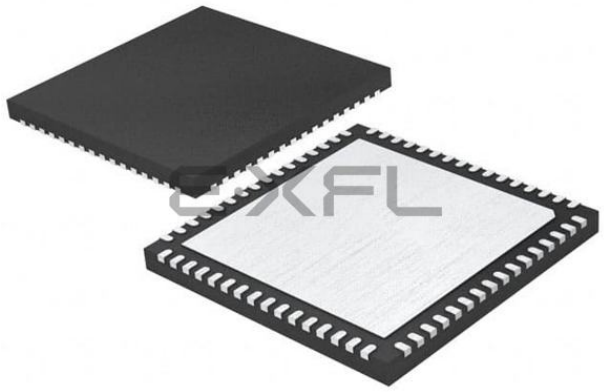

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"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable 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 ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-VQFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic32mx440f256ht-80i-mr

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 PIC32MX. 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 PIC32MX Starter Kit as a development tool to emulate and debug firmware on a target board. The manual is composed of the following chapters:

- **Chapter 1. "Introducing the PIC32MX Starter Kit"** provides a brief overview of the PIC32MX Starter Kit, highlighting its features and uses.
- **Chapter 2. "PIC32MX Starter Kit Tutorial"** provides step-by-step instructions for installing the PIC32MX and using the Microchip MPLAB® IDE to build and run the tutorial program on the PIC32MX 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 the PIC32MX Starter Kit.
- **Chapter 4. "PIC32MX Starter Kit Hardware"** provides a more detailed description of the features of the hardware included in the PIC32MX Starter Kit.
- **Appendix A. "PIC32MX Starter Kit Schematics"** provides a block diagram and detailed schematics of the PIC32MX Starter Kit.

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) { ... }`

Chapter 1. Introducing the PIC32MX Starter Kit

1.1 INTRODUCTION

Thank you for purchasing the Microchip Technology PIC32MX Starter Kit. This kit provides a low-cost, modular development system for Microchip's new line of 32-bit microcontrollers.

The starter kit comes pre-loaded with demonstration software for the user to explore the new features of the PIC32MX. It is also expandable through a modular expansion interface, which allows the user to extend its functionality. The PIC32MX Starter Kit also supplies on-board circuitry for full debug and programming capabilities.

1.2 HIGHLIGHTS

This chapter covers the following topics:

- Kit Contents
- PIC32MX Functionality and Features
- Installing the PIC32MX Starter Kit CD
- Using the PIC32MX Starter Kit Out of the Box
- PIC32MX Demonstration Program

The preprogrammed example code on the PIC32MX MCU has been included on the PIC32MX Starter Kit CD-ROM for future reference. All project files have been included, so that the code may be used directly to restore the PIC32MX 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.

1.3 KIT CONTENTS

The PIC32MX Starter Kit contains the following items:

- PIC32MX Starter Kit Board
- USB Mini-B cable
- PIC32 Starter Kit Installation CD-ROM, which includes:
  - *PIC32MX Starter Kit User's Guide* (DS61144)
  - *PIC32MX Family Data Sheet* (DS61143)
  - *PIC32MX Family Reference Manual* (DS61132)
  - *PIC32MX Peripheral Library Manual*
  - Code examples for use with the PIC32MX devices

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 page 44.

NOTES:

Chapter 2. PIC32MX Starter Kit Tutorial

2.1 INTRODUCTION

This chapter is a self-paced tutorial to get you started using the PIC32MX Starter Kit.

2.2 HIGHLIGHTS

Items discussed in this chapter include:

- Host Computer Requirements
- Installing the Starter Kit Board
- Starting with the Tutorial Project
- Building the Project
- Programming the Device
- Running the Program
- Operation of the Tutorial Program

2.3 HOST COMPUTER REQUIREMENTS

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

- PC-compatible system
- An available USB port on PC or powered USB hub
- CD-ROM drive
- Microsoft Windows XP®
  (The PIC32MX Starter Kit has not been tested on Windows NT®, Windows 2000® or Microsoft Vista™ operating systems)

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.

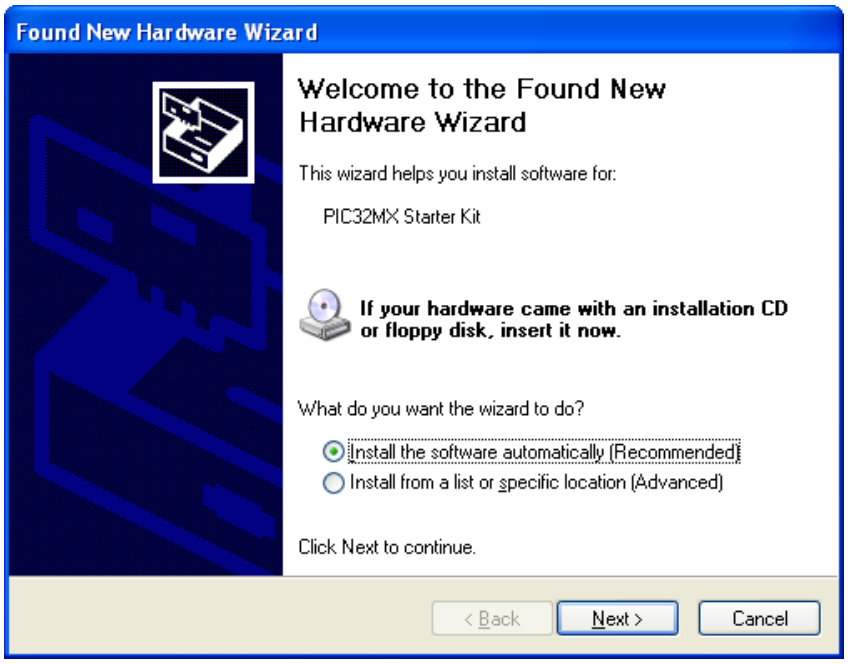
2.4.4 Install the USB Device Driver

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:

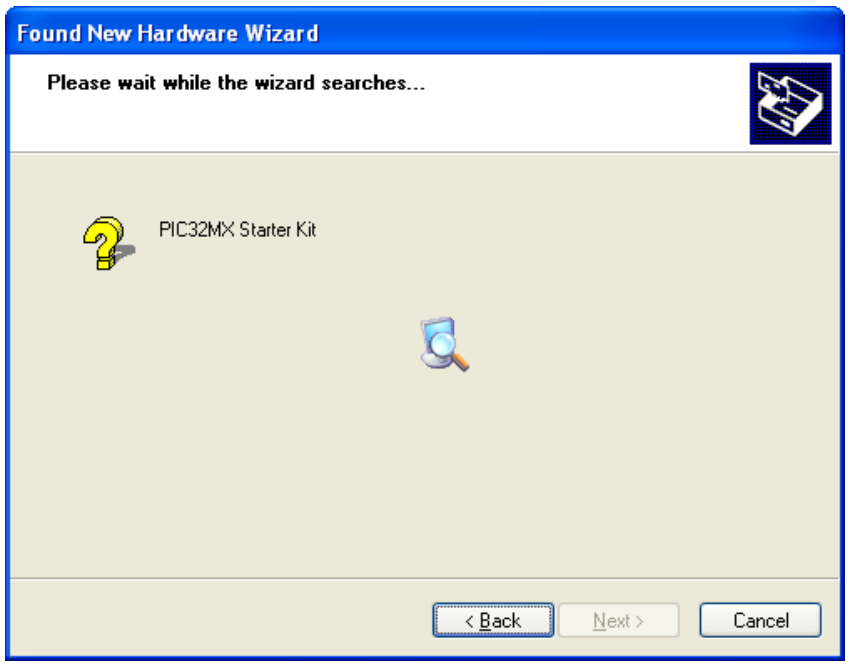
1. When the USB cable is connected, the "Found New Hardware Wizard" dialog box opens, as shown in Figure 2-2. When asked whether to install the software automatically or install from a list or specific location, select "Install software automatically" and click **Next**.

FIGURE 2-2: FOUND NEW HARDWARE WIZARD



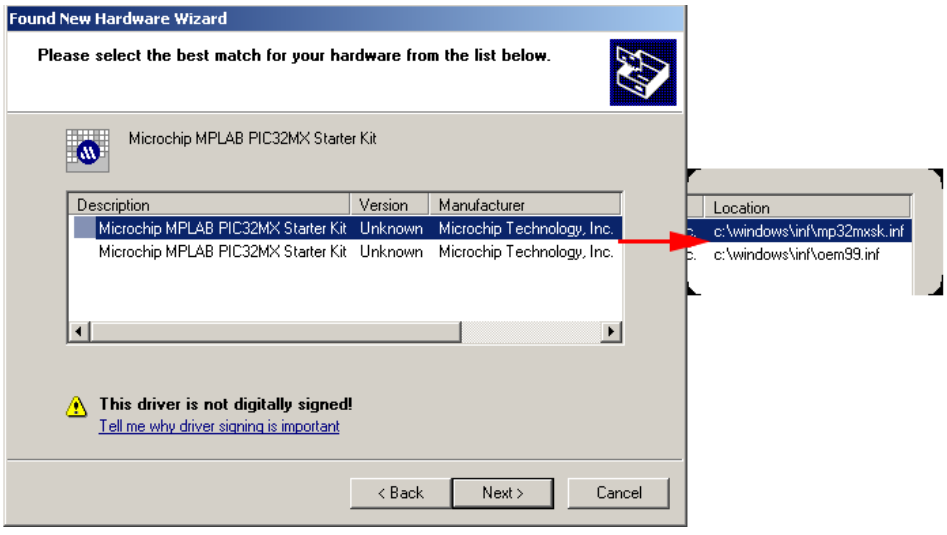
2. As shown in Figure 2-3, the next dialog box tracks the wizard as it searches for the device. (This activity may take several seconds.) When it is done, click **Next**.

FIGURE 2-3: HARDWARE WIZARD – SEARCHING FOR DEVICE



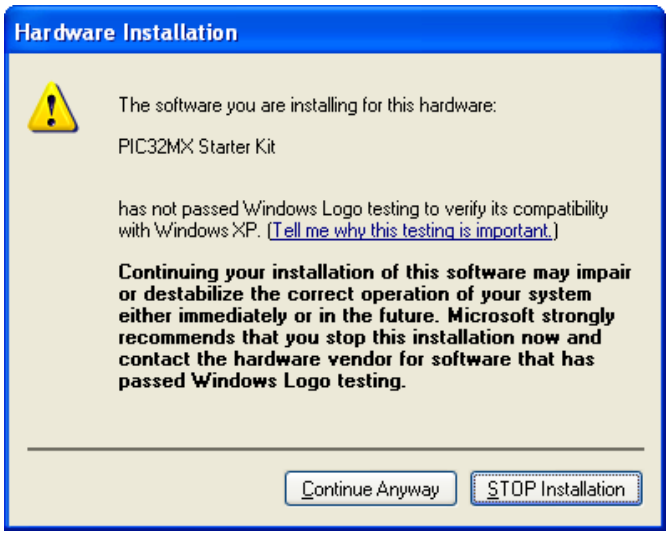
3. If prompted to select a driver, select `mp32mxsk.inf`, as shown in Figure 2-4. Click **Next** to continue.

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

2.5 STARTING THE TUTORIAL PROJECT

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

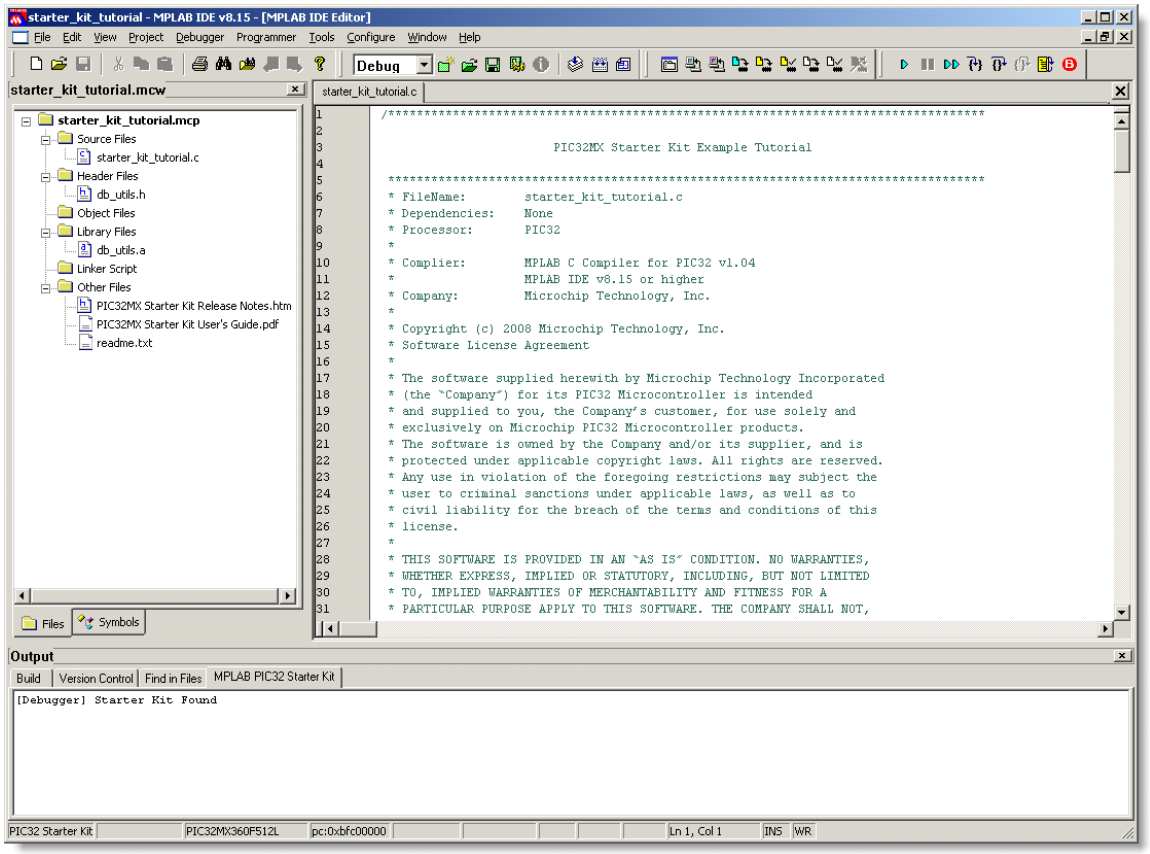
`[install directory]\PIC32 Starter Kits\`
`Starter_Kit_Tutorial\starter_kit_tutorial.mcw`

(or browse to the file path you used when you installed the 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.

FIGURE 2-7: MPLAB® IDE WORKSPACE



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

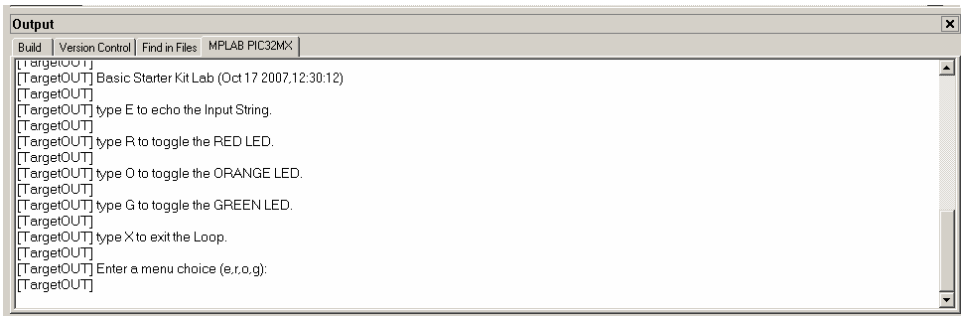
The starter kit tutorial demonstrates a simple application. The program responds according to the user input menu. The program prints the available menu choices to the starter kit Output window in the MPLAB IDE. The program flow is shown in Figure 2-13.

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.

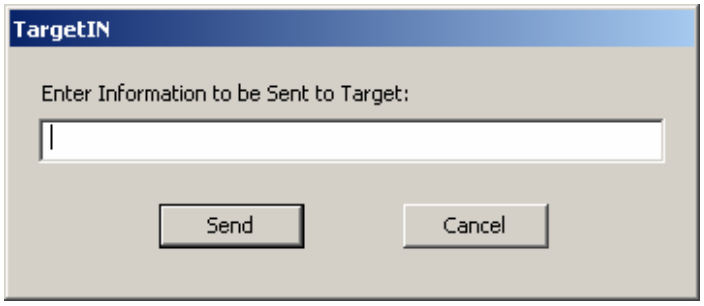
As the program runs, the Output window (Figure 2-14) tracks the progress.

FIGURE 2-14: OUTPUT WINDOW



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

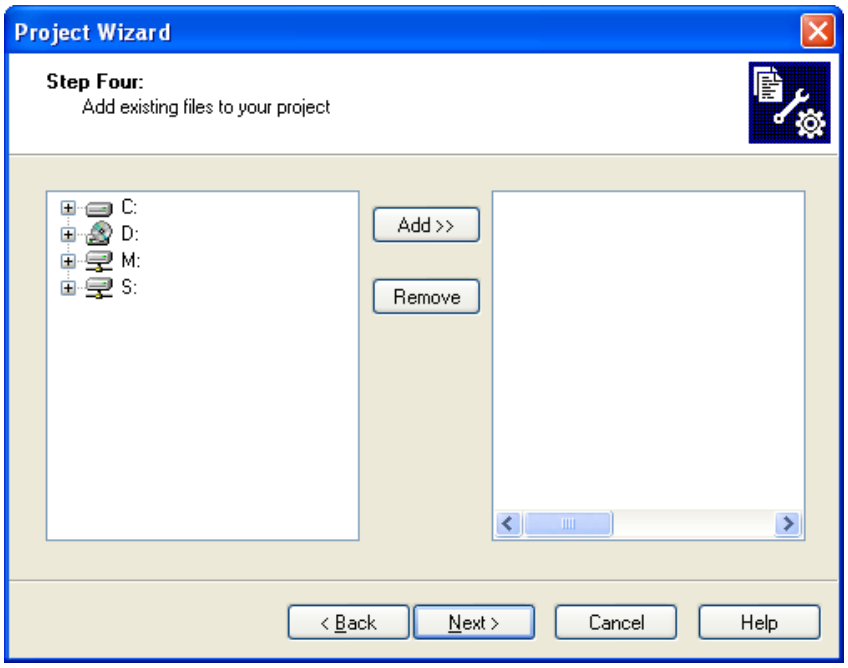
FIGURE 2-15: TARGET IN WINDOW



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.

FIGURE 3-4: ADDING FILES TO THE PROJECT



3.3.4 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.
3. A project and workspace have been created in the MPLAB IDE. `BlinkLED.mcw` is the workspace file and `BlinkLED.mcp` is the project file.
4. Click *File>New* from the menu bar to create a new file. A new file is displayed.
5. Click *File>Save As...* and save this file as '`BlinkLED.c`' in the same folder (in this case, the `C:\MyProject` folder).
6. 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

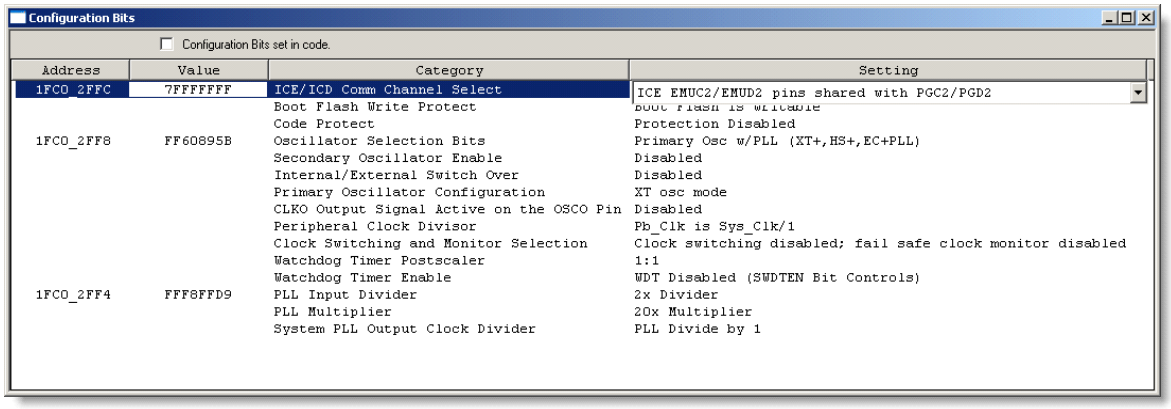
```
#include <plib.h>                       // Adds support for PIC32 Peripheral library
functions and macros

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;
}
```

3.3.5 Task 5, Confirm the Configuration Settings

Click *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 unchecked if the config 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



CAUTION

Setting the PIC32 Starter Kit configuration bits to cause the PIC32MX to operate faster than the maximum 80MHz system clock speed may cause the PIC32MX to stop communicating with the PIC18F4550 Starter Kit debugger. Should this occur, run the `sk_erase.exe` **utility to re-flash the PIC32MX with a default configuration. This utility is located on the PIC32 Starter Kit CD or in the PIC32MX Starter Kit directory:**

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

3.3.7 Task 7, Program the Device

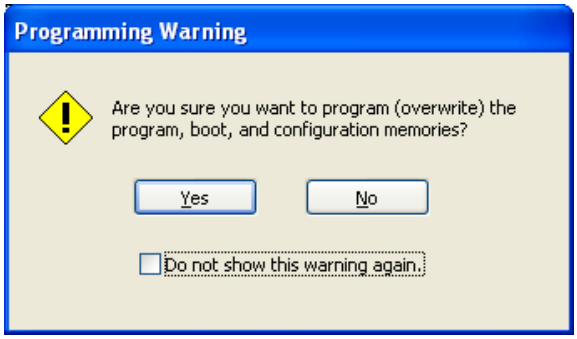
1. Click the Program All Memories icon on the Program Device Tool Bar, as shown in Figure 3-8.

FIGURE 3-8: PROGRAM DEVICE WINDOW

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

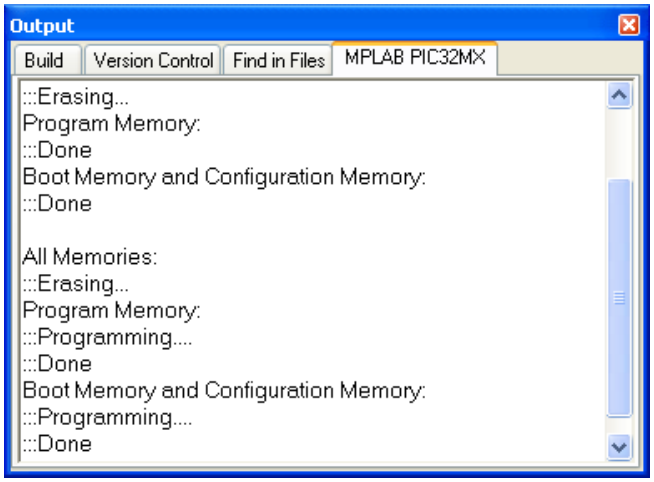
2. Click **Yes**.

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



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.

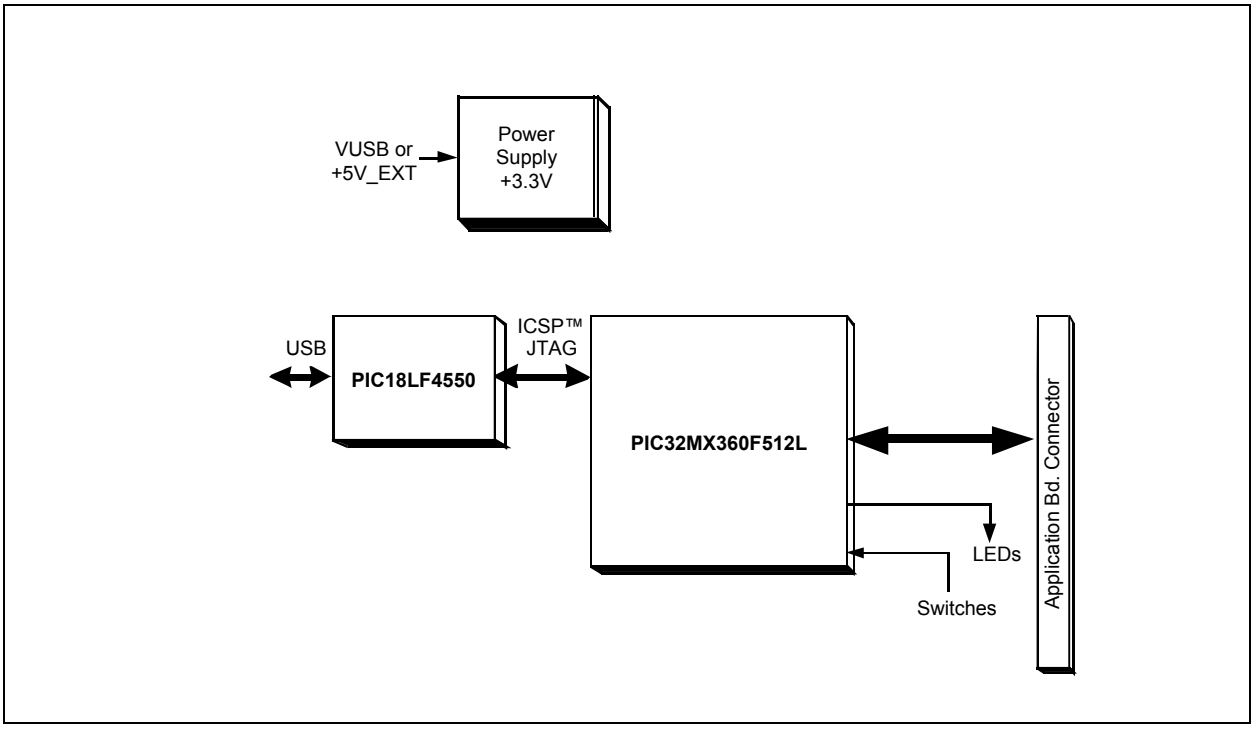
Appendix A. PIC32MX Starter Kit Schematics

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

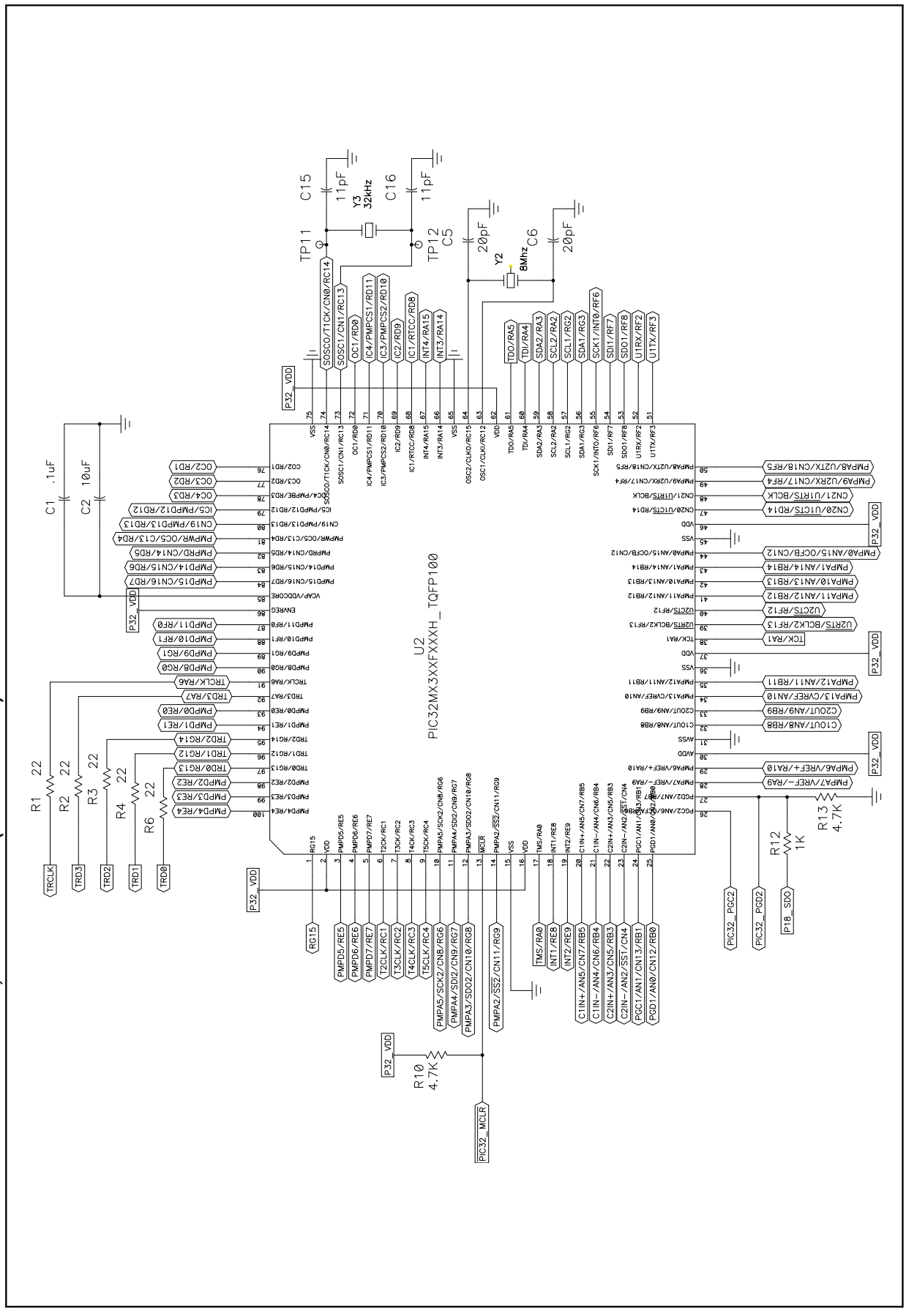


FIGURE A-2:PIC32MX SCHEMATIC, SHEET 1 OF 6 (PIC32MX CPU)

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