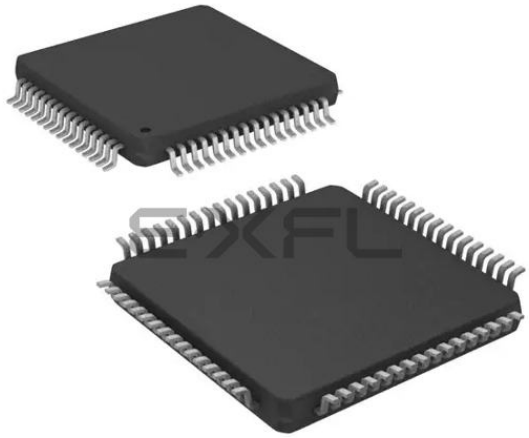
# Microchip Technology - PIC32MX440F256H-80V/PT Datasheet



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## What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

## Applications of "Embedded - Microcontrollers"

| Details | |
|---|---|
| Product Status | Active |
| Core Processor | MIPS32® M4K™ |
| Core Size | 32-Bit Single-Core |
| Speed | 80MHz |
| Connectivity | I²C, IrDA, LINbus, PMP, SPI, UART/USART, USB OTG |
| Peripherals | Brown-out Detect/Reset, DMA, POR, PWM, WDT |
| Number of I/O | 53 |
| Program Memory Size | 256KB (256K x 8) |
| Program Memory Type | FLASH |
| EEPROM Size | - |
| RAM Size | 32K x 8 |
| Voltage - Supply (Vcc/Vdd) | 2.3V ~ 3.6V |
| Data Converters | A/D 16x10b |
| Oscillator Type | Internal |
| Operating Temperature | -40°C ~ 105°C (TA) |
| Mounting Type | Surface Mount |
| Package / Case | 64-TQFP |
| Supplier Device Package | 64-TQFP (10x10) |
| Purchase URL | https://www.e-xfl.com/product-detail/microchip-technology/pic32mx440f256h-80v-pt |

**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."

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# PIC32MX STARTER KIT USER'S GUIDE

## Table of Contents

**NOTES:**

## 1.5 INSTALLING THE PIC32MX STARTER KIT CD

The default PIC32MX Starter Kit installation directory is:
`c:\Microchip Starter Kits\PIC32 Starter Kits`

Note, throughout this document, the following phrase "`[install directory]`" refers to this default installation, `c:\Microchip Starter Kits`, or a directory selected by the user during the time of installation.

The starter kit CD-ROM contains the MPLAB IDE, MPLAB C32 C Compiler tools, code examples, sample projects, technical documentation, a getting started tutorial, and this *PIC32MX Starter Kit User's Guide*. When the CD is placed into your CD drive, an automatic installation application will guide you to install the tools and relevant documents.

## 1.6 USING THE PIC32MX STARTER KIT OUT OF THE BOX

The PIC32MX Starter Kit may be used directly from the box as a demonstration board for the PIC32MX device. The PIC32MX is preprogrammed with the classic "Simon Says" game (`simon_says_demo.hex`) in the PIC32MX360F512L device and is ready for immediate use.

### 1.6.1 How to Play the Game

When the USB cable is plugged into the starter kit, 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 a game. After a brief pause, you can press a switch again to start a new game.

If the starter kit is connected to the MPLAB IDE, the game stops. It will be replaced by the MPLAB IDE project that you select when the program button is pressed. The game can be reloaded onto the starter kit by opening `simon_says_demo.mcw` from the following directory:
`[install directory]\PIC32 Starter Kits\simon_says_demo`

## 1.7 PIC32MX DEMONSTRATION PROGRAM

The preprogrammed example code on the PIC32MX has been included as part of the PIC32MX Starter Kit installation. All project files have been included, so that the code may be used directly to restore a PIC32MX 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.

### 2.4.2 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 2.5 "Starting the Tutorial Project"** on page 16.

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

### 2.4.3 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.

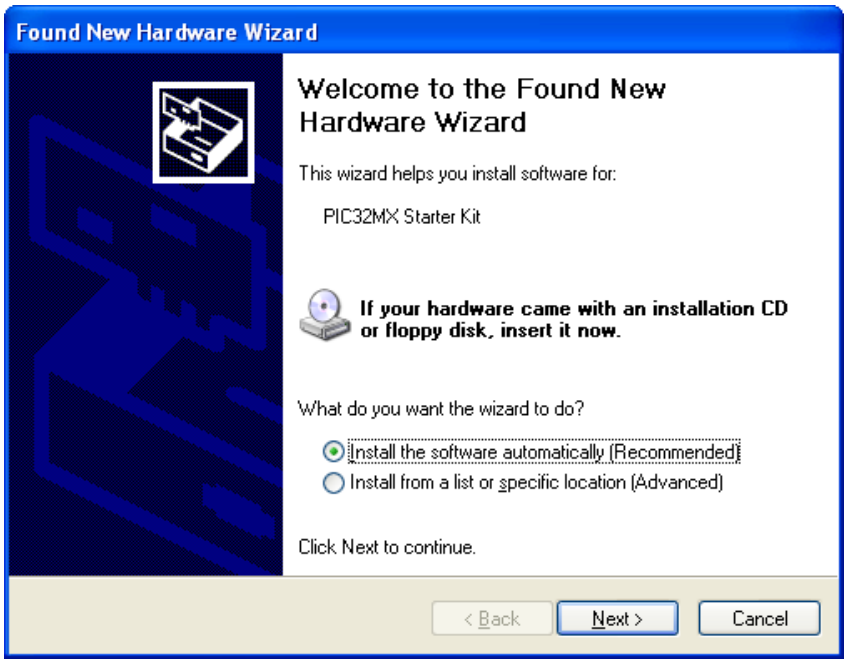
### 2.4.4 Install the USB Device Driver

**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 click **Next**.

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

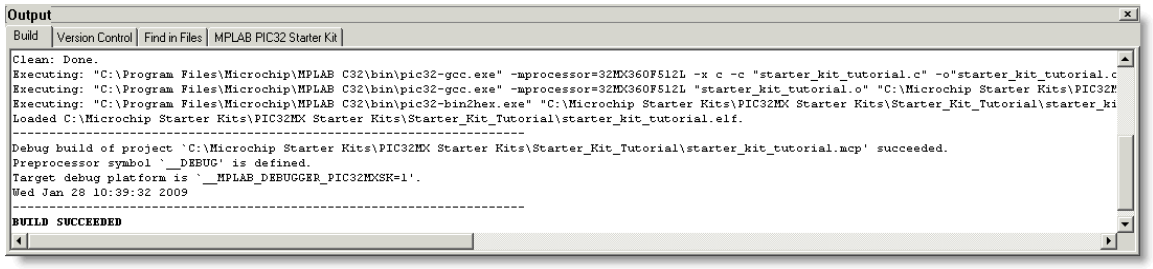


## 2.6 BUILDING THE PROJECT

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**



## 2.8 RUNNING THE PROGRAM

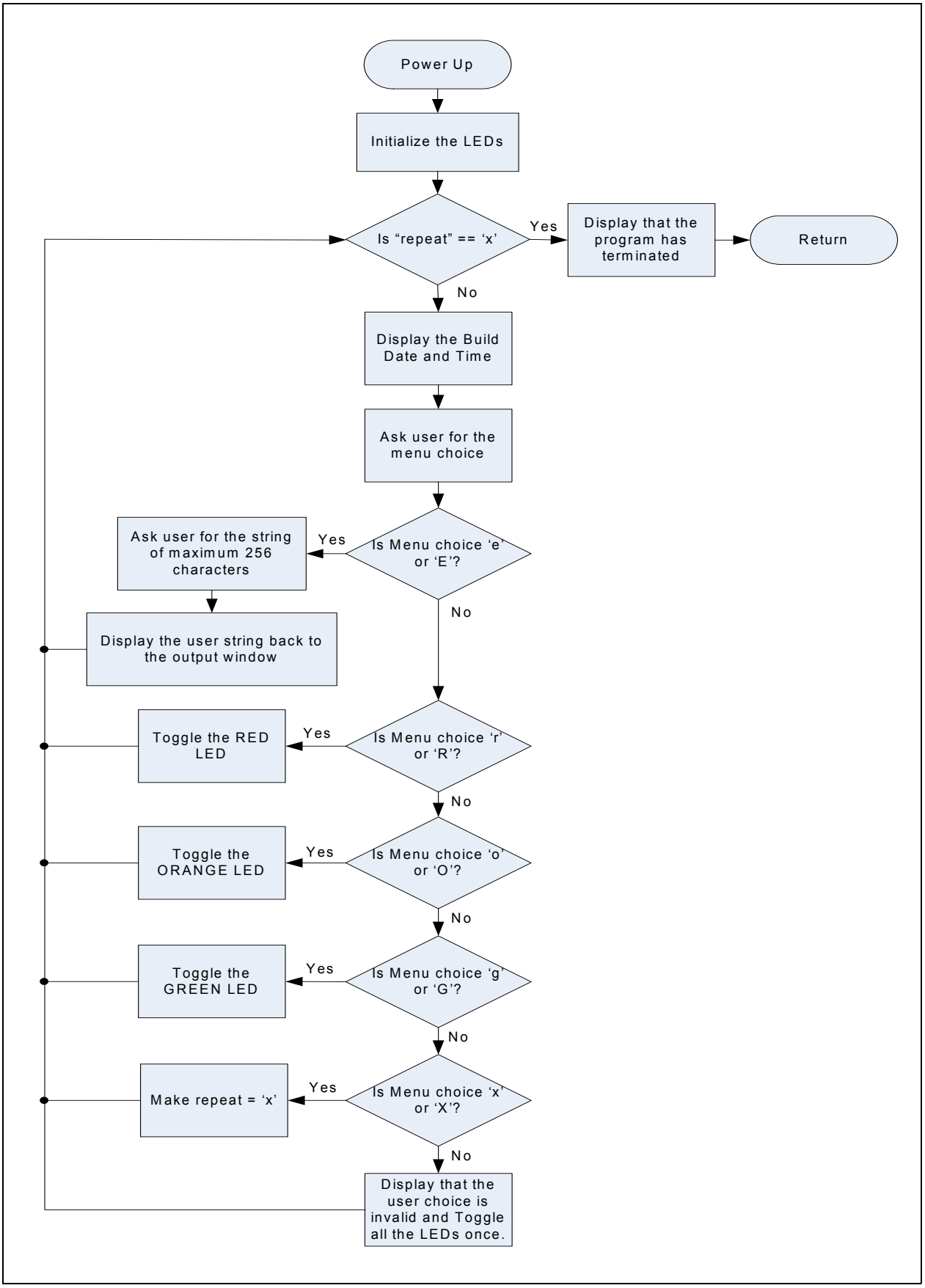
Either click *Debugger>Run* from the menu bar of the MPLAB IDE or click the Run icon (the turquoise triangle) on the Debug Tool Bar (Figure 2-12) to run the new program.

**FIGURE 2-12: DEBUG WINDOW**


## 2.9 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.

**FIGURE 2-13: PIC32MX TUTORIAL PROGRAM FLOWCHART**

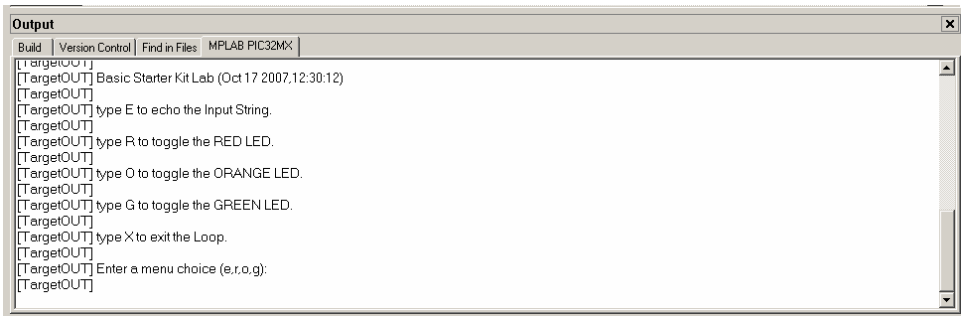


The tutorial program includes the Debug Print Library, which facilitates print functionality. A peripheral library header file for flashing the LEDs is also included. The header file for print functionality is `db_utils.h`.

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.

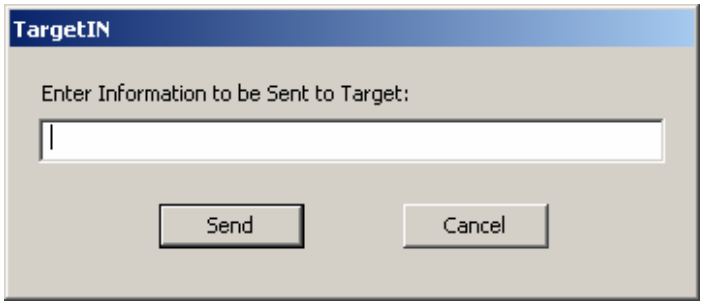
As the program runs, the Output window (Figure 2-14) tracks the progress.

**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.

# Chapter 3. Create a New Project

## 3.1 INTRODUCTION

This chapter explains how to create a new project.

## 3.2 HIGHLIGHTS

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 PIC32MX Starter Kit
- Program the chip, and run the program

## 3.3 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.

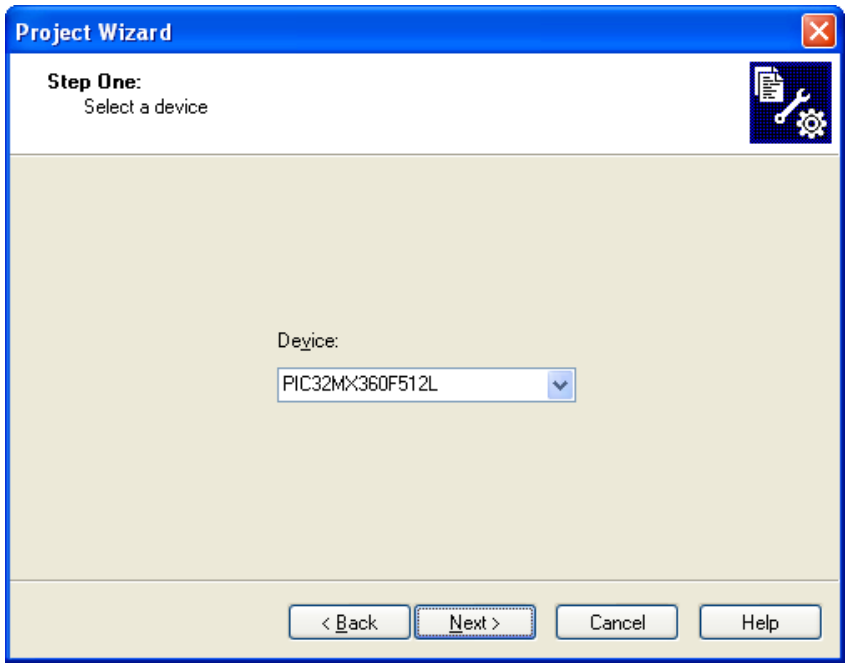
MPLAB IDE contains a Project Wizard to help create a new project.

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

### 3.3.1 Task 1, Select a Device

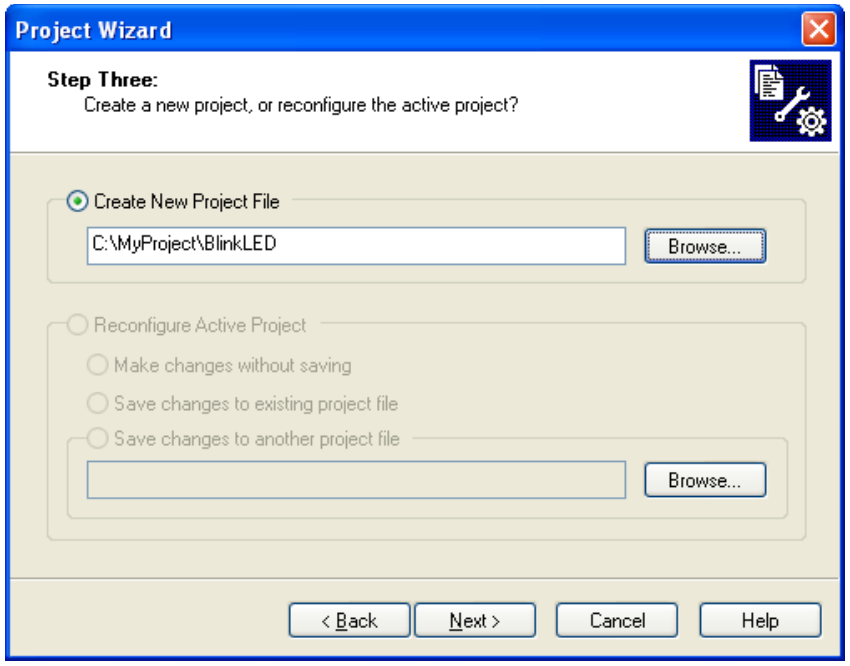
1. Start MPLAB IDE.
2. Click *File>Close Workspace* on the menu bar, to close any workspace that is open.
3. Click *Project>Project Wizard...* to start the wizard.
4. In the Welcome window, click **Next**. The Project Wizard Step One: window is displayed, as shown in Figure 3-1.

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




5. From the "Device" drop-down list, select "PIC32MX360F512L".
6. Click **Next**. The Project Wizard Step Two: dialog box opens, as shown in Figure 3-2.

**FIGURE 3-3: NAMING YOUR PROJECT**



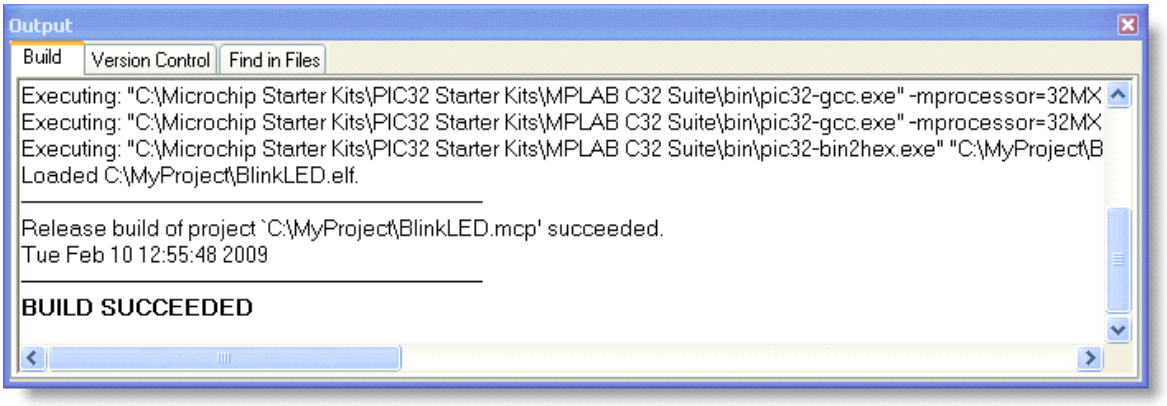

### 3.3.3 Task 3, Name Your Project

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.

### 3.3.6 Task 6, Build the Project

1. Click *Project>Make* from the menu bar of the main MPLAB IDE window. The build Output window displays (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**



### 3.3.7 Task 7, Program the Device

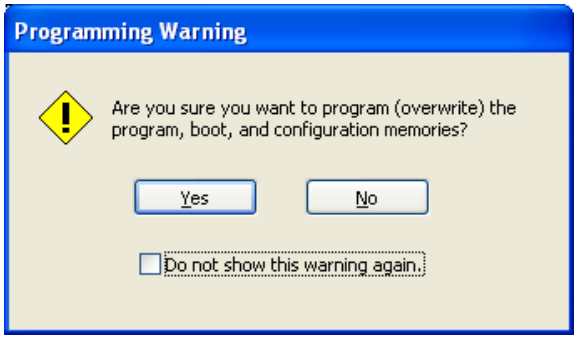
1. Click the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 3-8.

**FIGURE 3-8: PROGRAM DEVICE WINDOW**


A Programming Warning window (Figure 3-9) opens to warn you about overwriting the memory.

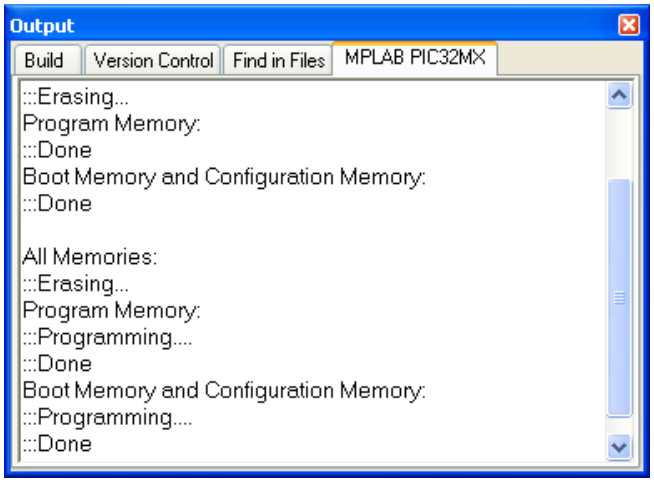
2. Click **Yes**.

**FIGURE 3-9: PROGRAMMING WARNING WINDOW**




The Output window (Figure 3-10) tracks the progress of the output. "Done" signals that the programming of the device is complete.

**FIGURE 3-10: OUTPUT WINDOW**



### 3.3.8 Task 8, Run the Program

Click *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.

# Chapter 4. PIC32MX Starter Kit Hardware

## 4.1 INTRODUCTION

This chapter describes the hardware features of the PIC32MX Starter Kit.

## 4.2 HARDWARE FEATURES

The key features of the PIC32MX Starter Kit are listed below. They are presented in the order given in **Section 1.4 "PIC32MX Functionality and Features"**. You can refer to Figure 1-1 on page 8 for their locations on the board.

### 4.2.1 Processor Support

The PIC32MX Starter Kit is designed with a permanently mounted (i.e., soldered) PIC32MX360F512L processor.

### 4.2.2 Power Supply

There are two ways to supply power to the PIC32MX 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 PIC32MX 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.

### 4.2.3 USB Connectivity

The PIC32MX 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.

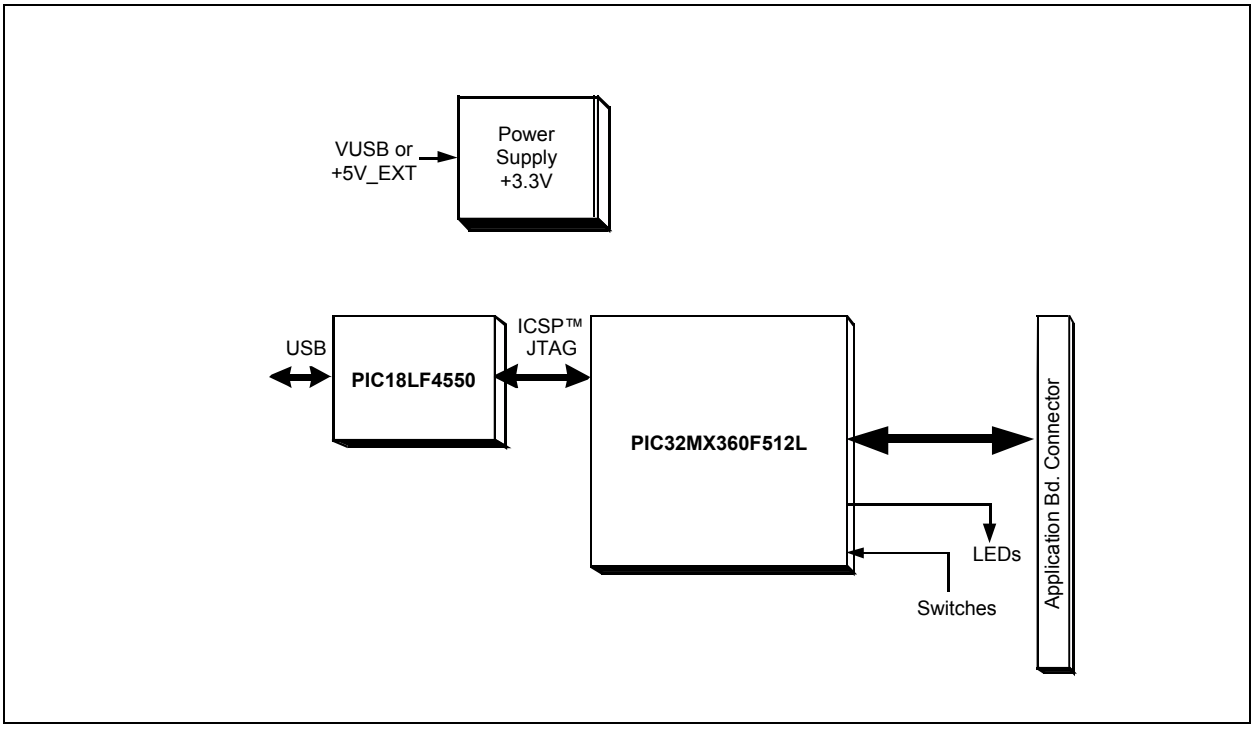
# Appendix A. PIC32MX Starter Kit Schematics

## A.1 INTRODUCTION

This section provides detailed technical information about the PIC32MX Starter Kit.

## A.2 DEVELOPMENT BOARD BLOCK DIAGRAM

**FIGURE A-1: HIGH-LEVEL BLOCK DIAGRAM OF THE PIC32MX STARTER KIT**




## A.3 STARTER KIT BOARD SCHEMATICS

Figure A-2. PIC32MX CPU
Figure A-3. PIC18LF4550 Debug CPU
Figure A-4. Application Board Connector
Figure A-5. Switches and LEDs
Figure A-6. Power Supply

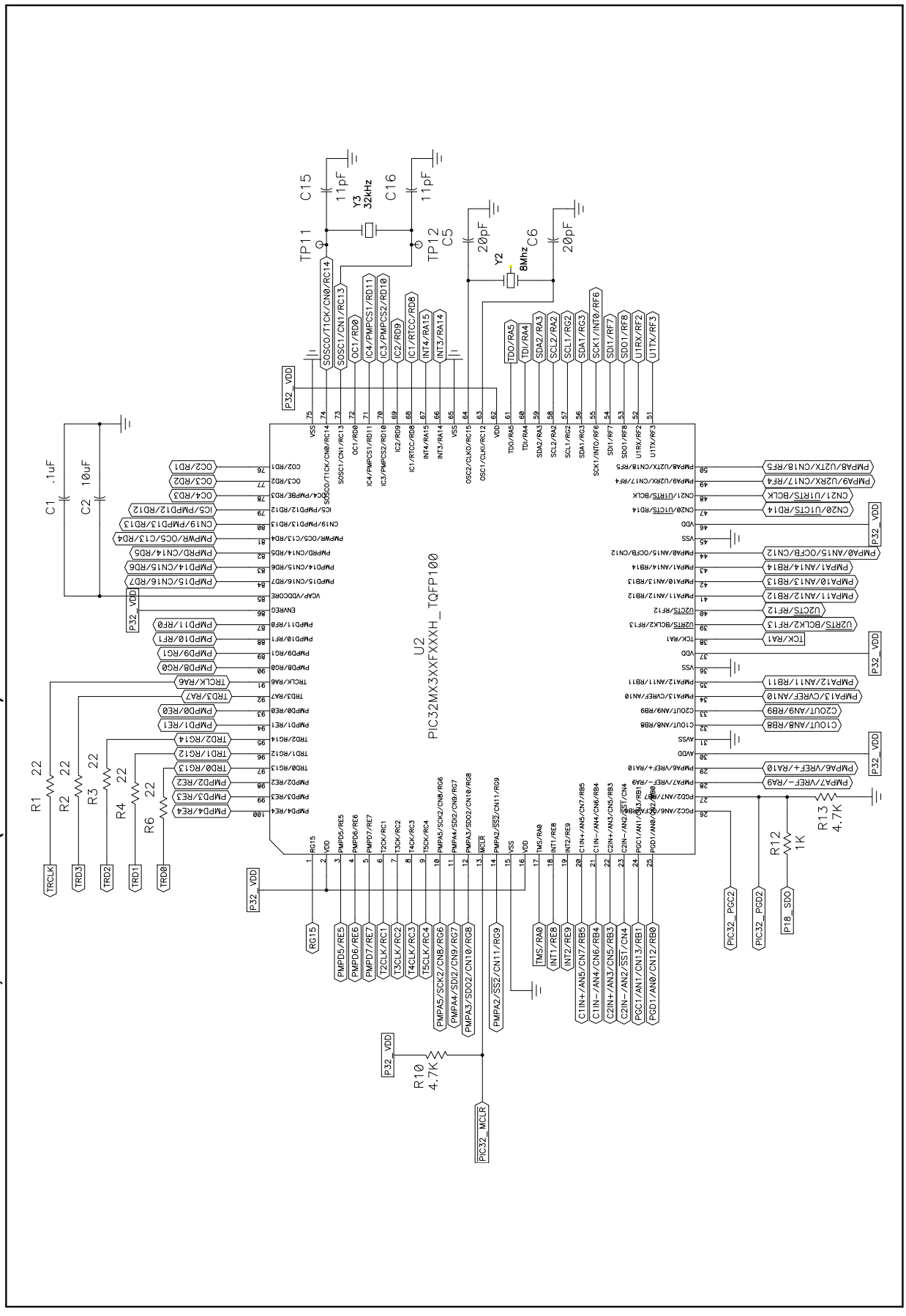



FIGURE A-2:PIC32MX SCHEMATIC, SHEET 1 OF 6 (PIC32MX CPU)

**FIGURE A-5: PIC32MX SCHEMATIC, SHEET 5 OF 6 (SWITCHES AND LEDS)**

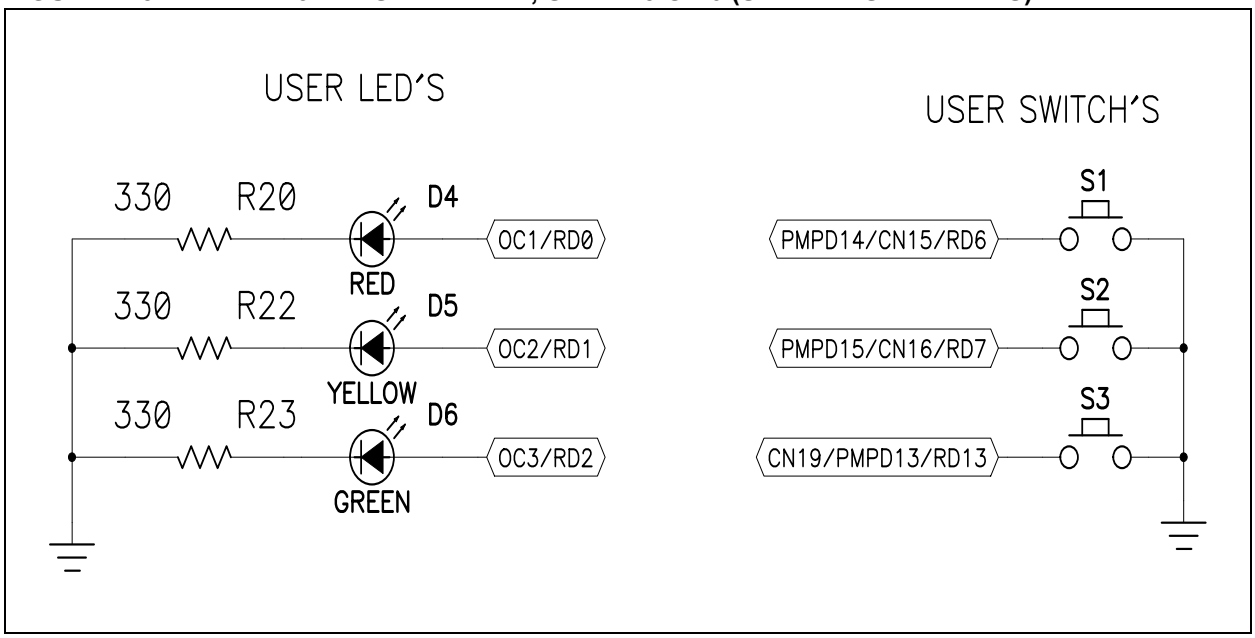


**FIGURE A-6: PIC32MX SCHEMATIC, SHEET 6 OF 6 (POWER SUPPLY)**