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Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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Note the following details of the code protection feature on Microchip devices:

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dsPICDEM™ 1.1 PLUS DEVELOPMENT BOARD USER'S GUIDE

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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 on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the dsPICDEM™ 1.1 Plus Development Board. Items discussed in this chapter include:

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

ABOUT THIS GUIDE

This document describes how to use the dsPICDEM™ 1.1 Plus Development Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

• **Chapter 1: Introduction** – This chapter introduces the dsPICDEM™ 1.1 Plus Development Board and provides a brief description of the hardware.
• **Chapter 2: Using dsPIC30F Devices** – This chapter goes through a basic step-by-step process for getting your dsPICDEM™ 1.1 Plus Development Board up and running with the MPLAB® In-Circuit Debugger 2 (ICD 2) using dsPIC30F devices.
• **Chapter 3: Demonstration Program Operation** – This chapter presents a detailed description of the operational functionality of the sample code, which is preprogrammed into the dsPIC30F device.

- **Chapter 4. Using dsPIC33F/PIC24H Devices** – This chapter goes through a basic step-by-step process for getting your dsPICDEM™ 1.1 Plus Development Board up and running with the MPLAB® ICD 2 using dsPIC30F devices.

- **Chapter 5: dsPICDEM™ 1.1 Plus Development Board Hardware** – This chapter presents the features of the dsPICDEM™ 1.1 Plus Development Board in more detail.

- **Appendix A: Hardware Drawings and Schematics** – This Appendix illustrates the dsPICDEM™ 1.1 Plus Development Board layout and hardware schematic diagrams.

- **Appendix B: LCD Controller Specification** – This section presents the 122 x 32 Graphics LCD Controller Interface Specifications.

- **Index** – This section provides cross-reference listing of terms, features and sections of this document.

- **Worldwide Sales and Service** – A listing of Microchip sales and service locations and telephone numbers worldwide.

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) { ... }`

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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 dsPICDEM™ 1.1 Plus Development Board. Other useful documents are listed below:

dsPIC30F Family Reference Manual (DS70046)

Consult this document for detailed information on the dsPIC30F device operation. The manual explains the operation of the dsPIC30F MCU family architecture and peripheral modules but does not cover the specifics of each device. Refer to the appropriate device data sheet, mentioned below, for device-specific information.

dsPIC30F/33F Programmer's Reference Manual (DS70157)

This manual is a software developer's reference for the dsPIC30F/33F 16-bit MCU device families. This manual describes the instruction set in detail and also provides general information to assist the user in developing software for the dsPIC30F MCU family.

dsPIC30F Family Overview (DS70043)

This document provides an overview of the features and functionality of the dsPIC® DSC product family. It helps determine how the dsPIC 16-bit Digital Signal Controller Family fits a specific product application. For detailed information about any of the functionality, refer to the "*dsPIC30F Family Reference Manual*" (DS70046).

PIC24H Family Data Sheet (DS70175)

This data sheet summarizes the features of the PIC24H family of devices. It provides essential information needed to develop software for these devices.

dsPIC33F Family Data Sheet (DS70165)

This data sheet summarizes the features of the dsPIC33F family of devices. It provides essential information needed to develop software for these devices.

MPLAB® ASM30, MPLAB® LINK30 and Utilities User's Guide (DS51317)

This document details Microchip Technology's language tools for dsPIC DSC devices based on GNU technology. The language tools discussed are:

• MPLAB ASM30 Assembler
• MPLAB LINK30 Linker
• MPLAB LIB30 Archiver/Librarian
• Other Utilities

MPLAB® C30 C Compiler User's Guide (DS51284)

The purpose of this document is to help you use Microchip's MPLAB C30 C compiler for dsPIC® DSC devices to develop your application. MPLAB C30 is a GNU-based language tool, based on source code from the Free Software Foundation (FSF). For more information about the FSF, see www.fsf.org.

Other GNU language tools available from Microchip are:

• MPLAB ASM30 Assembler
• MPLAB LINK30 Linker
• MPLAB LIB30 Librarian/Archiver

MPLAB IDE Simulator, Editor User's Guide (DS51025)

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

To obtain any of these documents, contact the nearest Microchip sales location (see back page) or visit the Microchip web site at: www.microchip.com.

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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

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 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 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.
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 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 SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus and PICkit™ 1 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 D (October 2006)

This revision reflects an upgrade to the dsPICDEM™ 1.1 Plus Development Board to allow it to accommodate dsPIC30F, dsPIC33F, PIC24H and PIC24F devices.

• Changed board name to dsPICDEM™ 1.1 Plus Development Board.
• Modified power supply circuits to accommodate both 3.3 V and 5V devices.
• Added tutorial and code examples for using the dsPICDEM™ 1.1 Plus Development Board with dsPIC33F and PIC24H/F devices (see **Chapter 4. "Using dsPIC33F and PIC24H/24F Devices"**).

Revision C (September 2005)

• Last Release of this Document.
• Previous releases contained Advance Information that was updated in Revision C.

NOTES:

Chapter 1. Introduction

1.1 INTRODUCTION

The dsPICDEM™ 1.1 Plus Development Board Kit serves as a development and evaluation tool for dsPIC30F/33F High Performance Digital Signal Controllers and PIC24H/24F PIC® microcontrollers.

1.2 HIGHLIGHTS

This chapter discusses:

- dsPICDEM™ 1.1 Plus Development Board Kit
- dsPICDEM™ 1.1 Plus Development Board Features
- Supported Plug-In Modules
- Running the dsPICDEM™ 1.1 Demonstration Program

1.3 dsPICDEM™ 1.1 PLUS DEVELOPMENT BOARD KIT

The dsPICDEM™ 1.1 Plus Development Board Kit contains the following items:

- The dsPICDEM™ 1.1 Plus Printed Circuit Board (Figure 1-1)
- Preprogrammed dsPIC30F6014A Plug-in Module (Figure 1-2)
- 9V DC Power Supply
- RS-232 Interface Cable
- dsPICDEM™ 1.1 Plus Development Board Kit CD containing demonstration programs

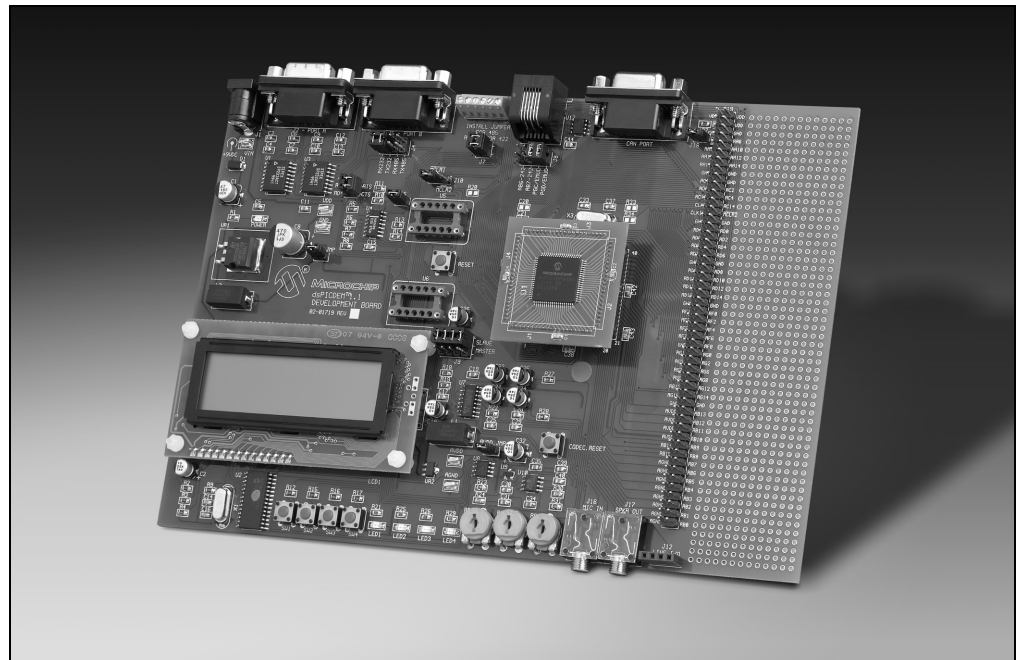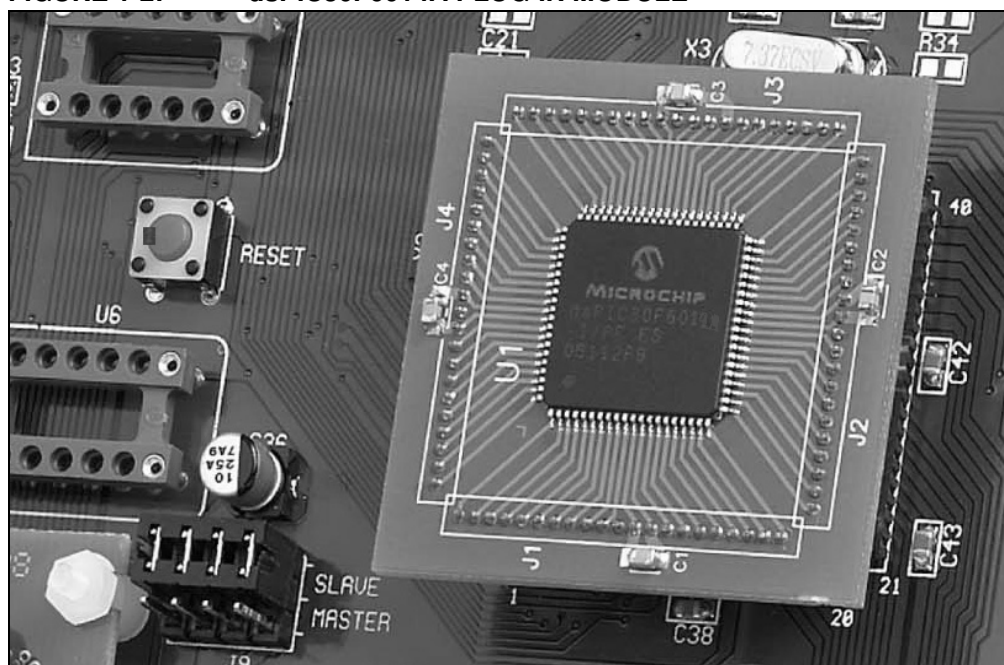FIGURE 1-1: dsPICDEM™ 1.1 PLUS DEVELOPMENT BOARD

FIGURE 1-2:   dsPIC30F6014A PLUG-IN MODULE

1.4   dsPICDEM™ 1.1 PLUS DEVELOPMENT BOARD FEATURES

The dsPICDEM™ 1.1 Plus Development Board supports the following features:

Development Board Power

- Separate on-board +5V and +3.3V regulators for V_{DD} and AV_{DD} with direct input from 9V, AC/DC wall adapter
- 9V DC power source input jack for development board
- LED power-on indicator

MPLAB ICD 2 and MPLAB ICE 4000 Connections

- MPLAB ICD 2 programming connector
- Jumper J8 for selection of processor interfaced to the MPLAB ICD 2 Debugger/Programmer
- Emulation header for connection to MPLAB ICE 4000 Emulator
- Pad location for 80-pin TQFP dsPIC DSC device

Serial Communication Channels

- Two RS-232 communication channels
- 6-pin terminal block and configuration jumper for RS-485 and RS-422 communication on UART1 from the dsPIC DSC device
- Single CAN communication channel

Voice Band Codec

- Si3000 Voice band Codec chip (U7)
- Jumper J9 for selection of Si3000 Codec mode (Master/Slave)
- Socket U6, optional clock oscillator for Si3000 Voice band Codec
- 4-pin header for the Codec Line In and Line Out
- One 3.5 mm phono jack for the Codec left and right speaker outputs
- One 3.5 mm phono jack for the Codec MIC input
- Codec reset push button switch

Analog

- Three 5 kΩ Potentiometers (RP1-RP3)
- Microchip TC1047A Thermal Sensor (U9)
- MCP41010 Digital Potentiometer (U8)
- MCP602 Operational Amplifiers configured as low-pass filters for temperature sensor and digital potentiometer (U10)

Device Clocking

- 7.3728 MHz crystal (X3) for dsPIC DSC device
- Socket U5, clock oscillator for dsPIC DSC device (alternate clock source, X3 removed)
- Pad for 32.768 kHz crystal (X2) and load caps

Miscellaneous

- Reset push button switch and jumper (J10) for resetting the PIC18F242 LCD controller or the dsPIC DSC device
- Four red LEDs (LED1-LED4)
- Four push button switches (SW1-SW4) for external input stimulus
- 122 x 32 dot addressable LCD
- PIC18F242 LCD controller
- 2 x 50 prototyping header for user hardware expansion (header not installed)
- Prototype area for user hardware

1.5   SUPPORTED PLUG-IN MODULES

The dsPICDEM™ 1.1 Plus Development Board supports these Plug-In Modules:

- dsPIC30F6014A 80L Plug-In Module (MA300014)
- dsPIC33FJ256GP710 100-to-80L Plug-In Module (MA330012)

1.6   RUNNING THE dsPICDEM™ 1.1 PLUS DEMONSTRATION PROGRAM

The dsPICDEM™ 1.1 Plus Development Board is supplied with a pre-loaded demonstration program that exercises principal CPU functions and peripheral options that interact with typical user application programs.

When you apply power to the dsPICDEM™ 1.1 Plus Development Board, the LCD menu displays these demonstration functions:

• Data Acquisition Display
• Digital Signal Processing (DSP) Operations
• Dual Tone Multi-Frequency (DTMF) Generation

Switches SW2-SW4 select one of these three choices. Each choice offers a submenu, which provides for additional options using switches SW1-SW4.

Refer to **Chapter 3. "dsPIC30F Demonstration Program Operation"** for full details on the demonstration code operation.

Chapter 2. Using dsPIC30F Devices

2.1   INTRODUCTION

This chapter is a self-paced tutorial to get you started using the dsPICDEM™ 1.1 Plus Development Board with dsPIC30F devices. The tutorial demonstrates the main features of MPLAB IDE Integrated Development Environment and the MPLAB ICD 2 In-Circuit Debugger as they are used with the dsPICDEM™ 1.1 Plus Development Board. Upon completing this tutorial, you should be able to:

• Create a project using the Project Wizard.
• Assemble and link the code and set the Configuration bits.
• Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
• Program the chip with the MPLAB ICD 2.
• View the code execution in program memory and source code.
• View registers in a Watch window.
• Set a breakpoint and make the code halt at a chosen location.
• Use the function keys to Reset, Run, Halt and Single Step the code.

2.2   HIGHLIGHTS

Items discussed in this chapter include:

• Tutorial Overview
• Creating the Project
• Building the Code
• Programming the Chip
• Debugging the Code

2.3   TUTORIAL OVERVIEW

The tutorial program in `Tut6014a.s` (included with the CD-ROM) is written in assembly code. This program displays text on the LCD and flashes an LED. The source file is used with a linker script file (`p30f6014a.gld`) and an include file (`p30f6014a.inc`) to form a complete project. The tutorial is a simple project that uses a single source code file. More complex projects might use multiple assembler and compiler source files as well as library files and precompiled object files. For simplicity, this tutorial uses only one source file.

There are four steps to this tutorial:

1. Create a project in MPLAB IDE.
2. Assemble and link the code.
3. Program the chip with the MPLAB ICD 2.
4. Debug the code with the MPLAB ICD 2.

2.4   CREATING THE PROJECT

The first step is to create a project and a workspace in MPLAB IDE. Usually, you will have one project in one workspace.

> **Note:** These instructions presume the use of MPLAB 7.20 or newer.

A project contains the files needed to build an application (source code, linker script files, etc.) along with their associations to various build tools and build options.

A workspace contains one or more projects and information on the selected device, debug tool and/or programmer, open windows and their location and other IDE configuration settings.

MPLAB IDE contains a Project Wizard to help create new projects. Before starting, create a folder for the project files for this tutorial (C:\Tutorial is assumed in the instructions that follow). From the dsPICDEM 1_1 Plus Development Board code\Tutorial Code folder on the dsPICDEM™ 1.1 Plus Development Kit CD, copy the Tut6014a.s file into the C:\Tutorial folder.

> **Note:** All files copied from the CD are read only. If the file needs to be edited, the attributes will need to be changed.

2.4.1   Select a Device

1. Start MPLAB IDE.
2. Close any workspace that might be open (*File>Close Workspace*).
3. From the *Project* menu, select *Project Wizard*.
4. From the Welcome screen, click **Next>** to display the Project Wizard Step One dialog (see Figure 2-1).

FIGURE 2-1:   **PROJECT WIZARD, STEP 1, SELECT A DEVICE**
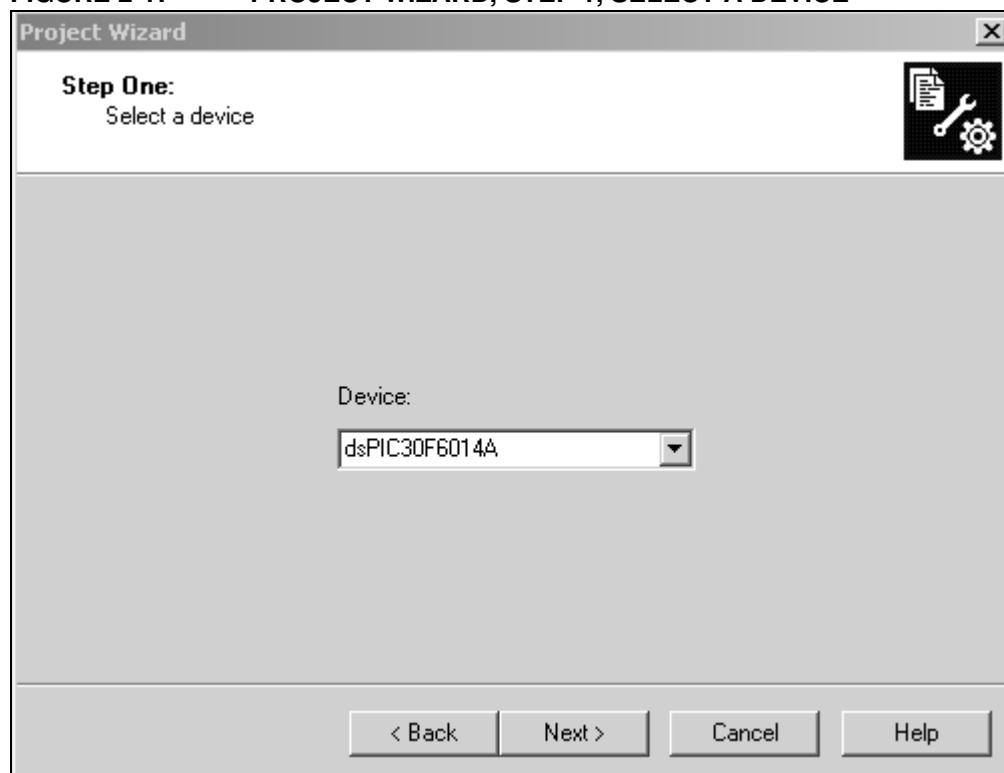
5. From the **Device:** pull-down list, select `dsPIC30F6014A` and click **Next>**. The Project Wizard Step Two dialog displays (see Figure 2-2).

FIGURE 2-2:   **PROJECT WIZARD, STEP 2, SELECT LANGUAGE TOOLSUITE**
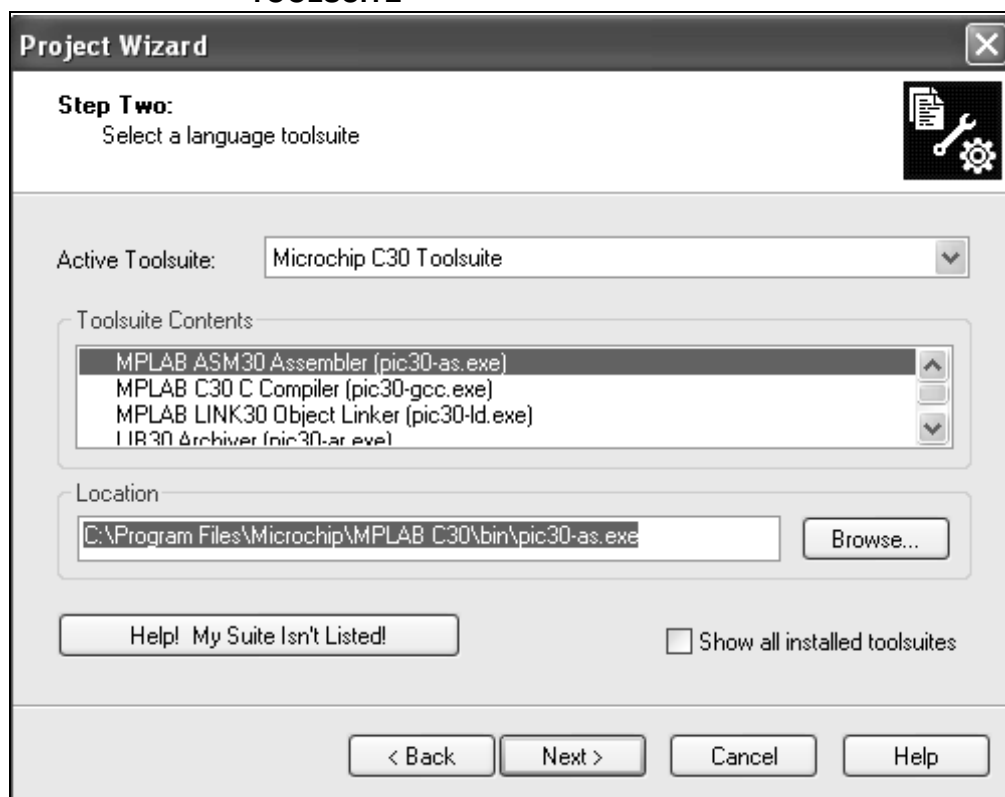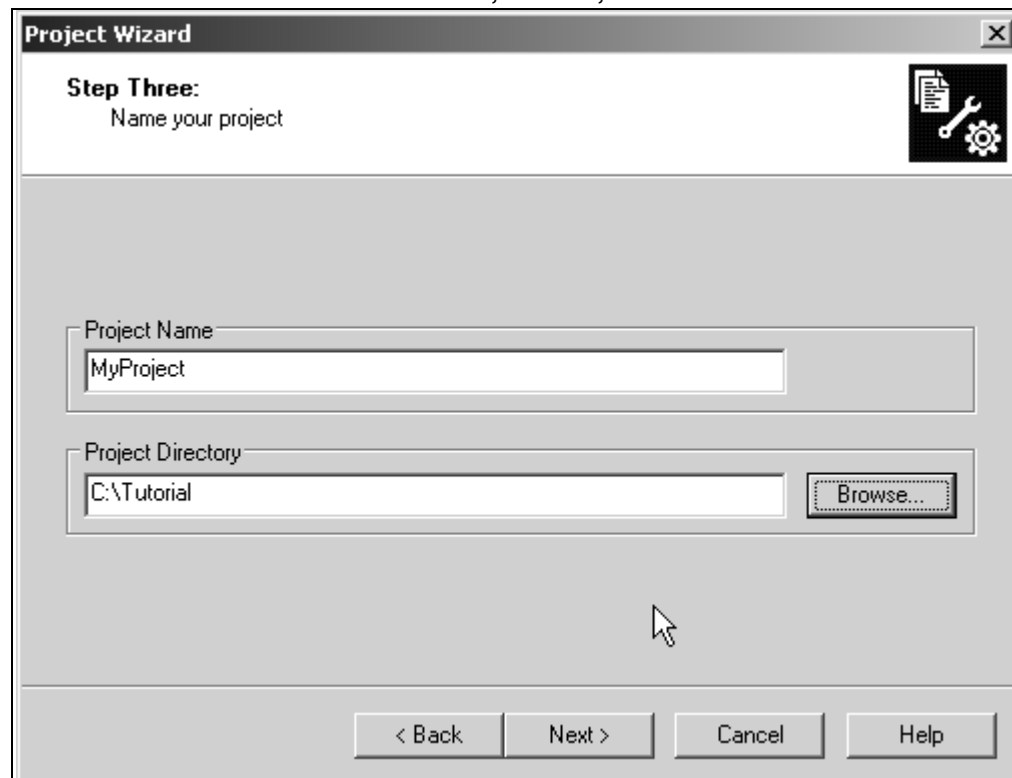

2.4.2   Select Language Toolsuite

1. From the **Active Toolsuite:** pull-down menu, select **Microchip C30 Toolsuite**. This toolsuite includes the assembler and linker that will be used (the C Compiler is not used).

> **Note:** Steps 2-4 are optional.

2. In the **Toolsuite Contents** block, select **MPLAB ASM30 Assembler (pic30-as.exe)**.

3. In the **Location** block, click **Browse...** and navigate to:

```
C:\Program Files\Microchip\MPLAB ASM30 Suite
\bin\pic30-as.exe
```

4. With **MPLAB LINK 30 Object Linker (pic30-ld.exe)** selected in **Toolsuite Contents**, click **Browse...** and navigate to:

```
C:\Program Files\Microchip\MPLAB ASM30 Suite
\bin\pic30-id.exe
```

5. Click **Next>** to continue. The Project Wizard Step Three dialog displays (see Figure 2-3).

> **Note:** The tool locations for your environment may be different from those shown in this tutorial.

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FIGURE 2-3:   **PROJECT WIZARD, STEP 3, NAME YOUR PROJECT**

2.4.3 Name Your Project

1. In the **Project Name** text box, type **MyProject**.
2. Click **Browse...** and navigate to `C:\Tutorial` to place your project in the Tutorial folder.
3. Click **Next>** to continue. The Project Wizard Step Four dialog displays (see Figure 2-4).

**FIGURE 2-4:** **PROJECT WIZARD, STEP 4, ADD FILES TO PROJECT**
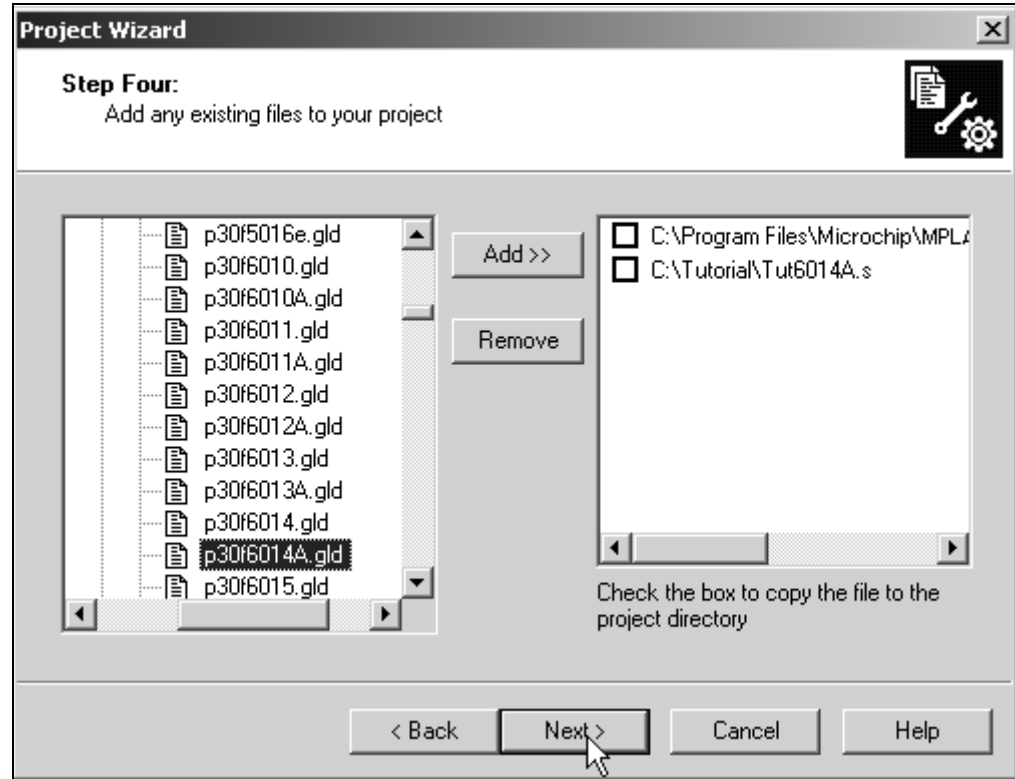
2.4.4 Add Files to Project

1. Locate the `C:\Tutorial` folder and select the `Tut6014A.s` file.
2. Click **Add>>** to include the file in the project.
3. Expand the `C:\Program Files\Microchip\MPLAB ASM30 Suite\Support\gld` folder and select the `p30f6014A.gld` file.
4. Click **Add>>** to include the file in the project. The project now has two files.
5. Click **Next>** to continue.
6. When the summary screen displays, click **Finish**.

After the project wizard completes, the MPLAB IDE project window shows the `Tut6014A.s` file in the **Source Files** folder and the `p30f6014A.gld` file in the **Linker Scripts** folder (see Figure 2-5).
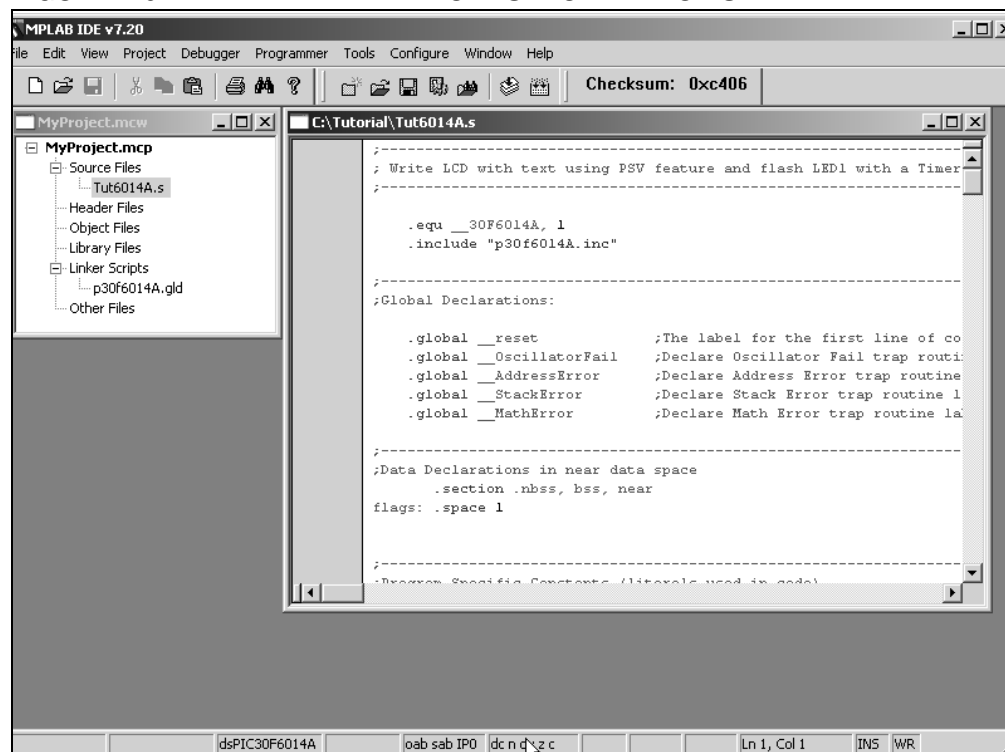
FIGURE 2-5: **MPLAB® IDE PROJECT WINDOW**
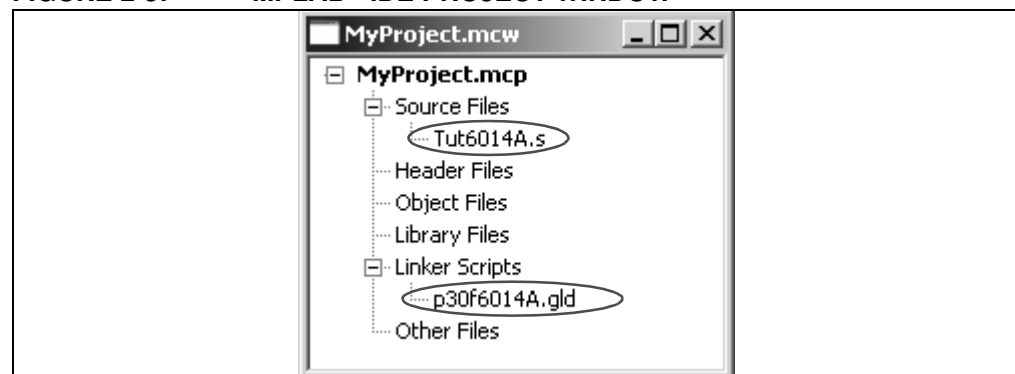
A project and workspace has now been created in MPLAB IDE. `MyProject.mcw` is the workspace file and `MyProject.mcp` is the project file. Double click the `Tut6014A.s` file in the project window to open the file. MPLAB IDE should now look similar to Figure 2-6.

FIGURE 2-6:   MPLAB® IDE WORKSPACE WINDOWS

2.5 BUILDING THE CODE

In this project, building the code consists of assembling the `Tut6014A.s` file to create an object file, `Tut6014A.o`, and then linking the object file to create the `Tut6014A.hex` and `Tut6014A.cof` output files. The `.hex` file contains the data necessary to program the device and the `.cof` file contains additional information that lets you debug at the source code level.

Before building, there are settings required to tell MPLAB IDE where to find the include files and to reserve space for the extra debug code when the MPLAB ICD 2 is used.

The following line is near the top of the `Tut6014A.s` file:

```
.include "p30f6014A.inc"
```

This line causes a standard include file to be used. Microchip provides these files with all the Special Function Register (SFR) labels already defined for convenience.

To build the code, select *Build Options>Project* from the *Project>* menu. The Build Options dialog displays, as shown in Figure 2-7.

FIGURE 2-7: BUILD OPTIONS
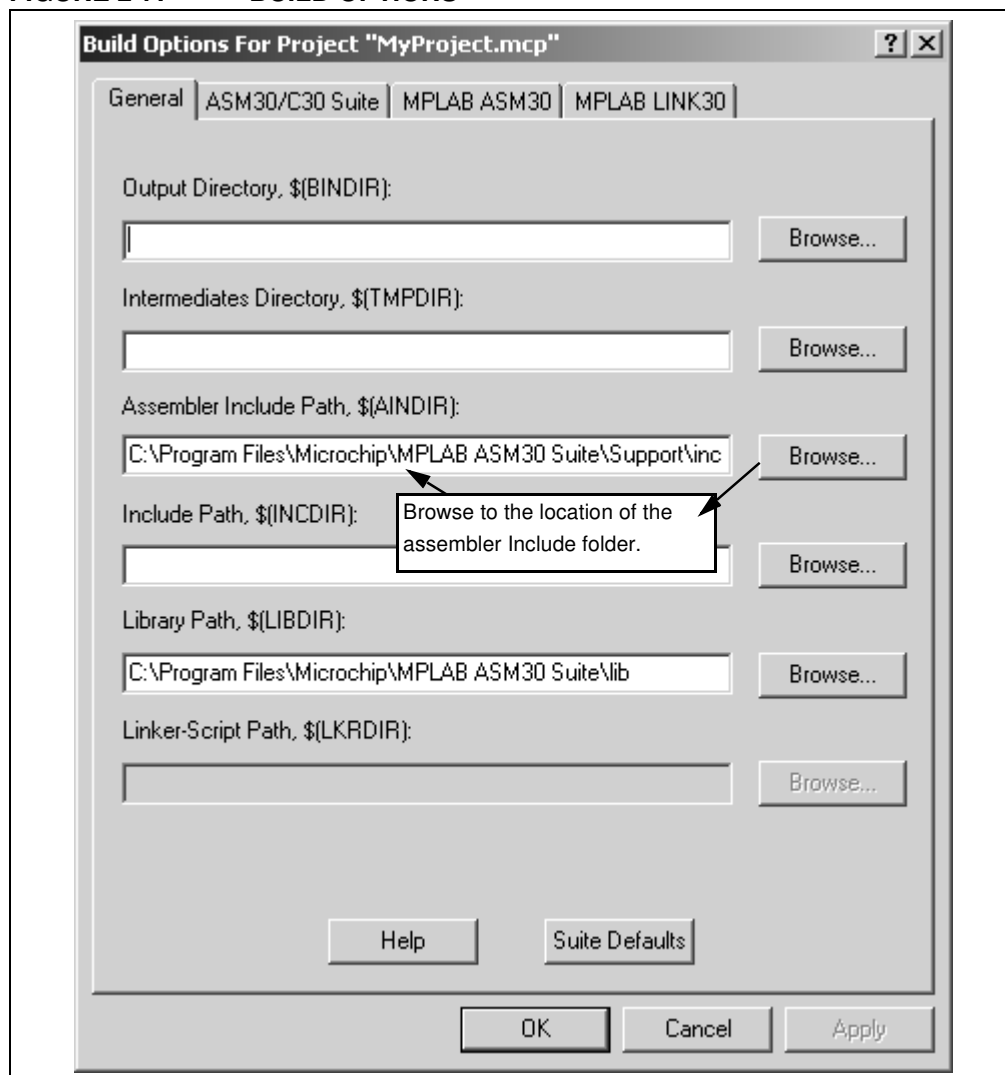
2.5.1   Identify Assembler Include Path

1. Select the General tab.
2. At the **Assembler Include Path, $(AINDIR)** box, click **Browse...** and navigate to:

   ```
   C:\Program Files\Microchip\MPLAB ASM30 Suite\Support\Inc
   ```

   This path tells MPLAB IDE where to find the Include files.

2.5.2   Link for ICD 2

1. Select the MPLAB LINK30 tab to view the linker settings (see Figure 2-8).
2. Check **Link for ICD 2**.
3. Click **Apply**, then click **OK**. The text box closes while the linker reserves space for the debug code used by the MPLAB ICD 2.
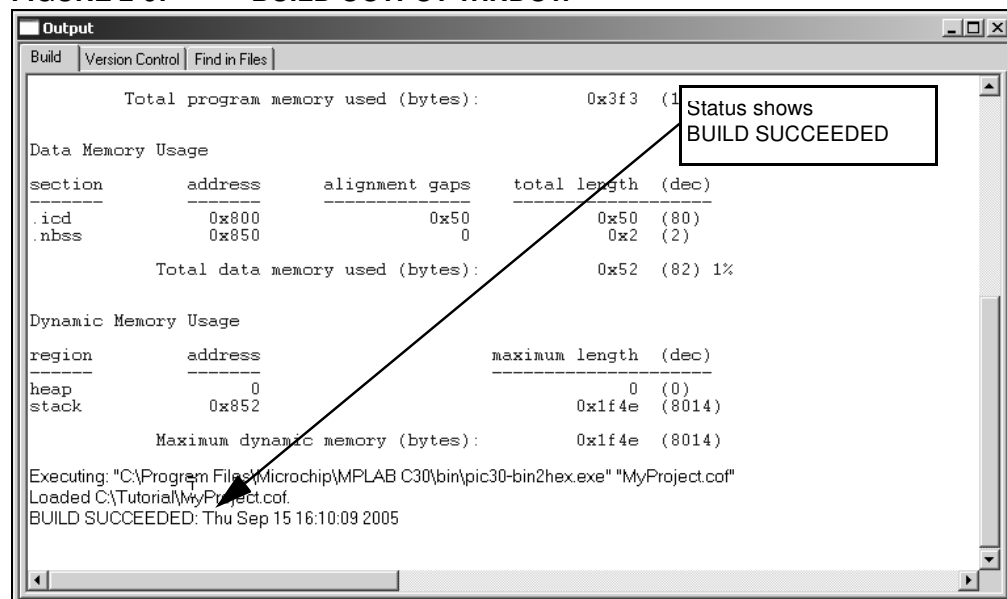4. Click **OK** again to save these changes. The project is now ready to build.

FIGURE 2-8:   MPLAB® LINK30 BUILD OPTIONS
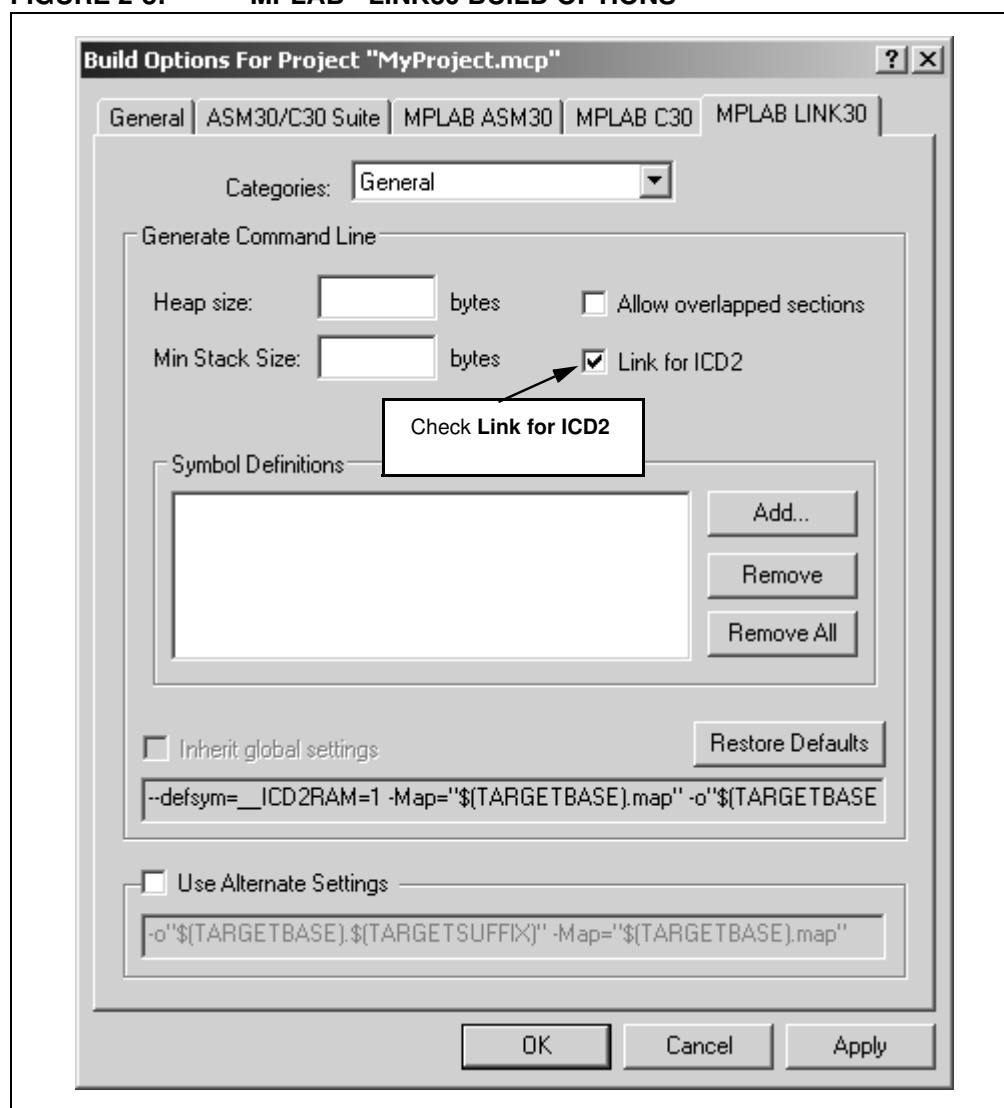
2.5.3   Build the Project

1. Select *Project>Build All*.
2. Observe the progress of the build in the Output window (Figure 2-9).
3. When BUILD SUCCEEDED displays you are ready to program the device.

FIGURE 2-9:   BUILD OUTPUT WINDOW

2.6   PROGRAMMING THE CHIP

The MPLAB ICD 2 In-Circuit Debugger can be used to program and debug the
dsPIC30F6014A device in-circuit on the dsPICDEM™ 1.1 Plus Development Board.

Note: Before proceeding, make sure that the USB driver for the MPLAB ICD 2 has
been installed on your PC (see the *"MPLAB® ICD 2 User's Guide"*,
DS51331) for more details regarding the installation of MPLAB ICD 2.

Use the following procedures to program the dsPIC30F6014A device.

2.6.1   Set Up the Device Configuration

1. Use the *Configure>Configuration Bits* menu to display the configuration settings.
2. Set up the Configuration bits as shown in Figure 2-10.

FIGURE 2-10:   CONFIGURATION SETTINGS