3.4 SELECTING TARGET COMMUNICATIONS

If you have not already done so, insert the desired driver board into the emulator pod and attach the cables. To change a driver board, unplug the USB and target power, remove the board, insert the other board, plug in the USB and power the target.

#### CAUTION

Neither the emulator nor target should be powered when inserting or removing a driver board or damage to the driver board could result.

A driver board is inserted into the pod to select the type of communication with the target, either standard (for header boards and many demo boards) or high speed (for target boards over six inches away from the emulator). See **Section 2.4 "System Configurations"** for more details.