PIC10(L)F32X Development Board User's Guide

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PIC10(L)F32X DEVELOPMENT BOARD USER'S GUIDE

Table of Contents

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 PIC10(L)F32X Development Board. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the PIC10(L)F32X Development Board as a development tool to emulate and debug firmware on a target board, as well as how to program devices. The document is organized as follows:

- **Chapter 1. "PIC10(L)F32X Development Board"** – An overview of the PIC10(L)F32X Development Board, PCB layout, parts and how to connect the provided jumper wires to the board.
- **Chapter 2. "Example Projects"** – Projects that describe how to implement the Numerically Controlled Oscillator (NCO), the Complementry Waveform Generator (CWG), and the Configurable Logic Cell (CLC).
- **Chapter 3. "Troubleshooting"** – Provides resolutions for solving common problems associated with using the PIC10(L)F32X Development Board.
- **Appendix A. "Hardware Schematics"** – Illustrates the PIC10(L)F32X Development Board hardware schematic diagrams.

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
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
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	`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) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use the PIC10(L)F32X Development Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

PICkit™ 3 Microcontroller Programmer User's Guide (DS51795)

Consult this document for instructions on how to use the PICkit 3 Microcontroller Programmer hardware and software.

MPLAB® ICD 3 In-Circuit Debugger User's Guide (DS51766)

Consult this document for information pertaining to Microchip's In-Circuit Debugger, MPLAB ICD 3. MPLAB ICD 3 utilizes the in-circuit debugging capability built into the Flash devices.

PIC10(L)F32X Data Sheet (DS41585)

Consult this document for information regarding the PIC10(L)F32X 6/8-pin Flash-based Microcontroller.

MPLAB® IDE, Simulator, Editor User's Guide (DS51519)

Consult this document for more information pertaining to the installation and features of the MPLAB Integrated Development Environment (IDE) Software.

THE MICROCHIP WEB SITE

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

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

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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 www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the Hitech C16, MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, ICD3, PICkit™ 3.
- **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 SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB ICD3 device programmers and PICkit™ 3 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://www.microchip.com/support.

REVISION HISTORY

Revision A (April 2012)

- Initial Release of this Document.

TROUBLESHOOTING

See **Chapter 3. “Troubleshooting”** for information on common problems.

Chapter 1. PIC10(L)F32X Development Board

1.1 INTRODUCTION

The PIC10(L)F32X Development Board is intended to be a learning tool for individuals interested in PIC® microcontroller design.

The PIC10F322 microcontroller is ideal for use on the PIC10(L)F32X Development Board due to their small size, high efficiency, speed and peripheral configurations.

This chapter introduces the PIC10(L)F32X Development Board. It describes the PCB layout, parts and electrical connection to the PICkit™ 3 Flash Programmer and MPLAB ICD 3 In-Circuit Debugger.

1.2 HIGHLIGHTS

This chapter discusses:

- Quick Start Guide
- The PIC10(L)F32X Development Board Kit Contents
- The PIC10(L)F32X Development Board Layout
- Required Tools
- PIC10(L)F32X Development Board Setup

1.3 QUICK START GUIDE

The PIC10(L)F32X Development Board is programmed at the factory with a demonstration program. The board doesn't need to be configured in any way in order to use the demonstration program. Once the board is powered up, the brightness of LED (D2) may be varied using the potentiometer (POT1). LED (D1) is powered as long as the PIC10F322 is operating, and will thus vary with the supply voltage.

Board Setup

There is no setup for this development board to operate.

Board Power-Up

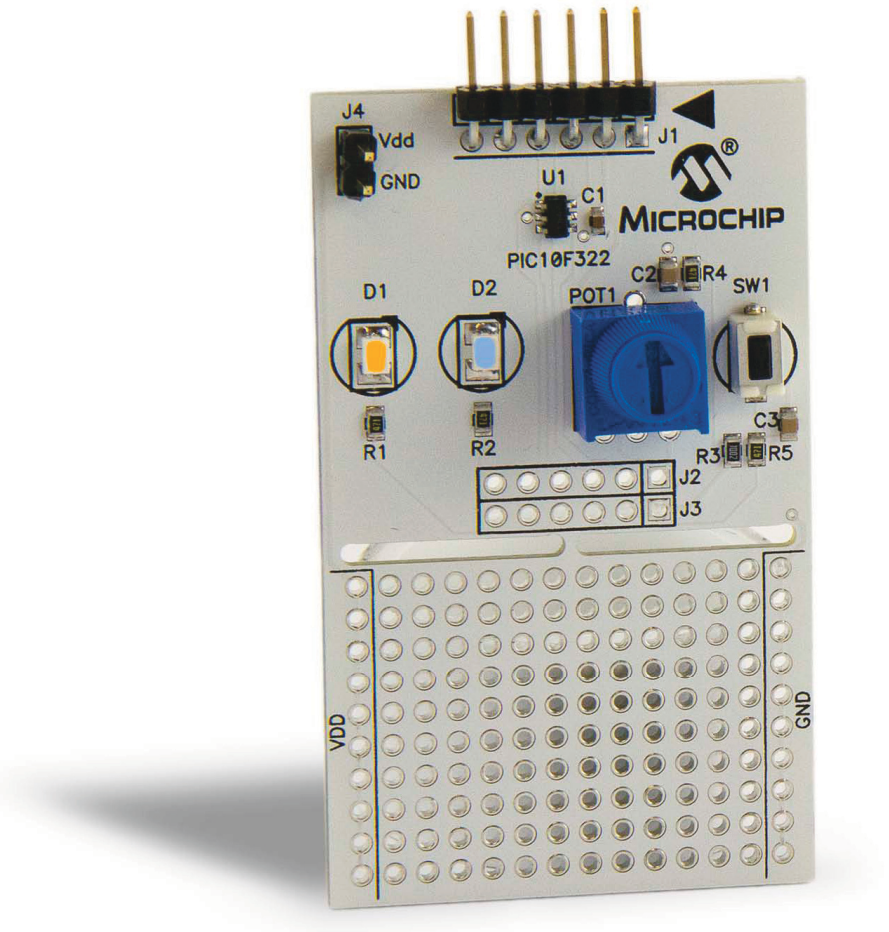
Supply power to the board in one of the following ways:

- Connect a 2.3-5 VDC supply using J4 (see Figure 1-1)
- Use the power supplied by the PICkit 3 or MPLAB ICD 3 programmers.

Demonstration Program

After applying power to the PIC10(L)F32X Development Board, LED (D1) will automatically turn on. Turn POT1 clockwise to increase the brightness of LED (D2). Press switch (SW1) to turn both LEDs D1 and D2 off, release switch (SW1) and LED's D1 and D2 will turn on.

FIGURE 1-1: QUICK BOARD SETUP



PIC10F32X Development Board
(Part # AC103011)

1.4 PIC10(L)F32X DEVELOPMENT BOARD KIT CONTENTS

The PIC10(L)F32X Development Board contains the following items:

1. PIC10(L)F32X Development Board Printed Circuit Board (PCB) with all components installed
2. Pre-programmed PIC10F322 device

1.5 PIC10(L)F32X DEVELOPMENT BOARD LAYOUT

The PIC10(L)F32X Development Board is shown in Figure 1-2.

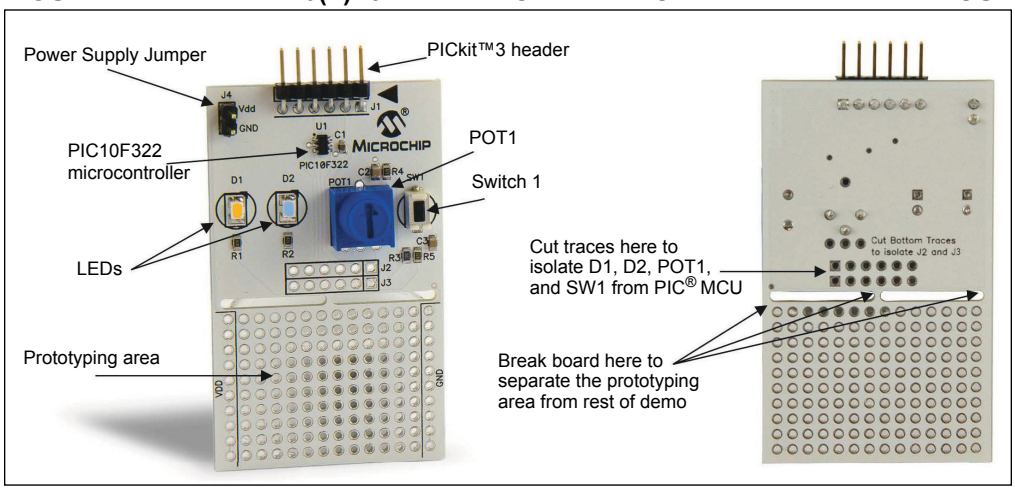
A PIC10F322 microcontroller is populated on the top center of the development board under the identification label U1. The PIC10F322 has 4 available I/O pins that are initially connected to the four major component on the board. The initial connections connect to the following components:

- Switch 1 (SW 1) – 1 pin: $\overline{\text{MCLR}}$ (pin 6) of microcontroller
- Pot 1 (POT1) – 1 pin: RA2 (pin 4) of micro-controller.
- LED (D1) – 1 pin: RA1 (pin 3) of micro-controller.
- LED (D2) – 1 pin: RA0 (pin 1) of micro-controller.

Should you choose to use the board to experiment on your own, the board allows you the flexibility to do so. You can try experimenting with peripherals not covered in the projects in **Chapter 2. "Example Projects"**.

A prototyping area is provided, with ground (GND) and supply voltage (VDD) connections on the left and right sides, to expand and experiment with the capabilities of the PIC10(L)F32X Development Board.

FIGURE 1-2: PIC10(L)F32X DEVELOPMENT BOARD HARDWARE LAYOUT



1.6 REQUIRED TOOLS

One of the following programming tools is needed in order to complete the projects in the next chapter:

- MPLAB® IDE
- PICkit™ 3 Microcontroller Programmer (Part# DV164131)
- MPLAB® ICD 3 In-Circuit Debugger/Programmer (Part# DV164035)

Figures 1-3 and 1-4 illustrate how to connect each of these tools to the PIC10(L)F32X Development Board.

1.7 PIC10(L)F32X DEVELOPMENT BOARD SETUP

There is no setup for this demo board to operate.

FIGURE 1-3: CONNECTING THE MPLAB® ICD 3 TO THE PIC10(L)F32X DEVELOPMENT BOARD

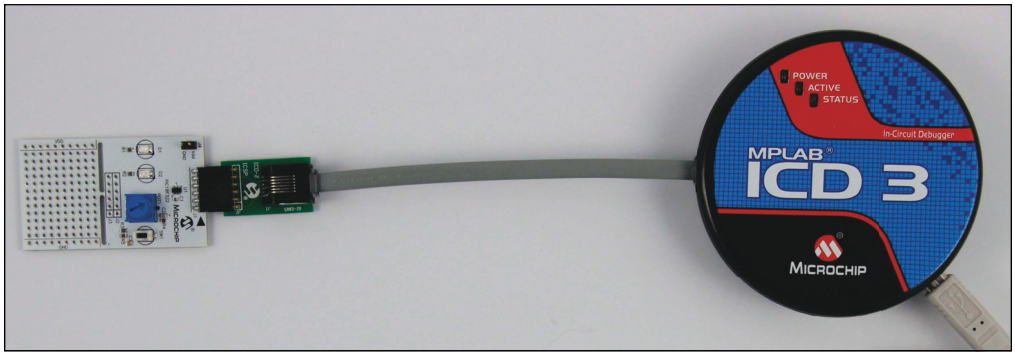
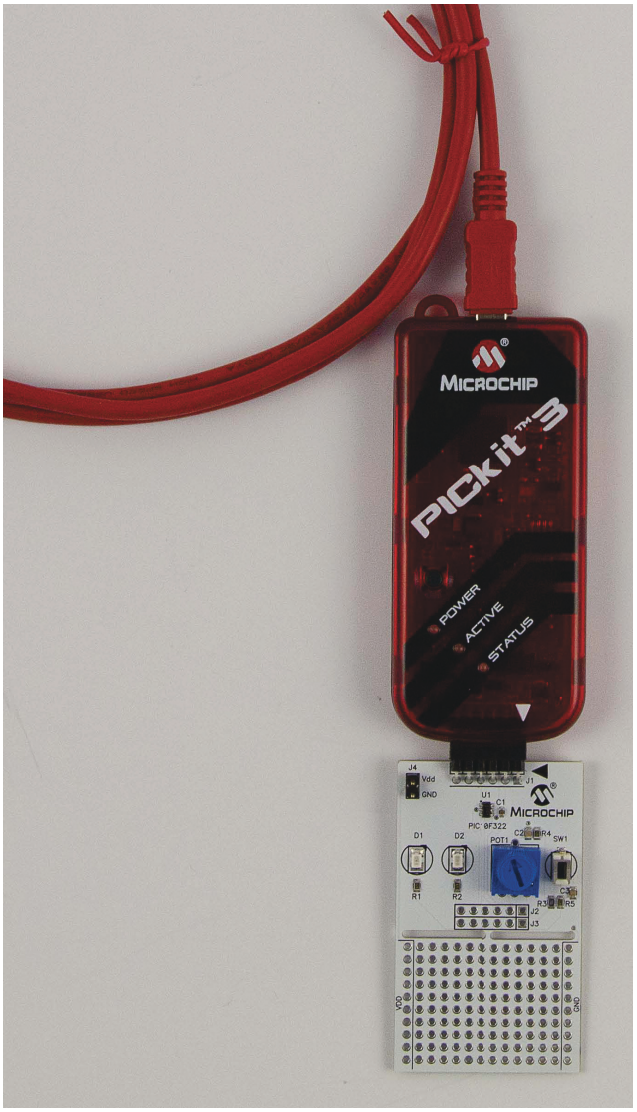


FIGURE 1-4: CONNECTING THE PICkit™ 3 TO THE PIC10(L)F32X DEVELOPMENT BOARD



1.8 GENERAL PIC10(L)F32X DEVELOPMENT BOARD INFORMATION

Power Supply Maximum Ratings

Supply voltage: 5 VDC

1.8.1 Experimentation

The PIC10(L)F32X Development Board was designed for your experimentation. After completing the projects in **Chapter 2. "Example Projects"**, please experiment freely on your own. Electronic components, other than those provided in the kit, may be used..

Note:	Although reasonable measures have been taken to protect the board from the occasional mistake, THE BOARD MAY BE DAMAGED if proper design techniques are not used and special attention to the schematic is not made.

1.9 HEADER/JUMPER FUNCTIONS

TABLE 1-1: HEADER/JUMPER FUNCTIONS

Header/ Jumper #	Description
J1*	Programming header for PICkit 3 programmer.
J2	Connects to header J3 and connects components SW1, POT1, D1, and D2 to the appropriate pins of the microcontroller. Traces connecting J2 to J3 can be cut to isolate these conponent from the microcontroller.
J3	Connects to header J2 and connects components SW1, POT1, D1, and D2 to the appropriate pins of the microcontroller. Traces connecting J2 to J3 can be cut to isolate these conponents from the microcontroller.
J4*	External voltage and ground connections.

NOTES:

Chapter 2. Example Projects

2.1 INTRODUCTION

The following projects provide examples of how to use the various PIC10F322 microcontroller peripherals. The projects are presented sequentially so that you will build knowledge as you progress from one project to the next.

Those who are new to programming PIC® microcontrollers should pay special attention to the comments in the source code for each of the projects. Though these projects are not intended to teach you the Microchip Assembly language, you will be able to get a good grasp of Microchip's Assembly language by reading the source code.

Microchip has published application notes and other documents covering the applications in each of these projects. These documents can be found on the provided CD-ROM. Any updates to the applicable documents are available on Microchip's web site. Please reference these documents while exploring each of the projects.

Note: See **Section 1.7 "PIC10(L)F32X Development Board Setup"** for instructions on how to setup the board to its "initial" condition prior to doing projects.

2.2 LOADING PROJECTS IN MPLAB® IDE

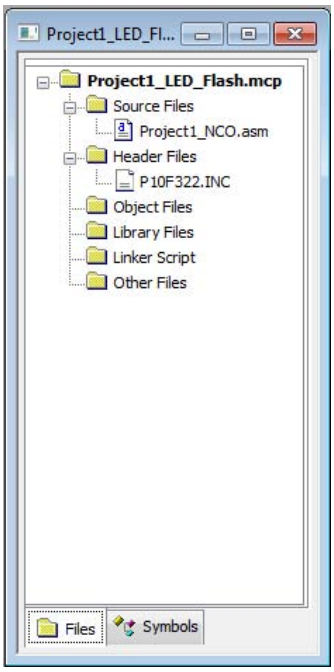
The firmware for the projects are arranged in corresponding project folders located at: http:\microchip.com\dev-tools\Pic10(L)F32x.

Opening a Project

1. Start MPLAB IDE.
2. In the menu bar choose *File -> Open Workspace*.
3. Find the project folder.
4. Open the **.mcw* file.

The project window for Project 1 is shown in Figure 2-1.

FIGURE 2-1: PROJECT WINDOW



2.3 EXAMPLE PROJECTS

PIC10(L)F32X Development Board Projects:

- Project 1: Hello World (LEDs flashing)
- Project 2: LED Dimmer

2.3.1 Project 1: Hello World (LEDs Flashing)

When learning to use a new computer language, the first practical lesson traditionally instructs the user how to light up one or more LEDs. Staying with tradition, this project will make your PIC10(L)F32X Development Board flash the LEDs.

Objectives

1. Use the Pic10F322 device to read a potentiometer input.
2. Implement the NCO and CWG modules.
3. Toggle the LEDs fast or slow by adjusting the potientiometer.

Applicable Technical Documents

PICkit™ 3 Programmer/Debugger User's Guide (DS51795)

MPLAB® ICD 3 In-Circuit Debugger User's Guide (DS51766)

Development Board Set-up

None

Instructions

Adjust POT1 to toggle the LEDs (D1 and D2) on and off fast or slow.

Discussion

By Adjusting POT1, the NCO increment value will adjust accordingly. This will increase or decrease the NCO output signal pulse width, which will increase or decrease the NCO frequency. Thus, as the NCO output signal goes through the CWG and a complementary waveform is generated, LEDs D1 and D2 will flash on and off with varying frequency.

> **Note:** See **Section 2.2 "Loading Projects in MPLAB® IDE"** for the location of the source files for this project and all subsequent projects.

2.3.2 Project 2: LED Dimmer

If you have lights at home that can be adjusted from very dim to very bright, then you are familiar with the application we will create in this project. The Pulse Width Modulator (PWM) module on the PIC10F322 will be used to adjust the voltage level from the potentiometer to the voltage level to the LEDs. When the duty cycle of the PWM signal is increased or decreased via the potentiometer, the LEDs will go from dim to bright.

Objectives

1. Use the internal PWM and CWG modules.
2. Have each LED adjust from dim to bright.

Applicable Technical Documents

PICKit™ 2 Programmer/Debugger User's Guide (DS51795)

MPLAB® ICD 3 In-Circuit Debugger User's Guide (DS51766)

Jumper Configuration

None

Instructions

After programming the PIC10F322 MCU, adjust the potentiometer (POT1) clockwise and watch LED D1 get brighter. Adjusting POT1 counter clockwise will cause LED D1 to get dimmer, and cause LED D2 to get brighter.

Discussion

By Adjusting POT1, the PWM duty cycle value will adjust accordingly. This will increase or decrease the PWM output signal pulse width, which will increase or decrease the PWM frequency. Thus, as the PWM output signal goes through the CWG and a complementary waveform is generated, LEDs D1 and D2 will flash on and off with varying frequency.

NOTES:

Chapter 3. Troubleshooting

3.1 INTRODUCTION

This chapter describes common problems associated with using the PIC10(L)F32X Development Board and steps on how to resolve them.

3.2 COMMON PROBLEMS

3.2.1 VDD Is Below 2.3V

The board must be powered by one of the following:

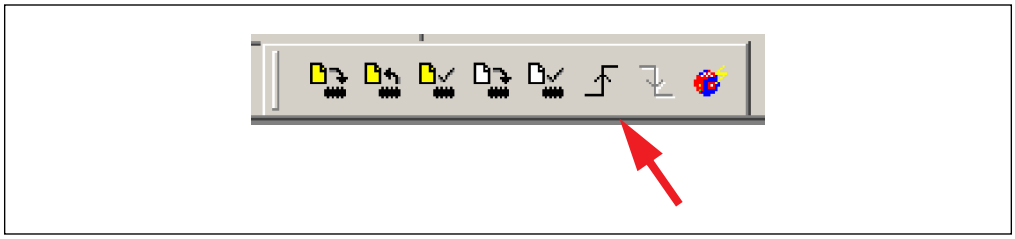
- An external power supply connected to the appropriate pins of J4.
- Use the power supplied by the PICkit™ 3 or MPLAB® ICD 3 programmers.

Supplying less than 2.3 VDD at J4 will not allow the microcontroller (U1) to function properly.

3.2.2 PIC® MCU Does Not Run After Programming By The MPLAB ICD 3

When using the MPLAB ICD 3 as a programmer, the microcontroller will not run unless you disconnect the MPLAB ICD 3 or release the MPLAB ICD 3 from Reset. Figure 3-1 shows the "Release From Reset" button.

FIGURE 3-1: RELEASE FROM RESET BUTTON



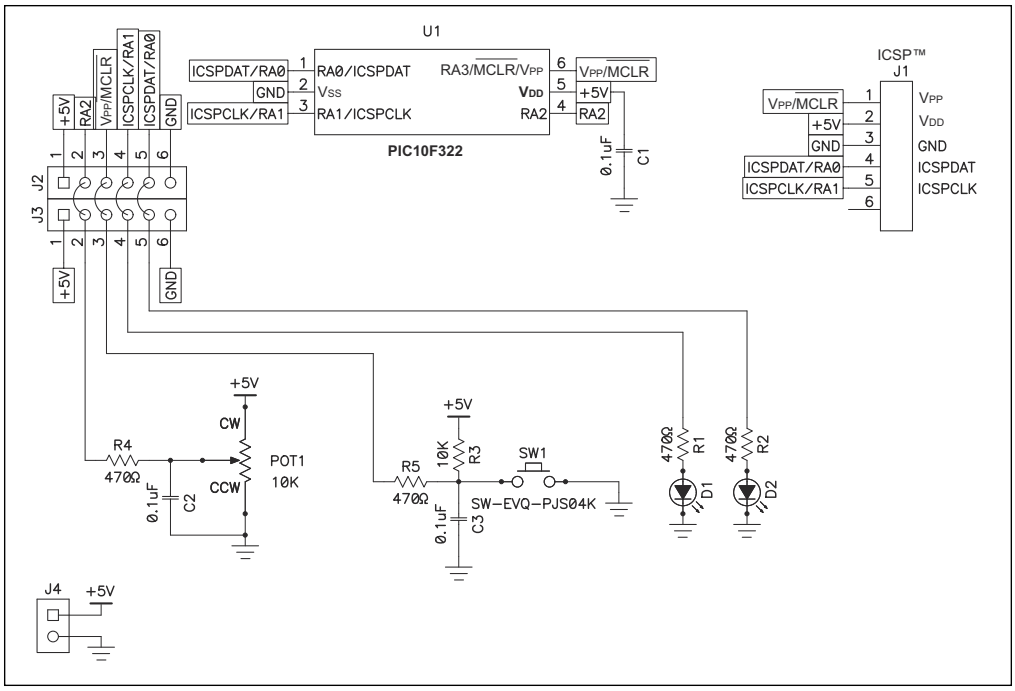
NOTES:

Appendix A. Hardware Schematics

A.1 INTRODUCTION

This appendix contains the PIC10(L)F32X Development Board Hardware Schematic Diagram.

FIGURE A-1: PIC10(L)F32X DEVELOPMENT BOARD HARDWARE SCHEMATIC DIAGRAM



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