



# **PIC32 Starter Kit User's Guide**

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## Preface

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### 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 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 starter kit. 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 (General Purpose) Starter Kit, PIC32 USB Starter Kit II, and the PIC32 Ethernet Starter Kit (all also referred to as “starter kit”) as a development tool to emulate and debug firmware on a target board. This user’s guide is composed of the following chapters:

- **Chapter 1. “Introduction”** provides a brief overview of each starter kit, highlighting their features and uses.
- **Chapter 2. “Tutorial”** provides step-by-step instructions for installing a starter kit and using the Microchip MPLAB IDE to build and run the tutorial program on a starter kit.
- **Chapter 3. “Create a New Project”** provides step-by-step instructions for creating a new project using the MPLAB® IDE and loading it onto a starter kit.
- **Chapter 4. “Starter Kit Demos”** provides a brief description of each demo provided with the PIC32 Starter Kit CD.
- **Chapter 5. “Hardware”** provides the hardware descriptions of each starter kit.
- **Appendix A. “Board Layout and Schematics”** provides a block diagram, board layouts, and detailed schematics of each starter kit.

# PIC32 Starter Kit User's Guide

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB<sup>®</sup> 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&gt;Save</i></u>
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 New font:</b>		
Plain Courier New	Sample source code	<code>#define START</code>
	Filenames	<code>autoexec.bat</code>
	File paths	<code>C:\mcc18\h</code>
	Keywords	<code>_asm, _endasm, static</code>
	Command-line options	<code>-Opa+, -Opa-</code>
	Bit values	<code>0, 1</code>
	Constants (in source code)	<code>0xFF, 'A'</code>
<i>Italic Courier New</i>	A variable argument	<i>file.o</i> , where file can be any valid filename
Square brackets [ ]	Optional arguments	<code>mcc18 [options] file [options]</code>
Curly brackets and pipe character: {   }	Choice of mutually exclusive arguments; an OR selection	<code>errorlevel {0 1}</code>
Ellipses...	Replaces repeated text	<code>var_name [, var_name...]</code>
	Represents code supplied by user	<code>void main (void) { ... }</code>

## RECOMMENDED READING

This user's guide describes how to use the starter kit. The following Microchip documents are available and recommended as supplemental reference resources.

### Release Notes for Starter Kit

For the latest information on the starter kit, open the `PIC32 Starter Kit Release Notes.htm` located in either the root directory of the PIC32 Starter Kit 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.

### PIC32MX3XX/4XX Family Data Sheet (DS61143) and PIC32MX5XX/6XX/7XX Family Data Sheet (DS61156)

Consult these documents for detailed information on PIC32 devices. Reference information found in these data sheets includes:

- Device memory maps
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the devices

### MPLAB<sup>®</sup> 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<sup>®</sup> 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

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## 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 (January 2010)**

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

# PIC32 Starter Kit User's Guide

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## Chapter 1. Introduction

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Thank you for purchasing a Microchip Technology PIC32 starter kit. The board included in the starter kit (PIC32 (General Purpose) Starter Kit, PIC32 USB Starter Kit II, or PIC32 Ethernet 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 starter kit 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 Starter Kit Software” for download and installation instructions.

### 1.1 KIT CONTENTS

#### 1.1.1 PIC32 (General Purpose) Starter Kit

The PIC32 Starter Kit contains the following items:

- PIC32 Starter Kit Board
- USB Mini-B cable
- PIC32 Starter Kit Installation CD-ROM

#### 1.1.2 PIC32 USB Starter Kit II

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

# PIC32 Starter Kit User's Guide

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## 1.1.3 PIC32 Ethernet Starter Kit

The PIC32 Ethernet Starter Kit contains the following items:

- PIC32 Ethernet Starter Kit 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
- RJ-45 CAT5 Ethernet patch cable – Ethernet CAT5 cable to communicate with the PIC32 Ethernet port

**Note:** If you are missing any part of a 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

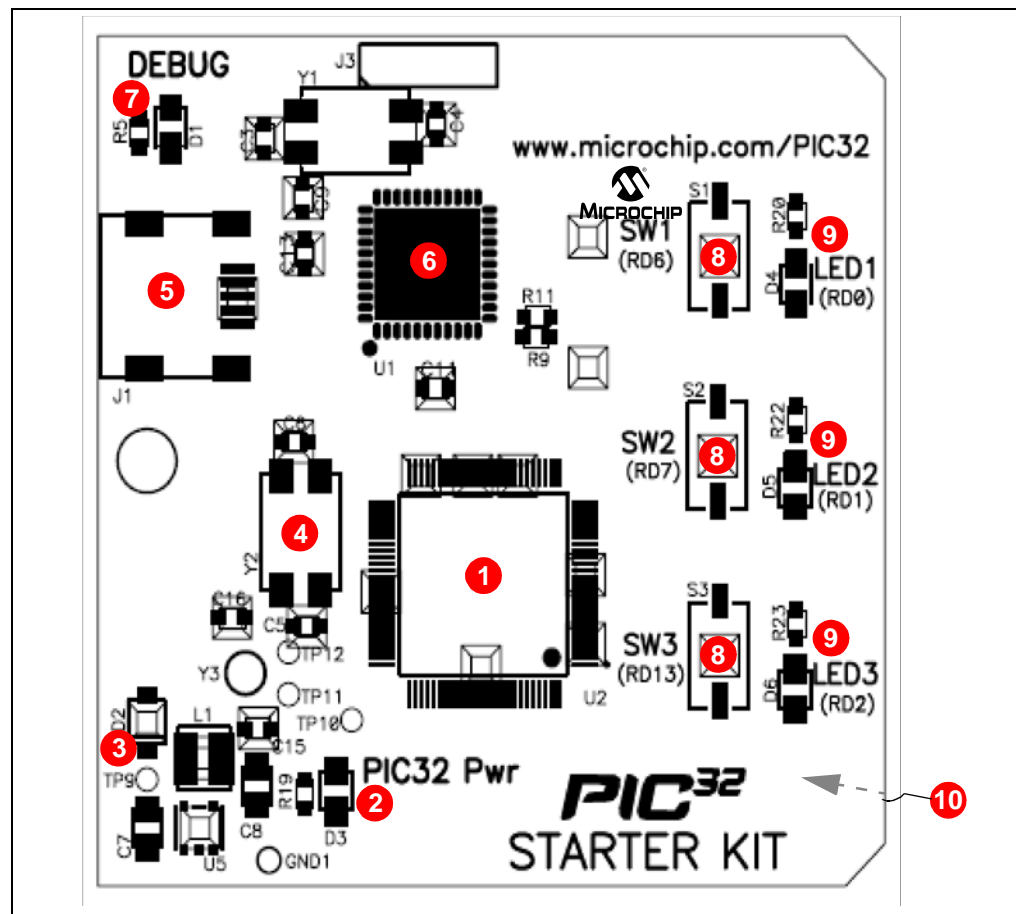
### 1.2.1 PIC32 (General Purpose) Starter Kit

A representation of the layout of the PIC32 Starter Kit is shown in Figure 1-1. The board includes these key features, as indicated in the diagram:

1. PIC32MX360F512L 32-bit microcontroller.
2. Green power indicator LED.
3. Regulated +3.3V power supply for powering the starter kit board via USB or expansion board.
4. On-board crystal for precision microcontroller clocking (8 MHz).
5. USB connectivity for on-board debugger communications.
6. PIC18LF4550 USB microcontroller for on-board debugging.
7. Orange Debug indicator LED.
8. Three push-button switches for user-defined inputs.
9. Three user-defined indicator LEDs.
10. Connector for connecting various expansion boards (on the underside of board).

For details on these features, refer to **Chapter 5. "Hardware"**.

**FIGURE 1-1: PIC32 STARTER KIT DEMO BOARD LAYOUT**



# PIC32 Starter Kit User's Guide

## 1.2.2 PIC32 USB Starter Kit II

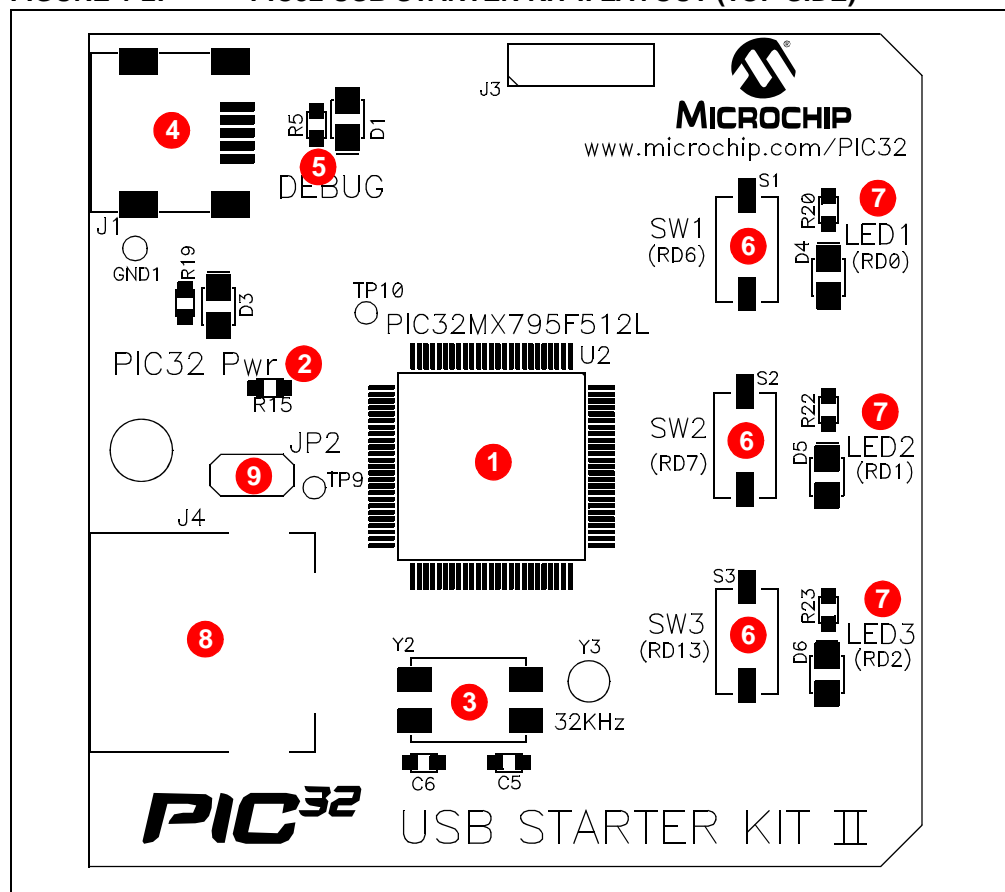
Representations of the layout of the PIC32 USB Starter Kit II are shown in Figure 1-2 and Figure 1-3.

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

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).

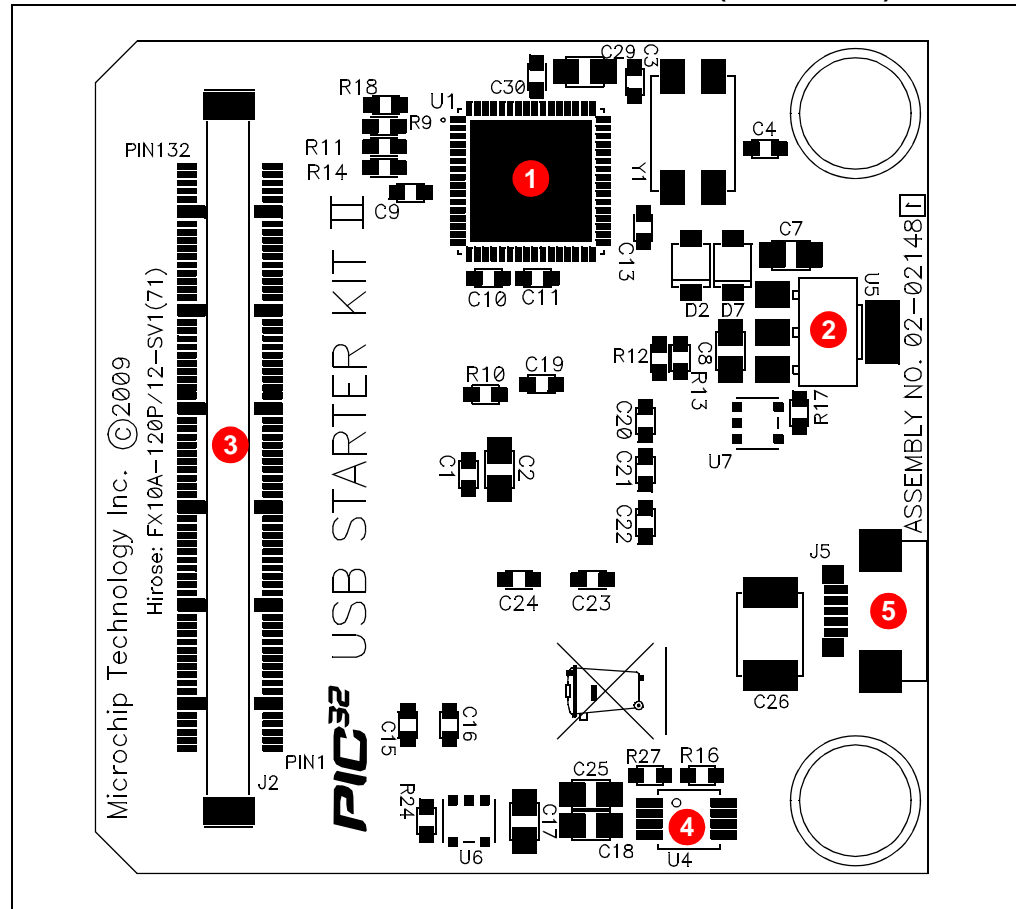
FIGURE 1-2: PIC32 USB STARTER KIT II LAYOUT (TOP SIDE)



The bottom assembly of the board includes these key features, as indicated in Figure 1-3:

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 1-3: PIC32 USB STARTER KIT II LAYOUT (UNDERSIDE)**



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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<sup>2</sup>C™, SPI or ECAN™ modules.

**TABLE 1-1: J2 CONNECTOR MAP FOR SERIAL COMMUNICATIONS**

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



### 1.2.3 PIC32 Ethernet Starter Kit

Representations of the layout of the PIC32 Ethernet Starter Kit are shown in Figure 1-4 and Figure 1-5.

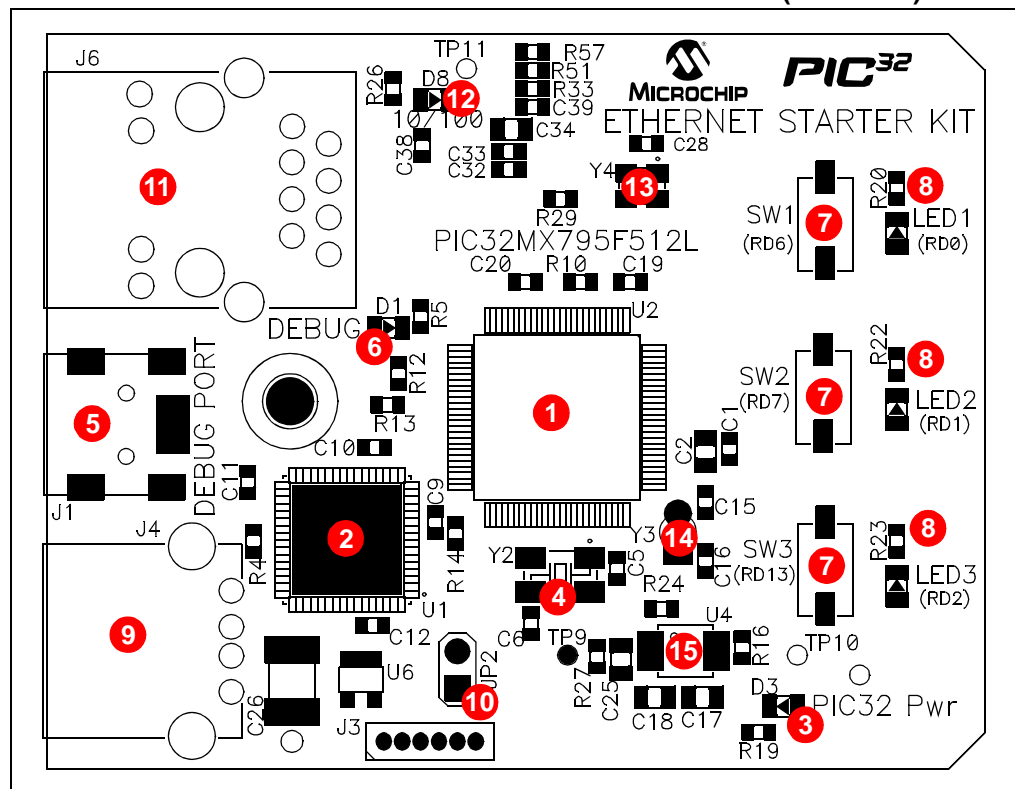
The top assembly of the board includes these key features, as indicated in Figure 1-4:

1. PIC32MX795F512L 32-bit microcontroller.
2. PIC32MX440F512H USB microcontroller for on-board debugging.
3. Green power indicator LED.
4. On-board crystal for precision microcontroller clocking (8 MHz).
5. USB connectivity for on-board debugger communications.
6. Orange debug indicator LED.
7. Three push button switches for user-defined inputs.
8. Three user-defined indicator LEDs.
9. USB Type A receptacle connectivity for PIC32 host-based applications.
10. HOST mode power jumper.
11. RJ-45 Ethernet port.
12. Ethernet 10/100 bus speed indicator LED.
13. 50 MHz Ethernet PHY oscillator.
14. 32 kHz oscillator (optional).
15. USB Host and OTG power supply for powering PIC32 USB applications.

**Note:** When running self-powered 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).

For details on these features, refer to **Chapter 5. "Hardware"**.

**FIGURE 1-4: PIC32 ETHERNET STARTER KIT LAYOUT (TOP SIDE)**



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The bottom assembly of the board includes these key features, as indicated in Figure 1-5:

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

**FIGURE 1-5: PIC32 ETHERNET STARTER KIT LAYOUT (UNDERSIDE)**

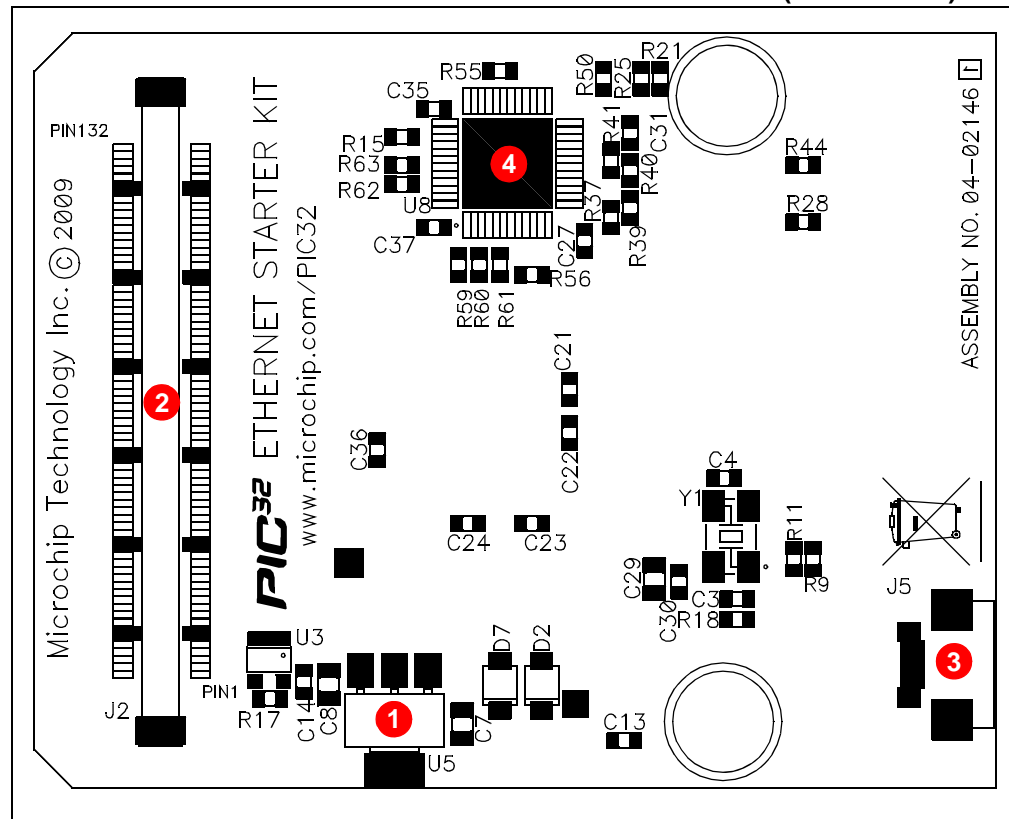


Table 1-2 shows the 100-pin to J2 connector serial communication mapping for the key digital modules available on the PIC32 device.

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<sup>2</sup>C, SPI or ECAN modules.

**TABLE 1-2: J2 CONNECTOR MAP FOR SERIAL COMMUNICATIONS**

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

# PIC32 Starter Kit User's Guide

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## **Chapter 2. Tutorial**

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This chapter is a self-paced tutorial to get you started using the starter kit. Items discussed in this chapter include:

- Host Computer Requirements
- Installing the Starter Kit Software
- Using the Starter Kit 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<sup>®</sup> XP<sup>®</sup> or Windows Vista<sup>®</sup> operating system (The PIC32 Ethernet Starter Kit has not been tested on the Windows NT<sup>®</sup> and Windows 2000<sup>®</sup> operating systems.)

# PIC32 Starter Kit User's Guide

## 2.2 INSTALLING THE STARTER KIT SOFTWARE

As a USB device, the starter kit 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 27.

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

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### 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.

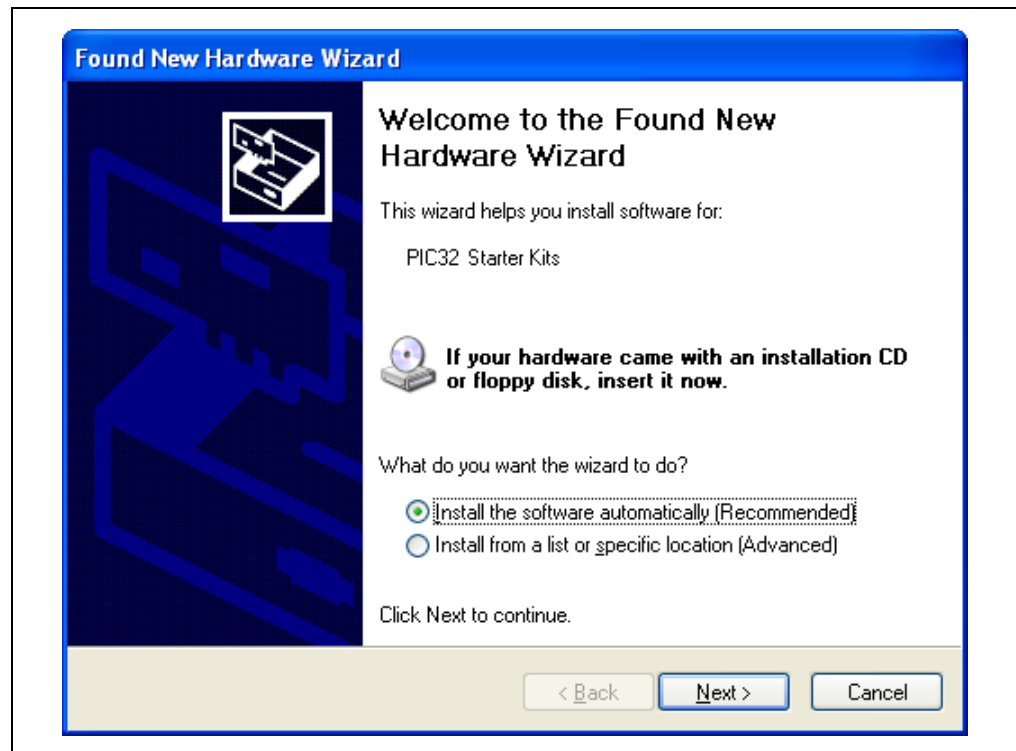
### 2.2.4 Install the USB Device Driver

**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**.

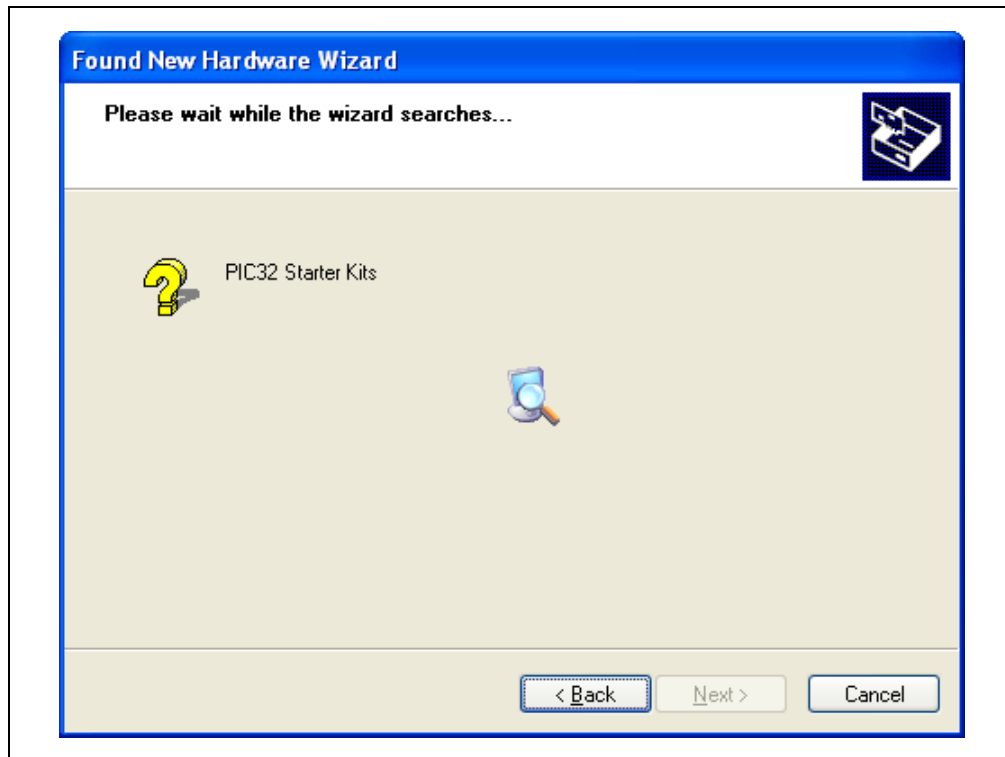
**FIGURE 2-2: FOUND NEW HARDWARE WIZARD**



# PIC32 Starter Kit User's Guide

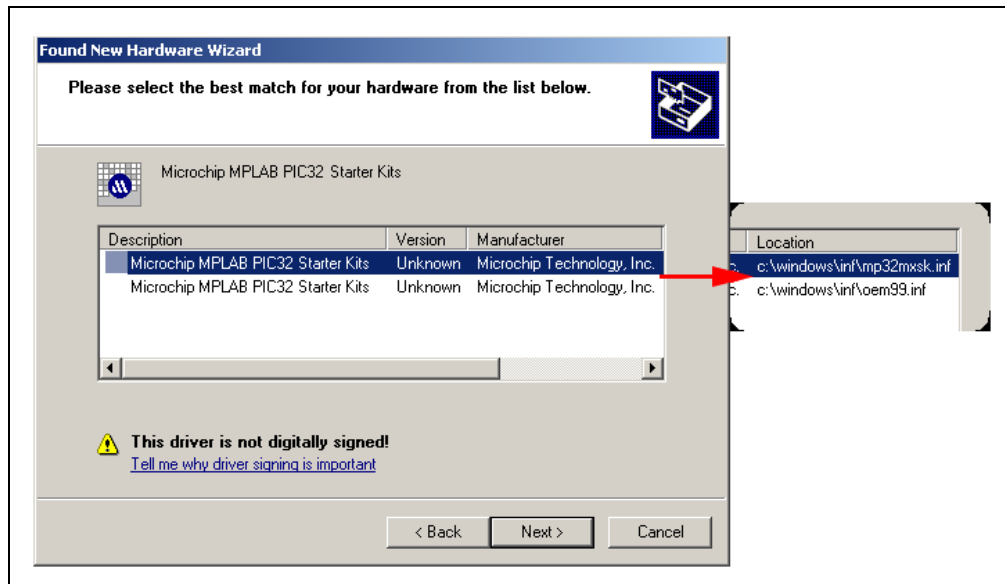
- As shown in Figure 2-3, the next dialog box tracks the wizard as it searches for the device. (This activity may take several seconds.) When it is done, click **Next**.

**FIGURE 2-3: HARDWARE WIZARD – SEARCHING FOR DEVICE**



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

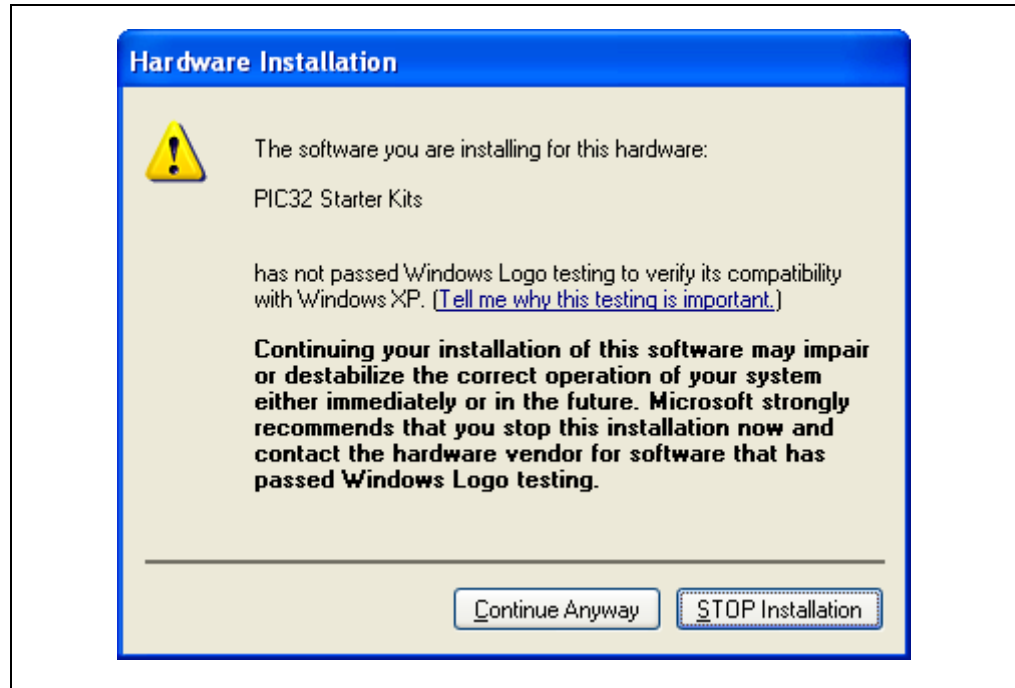
**FIGURE 2-4: HARDWARE WIZARD – SELECTING THE DRIVER**





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**



# PIC32 Starter Kit User's Guide

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## 2.3 USING THE STARTER KIT OUT OF THE BOX

Install the software before connecting the board to the host PC. The starter kit 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 PIC32 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 project application. However, the game can be reloaded onto the starter kit by importing 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 device has been included in the starter kit demo-projects download file, which is available from the Microchip web site ([www.microchip.com](http://www.microchip.com)). All project files have been included, so that the code may be used directly to restore a PIC32 device 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

Click the MPLAB IDE icon on your computer desktop. MPLAB IDE opens with the starter kit tutorial project loaded, as shown in Figure 2-7. If MPLAB IDE does not have the starter kit tutorial project loaded, select *File>Open Workspace...* from the menu bar and browse to the desired tutorial project file:

- PIC32 (General Purpose) Starter Kit:

```
[install directory]\PIC32 Starter Kits\Starter_Kit_Tutorial\  
starter_kit_tutorial - PIC32 Starter Kit.mcw  
(or browse to the file path you used when you installed MPLAB IDE).
```

- PIC32 USB Starter Kit II:

```
[install directory]\PIC32 Starter Kits\Starter_Kit_Tutorial\  
starter_kit_tutorial - PIC32 USB Starter Kit II.mcw  
(or browse to the file path that you used when you installed MPLAB IDE).
```

- PIC 32 Ethernet Starter Kit:

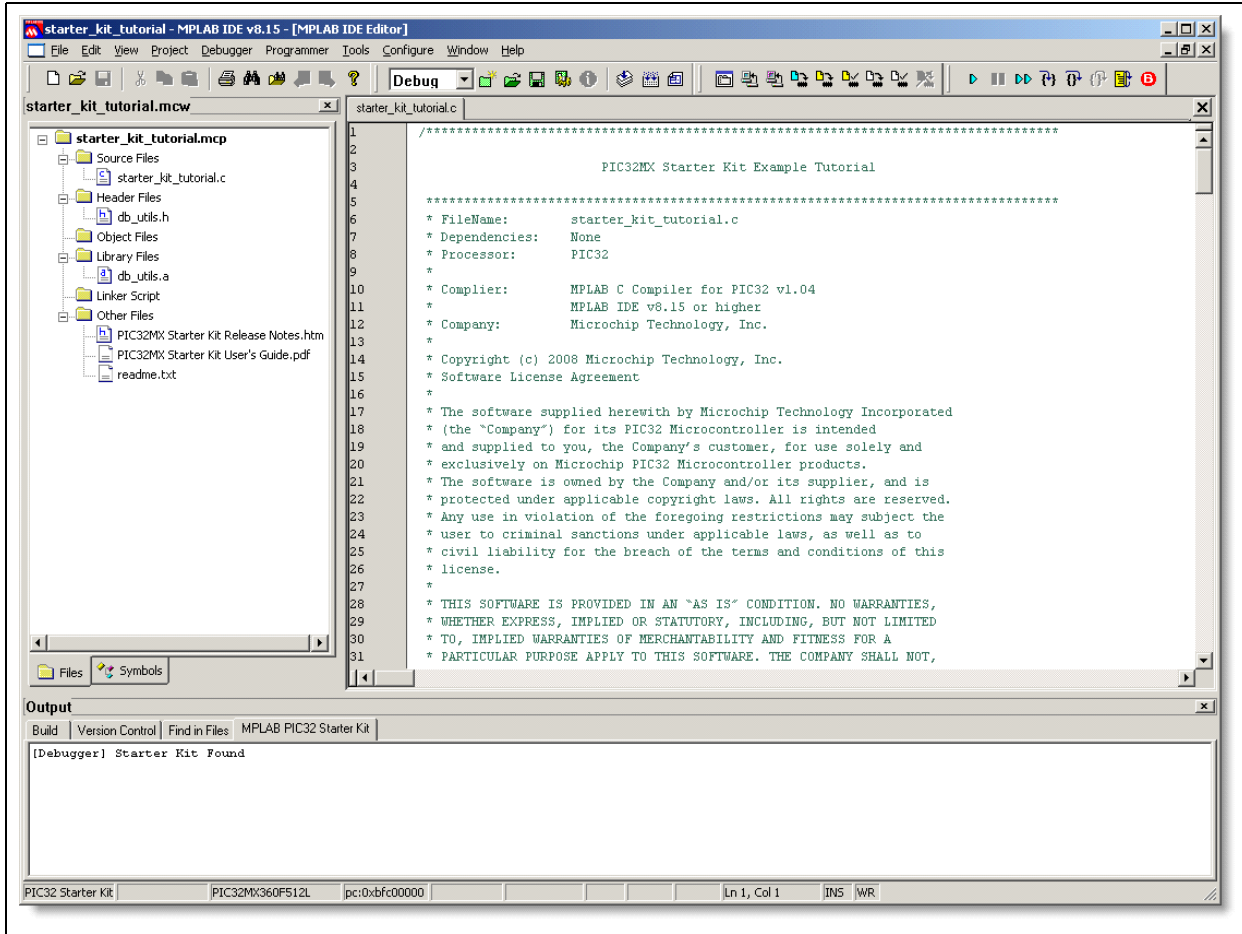
```
[install directory]\PIC32 Starter Kits\Starter_Kit_Tutorial\  
starter_kit_tutorial - PIC32 Ethernet Starter Kit.mcw  
(or browse to the file path you used when you installed MPLAB IDE).
```

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

"Starter Kit Found" should be displayed in the "Output" pane of the MPLAB IDE interface. If you do not see this message, select *Debugger>Select Tool>PIC32MX Starter Kit* from the menu bar. If that sequence fails to find the project, check the driver installation, as well as the connections between the hardware and the PC.

# PIC32 Starter Kit User's Guide

FIGURE 2-7: MPLAB® IDE WORKSPACE



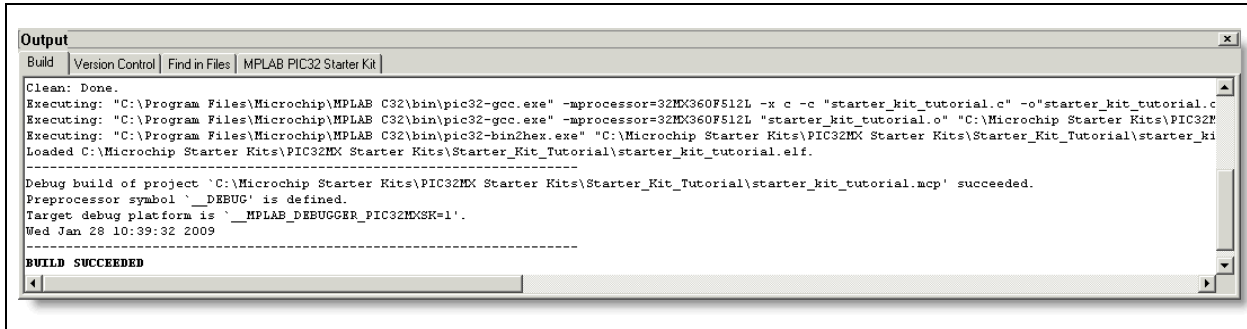
---

## 2.5 BUILDING THE PROJECT

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

Observe the progress of the build. When the “BUILD SUCCEEDED” message displays, you are ready to program the device.

**FIGURE 2-8: BUILD OUTPUT WINDOW**



```
Output
Build | Version Control | Find in Files | MPLAB PIC32 Starter Kit
Clean: Done.
Executing: "C:\Program Files\Microchip\MPLAB C32\bin\pic32-gcc.exe" -mprocessor=32MX360F512L -x c -c "starter_kit_tutorial.c" -o"starter_kit_tutorial.c
Executing: "C:\Program Files\Microchip\MPLAB C32\bin\pic32-gcc.exe" -mprocessor=32MX360F512L "starter_kit_tutorial.o" "C:\Microchip Starter Kits\PIC32M
Executing: "C:\Program Files\Microchip\MPLAB C32\bin\pic32-bin2hex.exe" "C:\Microchip Starter Kits\PIC32MX Starter Kits\Starter_Kit_Tutorial\starter_ki
Loaded C:\Microchip Starter Kits\PIC32MX Starter Kits\Starter_Kit_Tutorial\starter_kit_tutorial.elf.
-----
Debug build of project `C:\Microchip Starter Kits\PIC32MX Starter Kits\Starter_Kit_Tutorial\starter_kit_tutorial.mcp' succeeded.
Preprocessor symbol `__DEBUG' is defined.
Target debug platform is `__MPLAB_DEBUGGER_PIC32MXSR=1'.
Wed Jan 28 10:39:32 2009
-----
BUILD SUCCEEDED
```

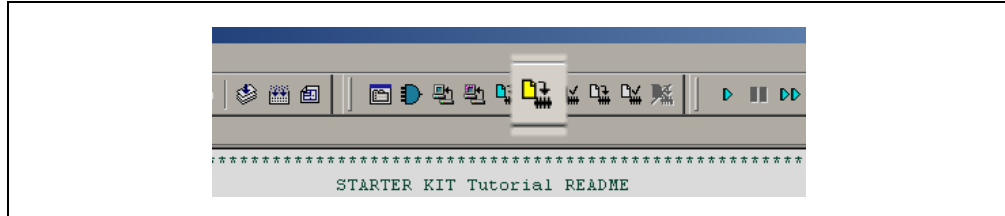
# PIC32 Starter Kit User's Guide

## 2.6 PROGRAMMING THE DEVICE

### 2.6.1 Program the Device

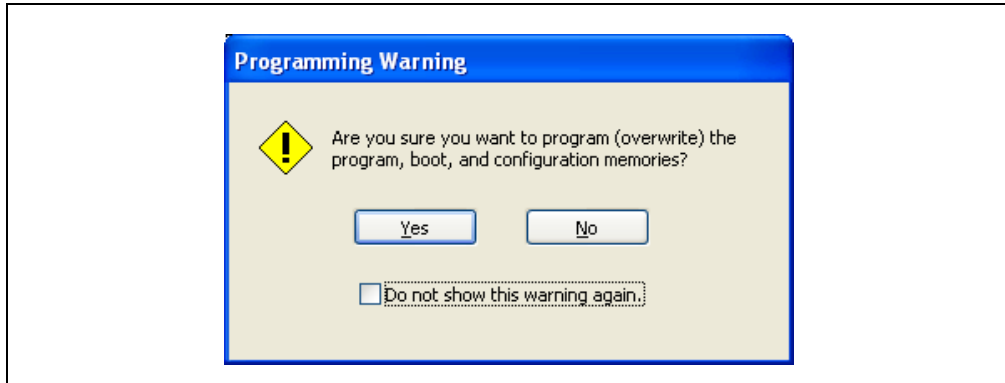
Click on the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 2-9).

**FIGURE 2-9: PROGRAM DEVICE TOOL BAR**



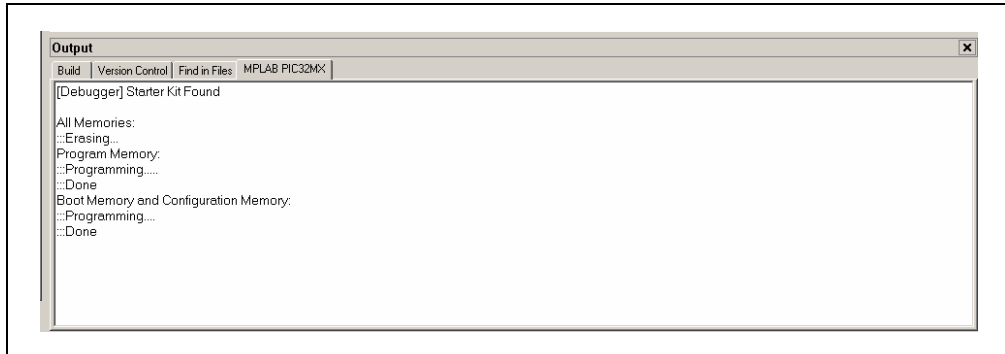
A Programming Warning window (Figure 2-10) opens to warn you about overwriting the memory. Click **Yes**.

**FIGURE 2-10: PROGRAMMING WARNING WINDOW**



The Output window (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**



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## 2.7 RUNNING THE PROGRAM

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

**FIGURE 2-12: DEBUG WINDOW**

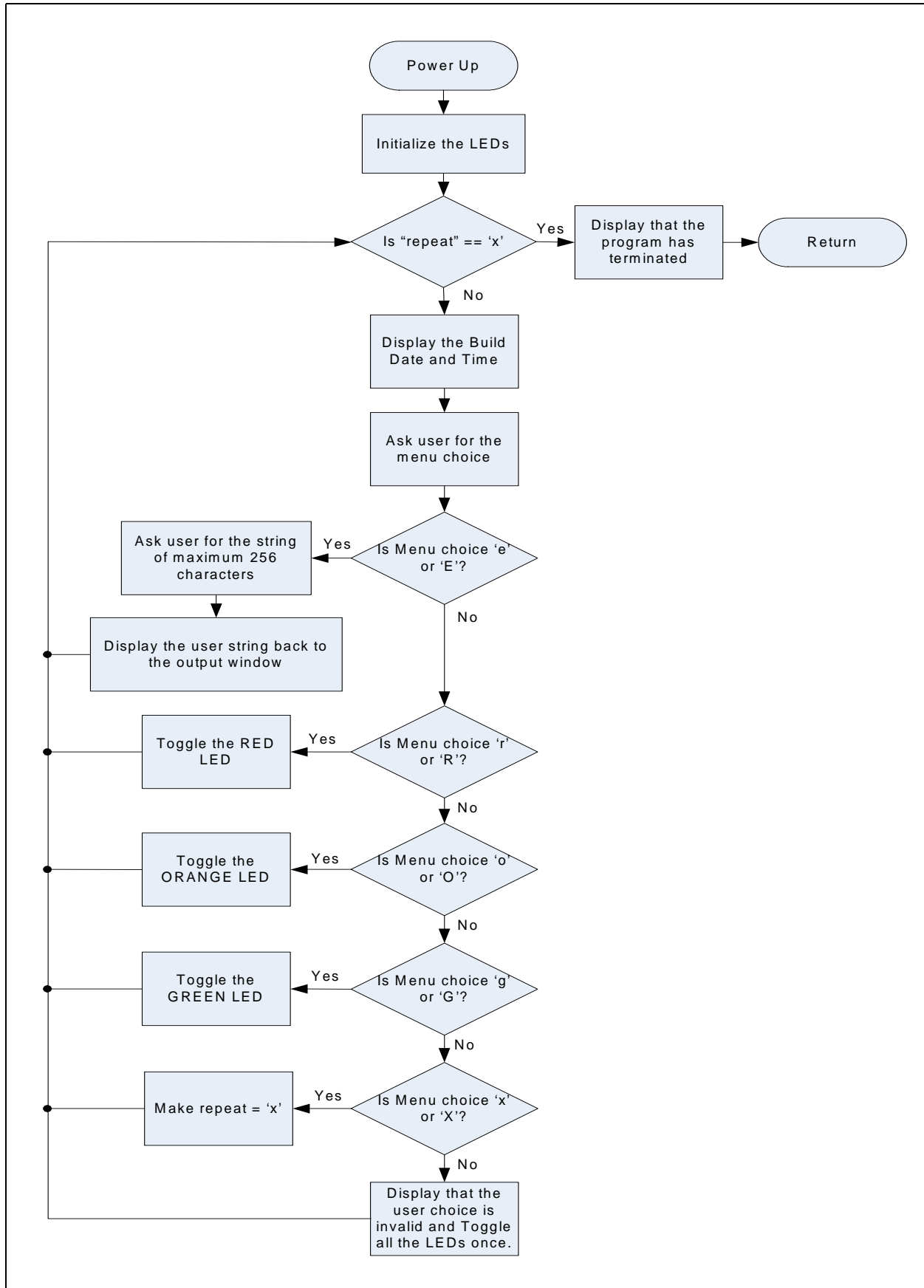


## 2.8 TUTORIAL PROGRAM OPERATION

The starter kit tutorial demonstrates a simple application. The program responds according to the user input menu. The program prints the available menu choices to the starter kit Output window in the MPLAB IDE. The program flow is shown in Figure 2-13.

# PIC32 Starter Kit User's Guide

FIGURE 2-13: PIC32MX TUTORIAL PROGRAM FLOWCHART





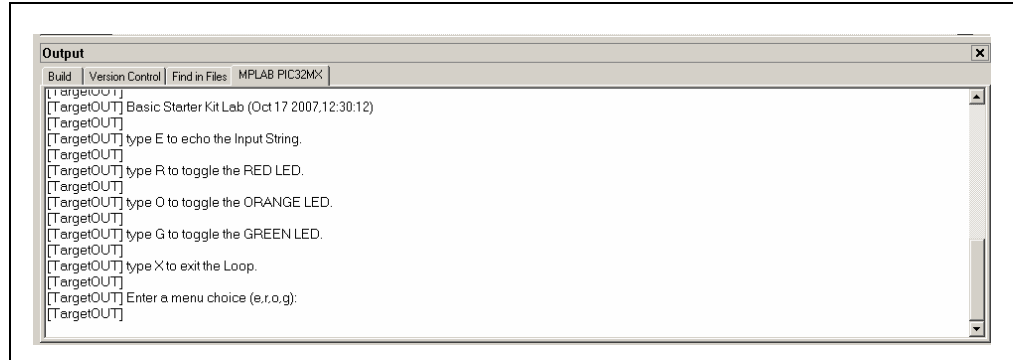
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The tutorial program includes the Debug Print Library, which facilitates print functionality. A peripheral library header file for flashing the LEDs is also included. The header file for print functionality is `appio.h`, which is automatically included by `plib.h`.

Depending on the macro definition given in the print header file, the debug print macros will be expanded. The print functionality in the tutorial is routed to the Output window on the **MPLAB PIC32MX** tab in the interface window. In order to achieve this, the macro definition "PIC32\_STARTER\_KIT" is added to the MPLAB C Compiler for PIC32 options.

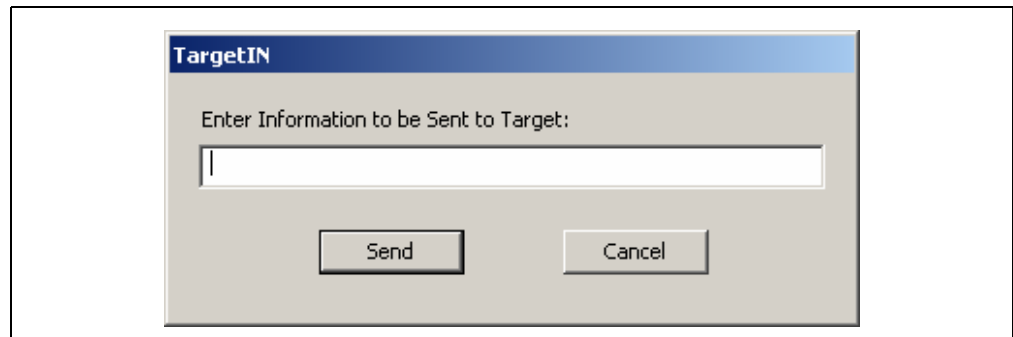
As the program runs, the Output window (Figure 2-14) tracks the progress.

**FIGURE 2-14: OUTPUT WINDOW**



After printing the menu, the application displays a prompt that requests your input, see Figure 2-15.

**FIGURE 2-15: TARGET IN WINDOW**



Type your choice into the Enter Information to be Sent to Target box, and click **Send**. The program responds according to the menu entry. Watch the LEDs on the starter kit board. If your entry is incorrect, the LEDs will toggle once.

# PIC32 Starter Kit User's Guide

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NOTES:

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## Chapter 3. Create a New Project

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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 starter kit
- 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:

<b>Task 1: Select a Device</b> .....	page 36
<b>Task 2: Select the Language Toolsuite</b> .....	page 37
<b>Task 3: Name Your Project</b> .....	page 38
<b>Task 4: Add Files to Your Project</b> .....	page 39
<b>Task 5: Confirm the Configuration Settings</b> .....	page 40
<b>Task 6: Build the Project</b> .....	page 42
<b>Task 7: Program the Device</b> .....	page 42
<b>Task 8: Run the Program</b> .....	page 43

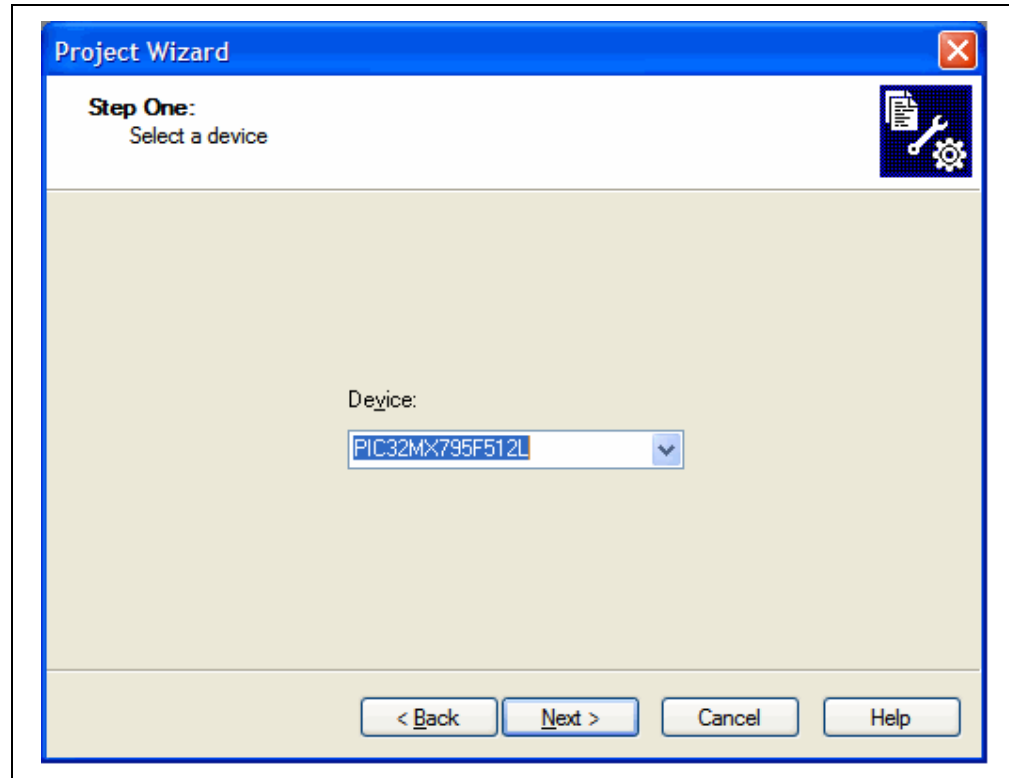
# PIC32 Starter Kit User's Guide

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## 3.1.1 Task 1: Select a Device

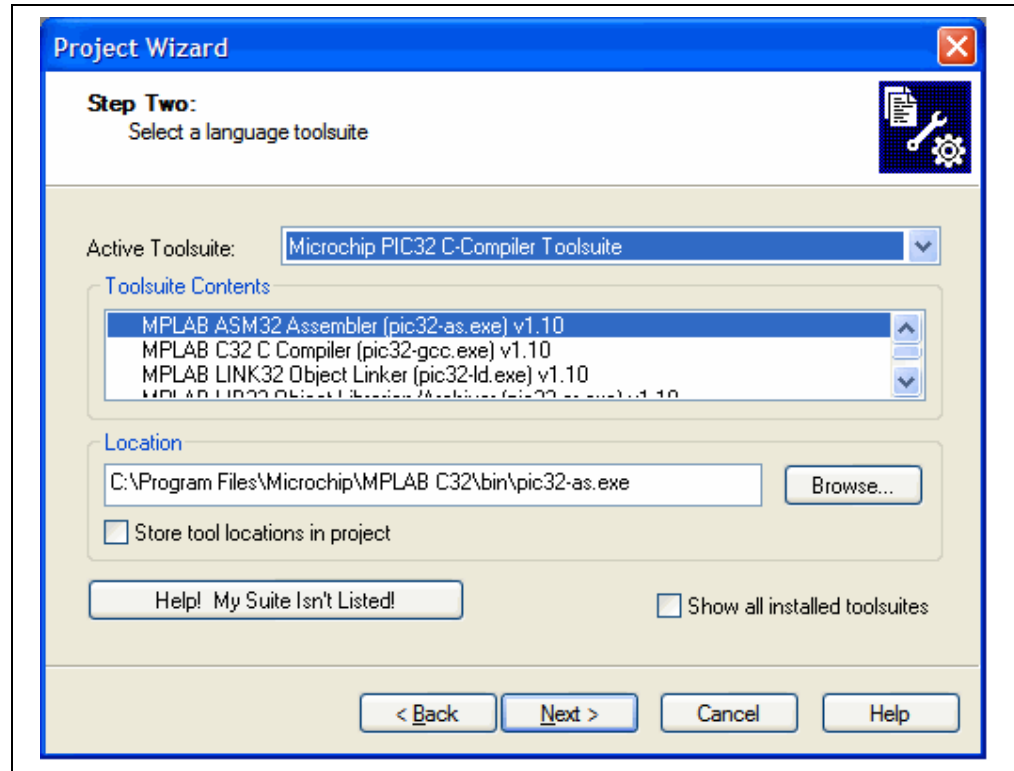
1. Start MPLAB IDE.
2. Select *File>Close Workspace* on the menu bar, to close any open workspace.
3. Select *Project>Project Wizard...* to start the wizard.
4. In the Welcome window, click **Next**. The Project Wizard Step One: window is displayed, as shown in Figure 3-1.

**FIGURE 3-1: SELECTING THE DEVICE**



5. From the Device drop-down list, select the desired device, PIC32MX360F512L for the PIC32 (General Purpose) Starter Kit, or PIC32MX795F512L for the PIC32 USB Starter Kit II or PIC32 Ethernet Starter Kit.
6. Click **Next**. The Project Wizard Step Two: dialog box opens, as shown in Figure 3-2.

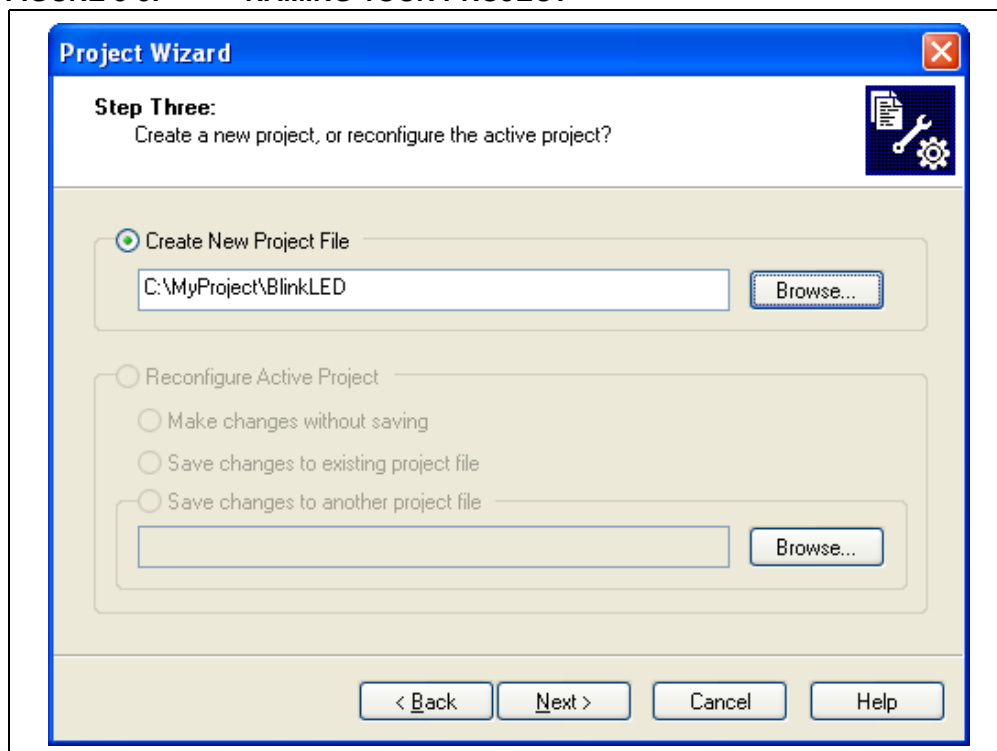
**FIGURE 3-2: SELECTING THE TOOLSUITE**



### 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.

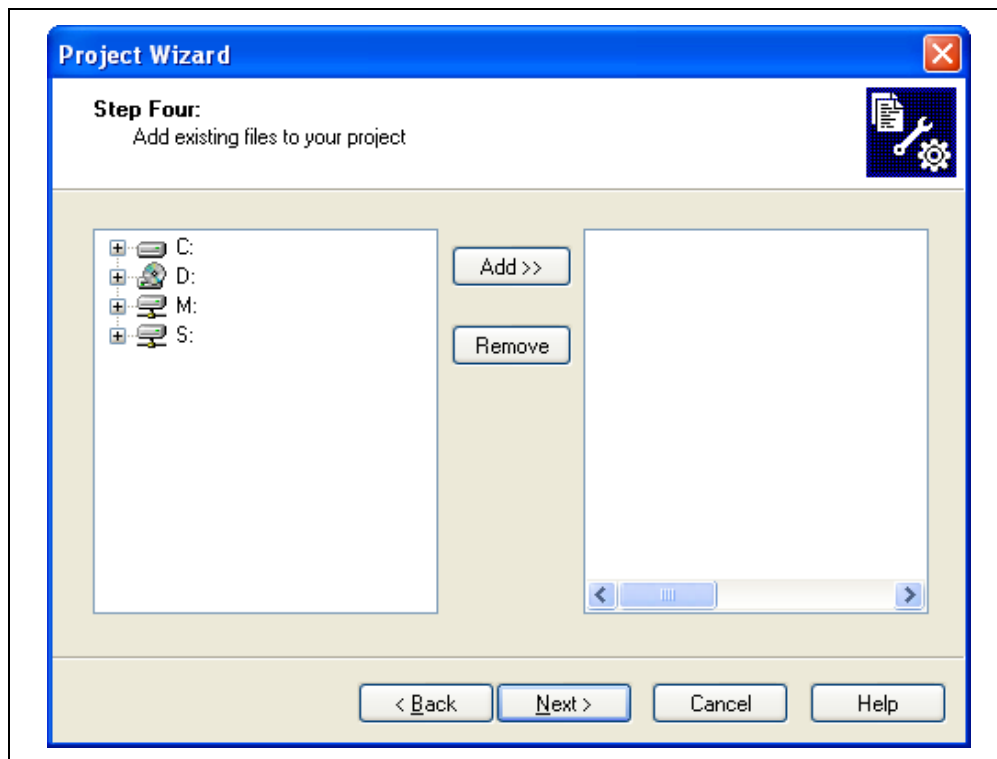
FIGURE 3-3: NAMING YOUR PROJECT



### 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



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### 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 Starter Kit 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

#define SYS_FREQ          (80000000)

void DelayMs(unsigned int msec)
{
    unsigned int tWait, tStart;

    tWait=(SYS_FREQ/2000)*msec;
    tStart=ReadCoreTimer();
    while((ReadCoreTimer()-tStart)<tWait); // wait for the time to pass
}

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)
    {
        DelayMs(100);
        mPORTDToggleBits(BIT_0); // toggle LED0 (same as LATDINV = 0x0001)

        DelayMs(100);
        mPORTDToggleBits(BIT_1); // toggle LED1 (same as LATDINV = 0x0002)

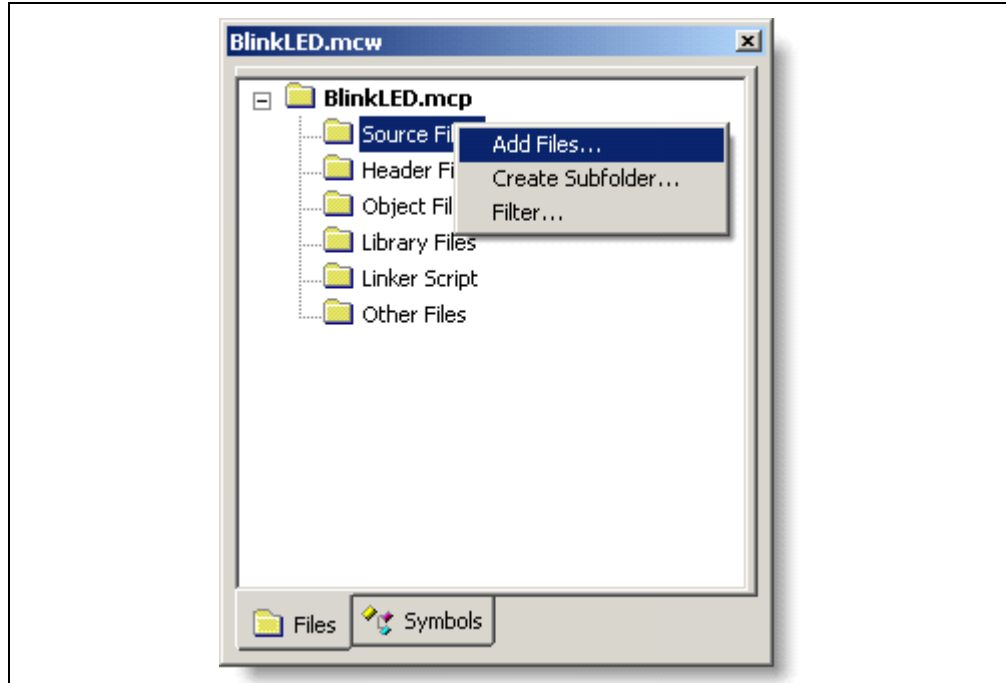
        DelayMs(100);
        mPORTDToggleBits(BIT_2); // toggle LED2 (same as LATDINV = 0x0004)
    };
    return 0;
}
```

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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 General Purpose Starter Kit are shown in Figure 3-6.

Figure 3-7 provides the configuration settings for the PIC32 USB Starter Kit II and the PIC32 Ethernet Starter Kit.

**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: PIC32 (GENERAL PURPOSE) STARTER KIT CONFIGURATION BIT SETTINGS**

Address	Value	Category	Setting
1FC0_2FFC	7FFFFFFF	ICE/ICD Comm Channel Select	ICE EMUC2/EMUD2 pins shared with PGC2/PGD2
1FC0_2FF8	FF60895B	Boot Flash Write Protect	boot flash is writable
		Code Protect	Protection Disabled
		Oscillator Selection Bits	Primary Osc w/PLL (XT+,HS+,EC+PLL)
		Secondary Oscillator Enable	Disabled
		Internal/External Switch Over	Disabled
		Primary Oscillator Configuration	XT 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 switching disabled; fail safe clock monitor disabled
		Watchdog Timer Postscaler	1:1
1FC0_2FF4	FFF8FFD9	Watchdog Timer Enable	WDT Disabled (SWDTEN Bit Controls)
		PLL Input Divider	2x Divider
		PLL Multiplier	20x Multiplier
		System PLL Output Clock Divider	PLL Divide by 1

**FIGURE 3-7: PIC32 USB STARTER KIT II AND PIC32 ETHERNET STARTER KIT CONFIGURATION BIT SETTINGS**

Address	Value	Category	Setting
1FC0_2FF0	FFFFFFFF	SRS Select	SRS Priority 7
1FC0_2FF4	FFF879D9	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
		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
Boot Flash Write Protect	Boot Flash is writable		
Code Protect	Protection Disabled		

### CAUTION

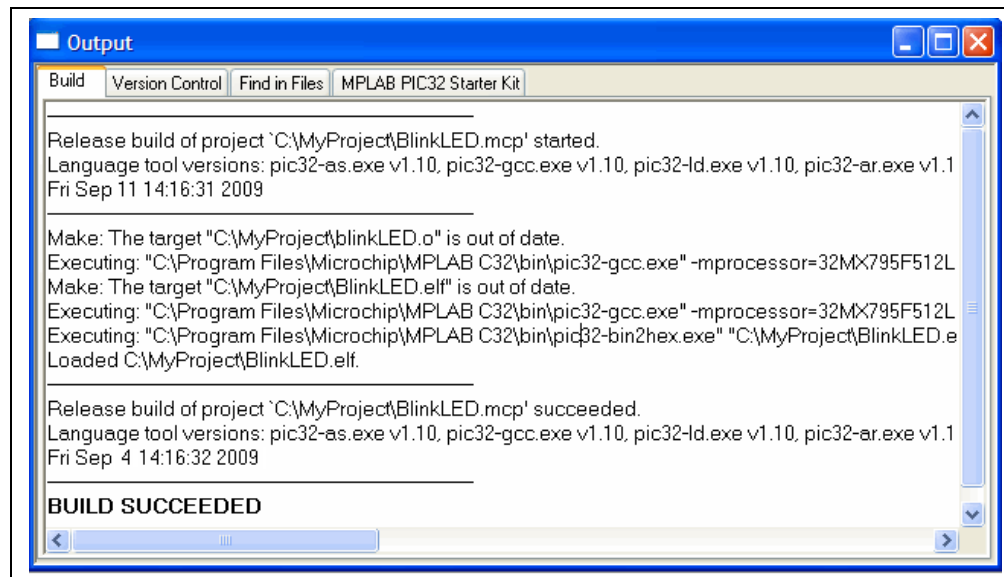
Setting the starter kit configuration bits to cause the PIC32 MCU to operate faster than the maximum 80 MHz system clock speed, may cause the PIC32 MCU to stop communicating with the starter kit debugger. Should this occur, run the `sk_erase.exe` utility to re-flash the PIC32 MCU with a default configuration. This utility is located on the PIC32 Starter Kit CD or in the PIC32 Starter Kit 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 3-8.
2. Observe the progress of the build. When the "BUILD SUCCEEDED" message displays, you are ready to program the device.

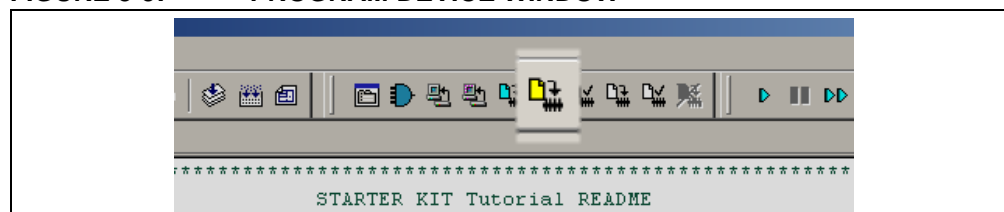
**FIGURE 3-8: BUILD OUTPUT WINDOW**



## 3.1.7 Task 7: Program the Device

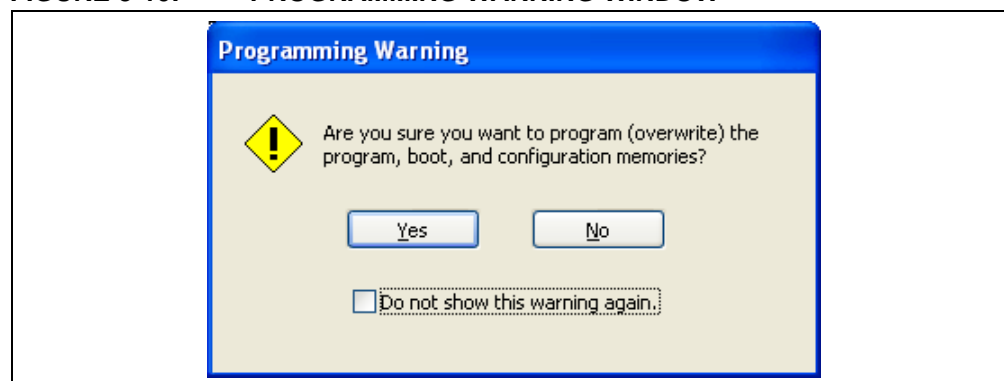
1. Click the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 3-9.

**FIGURE 3-9: PROGRAM DEVICE WINDOW**



A Programming Warning window opens to warn you about overwriting the memory, as shown in Figure 3-10. Click **Yes**.

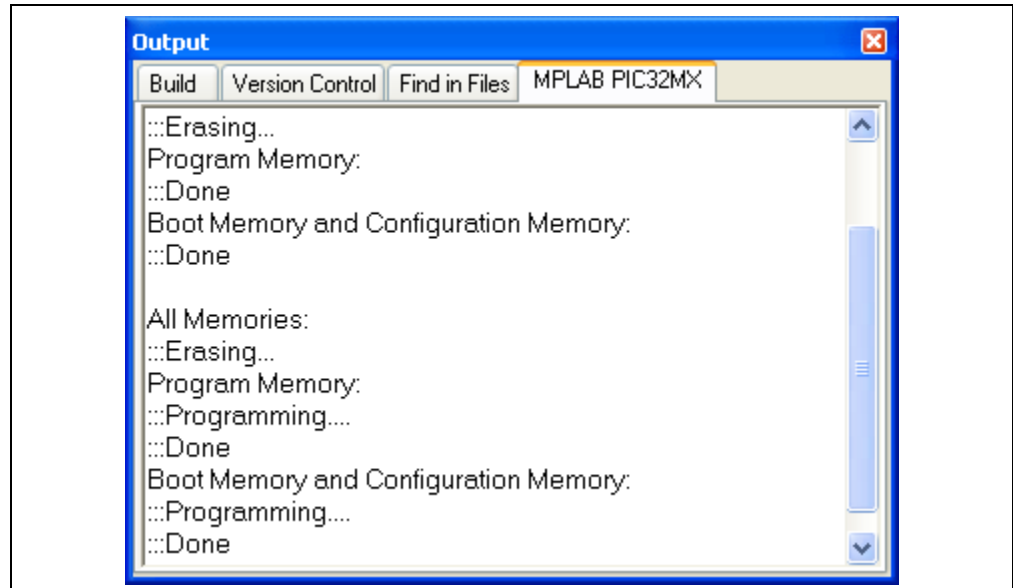
**FIGURE 3-10: PROGRAMMING WARNING WINDOW**



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

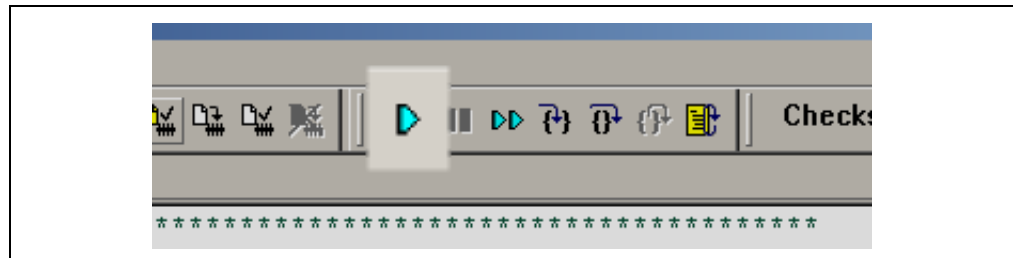
**FIGURE 3-11: OUTPUT WINDOW**



### 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 3-12, to run the new program.

**FIGURE 3-12: RUN THE PROGRAM**



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

# PIC32 Starter Kit User's Guide

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NOTES:

## Chapter 4. Starter Kit Demos

This chapter provides a brief description of each demo provided with the PIC32 Starter Kit CD. A “Getting Started” guide is provided along with each demo that describes how to use the demo along with any special hardware configuration necessary. The “Getting Started” guide for any given demo is located in the demo folder:

`<installed-directory>\PIC32 Starter Kits\<<demo-name>`

Where `<installed-directory>` is the directory in which the starter kit was installed and `<demo-name>` is the name of the demo in question.

The demos are broken into the following categories:

- General Purpose Demos (GP)
- USB Demos (USB)
- Ethernet Demos (ETH)

### 4.1 DEMO APPLICATIONS

The General Purpose demos do not require any special hardware and will run on all types of starter kits. USB demos will only run properly on starter kits that support USB and Ethernet demos will only run on starter kits that support Ethernet.

**TABLE 4-1: STARTER KIT DEMO APPLICATIONS**

Demo Application	Description	GP	USB	ETH
Starter_Kit_Tutorial	This PIC32MX Starter Kit tutorial program demonstrates many of the PIC32MX Starter Kit and MPLAB <sup>®</sup> IDE features.	X	X	X
Blink_leds	This example project demonstrates how to create, build, program and run a new project in MPLAB IDE.	X	X	X
simon_says_demo	This is the classic “Simon Says” game pre-programmed in the PIC32MX Starter Kit from the factory.	X	X	X
Hello_World	The classic “Hello World” C program. This project demonstrates a simple console output to an MPLAB IDE window using the Debug Print Library macros.	X	X	X
Port_IO	This simple project highlights the PIC32 Peripheral Library macros and how to use them to configure PORT I/O port pins as digital outputs and digital inputs as well as configure I/O pin Change Notice, I/O pin weak pull-ups and I/O pin Change Notice Interrupts. This project demonstrates 2 different methods for monitoring switch presses; polling and interrupt.	X	X	X
Timer_Interrupts	This project showcases the PIC32MX device’s 32-bit core timer which operates at half the System Clock Frequency and can be used for system events such as generating a tick timer.	X	X	X
PWM_DMA	A slightly more challenging project, this example demonstrates the use of 2 PWM and 2 DMA channels to automatically control and vary the intensity of 2 LEDs, without using the CPU.	X	X	X

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**TABLE 4-1: STARTER KIT DEMO APPLICATIONS (CONTINUED)**

Demo Application	Description	GP	USB	ETH
USB Device – CDC – Basic Demo	This project demonstrates the use of the USB CDC Function driver to echo characters (slightly modified) by emulating a serial port.		X	X
USB Device – HID – Mouse	This project demonstrates the use of the USB HID Function driver by emulating a mouse to make the cursor move “in a circle”.		X	X
USB Device – Mass Storage – SD Card Reader	This project demonstrates the use of the MSD Function driver by providing SD-card reader functionality.		X	X
USB Device – MCHPUSB – Generic Driver Demo	This project demonstrates the use of the Microchip “Generic” Function driver by emulating the original PIC18 FSUSB demo board. (Although most features of the original board are not supported, it does demonstrate 2-way communication.)		X	X
USB Host – Mass Storage – Simple Demo	This project demonstrates use of the USB MSD Host (client) driver to write a “canned” text file to a USB thumb drive.		X	X
USB Host – Mass Storage – Thumb Drive Demo	This project demonstrates the use of the MSD USB Host (client) driver by providing a USB thumb drive browser. It is based on the “Thumb Drive Data Logger” demo from the Microchip Application Libraries release, but it does not provide the “logger” functionality.		X	X
USB Host – MCHPUSB – Generic Driver Demo	This project demonstrates the use of the Microchip “Generic” Host (client) driver by acting as a host to the “Generic” device demo.		X	X
Ethernet – TCPIP-BSD – HTTP Server Demo	This application demonstrates the use of the BSD TCP/IP library to implement an embedded web server.			X

**Note:** All of the GP and USB demos described in Table 4-1 can also be run on a “Legacy” USB Starter kit (using a PIC32MX460F512L microcontroller). However, the processor selection will need to be changed.

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## Chapter 5. Hardware

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This chapter describes the hardware features of the starter kit.

### 5.1 HARDWARE FEATURES

#### 5.1.1 PIC32 (General Purpose) Starter Kit

The key features of the PIC32 Starter Kit 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.

##### 5.1.1.1 PROCESSOR SUPPORT

The PIC32 Starter Kit is designed with a permanently mounted (i.e., soldered) PIC32MX360F512L processor.

##### 5.1.1.2 POWER SUPPLY

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

- USB bus power connected to 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.

**Note:** The basic PIC32 Starter Kit does not include an application board and is intended to be USB bus powered.

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

##### 5.1.1.3 USB CONNECTIVITY

The PIC32 Starter Kit includes a PIC18LF4550 USB microcontroller, which provides both USB connectivity and support for protocol translation. The PIC18LF4550 is hard-wired to the PIC32MX device to provide two types of connectivity:

- I/O pins of PIC18LF4550 to ICSP™ pins of PIC32MX
- I/O pins of PIC18LF4550 to JTAG pins of PIC32MX

The PIC32MX Starter Kit currently uses the JTAG pins of the PIC32MX device for programming and debugging.

##### 5.1.1.4 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 debounce techniques. When Idle, the switches are pulled high (+3.3V). When pressed, they are grounded.

# PIC32 Starter Kit User's Guide

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## 5.1.1.5 LEDS

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

## 5.1.1.6 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 not required for PIC32 designs. Your design may use the internal oscillator, if desired.

The PIC18LF4550, at the heart of the USB subsystem, is independently clocked and has its own 8 MHz crystal (Y1).

## 5.1.1.7 120-PIN MODULAR EXPANSION CONNECTOR

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

**TABLE 5-1: STARTER BOARD CONNECTOR PART NUMBERS**

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



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## 5.1.2 PIC32 USB Starter Kit II

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 1-2 for their locations on the board.

### 5.1.2.1 PROCESSOR SUPPORT

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

### 5.1.2.2 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.

### 5.1.2.3 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.

### 5.1.2.4 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.

# PIC32 Starter Kit User's Guide

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## 5.1.2.5 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.

## 5.1.2.6 LEDES

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

## 5.1.2.7 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).

## 5.1.2.8 120-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 5-2: 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)

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### 5.1.3 PIC32 Ethernet Starter Kit

The key features of the PIC32 Ethernet Starter Kit are listed below. They are presented in the order given in **Section 1.2 “PIC32 Functionality and Features”**. You can refer to Figure 1-4 for their locations on the board.

#### 5.1.3.1 PROCESSOR SUPPORT

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

#### 5.1.3.2 POWER SUPPLY

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

- 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.

#### 5.1.3.3 DEBUG USB CONNECTIVITY

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

#### 5.1.3.4 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.

# PIC32 Starter Kit User's Guide

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## 5.1.3.5 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.

## 5.1.3.6 LEDES

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

## 5.1.3.7 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 32 kHz oscillator (Y3); however, this is not populated. A suitable oscillator, the ECS-3X8, can be obtained from Digi-Key: Part no. X801-ND CMR200TB32.768KDZFTR.

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

## 5.1.3.8 120-PIN MODULAR EXPANSION CONNECTOR

The PIC32 Ethernet Starter Kit 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 5-3: 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)

## 5.1.3.9 ETHERNET PHY

The PIC32 Ethernet Starter Kit has been designed with a National DP83848 PHY for connecting the Starter Kit using an RJ-45 cable to a network. The interface between the PHY and the PIC32 has been configured for the industry standard RMII interface and has been isolated from the Modular Expansion Connector. LED D8 indicates the Ethernet bus speed. When lit, the bus speed is 100 Mb/s; when off, the bus speed is 10 Mb/s.

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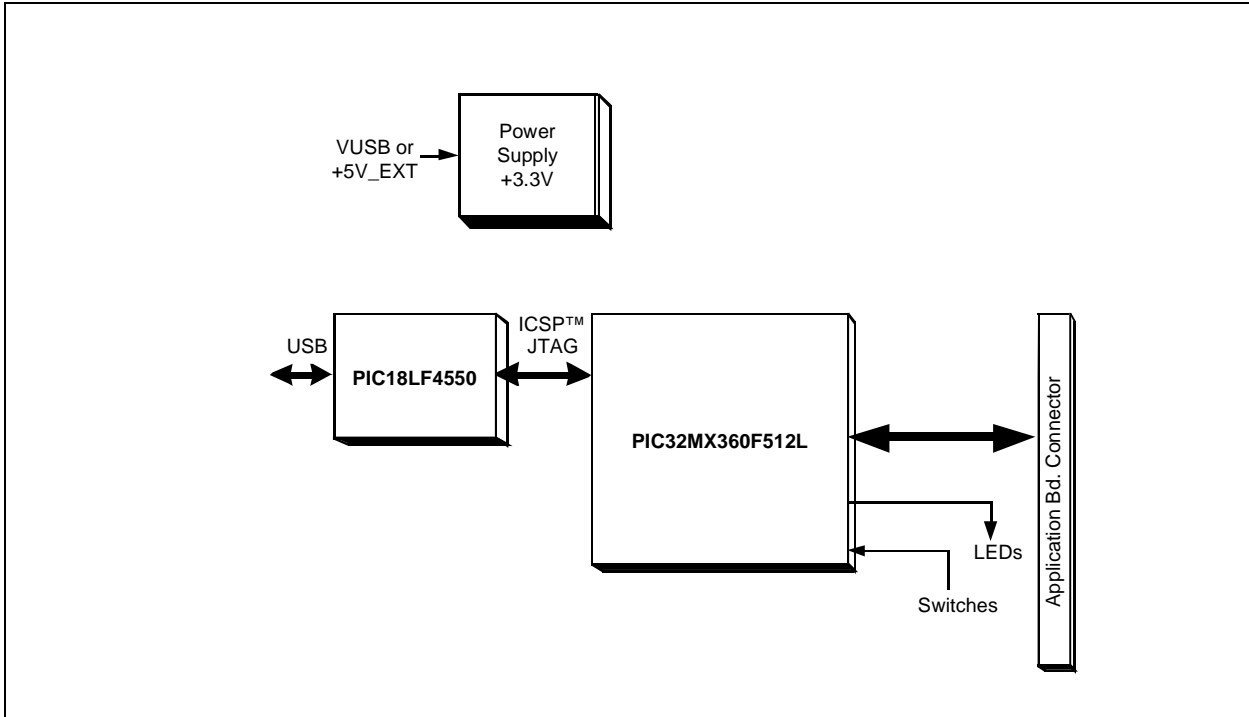
**Appendix A. Board Layout and Schematics**

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**A.1 PIC32 (GENERAL PURPOSE) STARTER KIT DEVELOPMENT BOARD  
BLOCK DIAGRAM**

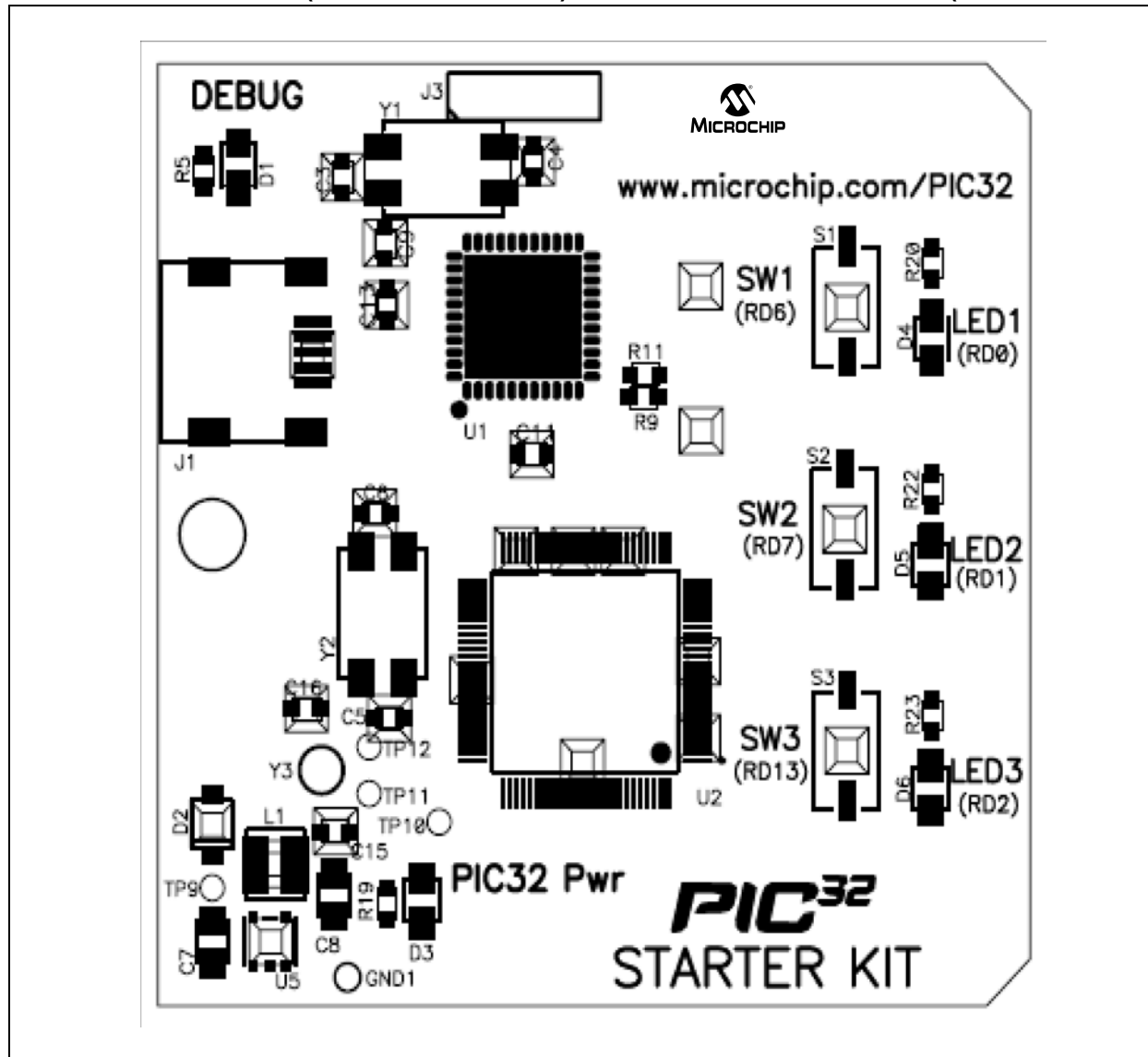
**FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32 STARTER KIT**



# PIC32 Starter Kit User's Guide

## A.2 PIC32 (GENERAL PURPOSE) STARTER KIT BOARD LAYOUT

FIGURE A-2: PIC32 (GENERAL PURPOSE) STARTER KIT BOARD LAYOUT (TOP ASSEMBLY)



### A.3 PIC32 (GENERAL PURPOSE) STARTER KIT BOARD SCHEMATICS

FIGURE A-3: PIC32 STARTER KIT SCHEMATIC, SHEET 1 OF 6 (PIC32MX CPU)

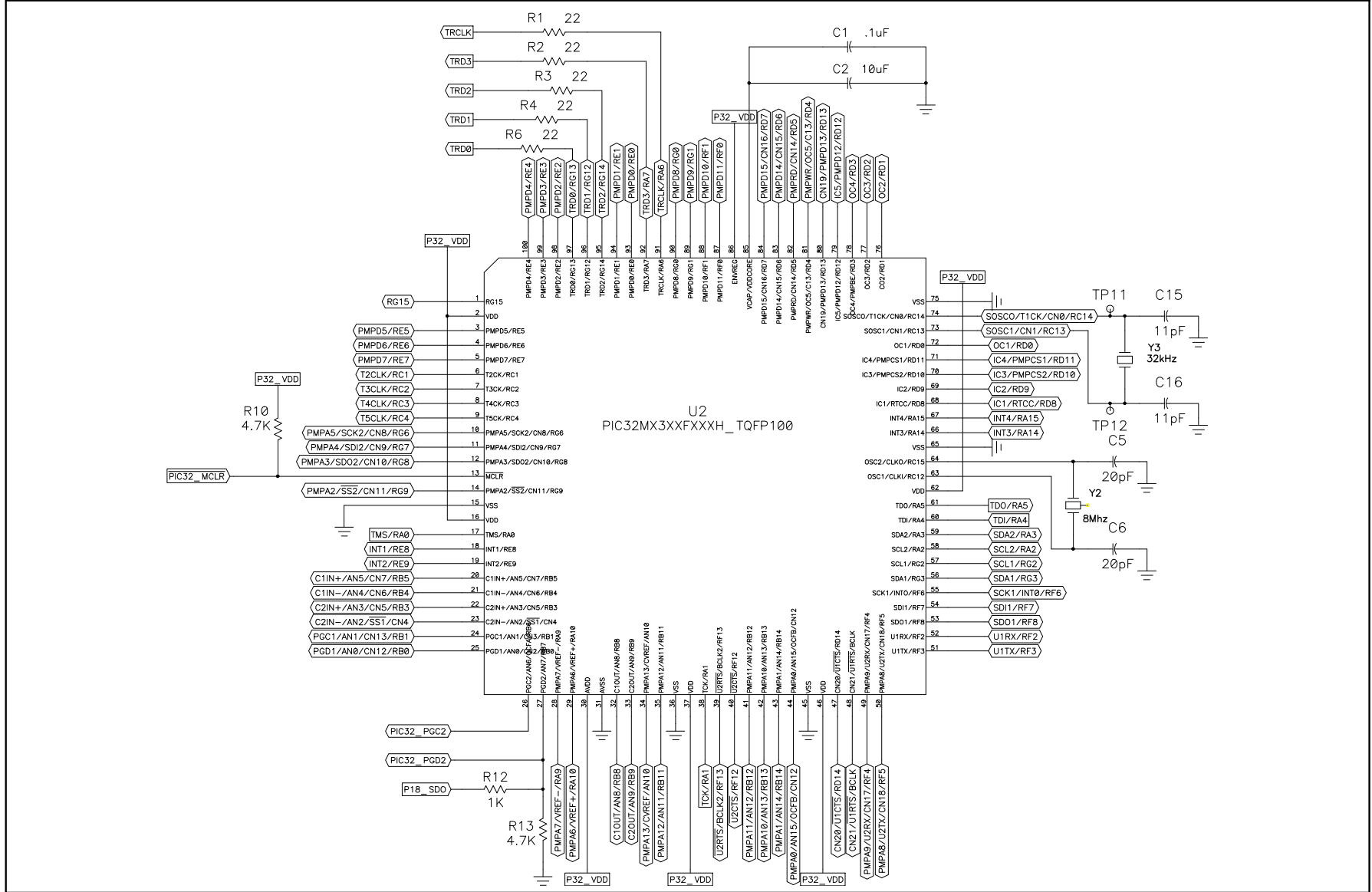
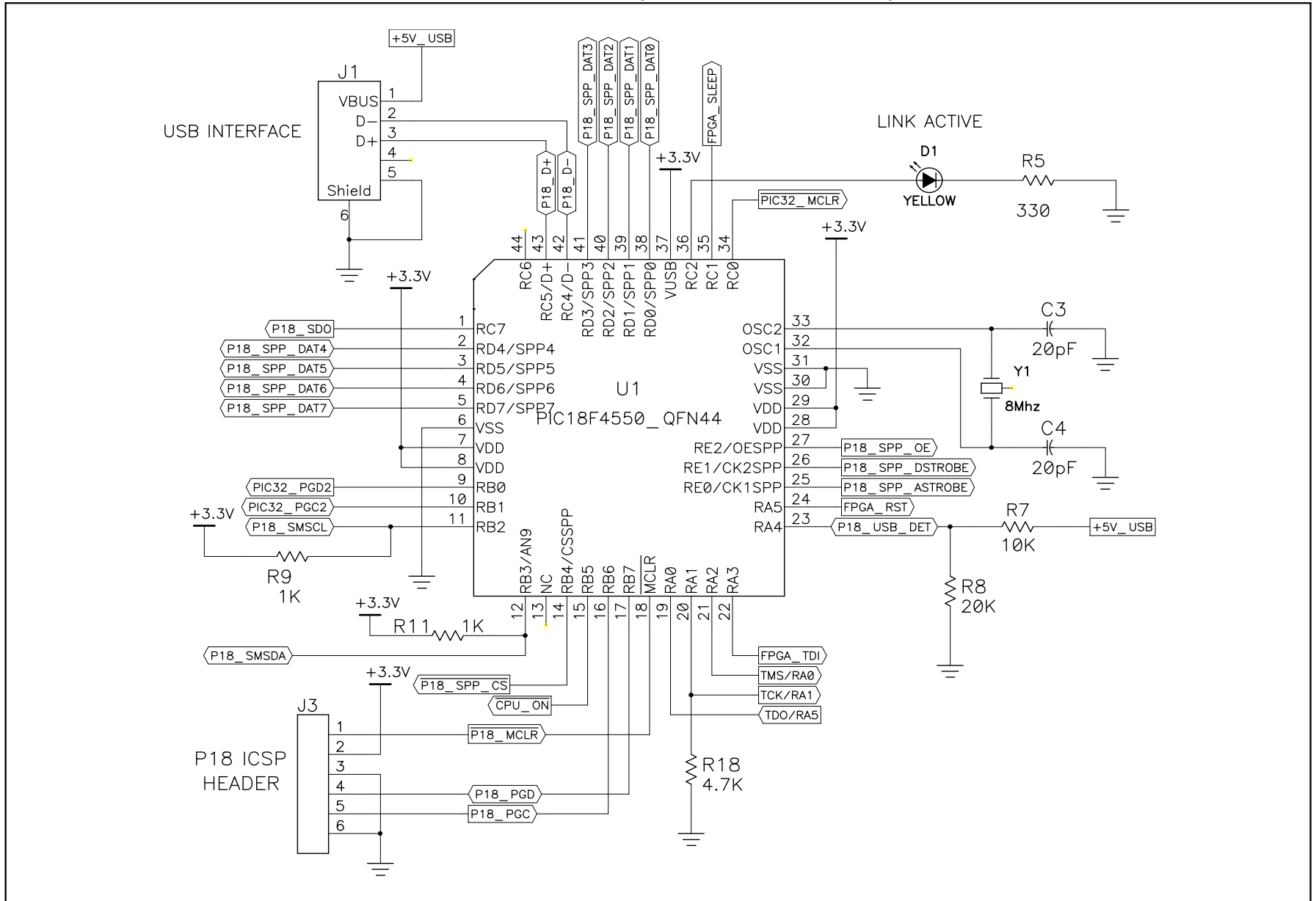
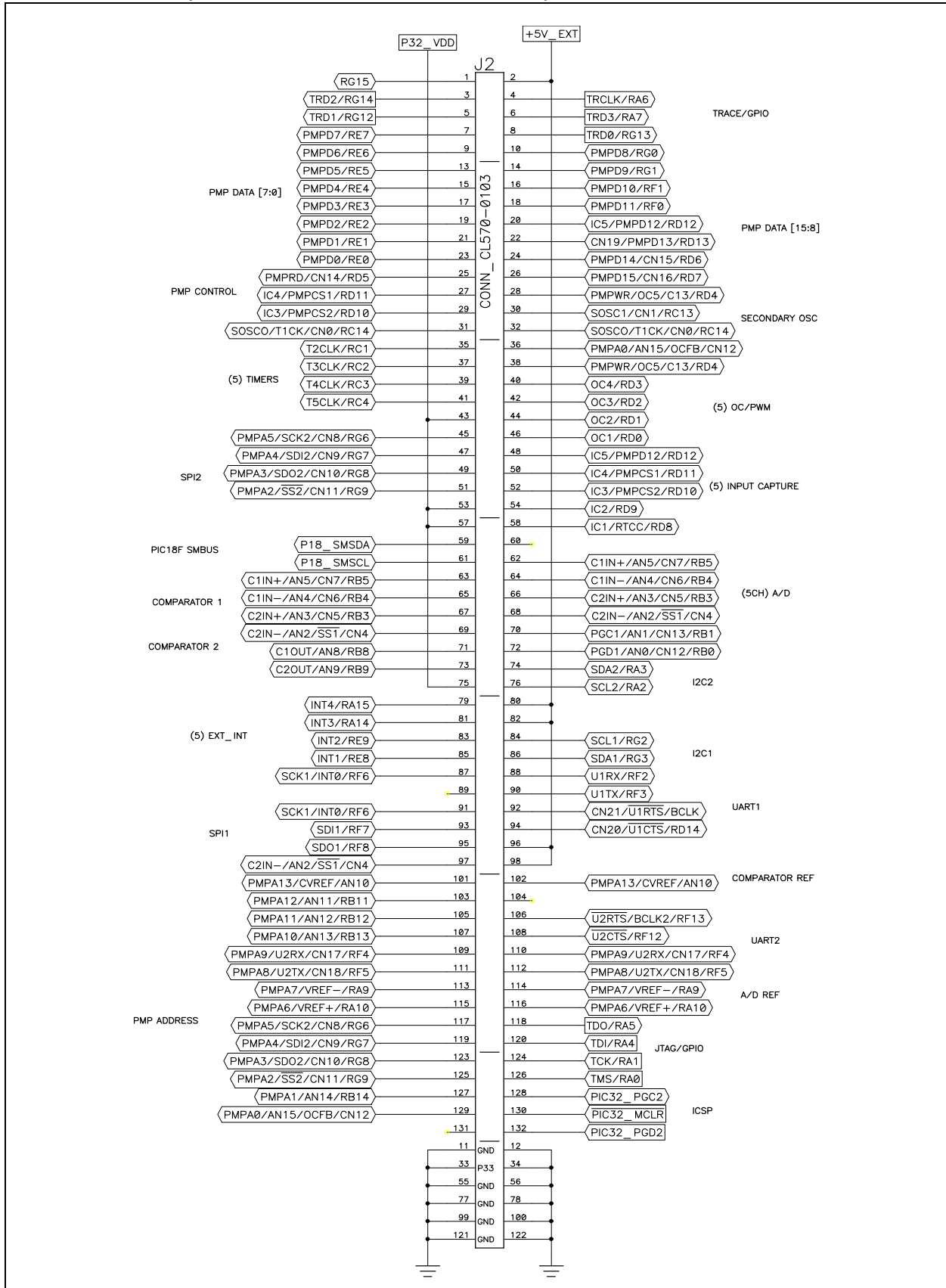


FIGURE A-4: PIC32 STARTER KIT SCHEMATIC, SHEET 2 OF 6 (PIC18LF4550 DEBUG CPU)



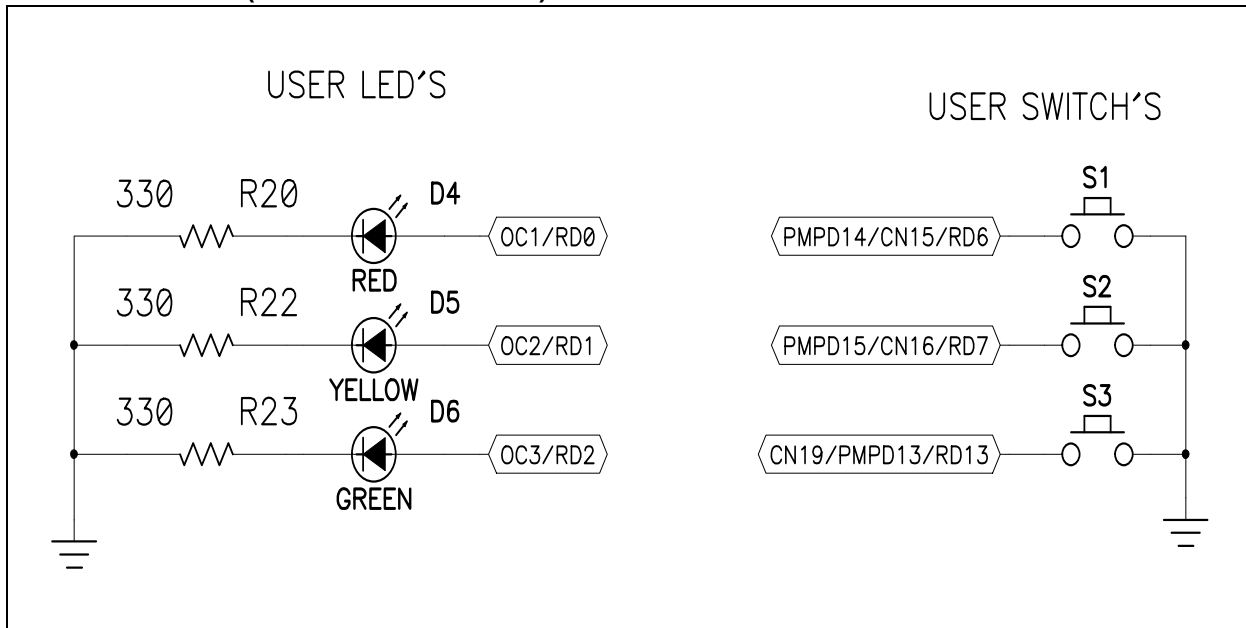


**FIGURE A-5: PIC32 STARTER KIT SCHEMATIC, SHEET 3 OF 6  
(APPLICATION BOARD CONNECTOR)**

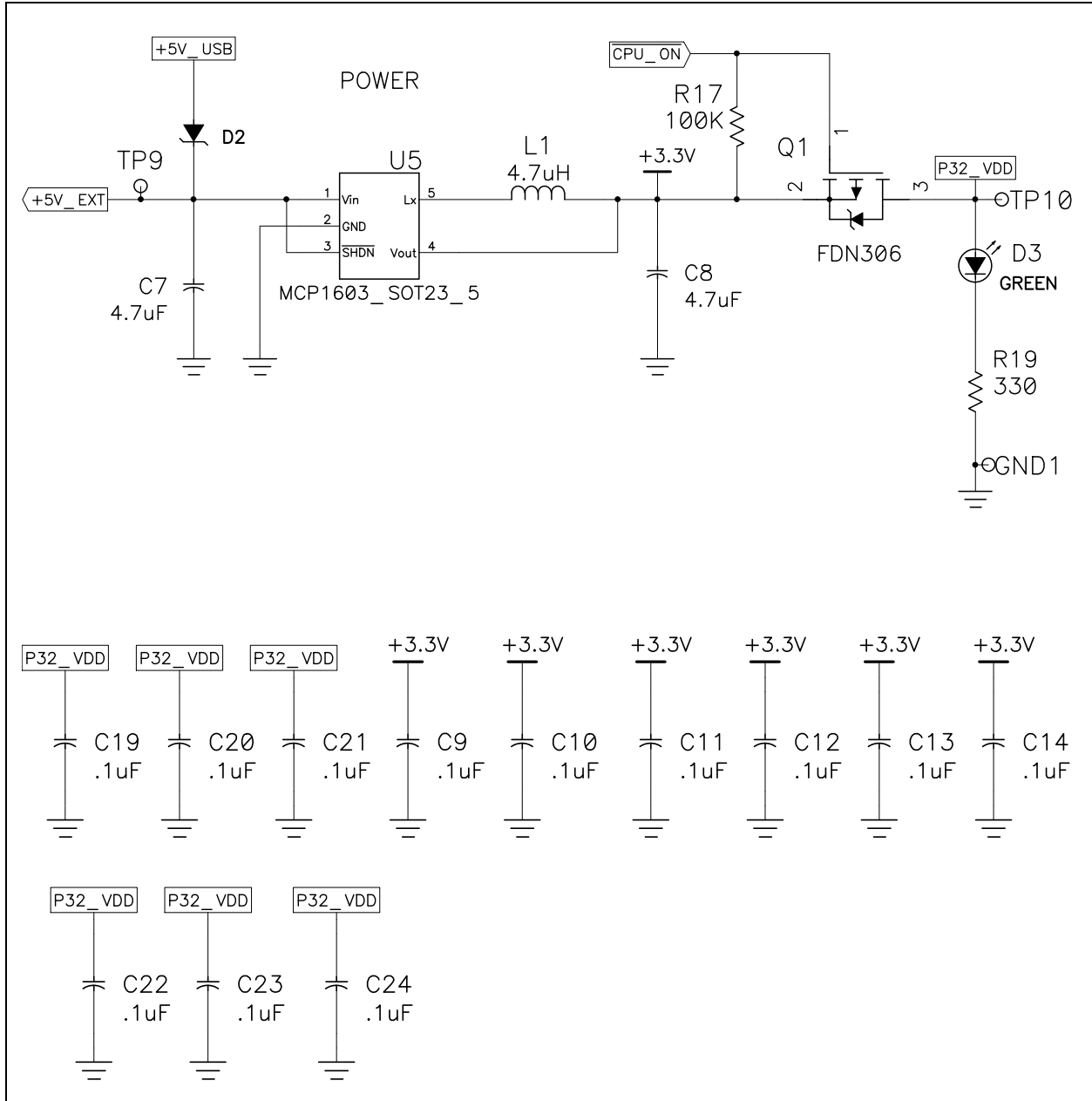


# PIC32 Starter Kit User's Guide

FIGURE A-6: PIC32 STARTER KIT SCHEMATIC, SHEET 5 OF 6 (SWITCHES AND LEDS)



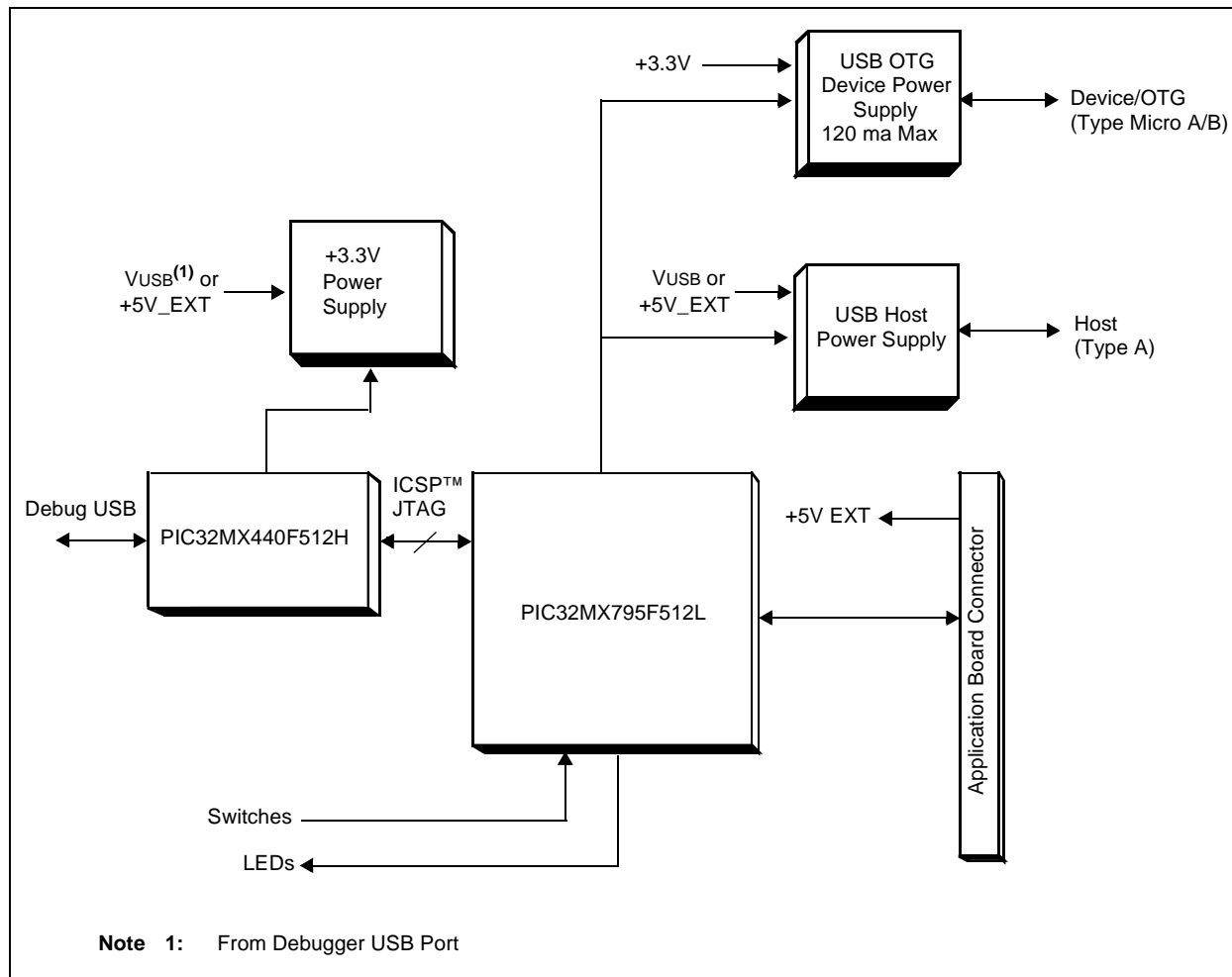
**FIGURE A-7: PIC32 STARTER KIT SCHEMATIC, SHEET 6 OF 6 (POWER SUPPLY)**



# PIC32 Starter Kit User's Guide

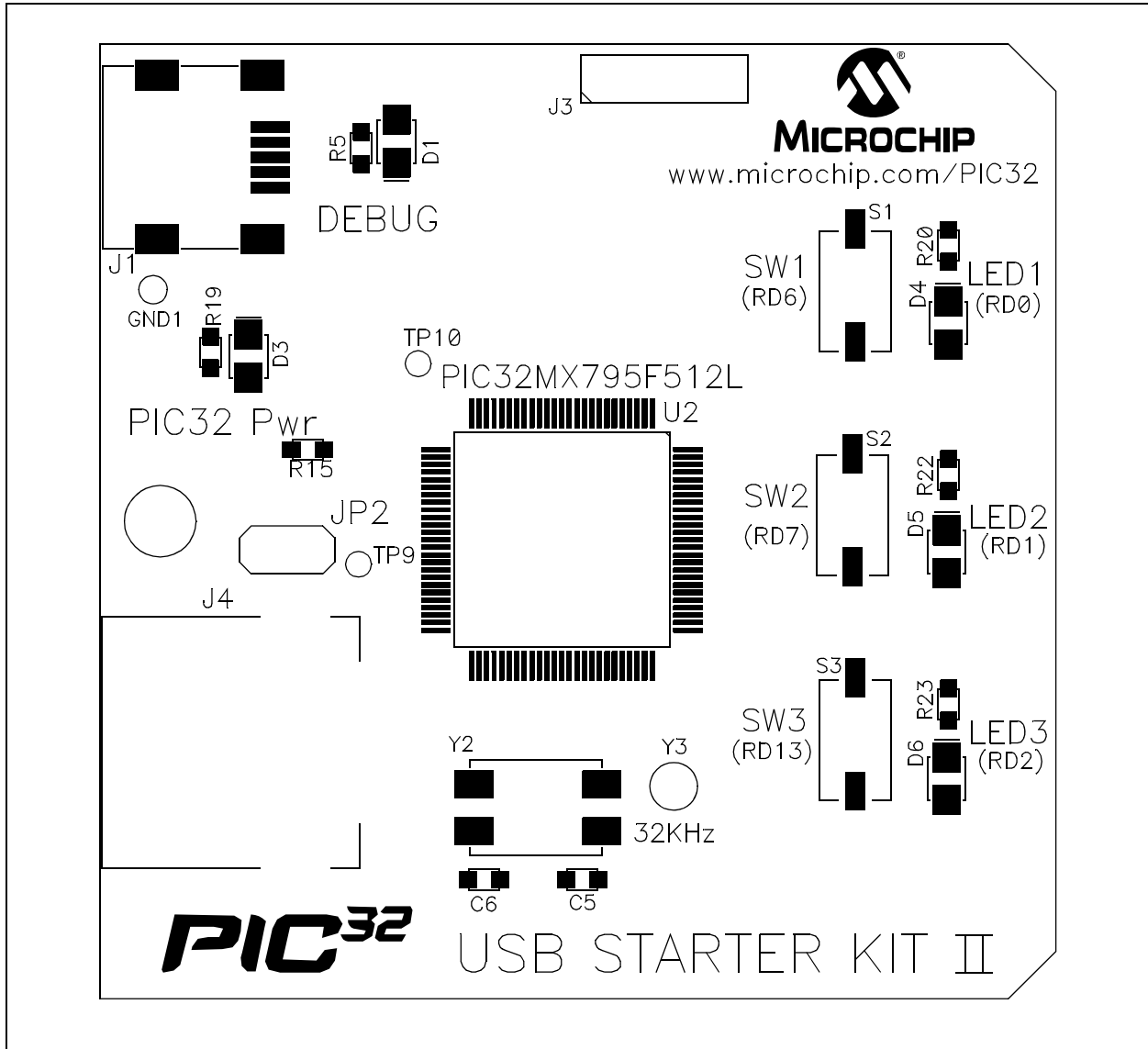
## A.4 PIC32 USB STARTER KIT II DEVELOPMENT BOARD BLOCK DIAGRAM

FIGURE A-8: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32 USB STARTER KIT II BOARD



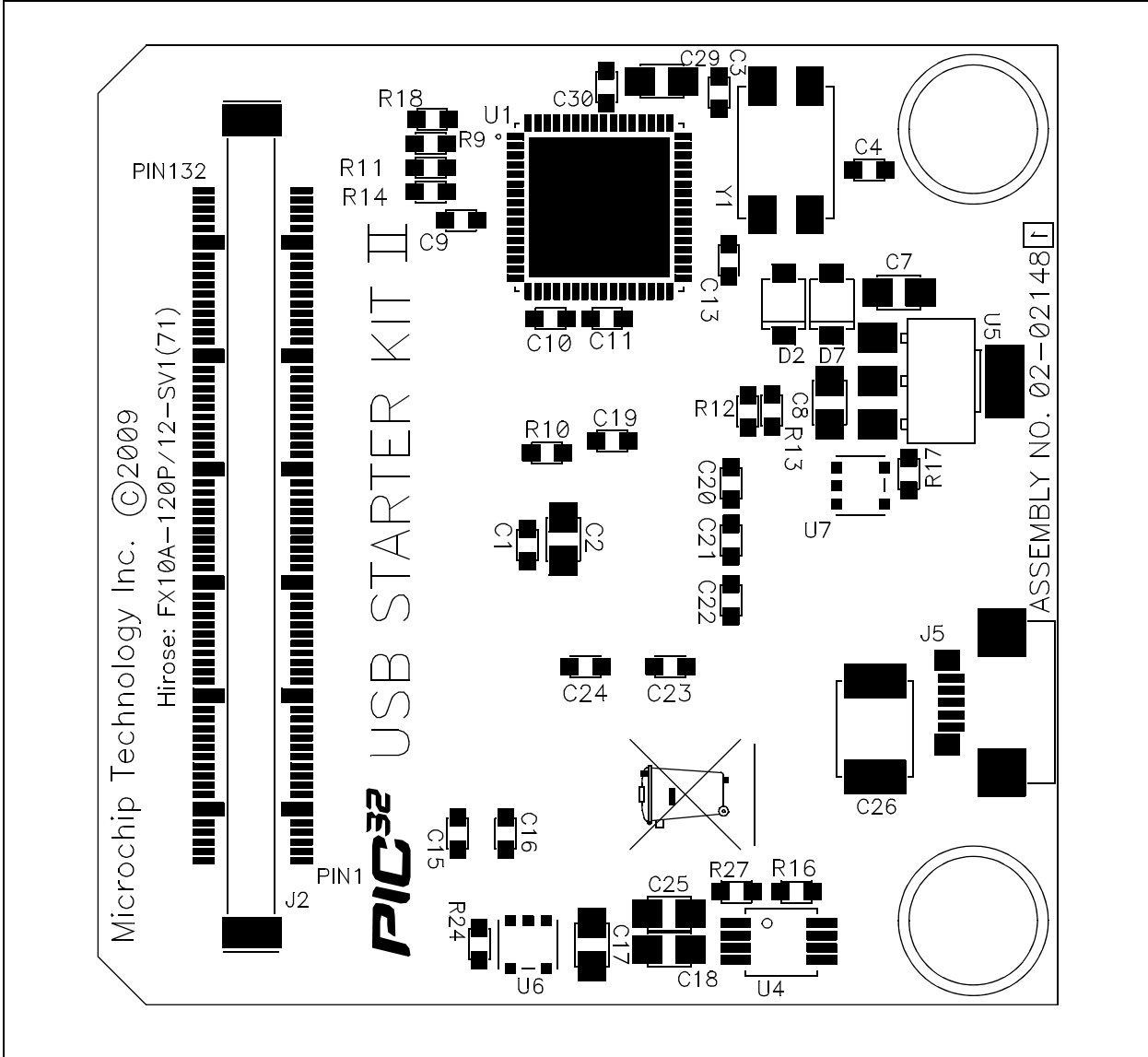
## A.5 PIC32 USB STARTER KIT II BOARD LAYOUT

FIGURE A-9: PIC32 USB STARTER KIT II LAYOUT (TOP ASSEMBLY)



# PIC32 Starter Kit User's Guide

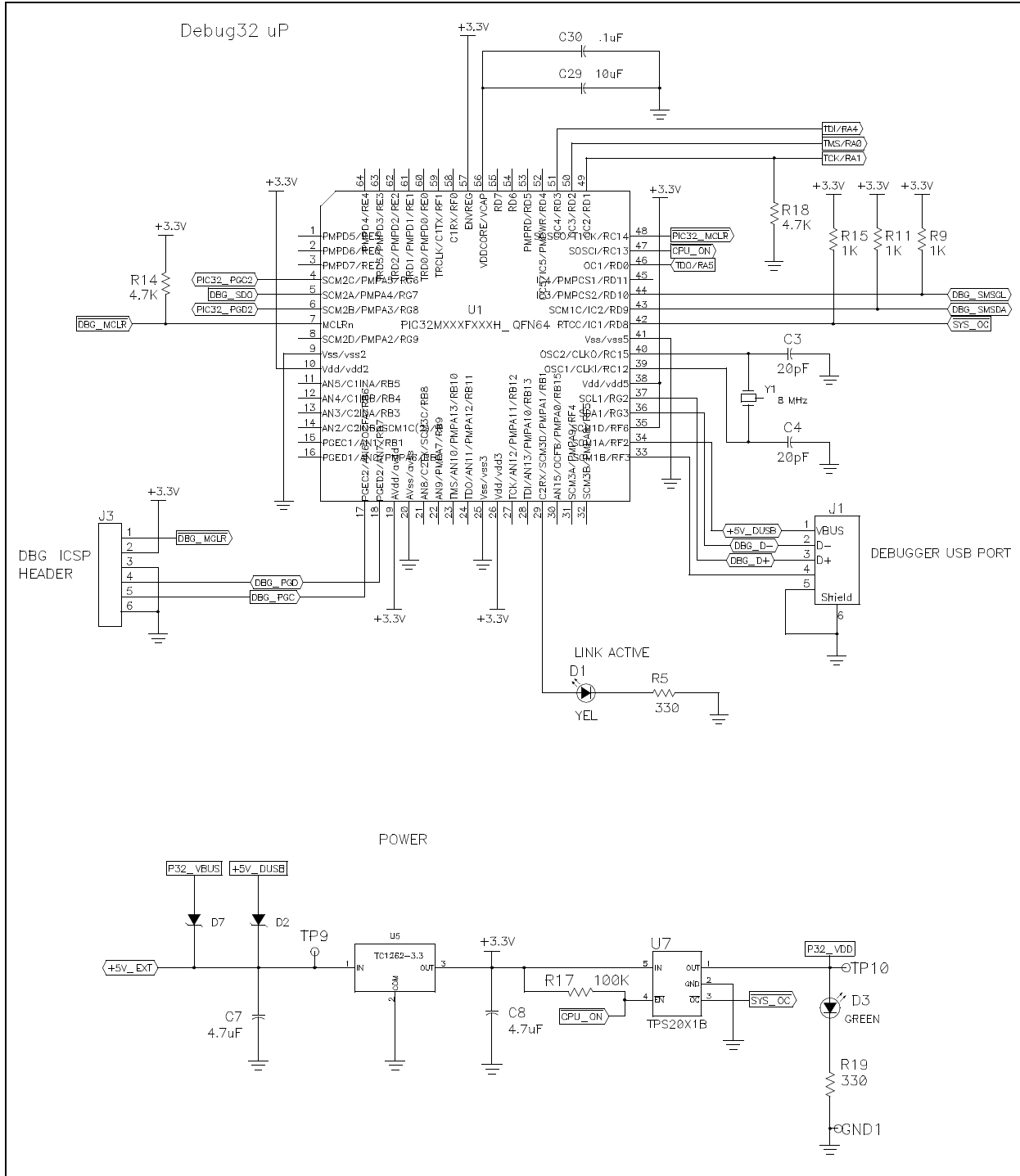
FIGURE A-10: PIC32 USB STARTER KIT II LAYOUT (BOTTOM ASSEMBLY)





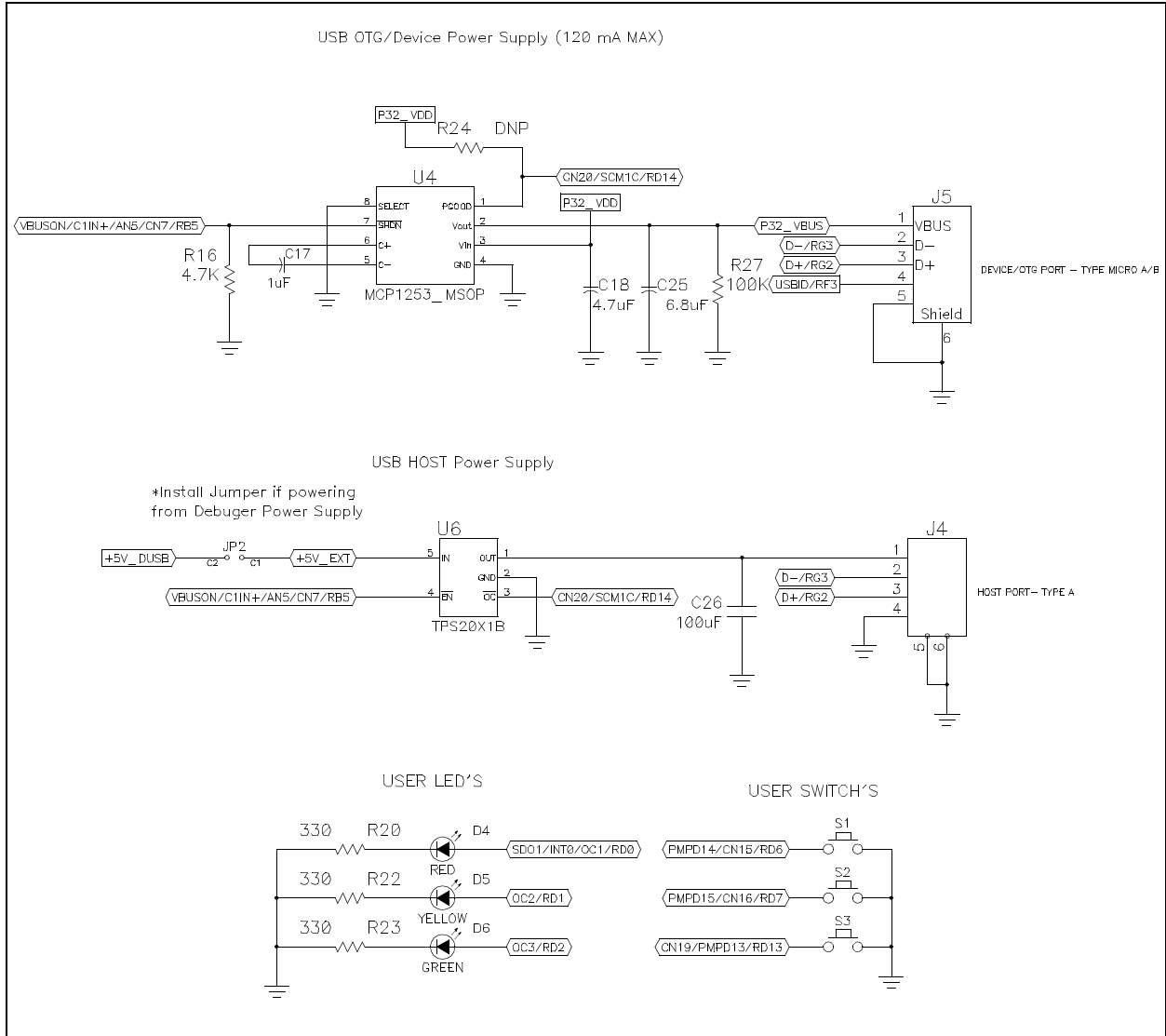
# PIC32 Starter Kit User's Guide

FIGURE A-12: PIC32 USB STARTER KIT II SCHEMATICS (SHEET 2 OF 3)





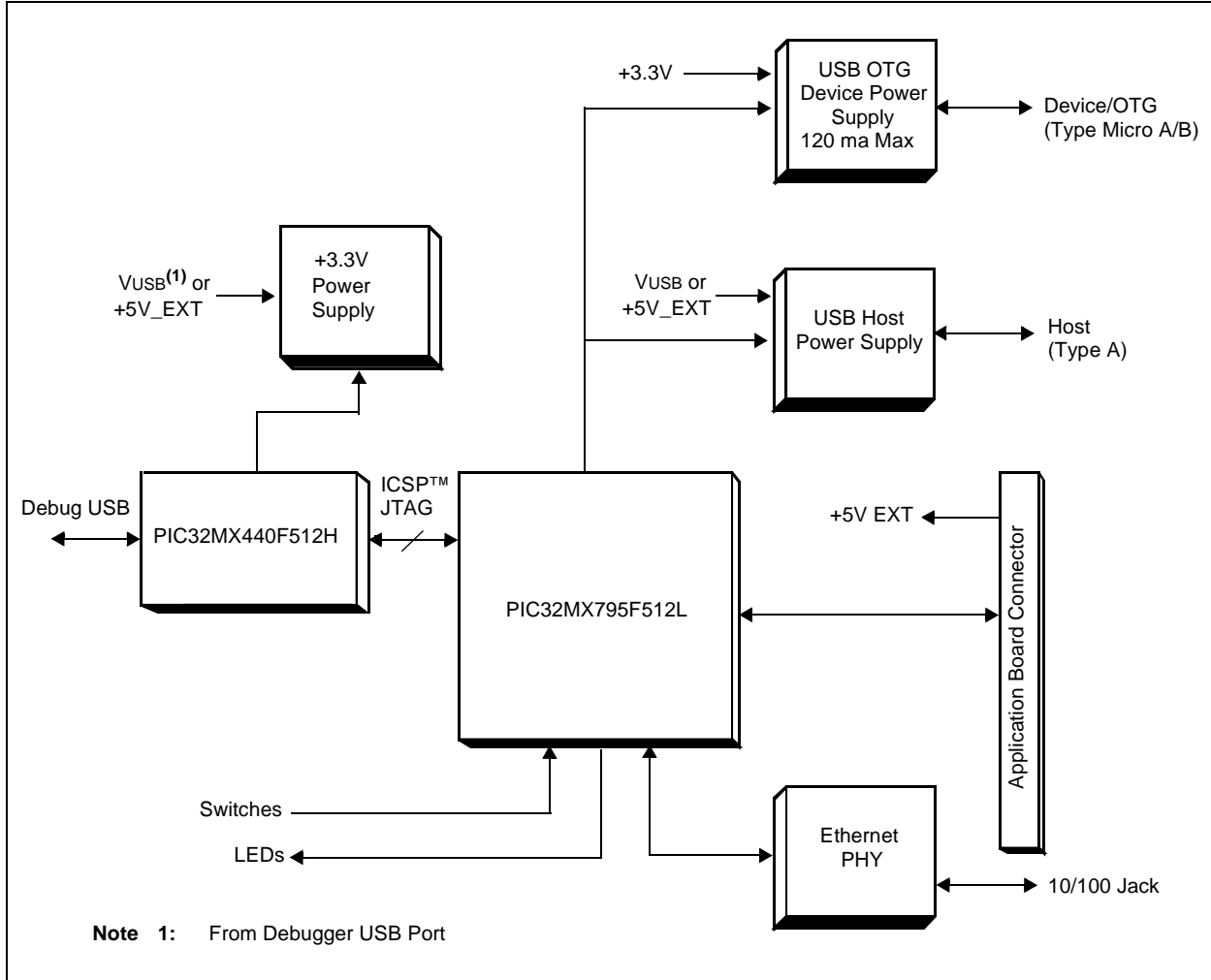
**FIGURE A-13: PIC32 USB STARTER KIT II SCHEMATICS (SHEET 3 OF 3)**



# PIC32 Starter Kit User's Guide

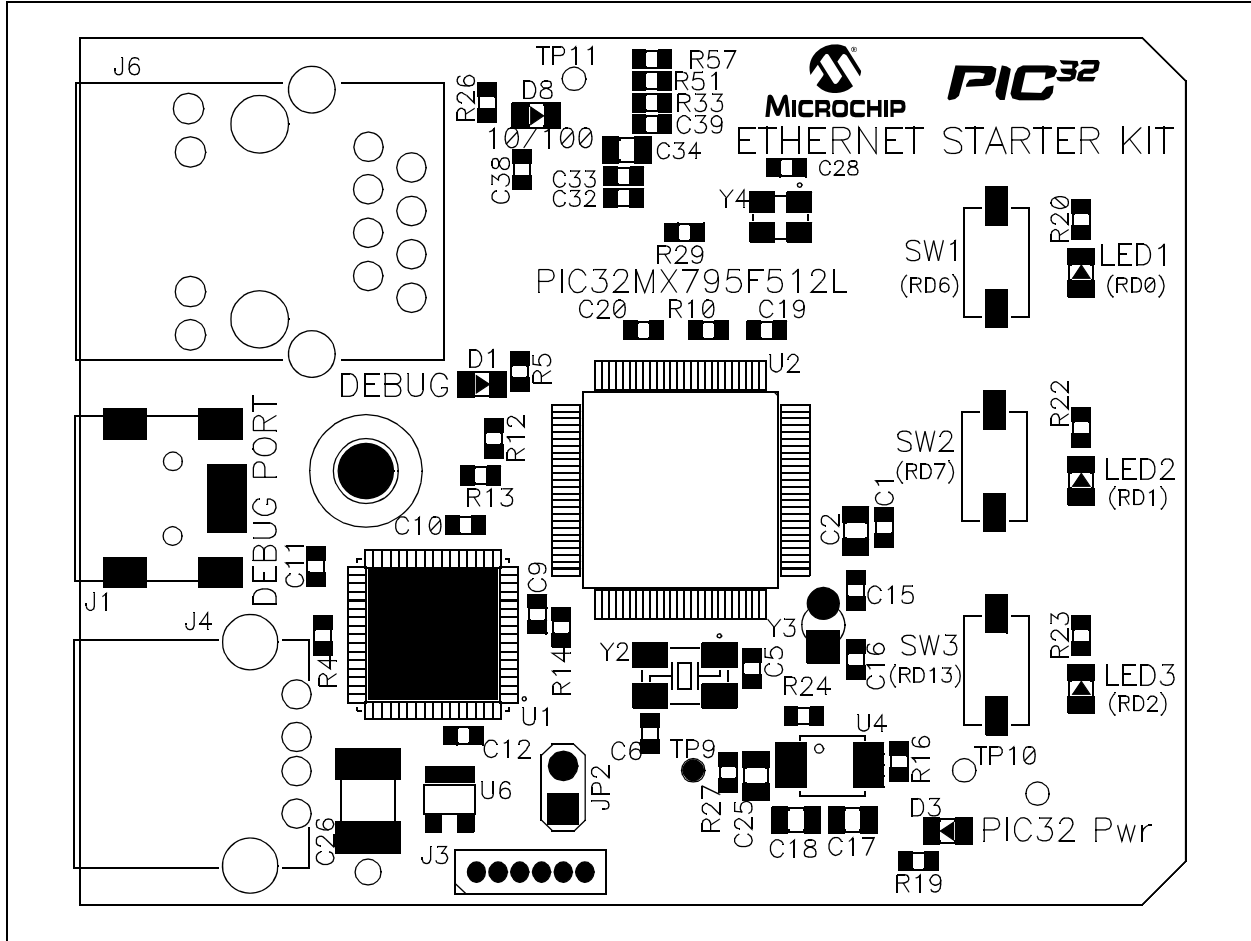
## A.7 PIC32 ETHERNET STARTER KIT BLOCK DIAGRAM

FIGURE A-14: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32 ETHERNET STARTER KIT



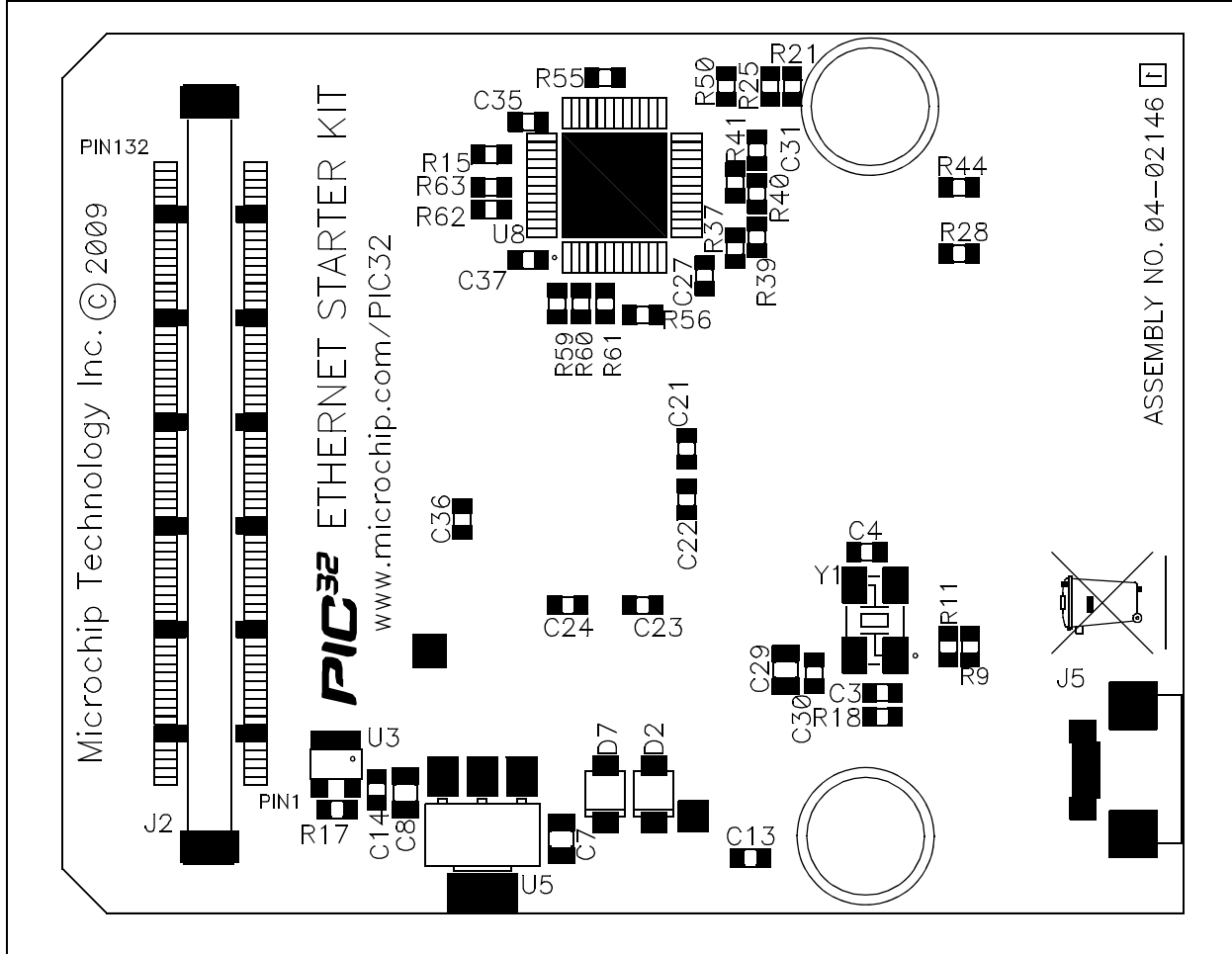
## A.8 PIC32 ETHERNET STARTER KIT BOARD LAYOUT

FIGURE A-15: PIC32 ETHERNET STARTER KIT LAYOUT (TOP ASSEMBLY)



# PIC32 Starter Kit User's Guide

FIGURE A-16: PIC32 ETHERNET STARTER KIT LAYOUT (BOTTOM ASSEMBLY)



## A.9 PIC32 ETHERNET STARTER KIT BOARD SCHEMATICS

FIGURE A-17: PIC32 ETHERNET STARTER KIT (ETHERNET)

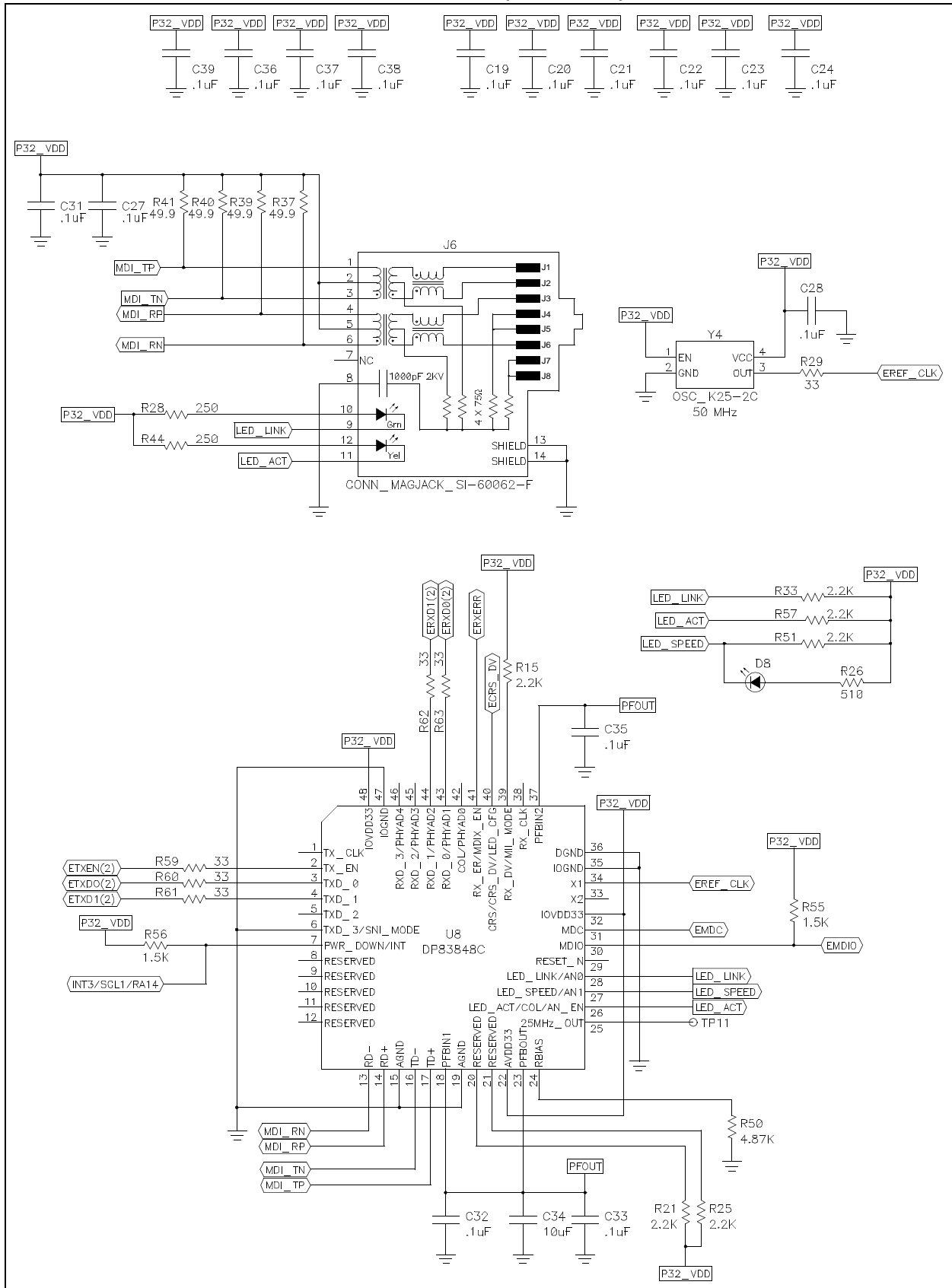


FIGURE A-18: PIC32 ETHERNET STARTER KIT (PIC32 DEVICE)

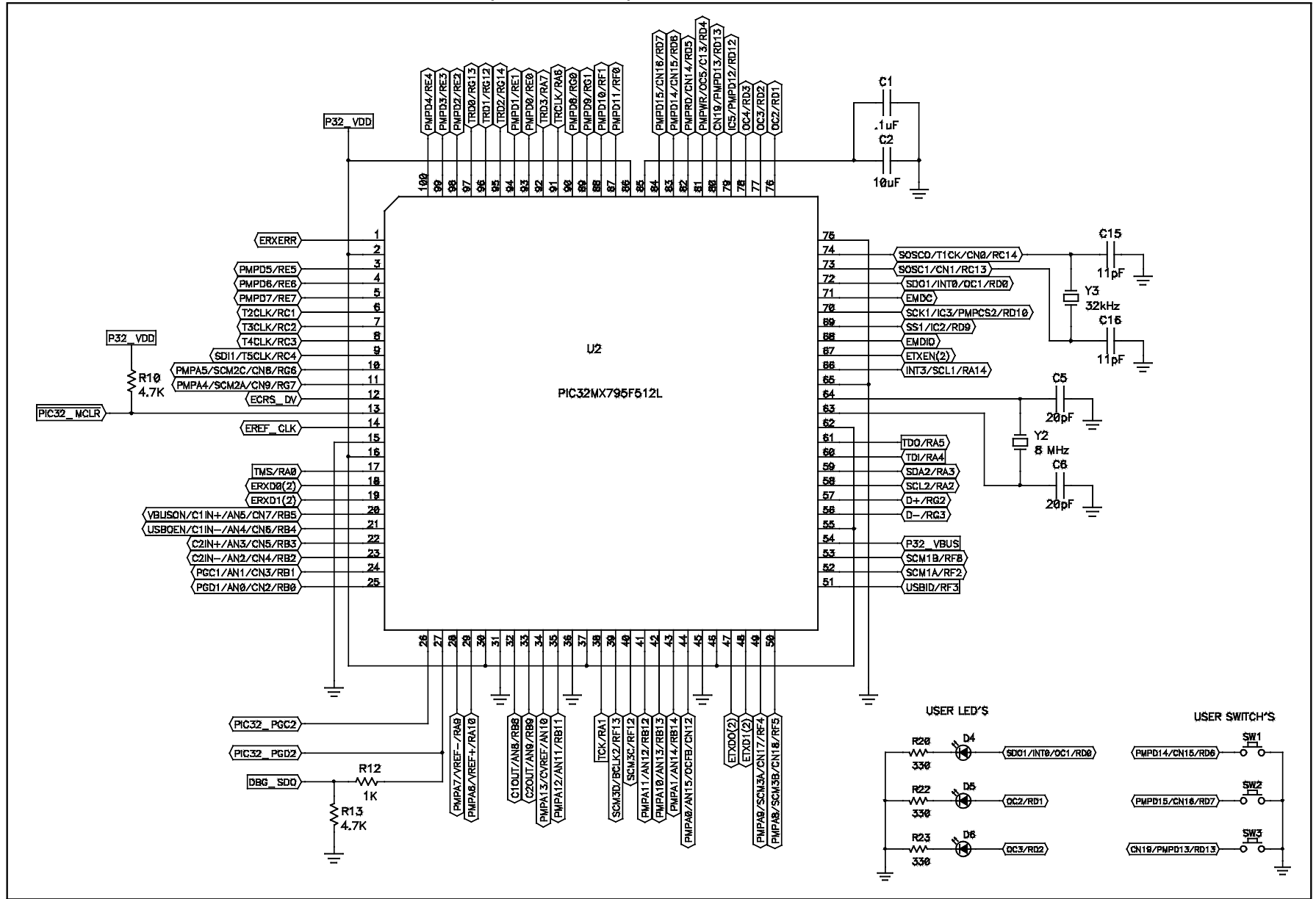


FIGURE A-19: PIC32 ETHERNET STARTER KIT (USB HOST AND OTG POWER SUPPLIES)

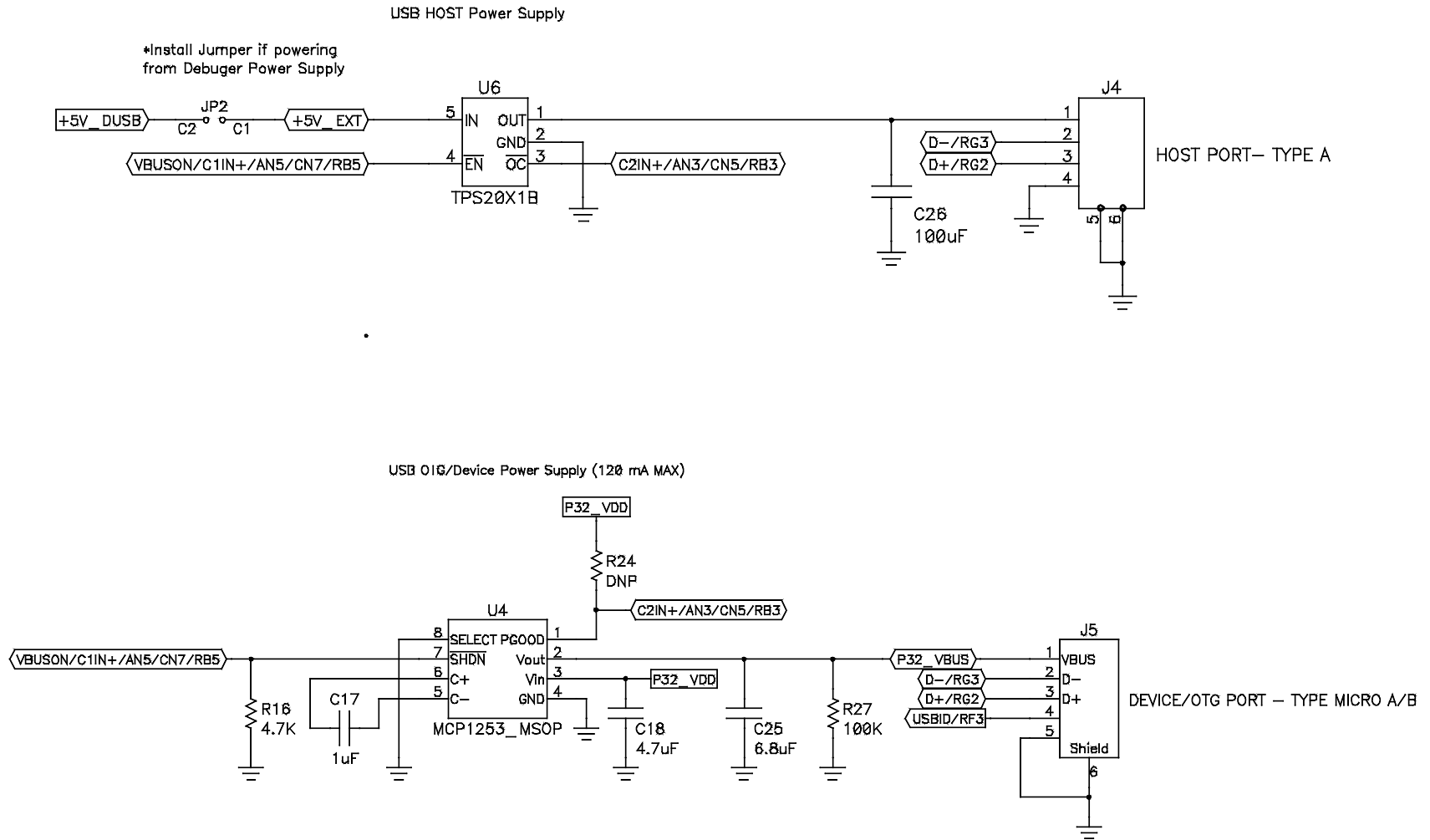


FIGURE A-20: PIC32 ETHERNET STARTER KIT (DEBUGGER)

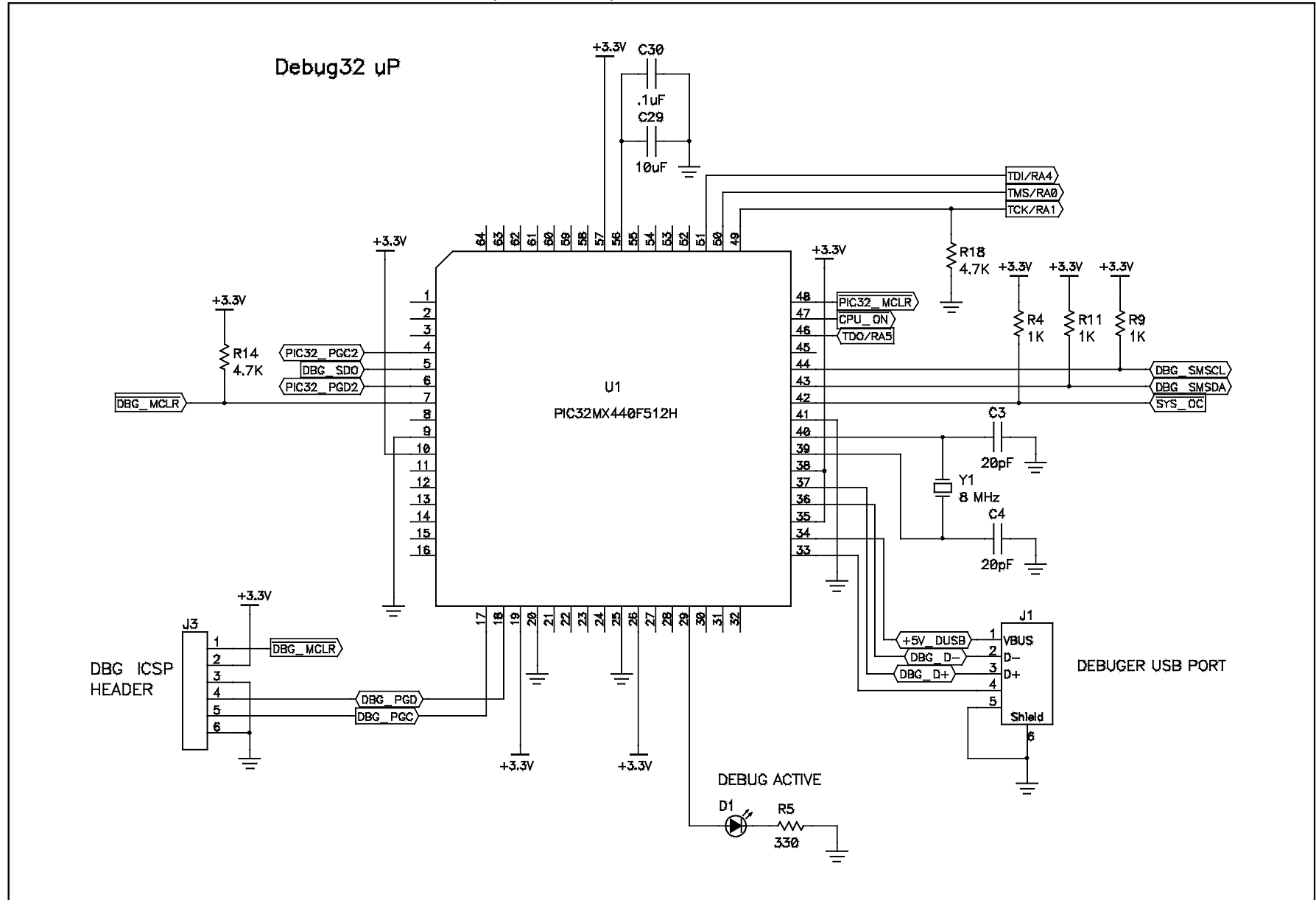
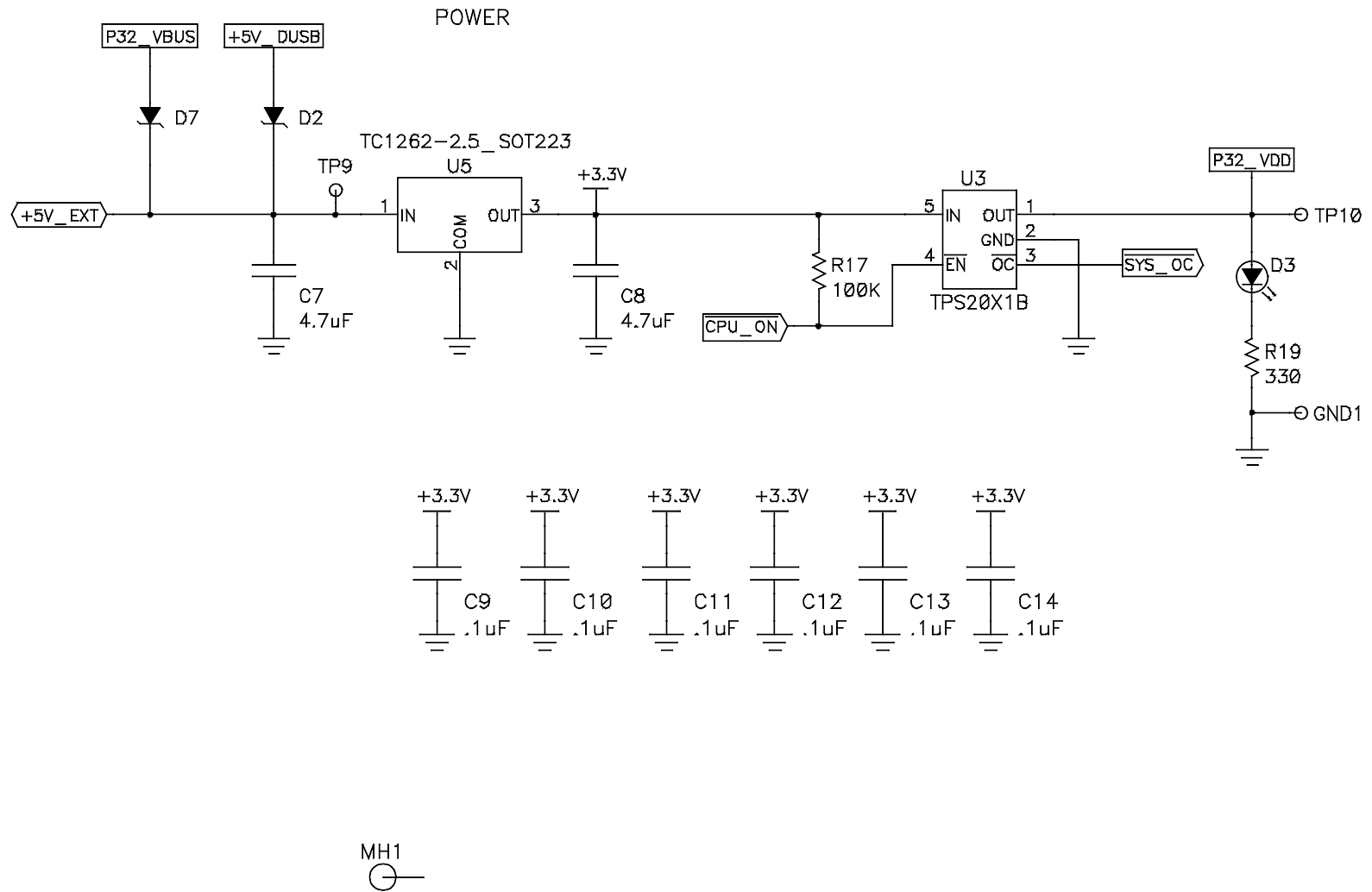


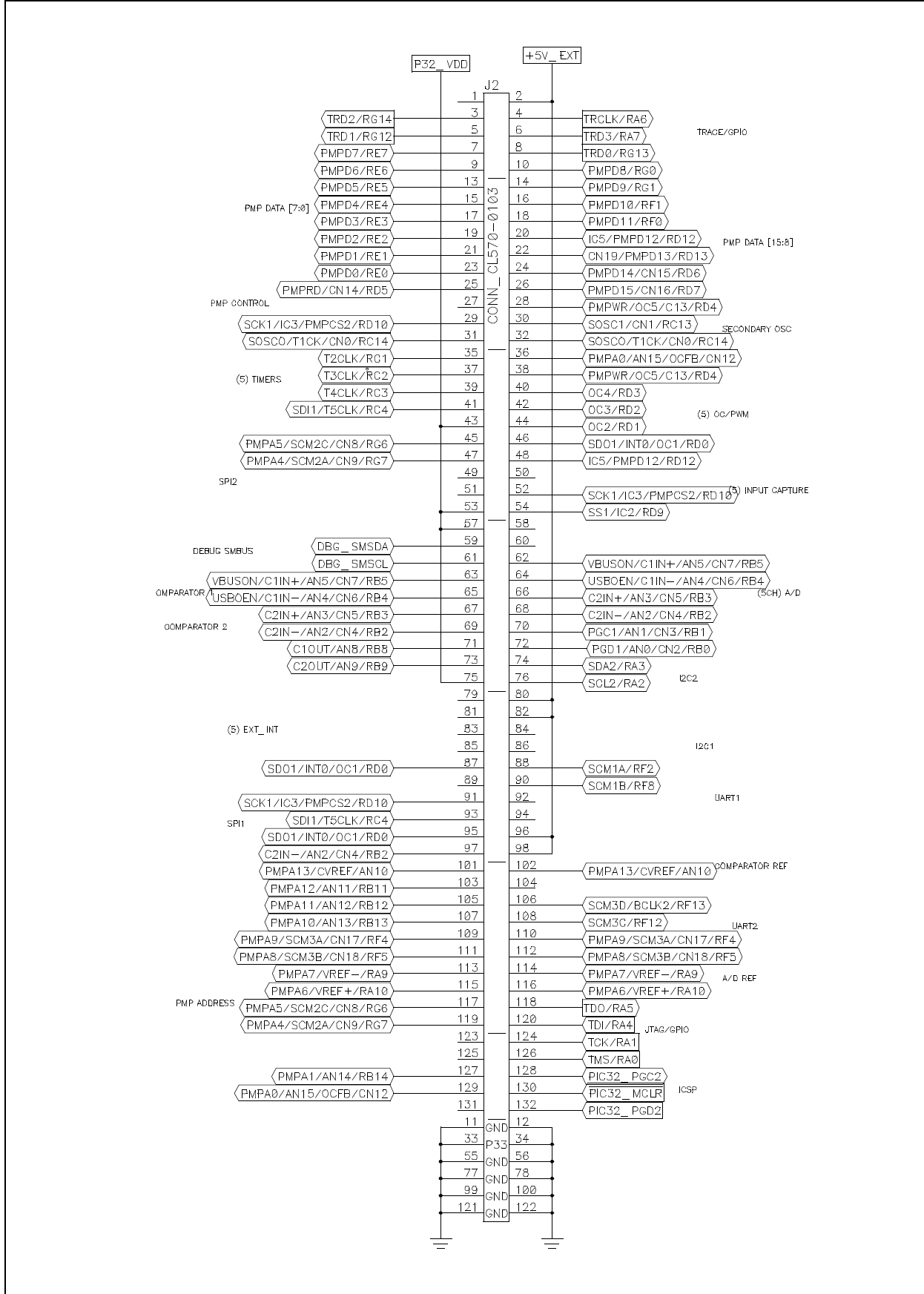


FIGURE A-21: PIC32 ETHERNET STARTER KIT (3.3V POWER SUPPLY)



# PIC32 Starter Kit User's Guide

**FIGURE A-22: PIC32 ETHERNET STARTER KIT (APPLICATION BOARD CONNECTOR)**



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## Worldwide Sales and Service

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### 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](http://www.microchip.com)

#### Atlanta

Duluth, GA  
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Fax: 678-957-1455

#### Boston

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Fax: 216-447-0643

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Fax: 972-818-2924

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Fax: 248-538-2260

#### Kokomo

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Fax: 765-864-8387

#### Los Angeles

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Fax: 949-462-9608

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Fax: 408-961-6445

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### ASIA/PACIFIC

#### Asia Pacific Office

Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
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Hong Kong  
Tel: 852-2401-1200  
Fax: 852-2401-3431

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Fax: 61-2-9868-6755

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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

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Fax: 86-532-8502-7205

#### China - Shanghai

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Fax: 86-21-5407-5066

#### China - Shenyang

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Fax: 86-24-2334-2393

#### China - Shenzhen

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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

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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

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#### Germany - Munich

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#### Italy - Milan

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#### 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

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