PIC32 USB Starter Kit II
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.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Trademarks

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, 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.

Table of Contents

NOTES:

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) 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 "DSXXXXXA", where "XXXXX" 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 online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the PIC32 USB Starter Kit II. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the PIC32 Starter Kit II as a development tool to emulate and debug firmware on a target board. The user guide is composed of the following chapters:

- **Chapter 1. "Introduction"** provides a brief overview of the PIC32 USB Starter Kit II, highlighting its features and uses.
- **Chapter 2. "Tutorial"** provides step-by-step instructions for installing the PIC32 USB Starter Kit II and MPLAB® IDE to build and run the tutorial program on the PIC32 USB Starter Kit II.
- **Chapter 3. "Create a New Project"** provides step-by-step instructions for creating a new project using the MPLAB IDE and loading it onto the PIC32 USB Starter Kit II.
- **Chapter 4. "Hardware"** provides the hardware description of the PIC32 USB Starter Kit II.
- **Appendix A. "Board Layout and Schematics"** provides a block diagram, board layouts, and detailed schematics of the PIC32 USB Starter Kit II.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* 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	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
`Plain Courier New`	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 (in source code)	`0xFF, 'A'`
`Italic Courier New`	A variable argument	*`file.o`*, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the PIC32 USB Starter Kit II. The following Microchip documents are available and recommended as supplemental reference resources.

Release Notes for PIC32 Starter Kit

For the latest information on the PIC32 USB Starter Kit II, open `PIC32 USB Starter Kit II Release Notes.htm` located in either the root directory of the PIC32 USB Starter Kit II CD or (default):

```
C:\Microchip Starter Kits\PIC32 Starter Kits\documentation
```

The file generally contains the most current update information, as well as any issues that may not have been available when this user's guide was published.

PIC32 Data Sheet (DS61143)

Consult this document for detailed information on PIC32 32-bit devices. Reference information found in this data sheet includes:

- Device memory map
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the device

MPLAB® C Compiler for PIC32 User's Guide (DS51686)

This document, formerly the MPLAB C32 C Compiler for PIC32 User's Guide, details the use of Microchip's MPLAB C Compiler for PIC32 to develop an application.

MPLAB® IDE User's Guide (DS51519)

Consult this document for more information pertaining to the installation and implementation of the MPLAB IDE software, as well as the MPLAB Editor and MPLAB SIM Simulator software that are included with it.

Universal Serial Bus Specification and Associated Documents

The Universal Serial Bus is defined by the USB 2.0 specification and its associated supplements and class-specific documents. These documents are available from the USB Implementers Forum. See their website at http://www.usb.org.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at http://www.microchip.com. This web site makes files and information easily available to customers. Accessible by most Internet browsers, 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 listings
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listings of seminars and events; and listings of Microchip sales offices, distributors and factory representatives

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at http://www.microchip.com, click **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, and MPLAB C Compiler for PIC32; ASM32, MPASM™ and MPLAB ASM30 assemblers; MPLINK™, and MPLAB LINK30, MPLAB LINK32 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators. This includes the MPLAB REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes the MPLAB ICD 3 and PICkit™ 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 device programmer and the PICSTART® Plus, PICkit™ 1 and PICkit 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

DOCUMENT REVISION HISTORY

Revision A (November 2009)

This is the initial release of the PIC32 USB Starter Kit II User's Guide.

NOTES:

Chapter 1. Introduction

Thank you for purchasing the Microchip Technology PIC32 USB Starter Kit II. The board included in the starter kit provides a low-cost, modular development system for Microchip's line of 32-bit microcontrollers.

The starter kit comes preloaded with demonstration software for the user to explore the new features of the PIC32. It is also expandable through a modular expansion interface, which allows the user to extend its functionality. The PIC32 USB Starter Kit II also supplies on-board circuitry for full debug and programming capabilities.

This chapter covers the following topics:

- Kit Contents
- PIC32 Functionality and Features

The preprogrammed example code on the PIC32 MCU is available via download from the Microchip web site at http://www.microchip.com. All project files have been included so that the code may be used directly to restore the PIC32 MCU on the starter kit to its original state (i.e., if the sample device has been reprogrammed with another program) or so you can use the tutorial code as a platform for further experimentation. Refer to **2.2 "Installing the PIC32 USB Starter Kit II Software"** for download and installation instructions.

1.1 KIT CONTENTS

The PIC32 USB Starter Kit II contains the following items:

- PIC32 USB Starter Kit II development board
- USB Mini-B to full-sized A cable – USB debug cable to debug and power the board
- USB Micro-B to full-sized A cable – PIC32 USB cable to communicate with the PIC32 USB port

If you are missing any part of the kit, contact a Microchip sales office for assistance. A list of Microchip offices for sales and service is provided on the back page of this document.

1.2 PIC32 FUNCTIONALITY AND FEATURES

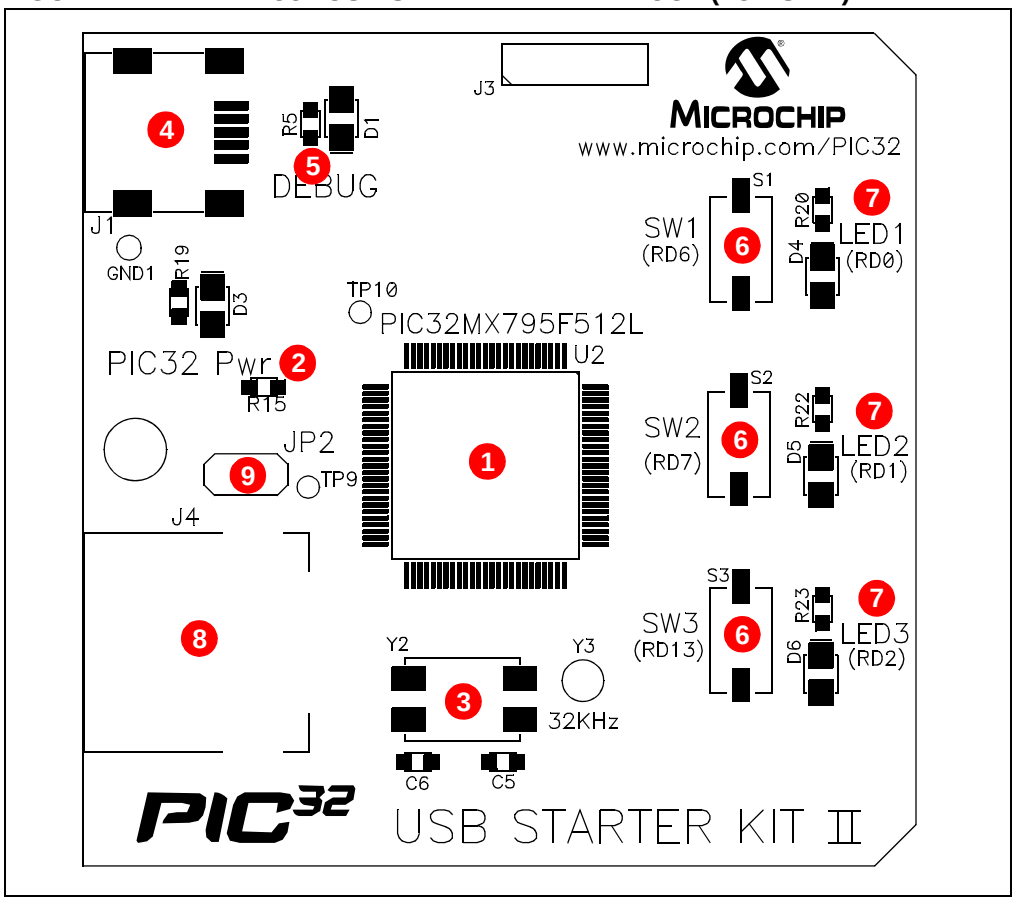
Representations of the layout of the PIC32 USB Starter Kit II are shown in Figure 1-1 and Figure 1-2.

The top assembly of the board includes these key features, as indicated in Figure 1-1:

1. PIC32MX795F512L 32-bit microcontroller.
2. Green power-indicator LED.
3. On-board crystal for precision microcontroller clocking (8 MHz).
4. USB connectivity for on-board debugger communications.
5. Orange debug indicator LED.
6. Three push button switches for user-defined inputs.
7. Three user-defined indicator LEDs.
8. USB Type A receptacle connectivity for PIC32 Host-based applications.
9. HOST mode power jumper.

Note: When running USB device applications, open the jumper JP2 to prevent possibly back-feeding voltage onto the VBUS from one port on the host to another (or from one host to another).

FIGURE 1-1: PIC32 USB STARTER KIT II LAYOUT (TOP SIDE)



The bottom assembly of the board includes these key features, as indicated in Figure 1-2:

1. PIC32MX440F512H USB microcontroller for on-board debugging.
2. Regulated +3.3V power supply for powering the starter kit via USB or expansion board.
3. Connector for various expansion boards.
4. USB Host and OTG power supply for powering PIC32 USB applications.
5. USB Type Micro-AB receptacle for OTG and USB device connectivity for PIC32 OTG/device-based applications.

FIGURE 1-2: PIC32 USB STARTER KIT II LAYOUT (UNDERSIDE)

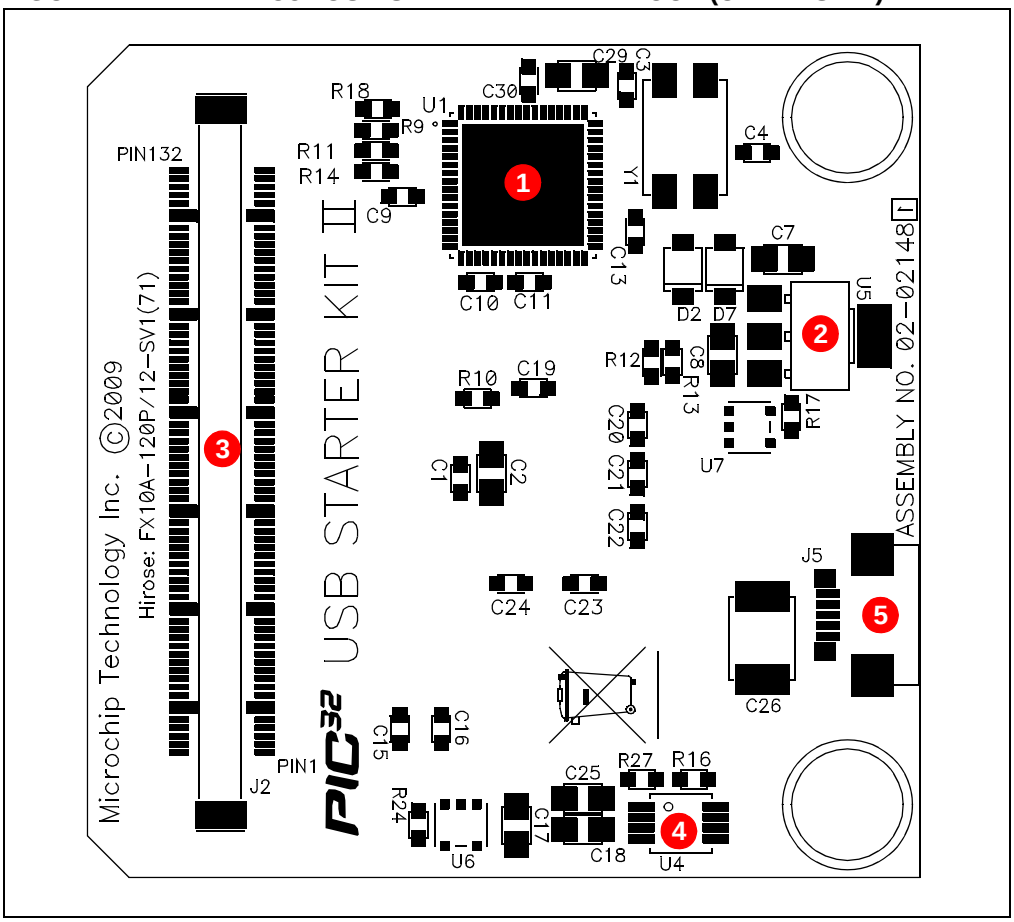


Table 1-1 shows the 100-pin to J2 connector serial communication mapping for the key digital modules available on the PIC32 device.

Serial communication module pins are multiplexed. These pins can be used for a single serial communication module or can be split between two serial communication modules. For example, four pins can be selected for the UART module with flow control, or the UART module can be selected without flow control, which uses only two pins, leaving two pins available for use by the I^2C™, SPI, or ECAN™ modules.

TABLE 1-1: J2 CONNECTOR MAP FOR SERIAL COMMUNICATIONS

PIC32 Pin	J2 Connector	UARTA	UARTB	I2CA	SPIA	ECAN™
10	45	$\overline{\text{U2ARTS}}$	U2BTX	—	SCK2A	—
11	47	U2ARX	—	SDA2A	SDI2A	—
12	49	U2ATX	—	SCL2A	SDO2A	—
14	51	$\overline{\text{U2ACTS}}$	U2BRX	—	$\overline{\text{SS2A}}$	—
39	106	$\overline{\text{U3ARTS}}$	U3BTX	—	SCK3A	AC1TX
40	108	$\overline{\text{U3ACTS}}$	U3BRX	—	$\overline{\text{SS3A}}$	AC1RX
47	94	$\overline{\text{U1ACTS}}$	U1BRX	—	$\overline{\text{SS1A}}$	—
48	92	$\overline{\text{U1ARTS}}$	U1BTX	—	SCK1A	—
49	110	U3ARX	—	SDA3A	SDI3A	—
50	112	U3ATX	—	SCL3A	SDO3A	—
52	88	U1ARX	—	SDA1A	SDI1A	—
53	90	U1ATX	—	SCL1A	SDO1A	—

Chapter 2. Tutorial

This chapter is a self-paced tutorial to get you started using the PIC32 USB Starter Kit II. Items discussed in this chapter include:

- Host Computer Requirements
- Installing the PIC32 USB Starter Kit II Software
- Using the PIC32 USB Starter Kit II Out of the Box
- Starting the Tutorial Project
- Building the Project
- Programming the Device
- Running the Program
- Tutorial Program Operation

2.1 HOST COMPUTER REQUIREMENTS

To communicate with and program the starter kit, the following hardware and software requirements must be met:

- PC-compatible system
- Two available USB ports on PC or powered USB hub
- Microsoft Windows® XP® or Windows Vista® operating system (the PIC32 USB Starter Kit II has not been tested on the Windows NT® and Windows 2000® operating systems).

2.2 INSTALLING THE PIC32 USB STARTER KIT II SOFTWARE

As a USB device, the starter kit board requires very little effort to install; most of the work is done by the operating system. Begin by closing all applications.

2.2.1 Install the Tools and Projects

1. Insert the PIC32 Starter Kit CD into your CD-ROM drive and click the **Install from CD** menu option. If the installation application does not automatically start, navigate to the files on the CD and open `setup.exe`.

   The following window appears:

FIGURE 2-1: INSTALLING THE PIC32 STARTER KIT BOARD

2. Reboot your system when prompted to do so.

Note:	The dialog also provides an option to check the Microchip web site for newer versions of the starter kit software.

2.2.2 View the Getting Started Tutorial

Perform the following steps to view the tutorial:

1. After your computer has rebooted, the Getting Started Tutorial menu opens.
2. View the tutorial instructions for connecting to the starter kit board and running the tutorial project.

If you performed the installation steps as you followed along in the Getting Started tutorial, skip to **Section 2.4 "Starting the Tutorial Project"** on page 21.

If you did not, continue to the next page for instructions about how to connect the board and install the device driver.

2.2.3 Connect the Starter Kit Board

Using the supplied USB cable, connect the board to an open USB port on your computer. (A USB hub that is *not bus-powered* can also be used.) Connect the other end of the cable into the USB connector on the starter kit board.

Check the board: the green power LED D3 should be lit. If it is not, check the connections at the port, hub and board.

2.2.4 Install the USB Device Driver

Note:	The USB driver installation steps described here refer specifically to installing the driver on a Microsoft Windows XP operating system.

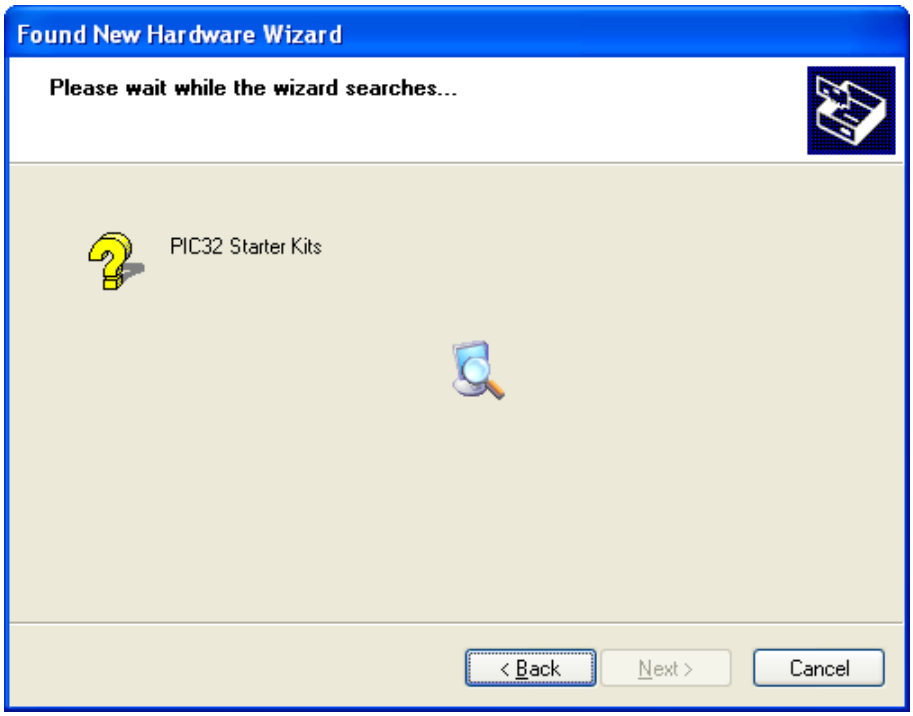
Perform the following steps to install the USB device driver:

1. When the USB cable is connected, the “Found New Hardware Wizard” dialog box opens, as shown in Figure 2-2. When asked whether to install the software automatically or install from a list or specific location, select “Install software automatically” and then click **Next**.

FIGURE 2-2: FOUND NEW HARDWARE WIZARD

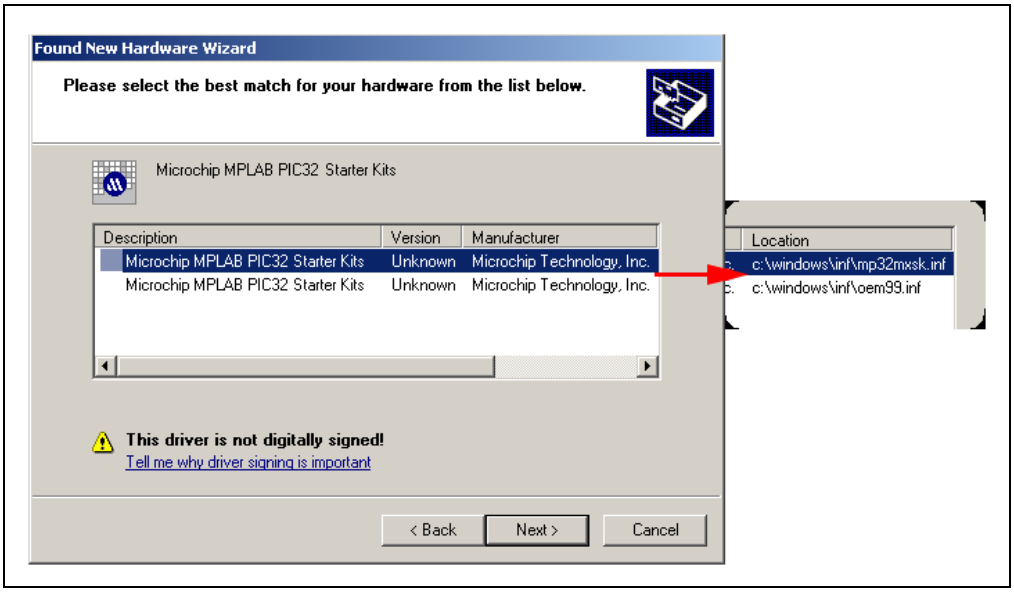
2. As shown in Figure 2-3, the next dialog box tracks the wizard as it searches for the device. (This activity may take several seconds.) When it is done, click **Next**.

FIGURE 2-3: HARDWARE WIZARD – SEARCHING FOR DEVICE



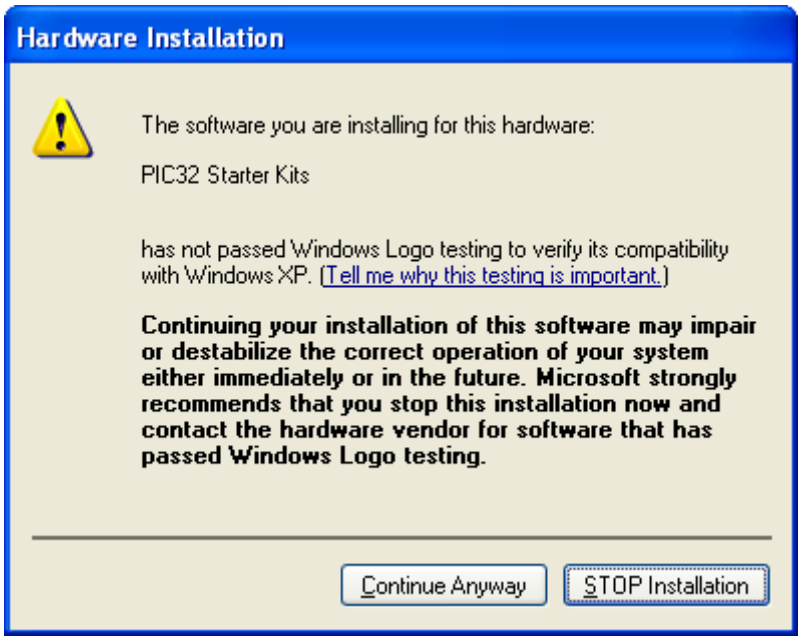
3. If prompted to select a driver, select `mp32mxsk.inf`, as shown in Figure 2-4. Click **Next** to continue.

FIGURE 2-4: HARDWARE WIZARD – SELECTING THE DRIVER



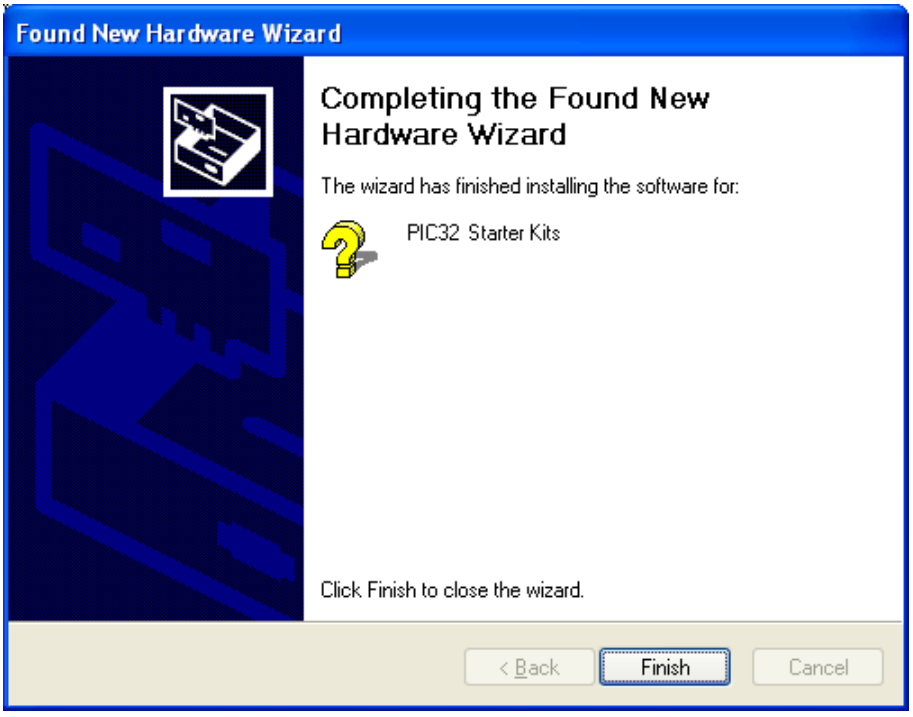
4. If prompted with a dialog box for Windows Logo testing, as shown in Figure 2-5, click **Continue Anyway**.

FIGURE 2-5: WINDOWS® LOGO TESTING



5. The next window (Figure 2-6) indicates that the installation of the software for the starter kit is complete. Click **Finish**.

FIGURE 2-6: COMPLETING DEVICE DRIVER INSTALLATION



2.3 USING THE PIC32 USB STARTER KIT II OUT OF THE BOX

Install the software before connecting the board to the host PC. The PIC32 USB Starter Kit II board may be used directly from the box as a demonstration board for the PIC32 device. The PIC32 is preprogrammed with the classic "Simon Says" game (`simon_says_demo.hex`) in the PIC32MX795F512L device and is ready for immediate use.

2.3.1 How to Play the Game

When the USB debug cable is plugged into the starter kit's Mini-B (debug) receptacle, the three LEDs start blinking to indicate the start of a new game. Begin the game by pressing one of the switches, SW1-SW3, to choose the level of game difficulty. SW3 is the easiest, SW1 is the hardest. The goal is to imitate the light patterns as long as you can, without getting frazzled. Ultimately, you will make a mistake and all of the LEDs will light up to signal the end of the game. After a brief pause, you can press any switch to start a new game.

If you launch MPLAB IDE and connect to the starter kit while the game is running, the game will stop. Further, if you perform a debug or program operation from MPLAB IDE, the demo application will be replaced with the current MPLAB IDE project application. However, the game can be reloaded onto the starter kit by opening the file, `simon_says_demo.mcw`, from the following location:

```
[install directory]\PIC32 Starter Kits\simon_says_demo
```

The preprogrammed example code on the PIC32 has been included in the PIC32 USB Starter Kit II demo-projects download file, which is available from the Microchip web site (www.microchip.com). All project files have been included so that the code may be used directly to restore a PIC32 to its original state (i.e., if the sample device has been reprogrammed with another program), or so you can use the tutorial code as a platform for further experimentation.

2.4 STARTING THE TUTORIAL PROJECT

1. Connect the starter kit to the host PC and click the MPLAB IDE icon on your computer desktop. Select *File>Open Workspace...* from the menu bar and browse to the tutorial project file:

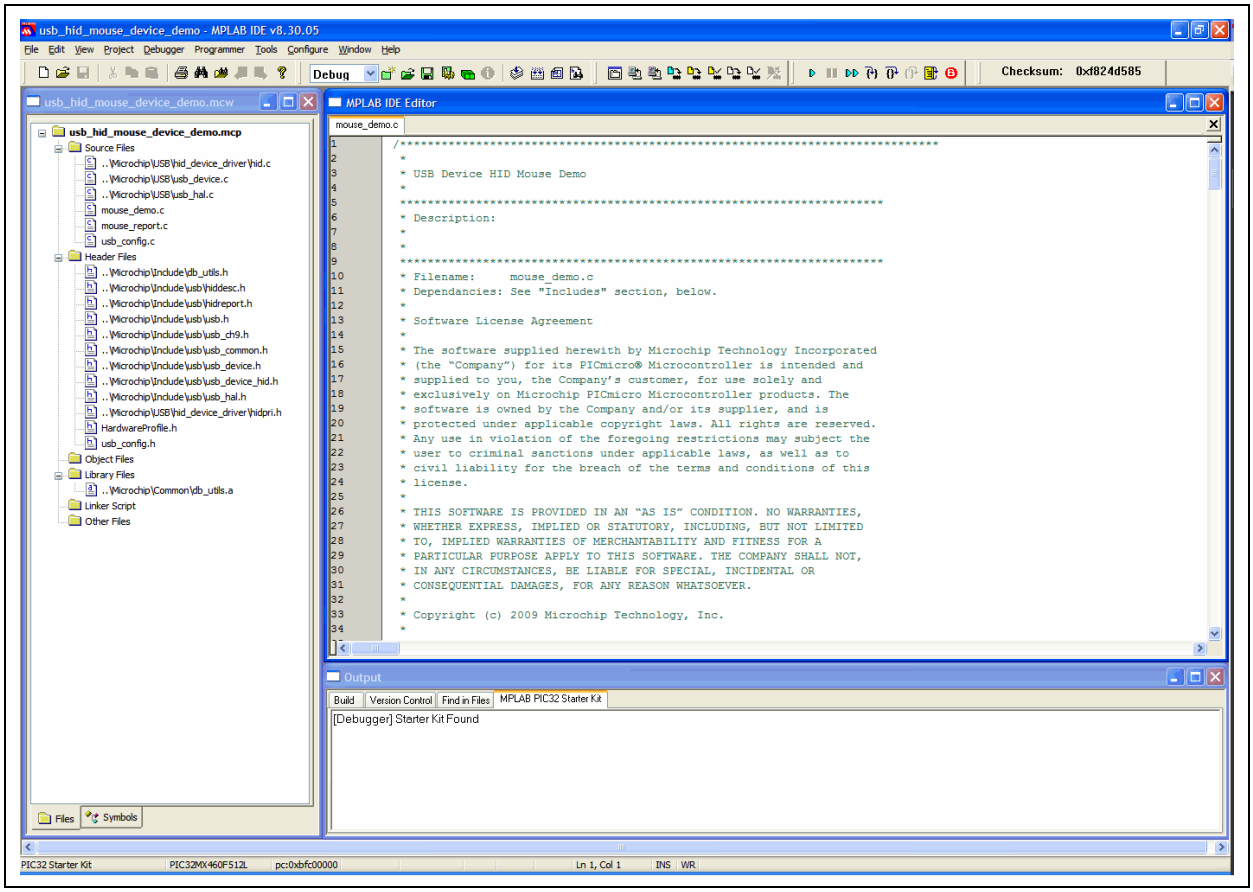
   ```
   [install directory]\PIC32 Starter Kits\
       usb_sk_hid_mouse_device_demo
   ```

   or browse to the file path that you used when you installed MPLAB IDE.

   The pane on the left of the MPLAB IDE interface displays project files, the '.c', '.h' and '.a' (library) files that are used to build an application. The project files are organized by type into folders.

2. Select *Debugger>Select Tool>PIC32 Starter Kit* from the menu bar. "Starter Kit Found" should appear in the "Output" pane of the MPLAB IDE interface. If not, check the driver installation, as well as the connections between the hardware and the PC.

FIGURE 2-7: MPLAB® IDE WORKSPACE

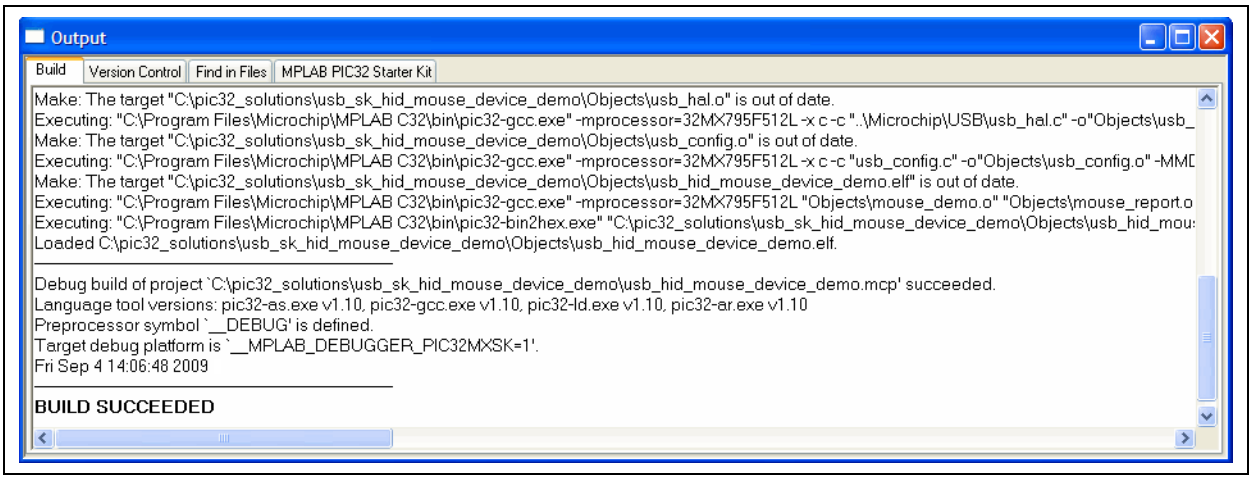


2.5 BUILDING THE PROJECT

From the menu bar of the main MPLAB IDE window, select *Project>Make*. The build Output window appears, as shown in Figure 2-8.

Observe the progress of the build. When the "BUILD SUCCEEDED" message appears, you are ready to program the device.

FIGURE 2-8: BUILD OUTPUT WINDOW



2.6 PROGRAMMING THE DEVICE

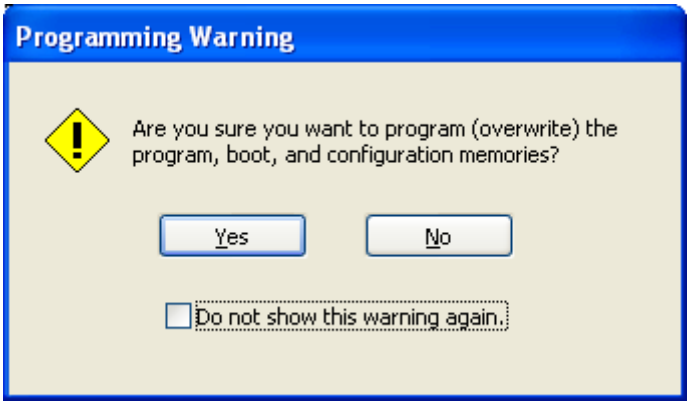
2.6.1 Program the Device

1. Click the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 2-9.

FIGURE 2-9: PROGRAM DEVICE TOOL BAR

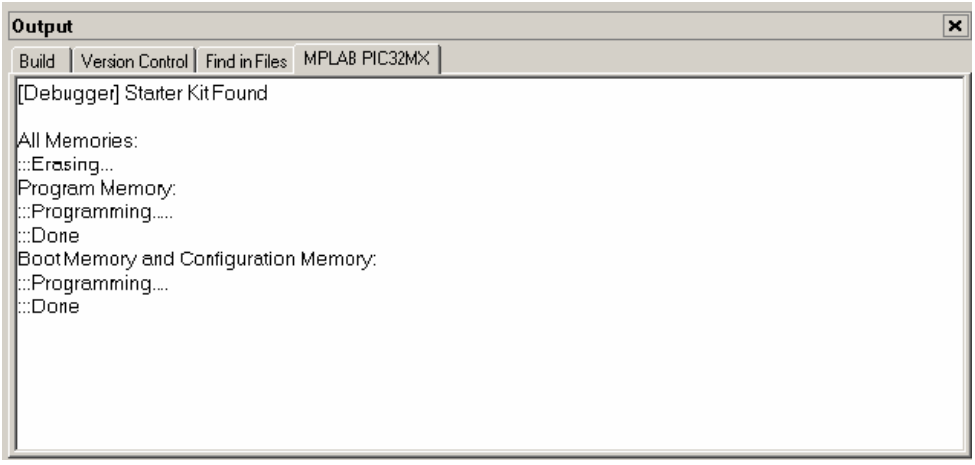
2. A Programming Warning window, shown in Figure 2-10, opens to warn you about overwriting the memory. Click **Yes**.

FIGURE 2-10: PROGRAMMING WARNING WINDOW



3. The Output window, shown in Figure 2-11, tracks the progress of the output. A “Done” entry indicates that the programming of the device is complete.

FIGURE 2-11: OUTPUT WINDOW



2.7 RUNNING THE PROGRAM

Either select *Debugger>Run* from the menu bar of the MPLAB IDE or click the Run icon (the turquoise triangle) on the Debug Tool Bar, shown in Figure 2-12, to run the new program.

FIGURE 2-12: DEBUG WINDOW

2.8 TUTORIAL PROGRAM OPERATION

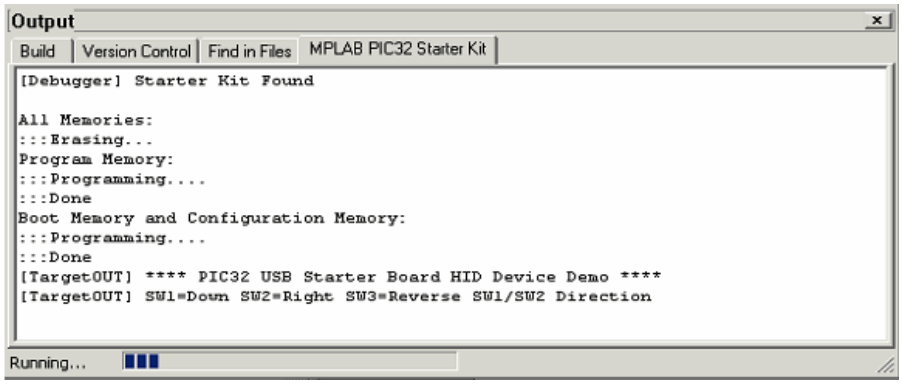
The USB Human Interface Device (HID) mouse tutorial project demonstrates a simple USB peripheral device by emulating a mouse. Make the following connections to run the mouse demo:

1. Move jumper JP2 to the open position.
2. Use the USB debug cable (Mini-B to A) to attach the board's debug connector J1 to the first USB port of the host PC. The board's power source comes from the debugger connection.
3. Use the USB Micro-B to full-sized A cable to attach the board's J5 connector (type Micro-AB receptacle) to the second USB port of the host PC.

Note: For the HID mouse demo (and all other USB device demos), the JP2 jumper should be open to prevent the possibility of back-feeding voltage onto the VBUS from one port on the host to another (or from one host to another).

After a pause, the PIC32 USB Starter Kit II will enumerate as a standard mouse HID, using drivers built into the host's operating system. The successful completion of this process is usually accompanied by a "bing-bong" tone from the host PC. The output window will display a message indicating that the demo is running, as shown in Figure 2-13.

FIGURE 2-13: OUTPUT WINDOW



To move the mouse cursor, press the button switches on the starter kit. Table 2-1 shows the action associated with each button.

TABLE 2-1: BUTTONS FOR CURSOR MOVEMENT

Button Pressed	Mouse Cursor Action
SW1	Moves Cursor Down
SW2	Moves Cursor to Right
SW1 and SW3	Moves Cursor Up
SW2 and SW3	Moves Cursor Left

To disable the HID mouse demo, disconnect the host PC from the Micro-AB receptacle on the starter kit. The host PC usually plays a reverse “bong-bing” tone to indicate the successful disconnection of the peripheral device.

NOTES:

Chapter 3. Create a New Project

This chapter explains how to create a new project. Items discussed in this chapter include:

- Creating a New Project
- Building the Project
- Programming the Device
- Running the Program

After completing this chapter, you should be able to accomplish the following tasks:

- Create a project using the Project Wizard
- Assemble and link the code, and set the Configuration bits
- Set up the MPLAB IDE to use the PIC32USB Starter Kit II
- Program the chip and run the program

3.1 CREATING A NEW PROJECT

The first step is to create a project and a workspace in the MPLAB IDE. Typically, there is a single project per workspace. A project contains the files needed to build an application (i.e., source code, header files, library, etc.), and their corresponding build options. A workspace contains one or more projects, information on the selected device, debug/programmer tool, and MPLAB IDE configuration settings.

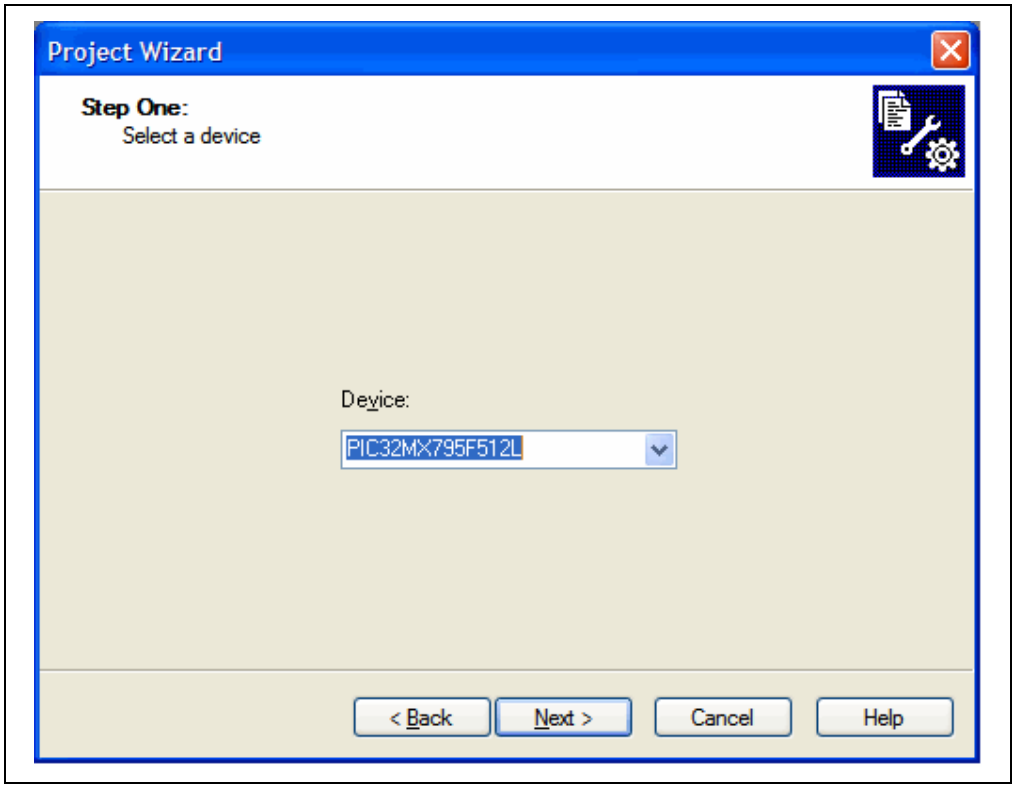
MPLAB IDE contains a Project Wizard to help create a new project.

You will perform the following tasks as you create a new project:

3.1.1 Task 1: Select a Device

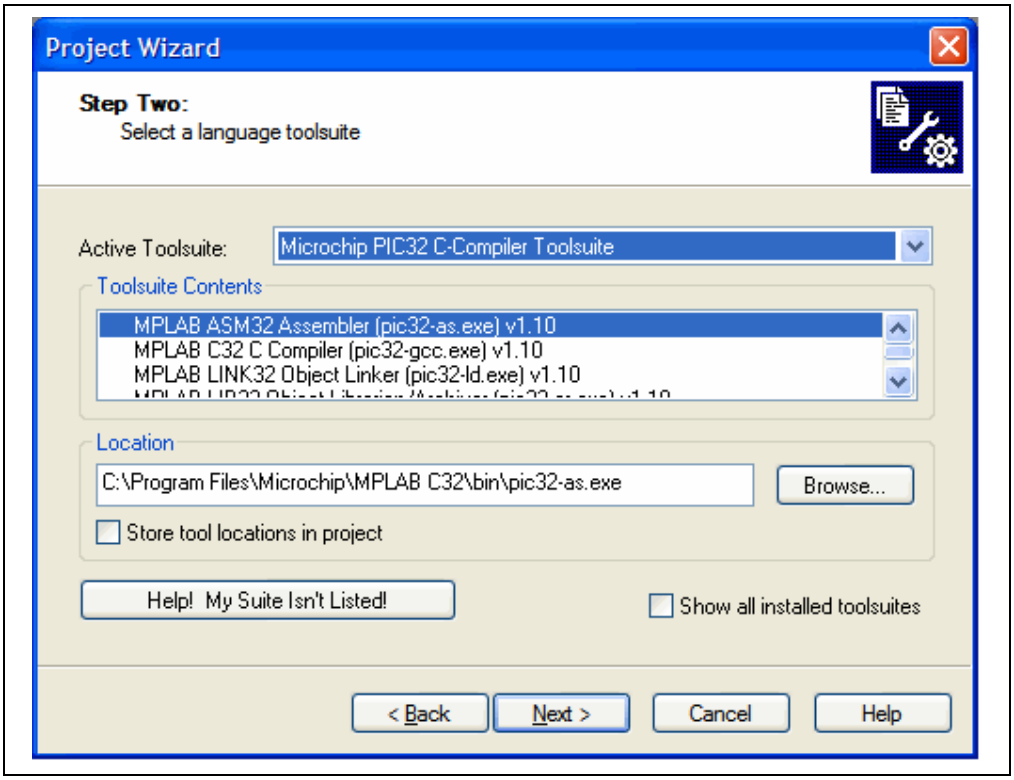
1. Start MPLAB IDE.
2. Select *File>Close Workspace* on the menu bar, to close any open workspace.
3. Select *Project>Project Wizard...* to start the wizard.
4. In the Welcome window, click **Next**. The Project Wizard Step One: window is displayed, as shown in Figure 3-1.

FIGURE 3-1: SELECTING THE DEVICE



5. From the "Device" drop-down list, select "PIC32MX795F512L".
6. Click **Next**. The Project Wizard Step Two: dialog box opens, as shown in Figure 3-2.

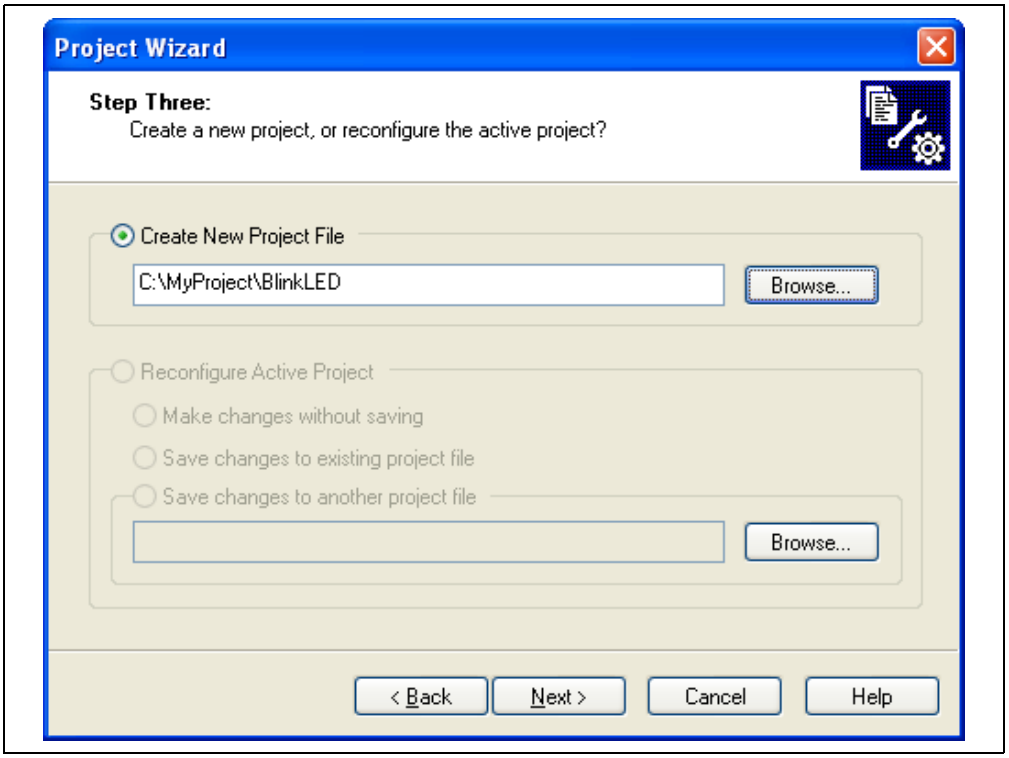
FIGURE 3-2: SELECTING THE TOOLSUITE



3.1.2 Task 2: Select the Language Toolsuite

1. From the “Active Toolsuite” drop-down list, select “Microchip PIC32 C Compiler Toolsuite”. The toolsuite includes the compiler, assembler and linker that will be used. If the PIC32 compiler option is not available, check the “Show all installed toolsuites” box.
2. Click **Next** to continue. The Project Wizard Step Three: dialog opens, as shown in Figure 3-3.

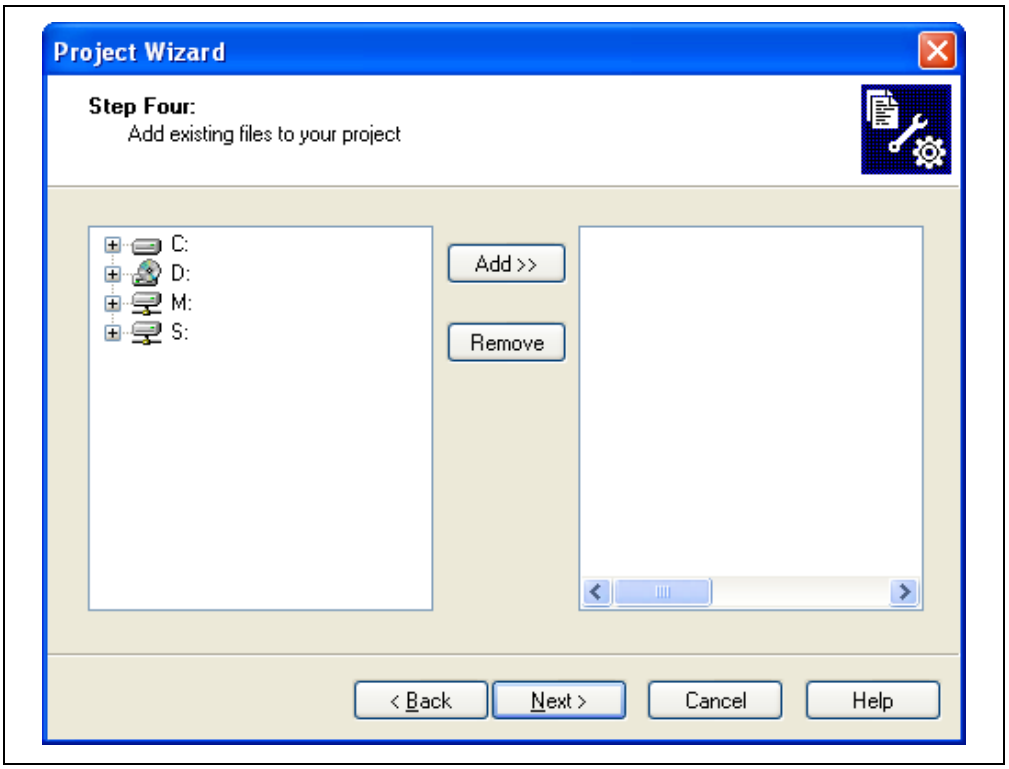
FIGURE 3-3: NAMING YOUR PROJECT



3.1.3 Task 3: Name Your Project

1. In the "Create New Project File" field, type `C:\MyProject\BlinkLED`.
2. Click **Next** and **OK** to continue. The Project Wizard Step Four: dialog opens, as shown in Figure 3-4.

FIGURE 3-4: ADDING FILES TO THE PROJECT



3.1.4 Task 4: Add Files to Your Project

This window can be skipped, since no '.c' files have been created.

1. Click **Next** to continue.
2. Click **Finish** on the summary screen. A project and workspace have been created in the MPLAB IDE.

   BlinkLED.mcw is the workspace file and BlinkLED.mcp is the project file.
3. Select *File>New* from the menu bar to create a new file. A new file is created.
4. Select *File>Save As...* and save this file as 'BlinkLED.c' in the same folder, in this case, the C:\MyProject folder.
5. Now copy the source code provided in Example 3-1 to the BlinkLED.c file. The source code file is located in the PIC32 USB Starter Kit II directory: [install directory]\PIC32 Starter Kits\Blink_Leds

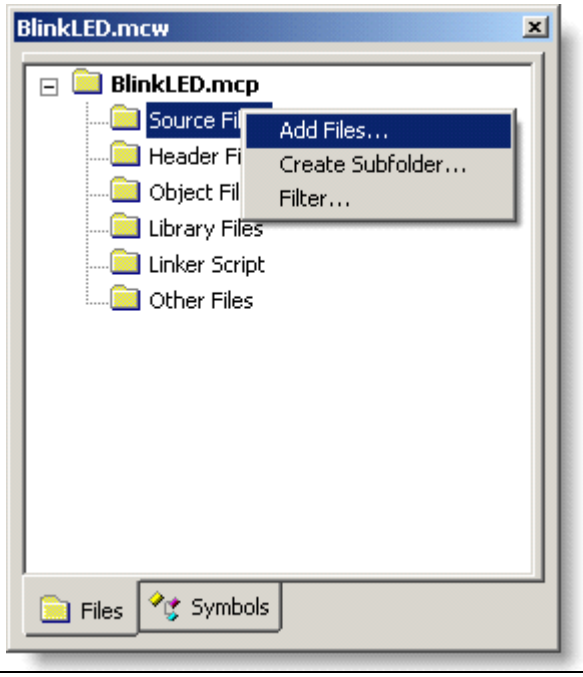
EXAMPLE 3-1: PROJECT SOURCE CODE

```
#include <plib.h>  // Adds support for PIC32 Peripheral Library functions and macros

void Delay(unsigned int count)
{
    while(--count);
}

int main(void)
{
   /* LED setup - Turn off leds before configuring the IO pin as output */
   mPORTDClearBits(BIT_0 | BIT_1 | BIT_2);             // same as LATDCLR = 0x0007

   /* Set RD0, RD1 and RD2 as outputs */
   mPORTDSetPinsDigitalOut(BIT_0 | BIT_1 | BIT_2 );    // same as TRISDCLR = 0x0007

   /* endless loop */
   while(1)
   {
      Delay(200000);
      mPORTDToggleBits(BIT_0);       // toggle LED0 (same as LATDINV = 0x0001)

      Delay(200000);
      mPORTDToggleBits(BIT_1);       // toggle LED1 (same as LATDINV = 0x0002)

      Delay(200000);
      mPORTDToggleBits(BIT_2);       // toggle LED2 (same as LATDINV = 0x0004)
   };
   return 0;
}
```

6. In the Project window, right click the Source Files folder. Select "Add Files" and choose BlinkLED.c to add the file to the source directory, as shown in Figure 3-5.

Note: The Debug Print Library is automatically included by defining PIC32_STARTER_KIT as a compile time option (*Project>Build Options>Project>MPLAB PIC32 Compiler>Preprocessor Macros*), and including the file, Plib.h, in the source file.

FIGURE 3-5: ADDING SOURCE FILES



7. Select *Debugger>Select Tool>PIC32 Starter Kit* from the menu bar, for the Target board.

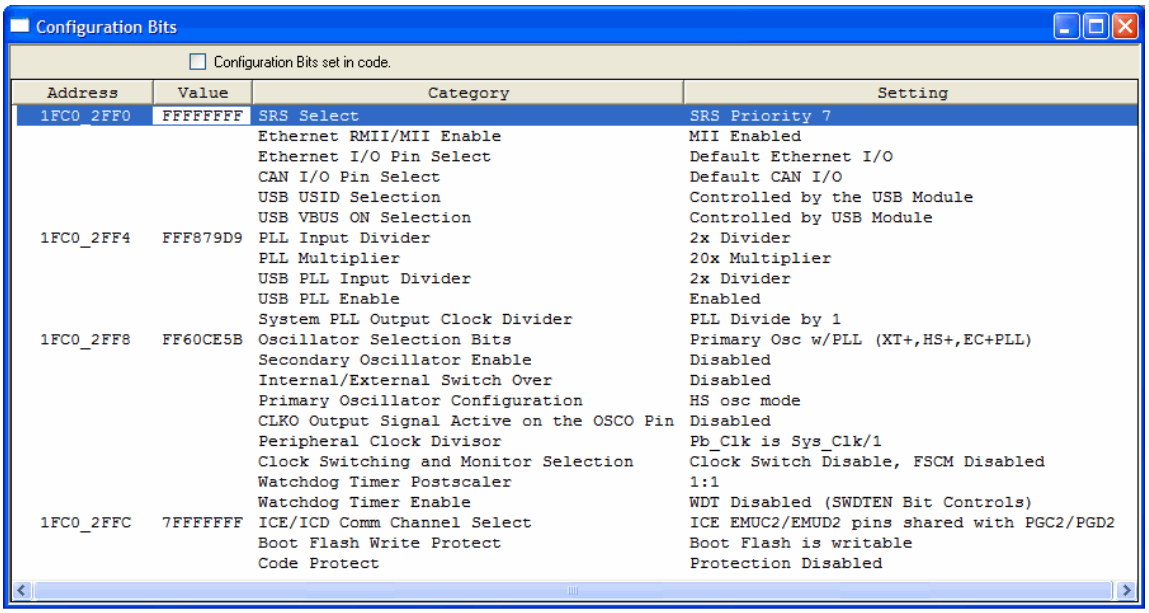
Note:	Make sure that the starter kit is connected to your PC.

3.1.5 Task 5: Confirm the Configuration Settings

Select *Configure>Configuration Bits* to confirm that the configuration settings are correct. Typical configuration settings for the starter kit are shown in Figure 3-6.

Note:	The "Configuration Bits set in code" check box must be clear (not checked) if the configuration bits are set via this window and not in the code. The configuration settings can also be embedded in the source file. See the "*MPLAB C Compiler for PIC32 User's Guide*" (DS51686) for information.

FIGURE 3-6: CONFIGURATION BIT SETTINGS



Address	Value	Category	Setting
1FC0_2FF0	FFFFFFFF	SRS Select	SRS Priority 7
		Ethernet RMII/MII Enable	MII Enabled
		Ethernet I/O Pin Select	Default Ethernet I/O
		CAN I/O Pin Select	Default CAN I/O
		USB USID Selection	Controlled by the USB Module
		USB VBUS ON Selection	Controlled by USB Module
1FC0_2FF4	FFF879D9	PLL Input Divider	2x Divider
		PLL Multiplier	20x Multiplier
		USB PLL Input Divider	2x Divider
		USB PLL Enable	Enabled
		System PLL Output Clock Divider	PLL Divide by 1
1FC0_2FF8	FF60CE5B	Oscillator Selection Bits	Primary Osc w/PLL (XT+,HS+,EC+PLL)
		Secondary Oscillator Enable	Disabled
		Internal/External Switch Over	Disabled
		Primary Oscillator Configuration	HS osc mode
		CLKO Output Signal Active on the OSCO Pin	Disabled
		Peripheral Clock Divisor	Pb_Clk is Sys_Clk/1
		Clock Switching and Monitor Selection	Clock Switch Disable, FSCM Disabled
		Watchdog Timer Postscaler	1:1
		Watchdog Timer Enable	WDT Disabled (SWDTEN Bit Controls)
1FC0_2FFC	7FFFFFFF	ICE/ICD Comm Channel Select	ICE EMUC2/EMUD2 pins shared with PGC2/PGD2
		Boot Flash Write Protect	Boot Flash is writable
		Code Protect	Protection Disabled

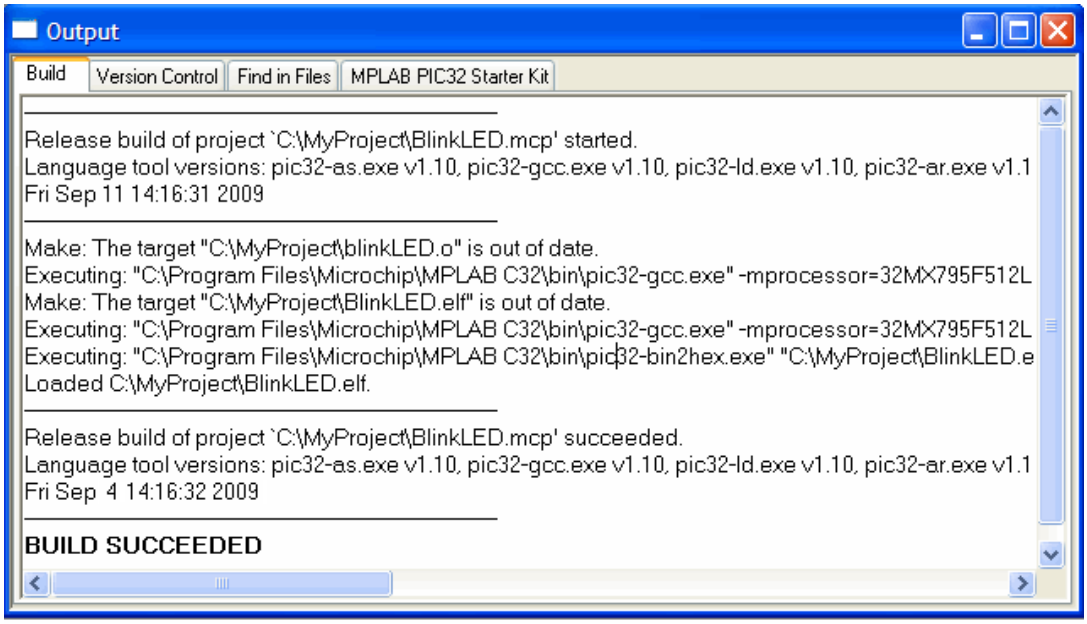
CAUTION

Setting the PIC32 USB Starter Kit II configuration bits to cause the PIC32 MCU to operate faster than the maximum 80 MHz system clock speed may cause the PIC32 MCU to stop communicating with the PIC32MX440F512H Starter Kit debugger. Should this occur, run the `sk_erase.exe` **utility to re-flash the PIC32 MCU with a default configuration. This utility is located on the PIC32 USB Starter Kit II CD or in the PIC32 USB Starter Kit II directory:**
`[install directory]\PIC32 Starter Kits\tools`

3.1.6 Task 6: Build the Project

1. Select *Project>Make* from the menu bar of the main MPLAB IDE window. The build Output window appears, as shown in Figure 3-7.
2. Observe the progress of the build. When the “BUILD SUCCEEDED” message displays, you are ready to program the device.

FIGURE 3-7: BUILD OUTPUT WINDOW



3.1.7 Task 7: Program the Device

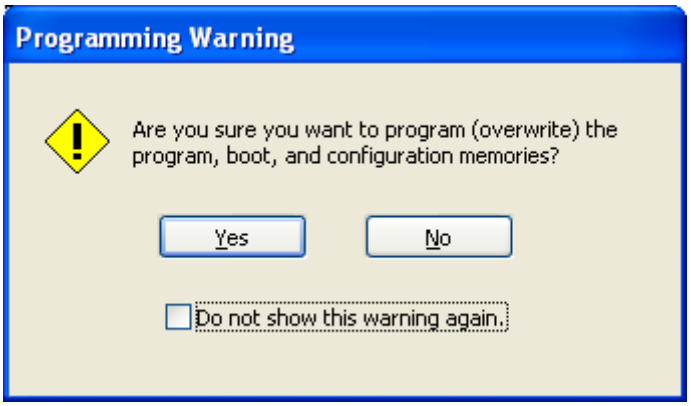
1. Click the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 3-8.

FIGURE 3-8: PROGRAM DEVICE WINDOW

A Programming Warning window opens to warn you about overwriting the memory, as shown in Figure 3-9.

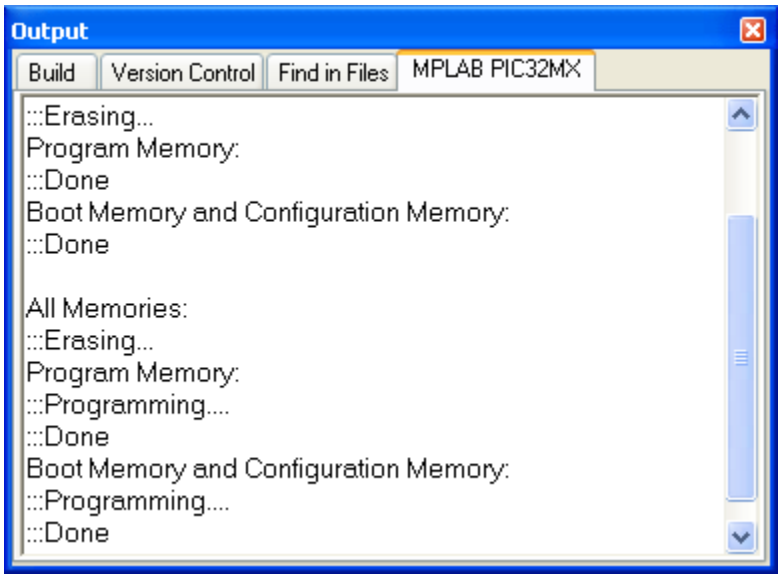
2. Click **Yes**.

FIGURE 3-9: PROGRAMMING WARNING WINDOW



The Output window, shown in Figure 3-10, tracks the progress of the output. A “Done” entry signals that the programming of the device is complete.

FIGURE 3-10: OUTPUT WINDOW



3.1.8 Task 8: Run the Program

Select *Debugger>Run* from the menu bar of the MPLAB IDE or click the Run icon (the turquoise triangle) on the Debug Tool Bar, as indicated in Figure 3-11, to run the new program.

FIGURE 3-11: RUN THE PROGRAM

The starter kit LEDs blink to indicate that the program is running successfully.

NOTES:

Chapter 4. Hardware

This chapter describes the hardware features of the PIC32 USB Starter Kit II.

4.1 HARDWARE FEATURES

The key features of the PIC32 USB Starter Kit II are listed below. They are presented in the order given in **Section 1.2 "PIC32 Functionality and Features"**. You can refer to Figure 1-1 for their locations on the board.

4.1.1 Processor Support

The PIC32 USB Starter Kit II is designed with a permanently mounted (i.e., soldered) PIC32MX795F512L processor.

4.1.2 Power Supply

There are two ways to supply power to the PIC32 USB Starter Kit II:

- USB bus power connected to USB debug connector J1.
- An external application board with a regulated DC power supply that provides +5V can be connected to the J2 application board connector that is provided on the bottom side of the board.

One green LED (D3) is provided to show that the PIC32 microcontroller is powered up.

4.1.3 Debug USB Connectivity

The PIC32 USB Starter Kit II includes a PIC32MX440F512H USB microcontroller that provides debugger connectivity over USB. The PIC32MX440F512H is hard wired to the PIC32 device to provide two types of protocol translation:

- I/O pins of PIC32MX440F512H to the ICSP™ pins of the PIC32
- I/O pins of PIC32MX440F512H to the JTAG pins of the PIC32

The PIC32 USB Starter Kit II currently uses the JTAG pins of the PIC32 device for programming and debugging.

4.1.4 PIC32 USB Connectivity

There are three possible ways to connect to the PIC32 USB microcontroller:

HOST Mode

Connect the device to the Type A connector J4, located on the top side of the starter kit. If using the Debug USB port to power the Host port, install jumper JP2 to short the back-power prevention diode. Note that a maximum of ~400 mA can be supplied from the Debug USB port to the Host port using this method.

If the full 500 mA supply is needed, an external supply must be connected to the application board and jumper JP2 must be removed to prevent back-powering the Debug USB port.

DEVICE Mode

First, connect the debug Mini-B USB cable to port J1. Next, connect the starter kit to the host using a cable with a Type-B Micro plug to the starter kit's Micro A/B port J5, located on the bottom side of the starter kit. The other end of the cable must have a Type-A plug. Connect it to a USB host. Jumper J2 should be removed.

OTG Mode

Connect the starter kit to the OTG device using an OTG Micro A/B cable to the Micro A/B port J5, located on the bottom side of the starter kit. The starter kit provides an on-board power supply capable of providing 120 mA Max. This supply is controlled by the PIC32MX795F512L microcontroller. Jumper J2 should be removed.

4.1.5 Switches

Push button switches provide the following functionality:

- SW1: Active-low switch connected to RD6
- SW2: Active-low switch connected to RD7
- SW3: Active-low switch connected to RD13

The switches do not have any debounce circuitry and require the use of internal pull-up resistors; this allows you to investigate software debounce techniques. When idle, the switches are pulled high (+3.3V). When pressed, they are grounded.

4.1.6 LEDs

The RD0 through RD2 LEDs are connected to PORTD of the processor. The PORTD pins are set high to light the LEDs.

4.1.7 Oscillator Options

The installed microcontroller has an oscillator circuit connected to it. The main oscillator uses an 8 MHz crystal (Y2) and functions as the controller's primary oscillator. Use of an external crystal is required to develop USB applications. The USB specification dictates a frequency tolerance of +/- 0.25% for full speed. Non-USB applications can use the internal oscillators. The starter kit also has provisions for an external secondary oscillator (Y3); however, this is not populated.

The PIC32MX440F512H is independently clocked and has its own 8 MHz crystal (Y1).

4.1.8 120-Pin Modular Expansion Connector

The PIC32 USB Starter Kit II has been designed with a 120-pin modular expansion interface, which allows the board to provide basic generic functionality now, and easy extendability to new technologies as they become available.

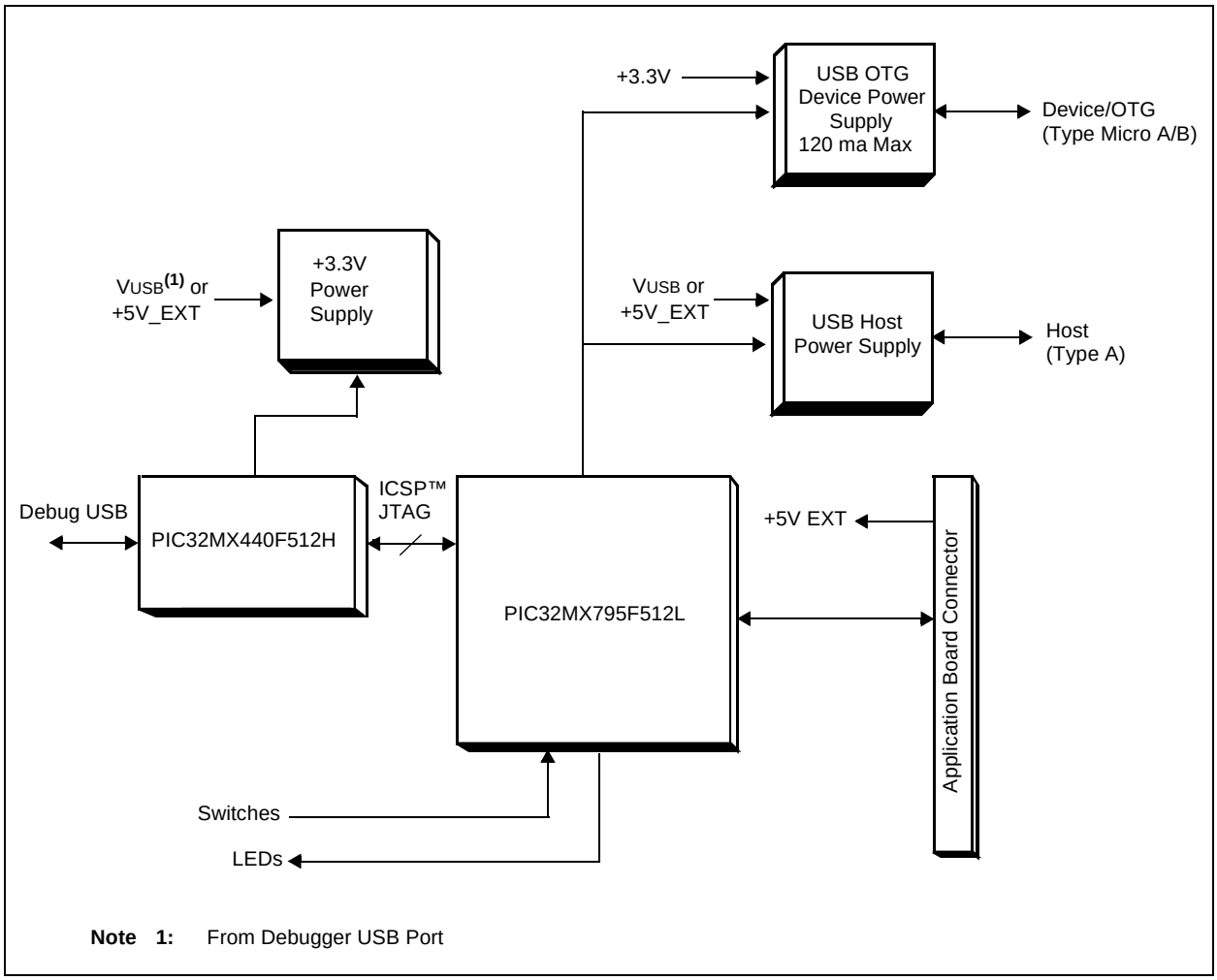
TABLE 4-1: STARTER KIT CONNECTOR PART NUMBERS

Connector	HIROSE Electric PN
Starter Kit Connector	FX10A-120P/12-SV1(71)
Application Board Connector	FX10A-120S/12-SV(71)

Appendix A. Board Layout and Schematics

A.1 BLOCK DIAGRAM

FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32 USB STARTER KIT II



Note 1: From Debugger USB Port

A.2 BOARD LAYOUT

FIGURE A-2: PIC32 USB STARTER KIT II LAYOUT (TOP ASSEMBLY)

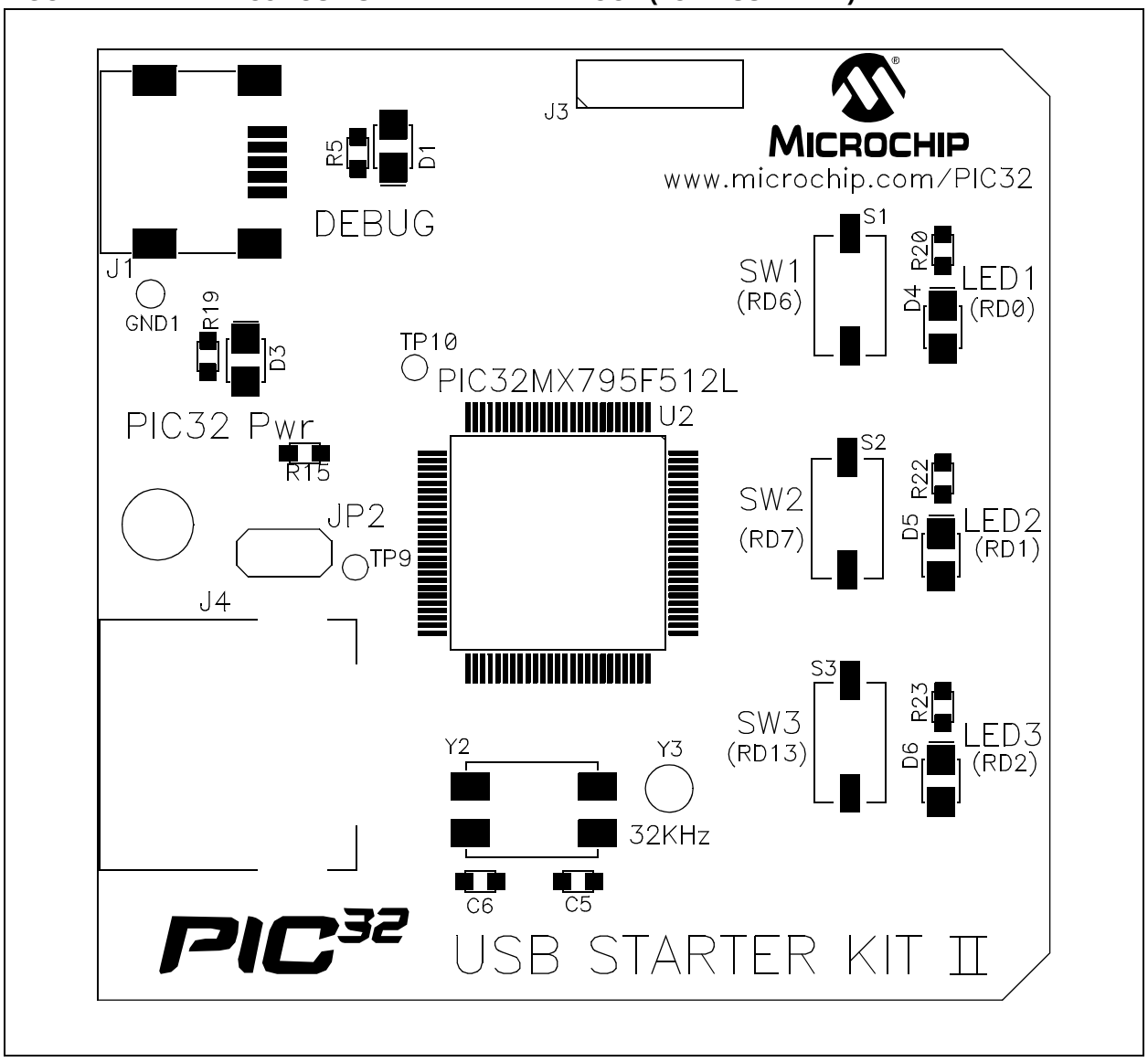
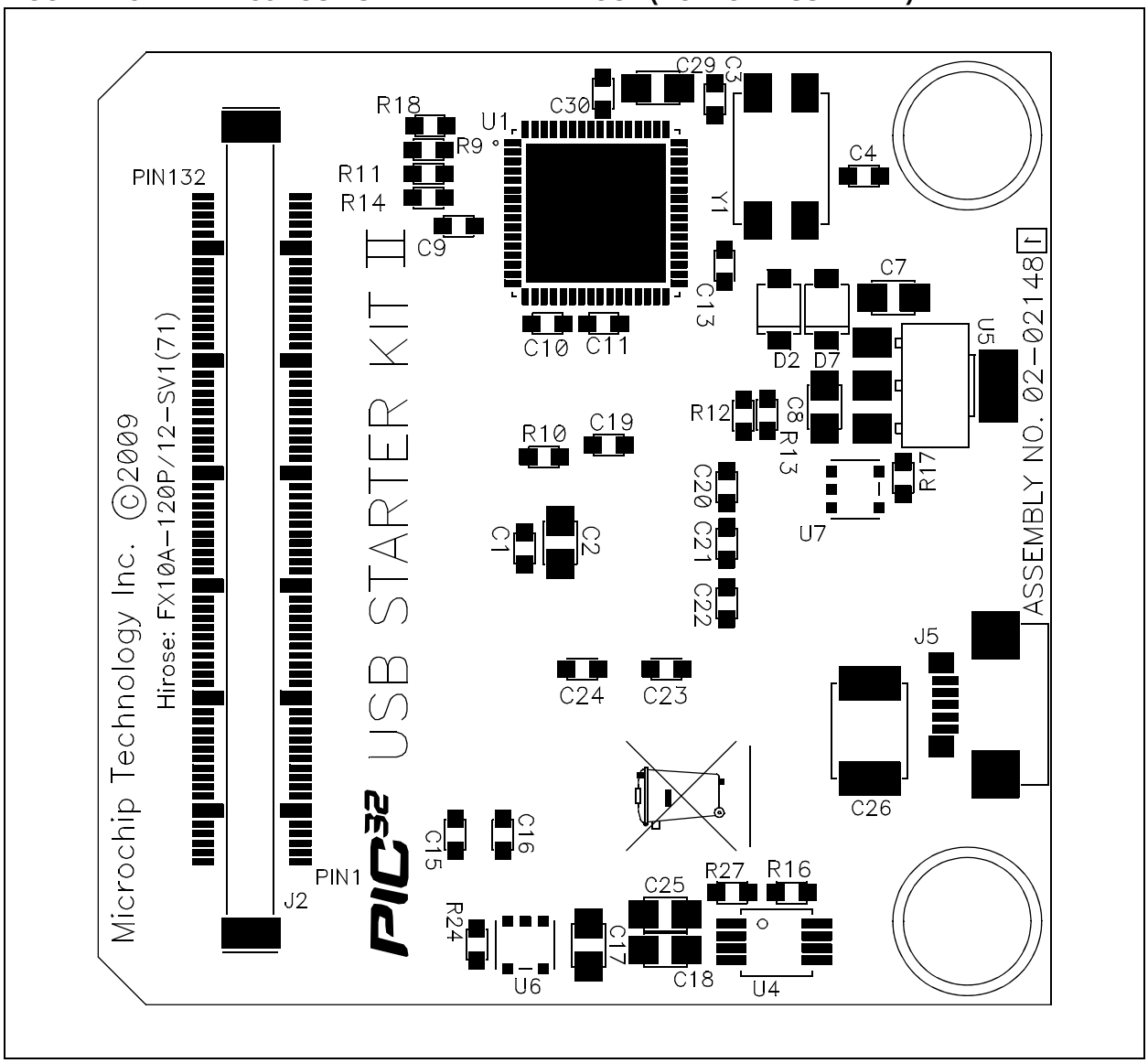


FIGURE A-3: PIC32 USB STARTER KIT II LAYOUT (BOTTOM ASSEMBLY)



A.3 BOARD SCHEMATICS

FIGURE A-4: PIC32 USB STARTER KIT II SCHEMATICS (SHEET 1 OF 3)

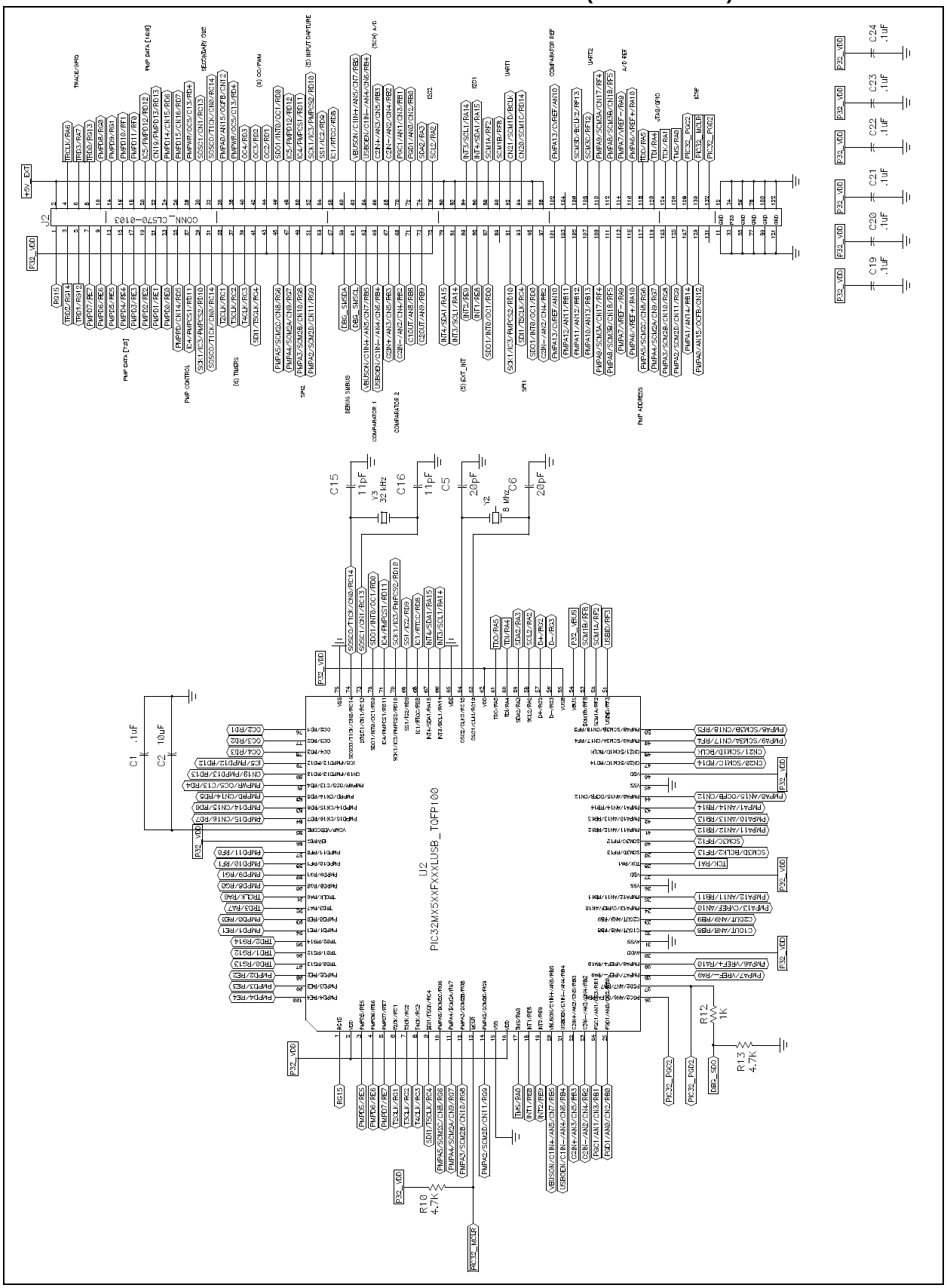


FIGURE A-5: PIC32 USB STARTER KIT II SCHEMATICS (SHEET 2 OF 3)

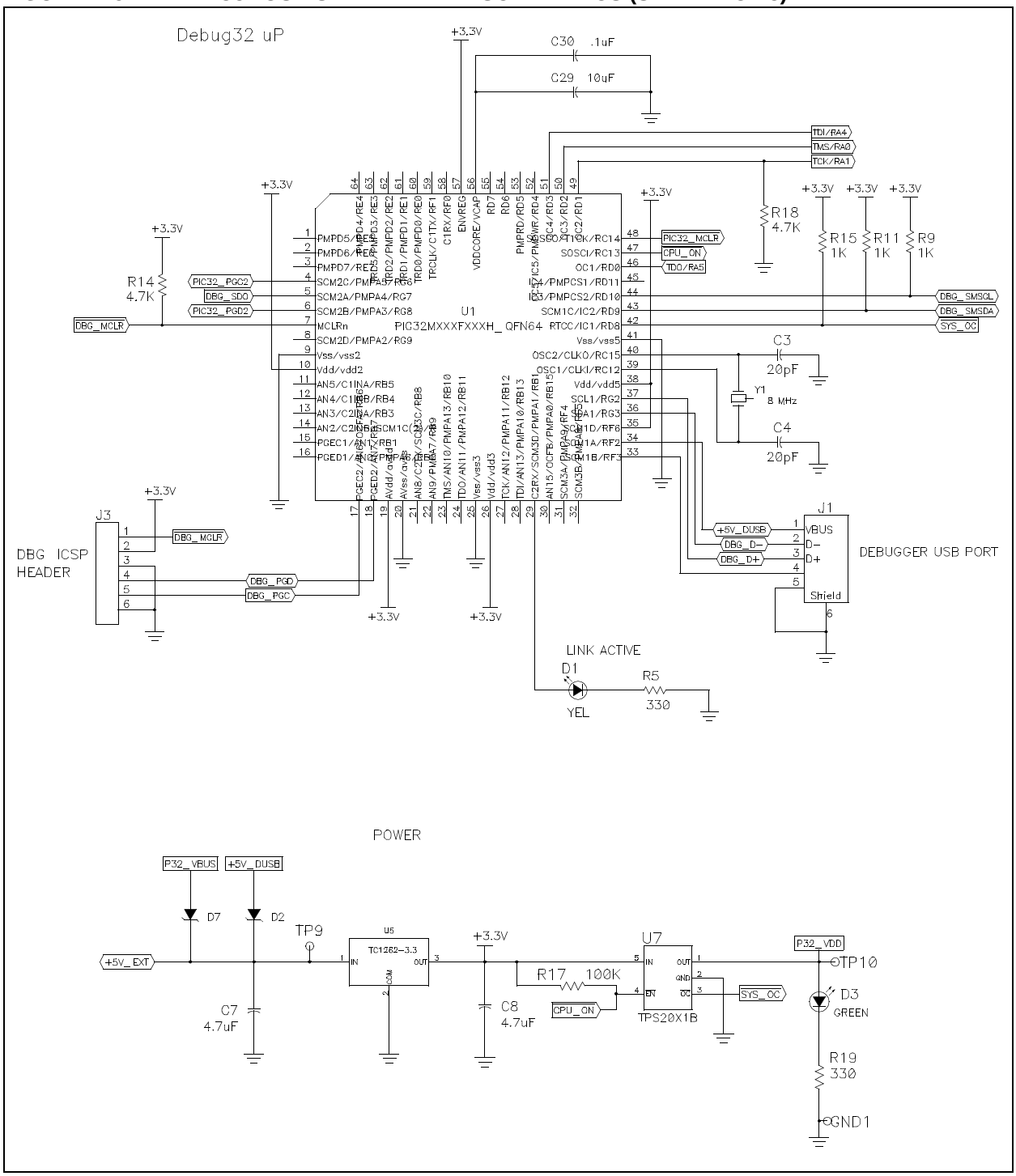
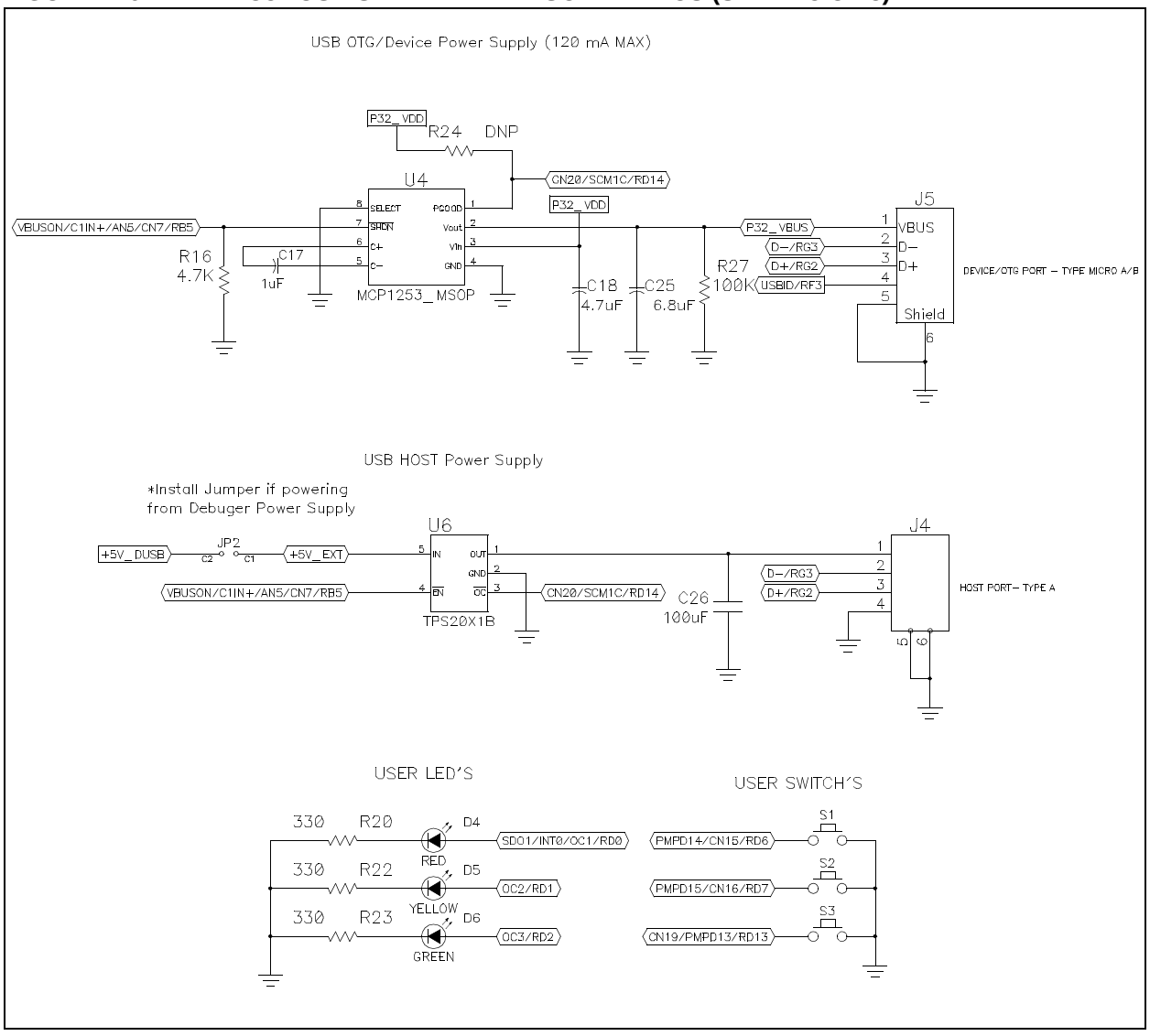


FIGURE A-6: PIC32 USB STARTER KIT II SCHEMATICS (SHEET 3 OF 3)



Index

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4080

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-6578-300
Fax: 886-3-6578-370

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

03/26/09