

dsPICDEM™ 2 Development Board User's Guide

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dsPICDEM™ 2 DEVELOPMENT BOARD USER'S GUIDE

Table of Contents

Preface 1

Chapter 1. Introduction

1.1 Introduction 7
1.2 Highlights 7
1.3 dsPICDEM™ 2 Development Board 7
1.4 dsPICDEM™ 2 Development Board Resources 8
1.5 Sample Application Projects 12
1.6 Host System Environment 12

Chapter 2. Getting Started

2.1 Introduction 13
2.2 Highlights 13
2.3 Getting Started 13
2.4 Out-of-the-Box Demo 14
2.5 Device Programming Process 17
2.6 In-Circuit Debugging Process 19
2.7 Summary 20

Chapter 3. Using the dsPIC30F2010

3.1 Introduction 21
3.2 Highlights 21
3.3 Board Setup for the dsPIC30F2010 Sample Application 21
3.4 Device Programming 23
3.5 Observing the Sample Application 24
3.6 In-Circuit Debugging 25
3.7 Summary 26

Chapter 4. Using the dsPIC30F2011

4.1 Introduction 27
4.2 Highlights 27
4.3 Board Setup for the dsPIC30F2011 Sample Application 27
4.4 Device Programming 29
4.5 Observing the Sample Application 30
4.6 In-Circuit debugging 31
4.7 Summary 32

Chapter 5. Using the dsPIC30F2012

5.1 Introduction 33
5.2 Highlights 33
5.3 Board Setup for the dsPIC30F2012 Sample Application 33
5.4 Device Programming 35

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5.5 Observing the Sample Application 36
5.6 In-Circuit Debugging 37
5.7 Summary 38

Chapter 6. Using the dsPIC30F3010

6.1 Introduction 39
6.2 Highlights 39
6.3 Board Setup for the dsPIC30F3010 Sample Application 39
6.4 Device Programming 41
6.5 Observing the Sample Application 42
6.6 In-Circuit Debugging 43
6.7 Summary 44

Chapter 7. Using the dsPIC30F3011

7.1 Introduction 45
7.2 Highlights 45
7.3 Board Setup for the dsPIC30F3011 Sample Application 45
7.4 Device Programming 47
7.5 Observing the Sample Application 48
7.6 In-Circuit Debugging 49
7.7 Summary 50

Chapter 8. Using the dsPIC30F3012

8.1 Introduction 51
8.2 Highlights 51
8.3 Board Setup for the dsPIC30F3012 Sample Application 51
8.4 Device Programming 53
8.5 Observing the Sample Application 54
8.6 In-Circuit Debugging 55
8.7 Summary 56

Chapter 9. Using the dsPIC30F3013

9.1 Introduction 57
9.2 Highlights 57
9.3 Board Setup for the dsPIC30F3013 Sample Application 57
9.4 Device Programming 59
9.5 Observing the Sample Application 60
9.6 In-Circuit Debugging 61
9.7 Summary 62

Chapter 10. Using the dsPIC30F3014

10.1 Introduction 63
10.2 Highlights 63
10.3 Board Setup for the dsPIC30F3014 Sample Application 63
10.4 Device Programming 65
10.5 Observing the Sample Application 66
10.6 In-Circuit Debugging 67
10.7 Summary 68

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Chapter 11. Using the dsPIC30F4011
11.1 Introduction 69
11.2 Highlights 69
11.3 Board Setup for the dsPIC30F4011 Sample Application 69
11.4 Device Programming 71
11.5 Observing the Sample Application 72
11.6 In-Circuit Debugging 73
11.7 Summary 74
Chapter 12. Using the dsPIC30F4012
12.1 Introduction 75
12.2 Highlights 75
12.3 Board Setup for the dsPIC30F4012 Sample Application 75
12.4 Device Programming 77
12.5 Observing the Sample Application 78
12.6 In-Circuit Debugging 79
12.7 Summary 80
Chapter 13. Using the dsPIC30F4013
13.1 Introduction 81
13.2 Highlights 81
13.3 Board Setup for the dsPIC30F4013 Sample Application 81
13.4 Device Programming 83
13.5 Observing the Sample Application 84
13.6 In-Circuit Debugging 85
13.7 Summary 86
Chapter 14. Hardware
14.1 Hardware Overview 87
Appendix A. Hardware Drawings and Schematics
A.1 Introduction 95
Appendix B. Writing to LCD
B.1 Overview 103
B.2 LCD Hardware Setup 103
B.3 LCD Software Specification 103
B.4 LCD Firmware Programming: 104
Appendix C. Board Errata
C.1 H7 and H6 Labelling Error 105
Index 107
Worldwide Sales and Service 114

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dsPICDEM™ 2 DEVELOPMENT BOARD USER'S GUIDE

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, including errata documents applicable to this product. Also, refer to the errata information in Appendix C.

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 2 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
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use dsPICDEM 2 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 2 Development Board, provides a brief description of the hardware components on the board and introduces the demonstration software provided with each of the supported dsPIC30F devices.
- **Chapter 2. Getting Started** – This chapter describes the out-of-the-box operation of the dsPICDEM 2 Development Board. It also provides a detailed descripton of how to perform programming and in-circuit debugging operations.
- **Chapter 3. Using the dsPIC30F2010** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F2010 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F2010 using the sample application.

- **Chapter 4. Using the dsPIC30F2011** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F2011 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F2011using the sample application.
- **Chapter 5. Using the dsPIC30F2012** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F2012 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F2012 using the sample application.
- **Chapter 6. Using the dsPIC30F3010** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F3010 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F3010 using the sample application.
- **Chapter 7. Using the dsPIC30F3011** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F3011 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F3011 using the sample application.
- **Chapter 8. Using the dsPIC30F3012** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F3012 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F3012 using the sample application.
- **Chapter 9. Using the dsPIC30F3013** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F3013 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F3013 using the sample application.
- **Chapter 10. Using the dsPIC30F3014** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F3014 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F3014 using the sample application.
- **Chapter 11. Using the dsPIC30F4011** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F4011 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F4011 using the sample application.
- **Chapter 12. Using the dsPIC30F4012** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F4012 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F4012 using the sample application.
- **Chapter 13. Using the dsPIC30F4013** – This chapter describes how to configure the dsPICDEM 2 Development Board for use with the dsPIC30F4013 Digital Signal Controller. It provides suggested procedures for device programming and in-circuit debugging of the dsPIC30F4013 using the sample application.
- **Chapter 14. Hardware** – This chapter provides detailed information related to the hardware components used on the dsPICDEM 2 Development Board.
- **Appendix A. Hardware Drawings and Schematics** – This appendix illustrates the dsPICDEM 2 Development Board layout and includes complete schematic diagrams.
- **Appendix B. Writing to LCD** – This appendix provides detailed instructions for writing to the 2 x 16 character LCD.
- **Appendix C. Board Errata** – This appendix describes errata associated with certain revisions of the dsPICDEM 2 Development Board.
- **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.

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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
'b*nnnn*	A binary number where *n* is a digit	'b00100, 'b10
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier font:		
Plain Courier	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`
Italic Courier	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
`0x`*`nnnn`*	A hexadecimal number where *`n`* is a hexadecimal digit	`0xFFFF`, `0x007A`
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 dsPICDEM 2 Development Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

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 Data Sheet, Motor Control and Power Conversion Family (DS70082)

Consult this document for information regarding the dsPIC30F Motor Control and Power Conversion devices. Reference information found in this data sheet includes:

- Device memory map
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the device

dsPIC30F Data Sheet, General Purpose and Sensor Families (DS70083)

Consult this document for information regarding the dsPIC30F General Purpose and Sensor devices. Reference information found in this data sheet includes:

- Device memory map
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the device

dsPIC30F Programmer's Reference Manual (DS70030)

This manual is a software developer's reference for the dsPIC30F 16-bit MCU family of devices. 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, dsPIC® High Performance 16-bit Digital Signal Controller (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).

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

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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.

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
- Development Systems Information Line

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

In addition, there is a Development Systems Information Line which lists the latest versions of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Development Systems Information Line numbers are:

1-800-755-2345 – United States and most of Canada

1-480-792-7302 – Other International Locations

Customers may also exchange ideas with each other and with Microchip personnel by logging on to http:\\forum.microchip.com.

DOCUMENT REVISION HISTORY

Revision A (June 2005)

- Initial Release of this Document.

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Chapter 1. Introduction

1.1 INTRODUCTION

The dsPICDEM™ 2 Development Board is a development and evaluation tool that helps you create embedded applications using dsPIC30F Digital Signal Controllers (DSC) in 18-pin PDIP, 28-pin SPDIP and 40-pin PDIP packages. The dsPICDEM™ 2 Development Board provides both a hardware and software baseline capability to help jump start your application.

Sockets are provided for 28 and 40-pin devices in the dsPIC30F Motor Control family and 18, 28 and 40-pin devices in the dsPIC30F General Purpose and Sensor family. For each device supported by the board, the product CD includes a sample application program designed specifically for that device. Thus, regardless of the dsPIC30F device you choose for your application, you also have sample code appropriate to that device.

1.2 HIGHLIGHTS

This chapter discusses:

- dsPICDEM™ 2 Development Board
- dsPICDEM™ 2 Development Board Resources
- Sample Application Projects
- Host System Environment

1.3 dsPICDEM™ 2 DEVELOPMENT BOARD

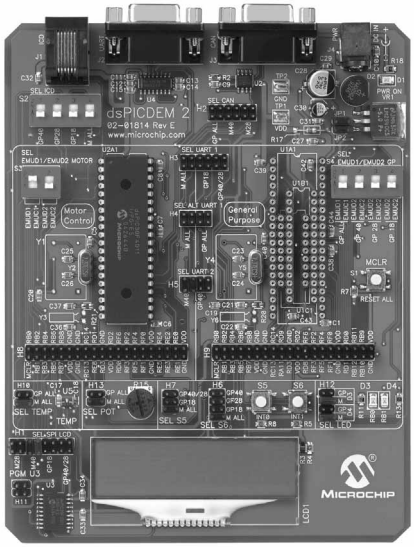
The dsPICDEM™ 2 Development Board (Figure 1-1) includes a dsPIC30F4011 Digital Signal Processor in the 40-pin motor control socket, a power supply regulator, crystal oscillators for each set of sockets, an ICD header for the MPLAB ICD 2 In-Circuit Debugger and both UART and CAN ports for external communication. In addition, the board is populated with prototyping hardware, including LED indicators, push-button switches, a potentiometer, a temperature sensor and an LCD screen. All pins on all the device sockets are accessible on prototyping areas. Also included is the dsPICDEM™ 2 Development Kit CD, which contains software and this User's Guide.

Key hardware features include:

- Multiple sockets for 18, 28 and 40-pin PDIP and SPDIP devices
- dsPIC30F4011 40-pin PDIP sample device installed on the board
- 5V regulator provides V_{DD} and AV_{DD} from a 9V DC power supply. An LED indicates when the power is on.
- Connector for MPLAB® ICD 2 In-Circuit Debugger or MPLAB ICE 4000 In-Circuit Emulator
- RS-232 interface
- Controller Area Network (CAN) interface
- Temperature sensor and analog potentiometer to simulate A/D inputs
- Pushbutton switches and LED indicators to simulate digital input and output
- 2x16 ASCII Character LCD with SPI™ interface
- 2x20 prototyping header area for user hardware expansion (header not provided)

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FIGURE 1-1: dsPICDEM™ 2 DEVELOPMENT BOARD



1.4 dsPICDEM™ 2 DEVELOPMENT BOARD RESOURCES

The dsPICDEM™ 2 Development Board accommodates the devices listed in Table 1-1.

TABLE 1-1: DEVICES SUPPORTED BY dsPICDEM™ 2

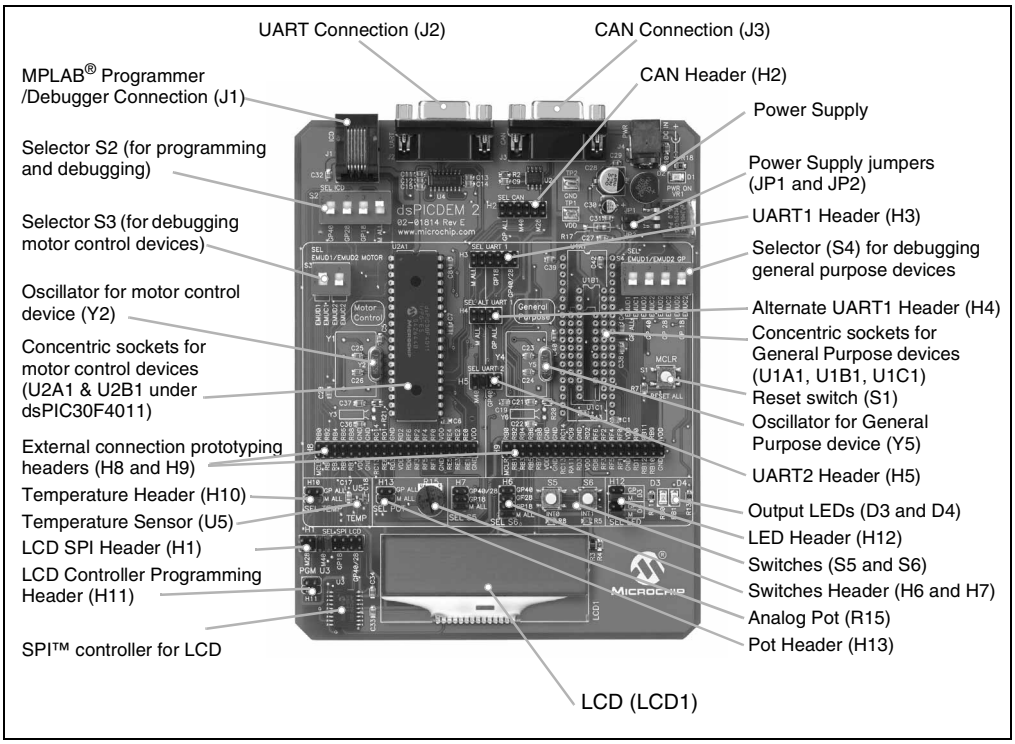
dsPIC30F Device	Pins	Socket	Resources
Motor Control Family			
2010	28	U2B1	Six 10-bit A/D (500 ksps) channels, UART, SPI, I^2C™ and 20 I/O pins*
3010	28	U2B1	Six 10-bit A/D (500 ksps) channels, UART, SPI, I^2C and 20 I/O pins*
3011	40	U2A1	Nine 10-bit A/D (500 ksps) channels, two UARTs, SPI, I^2C and 30 I/O pins*
4011	40	U2A1	Nine 10-bit A/D (500 ksps) channels, two UARTs, SPI, I^2C, CAN and 30 I/O pins*
4012	28	U2B1	Six 10-bit A/D (500 ksps) channels, UART, SPI, I^2C, CAN and 20 I/O pins*
General Purpose and Sensor Family			
2011	18	U1C1	Eight 12-bit A/D (100 ksps) channels, UART, SPI, I^2C and 12 I/O pins*
3012	18	U1C1	Eight 12-bit A/D (100 ksps) channels, UART, SPI, I^2C and 12 I/O pins*
2012	28	U1B1	Ten 12-bit A/D (100 ksps) channels, UART, SPI, I^2C and 20 I/O pins*
3013	28	U1B1	Ten 12-bit A/D (100 ksps) channels, two UARTs, SPI, I^2C and 20 I/O pins*
3014	40	U1A1	13 12-bit A/D (100 ksps) channels, two UARTs, SPI, I^2C and 30 I/O pins*
4013	40	U1A1	13 12-bit A/D (100 ksps) channels, two UARTs, SPI, I^2C, CAN and 30 I/O pins*

* Includes pins shared by the peripheral functions

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The dsPICDEM™ 2 must be configured for the device you have chosen for your application. Switches and headers are provided to connect hardware components on the board with corresponding pins on the dsPIC30F device. Figure 1-2 shows the location of hardware components and configuration headers that need to be set up depending on the dsPIC30F device.

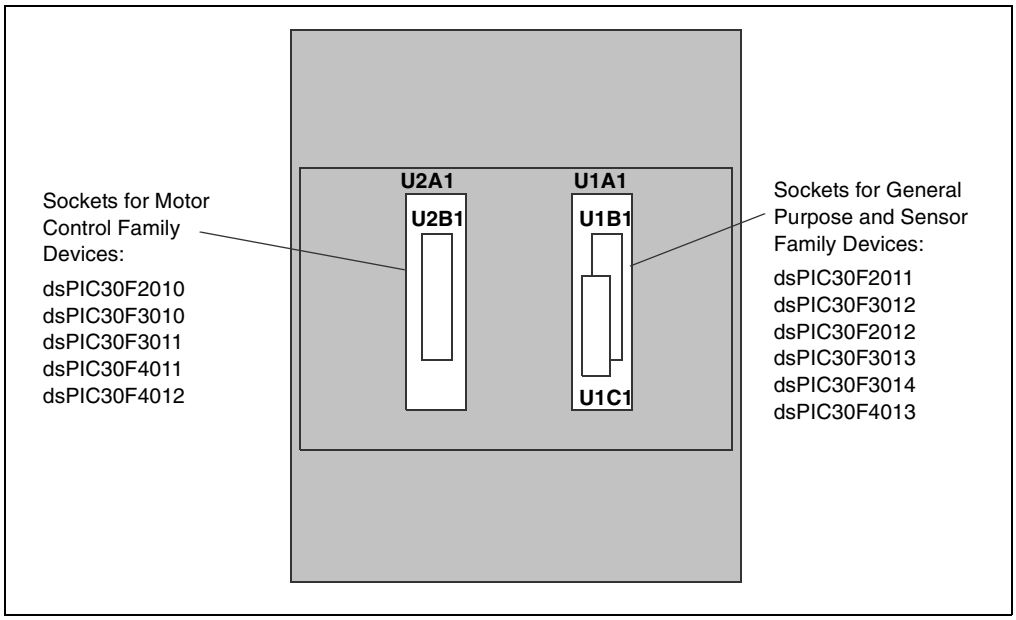
FIGURE 1-2: dsPICDEM™ 2 HARDWARE COMPONENTS



1.4.1 dsPIC30F Device Sockets

For convenience, the board provides separate sockets for Motor Control family devices and general purpose/sensor family devices. As shown in Figure 1-3, the left side of the board includes concentric sockets (U2B1 and U2A1) for 28 and 40-pin devices, respectively, in the Motor Control family. The right side includes concentric sockets (U1C1, U1B1 and U1A1) for 18, 28 and 40-pin devices, respectively, in the General Purpose and Sensor family.

FIGURE 1-3: dsPICDEM™ 2 DEVELOPMENT BOARD LAYOUT



1.4.2 MPLAB ICD 2 Header

An RJ11 connector (J1) allows the MPLAB ICD 2 Debugger/Programmer to be used with the dsPIC30F device you have plugged into the board. Switches S2, S3 and S4 physically connect this interface to the device sockets. Switch S2 connects the MPLAB ICD 2 interface to the default programming and debugging pins on the dsPIC30F devices (PGC/EMUC and PGD/EMUD). This switch should be turned on during programming.

Switches S3 and S4 connect the MPLAB ICD 2 interface to alternative debugging pins on the dsPIC30F devices (EMUC1/EMUD1 and EMUC2/EMUD2). These switches should be turned off during device programming and turned on during debugging, if needed.

1.4.3 UART Connection

A DB9 connector (J2) facilitates external RS-232RS-232 communication. Headers H3, H4 and H5 connect this interface to the UART peripheral in the dsPIC DSC device. Header H3 selects UART1. Header H4 selects alternate pins for UART1 in all dsPIC30F devices supported by this board. Header H5 selects UART2 in dsPIC30F devices that provide two UARTs (dsPIC30F3011, 3013, 3014, 4011 and 4013).

1.4.4 CAN Connection

A second DB9 connector (J3) is used for CAN communication. Header H2 selects the dsPIC DSC device for the CAN interface. The CAN interface is supported by dsPIC30F4011, 4012 and 4013 devices.

1.4.5 Power Supply

The dsPICDEM™ 2 power supply IS powered from an AC/DC wall adapter that furnishes 9 VDC to the PWR jack (J4). The power supply is split at the regulator to provide a separate, de-coupled analog supply voltage useful in designs taking advantage of the dsPIC30F A/D converters. The power supply includes an on-board +5V regulator for supplying V_{DD} and AV_{DD}. An LED indicates when the power is on. Jumpers (JP1 and JP2) let you disconnect the power supply from the board if you want to supply external DC power via terminals TP1 and TP2.

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1.4.6 Reset Switch

This pushbutton switch (S1) is tied to the $\overline{\text{MCLR}}$ pin on the dsPIC30F device. It is used to reset the device regardless of the socket used.

1.4.7 Device Clocking

Device clocking can be provided by on-chip RC oscillators, on-board crystal oscillators or external sources. Crystal (Y1) provides a 7.3728 MHz oscillator for the motor control device. Crystal (Y2) provides a 7.3728 MHz oscillator for the general purpose and sensor devices.

1.4.8 Analog and Digital Inputs

The dsPICDEM™ 2 provides the following sensors that can be used to provide input signals to your application program:

- Temperature sensor (U5)
- Potentiometer (R15)
- Pushbutton switches (S5 and S6)

1.4.8.1 TEMPERATURE SENSOR

The temperature sensor is a TC1047A that provides an analog signal to analog channel AN3 in either the general purpose or motor control device via header H10.

1.4.8.2 ANALOG POTENTIOMETER

A 5-kOhm potentiometer provides an analog signal to analog channel AN2 in either the general purpose or motor control device via header H13. The voltage source to the potentiometer is provided by VR1, through a low-pass filter. VR1 is the main voltage regulator for all components on the development board.

1.4.8.3 PUSHBUTTON SWITCHES

Two pushbutton switches, S5 and S6, are connected to external interrupt pins INT0 and INT1, respectively, on the dsPIC30F device via headers H6 and H7, respectively.

1.4.9 Digital Outputs

The dsPICDEM™ 2 provides the following output devices that can be used to display output information from your application program:

- LED Indicators (D3 and D4)
- LCD Display (LCD1/LCD2)

1.4.9.1 LED INDICATORS

LEDs D3 and D4 are connected to port pins RB0 and RB1, respectively on the installed dsPIC DSC device via header H12. The LED anodes are tied to VDD through a 1.2K resistor.

1.4.9.2 LCD DISPLAY

A 2 x 16 character dot matrix LCD display is provided on the development board. The installed dsPIC30F device writes characters to the LCD via the clock (SCK1) and data (SDO1) pins on the device's SPI1 module.

1.4.10 External Connections

Prototyping areas H8 and H9 provide external connections from the motor control and general purpose devices, respectively. These connections allow you to use hardware and test equipment not provided on the dsPICDEM™ 2 board.

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1.5 SAMPLE APPLICATION PROJECTS

The dsPICDEM™ 2 Development Kit CD contains sample projects for each of the dsPIC DSC devices supported by the dsPICDEM™ 2 Development Board. These sample programs are intended to jump start your application development by showing you how to implement and configure dsPIC30F peripherals such as A/D converters, external interrupts, timers, SPI, and UART interfaces and I/O ports. Complete C source code is provided that shows how to how to write interrupt service routines and how to use device control register structures for configuring peripherals and I/O ports. These sample C files are bundled into MPLAB IDE projects that let you begin work out of the box.

The sample application projects and source code were created with:

- MPLAB IDE v7.11
- MPLAB C30 v1.32

The sample application projects for each dsPIC30F device are located in the folder:

`path/dsPICDEM 2 Development Kit/Example Software/`

1.6 HOST SYSTEM ENVIRONMENT

A host system is used to support the MPLAB IDE and ICD 2 development tools (as well as HyperTerminal® communication). Minimum requirements are:

- PC-compatible system with an Intel Pentium class or higher processor, or equivalent
- A minimum of 16 MB RAM
- A minimum of 40 MB available hard drive space
- CD ROM drive
- Microsoft Windows® 98, Windows NT®4.0, Windows 2000 or Windows XP

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Chapter 2. Getting Started

2.1 INTRODUCTION

The dsPICDEM™ 2 Development Board provides both a hardware and software baseline capability to help jump start your application. The board is pre-configured for and populated with a dsPIC30F4011 Digital Signal Controller (DSC). The dsPIC30F4011 is preprogrammed with a sample application program ready to run out of the box.

This chapter describes how to run the application and evaluate the program to take advantage of the sample software.

2.2 HIGHLIGHTS

Items discussed in this chapter include:

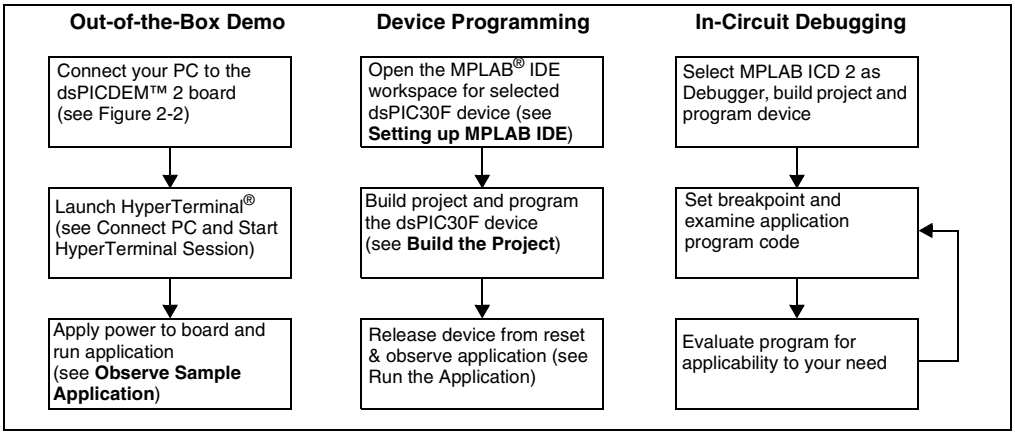
- Getting Started
- Out-of-the-Box Demo
- Device Programming Process
- In-Circuit Debugging Process
- Summary

2.3 GETTING STARTED

The dsPICDEM 2 sample application program demonstrates key functionality of the dsPIC30F devices. This sample application program processes analog data from a temperature sensor and potentiometer provided on the board. It also processes interrupts generated from pushbutton switches on the board. Based on the input data, the program creates output in the form of LED indicators, which blink in response to the pushbutton switches, and an LCD screen, which displays the temperature and potentiometer values. The program also uses the dsPIC30F's UART module to mirror LCD information (via RS-232 connection) to a remote terminal.

The sample application is written in C language and tailored specifically for each dsPIC30F device supported by the dsPICDEM™ 2 Development Board. Figure 2-1 outlines helpful processes to get you started using the dsPICDEM 2 board.

FIGURE 2-1: GETTING STARTED PROCESSES



Out-of-the-box, you can power up the dsPICDEM™ 2 Development Board and run the sample application on the dsPIC30F4011 device. The objective of this process is to acquaint you with the board and demonstrate how the dsPIC30F device interacts with the hardware components used for the demo (see **Section 2.4 "Out-of-the-Box Demo"**).

Eventually, as you develop your own application, you will need to program and debug the dsPIC30F device. The second phase of the getting-started process is programming the device for stand-alone operation. For this process, you attach the MPLAB ICD 2 In-Circuit Debugger to the dsPICDEM 2 board, designate it as a programmer in MPLAB IDE, build your program in MPLAB IDE and then program the device with MPLAB ICD 2. The procedures for this process are outline in **Section 2.5 "Device Programming Process"**, using the dsPIC30F4011 device as an example.

To examine program operation on a step-by-step basis, you need to set up MPLAB ICD 2 as a debugger. For this process you attach the MPLAB ICD 2 In-Circuit Debugger to the dsPICDEM 2 board, designate it as a debugger in MPLAB IDE, build your program in MPLAB IDE and then program the device for debug mode with MPLAB ICD 2. The procedures for this process are outline in **Section 2.6 "In-Circuit Debugging Process"**, using the dsPIC30F4011 device as an example.

2.4 OUT-OF-THE-BOX DEMO

As the first phase of your getting-started process, you only need to connect your PC to the dsPICDEM™ 2 Development Board, apply power to the board and observe the sample application on the board and on HyperTerminal®.

2.4.1 dsPICDEM 2 Configuration

Out-of-the-box, the dsPICDEM™ 2 Development Board is configured to operate with the dsPIC304011 device. When you use a different type of supported device you need to reconfigure the board for that device. In general, you follow this process to reconfigure the dsPICDEM™ 2 Development Board. For the out-of-the-box configuration, you simply can verify these settings:

1. Select a supported dsPIC30F device and plug it into the appropriate socket (not necessary out of the box).
2. Note the hardware configuration for the dsPIC30F4011device:

This functionality:	**Is set up by this hardware component:**
Program/Debug device	Switch S2 switched OFF
Alternate Debugging	Switch S3 or S4 – all switches OFF
Temperature (A/D)	H10 set to M ALL
Potentiometer (A/D)	H13 set to M ALL
CAN	H2 open
UART1	H3 open
Alternate UART1	H4 set to M ALL
UART2	H5 open
LCD (SPI)	H1 set to M 40
SPI™ Controller Programming	H11 open
Switch S5 (INT0)	H6 set to M ALL
Switch S6 (INT1)	H7 set to M ALL
External connections	H8 or H9 open
LEDs D3 and D4 (I/O)	H12 set to M
Power Supply	Jumpers JP1 and JP2

Note: Chapters 3-13 provide specific set-up instructions for each type of dsPIC30F device supported by the dsPICDEM™ 2 Development Board.

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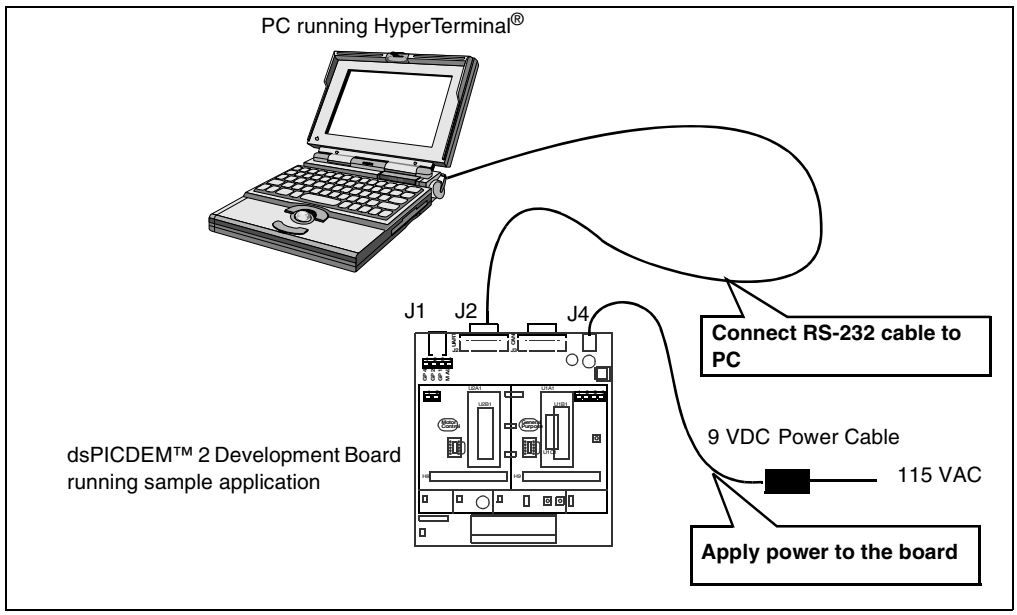
2.4.2 Connect PC and Start HyperTerminal Session

Follow the information in Figure 2-2 to set up your PC to operate with the dsPICDEM™ 2 Development Board.

1. Use an RS-232 cable to connect the serial port on your PC to the UART connector (J2) on the board.
2. On your PC, start a HyperTerminal session and set it up with these port settings:
   9600 baud
   8 data bits
   No parity
   1 stop bit
   No flow control

Note: For convenience, each of the sample program folders contains a utility that automatically launches HyperTerminal set up to run with the demo program. Double clicking the file (`Hyperterminal_RS232_dsPICDEM2.ht`) starts the session.

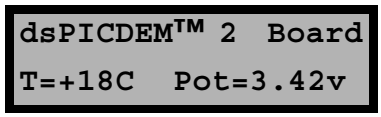
FIGURE 2-2: SETUP DIAGRAM



2.4.3 Observe Sample Application

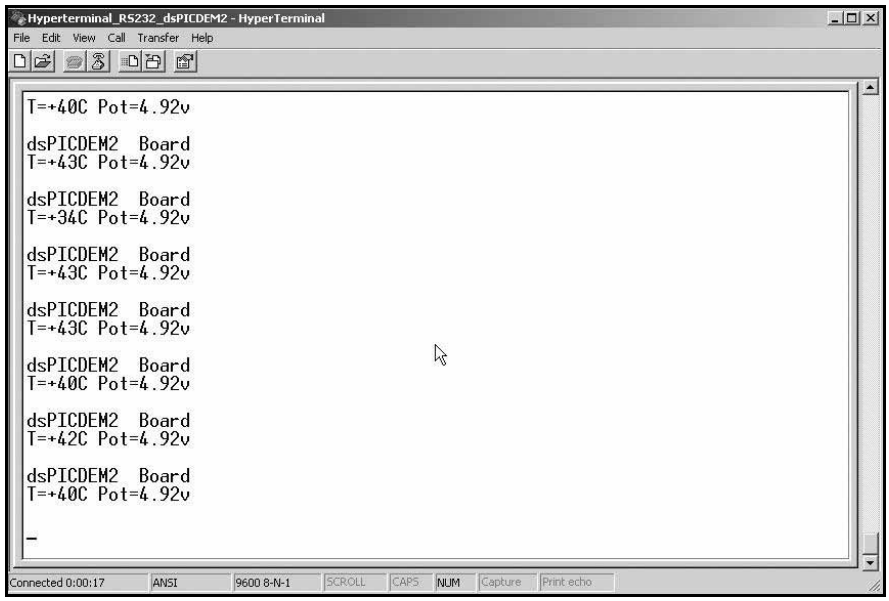
To run and observe the sample application follow these steps:

1. Plug the 9 VDC cable into the **DC IN** connector (J4). The **PWR ON** indicator should illuminate.
2. Press the **RESET ALL** pushbutton (S1). The LCD displays the current temperature and voltage values, which represent the A/D conversions from the temperature sensor and potentiometer, respectively.

   The LED indicators (D3 and D4) should initially be off and then start to blink.
3. Touch the temperature sensor for a moment and observe the temperature reading. It should increase as your finger warms the sensor.
4. Adjust the potentiometer clockwise and observe the voltage reading increase. Then readjust it counterclockwise and observe the voltage reading decrease.
5. Observe the HyperTerminal screen and note that the information is updated to match the LCD (see Figure 2-3).

FIGURE 2-3: TYPICAL HyperTerminal® SESSION



6. Press pushbutton S5 (INT0) once and note that the rate at which D3 and D4 blink changes. As you press S5 again, observe that the blink rate cycles from extremely fast (both LEDs appear to be on) to fast (blinking rapidly) to moderate (blinking slowly) to slow (appear to be switching on and off).
7. Press pushbutton S6 (INT1) once and note that D3 and D4 blink alternately. As you press S6 again, note the LEDs cycle between blinking together and blinking alternately.

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2.5 DEVICE PROGRAMMING PROCESS

The second phase of the getting-started process introduces the MPLAB Integrated Development Environment (IDE) and MPLAB ICD 2 In-Circuit Debugger. The emphasis in this phase is to program the sample application into a dsPIC30F4011 device. After observing the demonstration, this process gets you ready to examine what you observed.

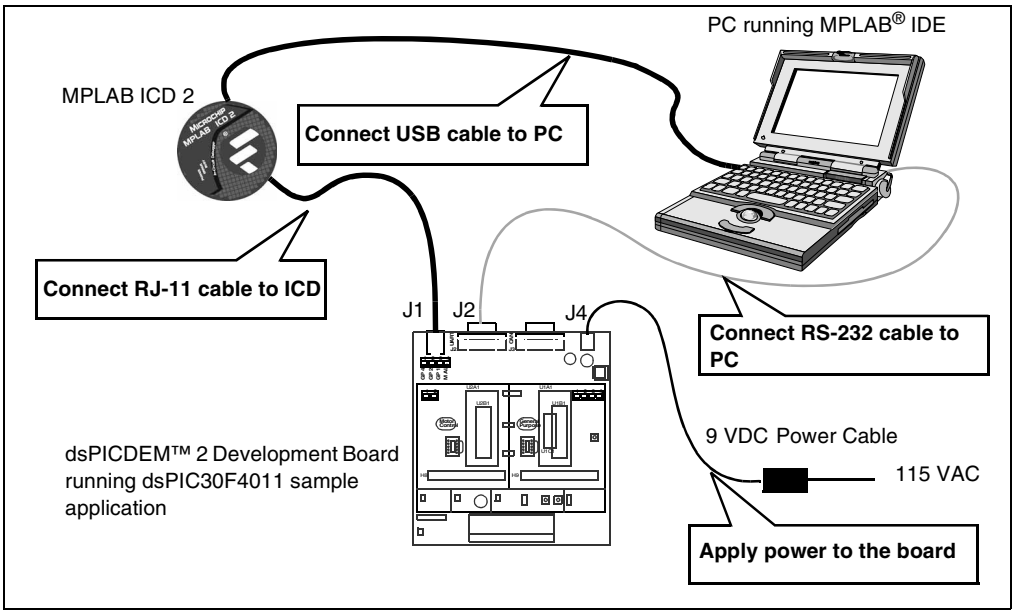
2.5.1 Connect MPLAB ICD 2

Follow the information in Figure 2-2 to set up the MPLAB ICD 2 for use as a programmer.

1. With an RJ11 cable, connect the MPLAB ICD 2 to the ICD header (J1) on the board.
2. Use a USB cable to connect the MPLAB ICD 2 to your PC.

Note: 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).

FIGURE 2-4: MPLAB® ICD 2 CONNECTION DIAGRAM



2.5.2 Setting up MPLAB IDE

The sample application program files on the dsPICDEM 2 CD contain a workspace and project information needed by MPLAB IDE, MPLAB ICD 2 and MPLAB C30.

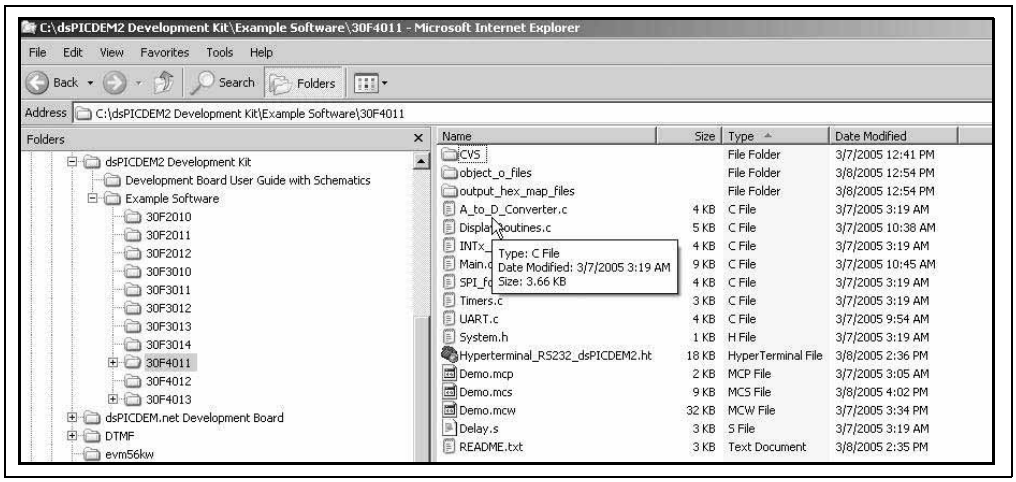
The first step is to open the sample application project in MPLAB IDE.

Note: These instructions presume the use of MPLAB IDE version 7.11 or newer and MPLAB C30 version 1.32 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 information on the selected device, debug tool and/or programmer, open windows and their location, and other MPLAB IDE configuration settings.

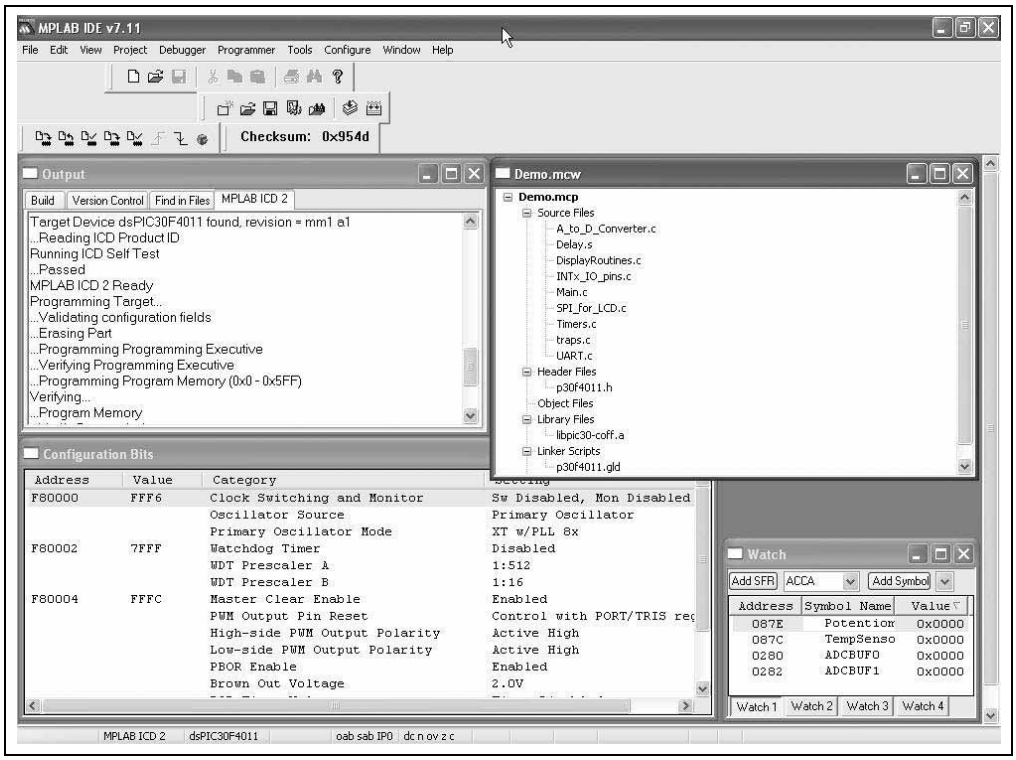
1. Start MPLAB IDE.
2. From the *File* menu select *Open Workspace>[path]*, as shown in Figure 2-5, where *[path]* is the location of the sample application files.

FIGURE 2-5: OPEN WORKSPACE DIALOG



3. Select **30F4011/Demo.mcw**. A project and workspace is created in MPLAB IDE. As shown in Figure 2-6, `Demo.mcw` is the workspace file and `Demo.mcp` is the project file.

FIGURE 2-6: PROJECT WORKSPACE IN MPLAB® IDE



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2.5.3 Build the Project

1. Select *Project>Build All*.
2. Observe the progress of the build in the Output window.
3. When BUILD SUCCEEDED displays you are ready to program the device.
4. Program the dsPIC30F4011device (*Programmer>Program*)

2.5.4 Run the Application

1. From the *Programmer* menu, select *Release from Reset* to enable code exectution.
2. On the board, turn off the M ALL switch in S2.
3. As the code begins executing, note that the operation is identical to what you observed out-of-the-box (see **Section 2.4.3 "Observe Sample Application"**)

2.6 IN-CIRCUIT DEBUGGING PROCESS

MPLAB IDE lets you run, halt and step the program. It lets you set breakpoints to examine the code at specific locations or on occurrence of specific events. It also lets you examine the contents of the RAM and registers. The MPLAB ICD 2 allows you to run the application on the dsPICDEM 2 while monitoring it in MPLAB IDE on your PC.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F4011 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F device that were specified in MPLAB IDE.

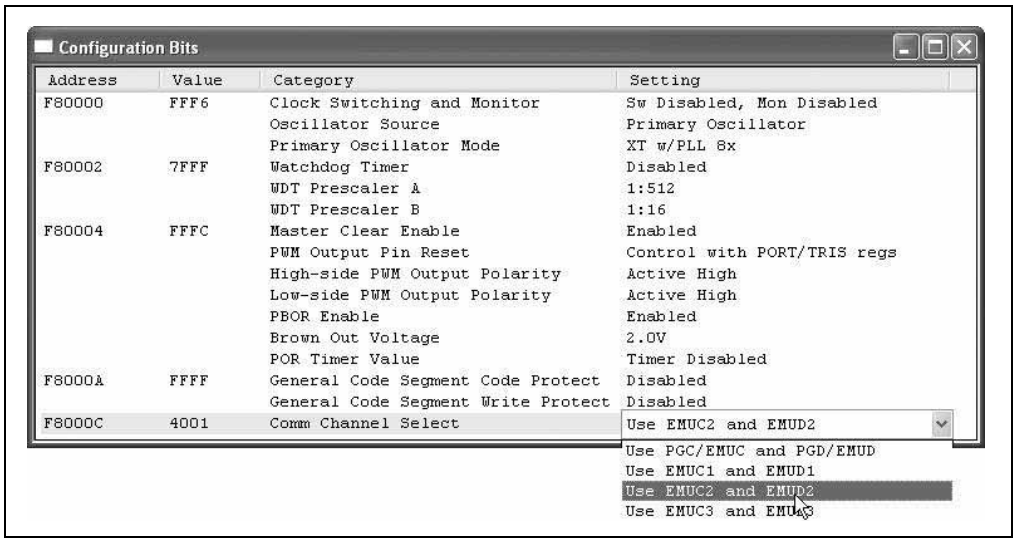
Note: The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

2.6.1 Select MPLAB ICD 2 as Debugger

To change MPLAB ICD 2 from a programmer to a debugger for a dsPIC30F4011 device:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 2-7.
3. Change the "Comm Channel Select" parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Program the dsPIC30F device (*Debugger>Program* menu).
6. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
7. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 2-7: CONFIGURATION BITS WINDOW



2.6.2 Debugging the Code

The MPLAB ICD 2 In-Circuit Debugger can be used to run, halt and step the code. A breakpoint can be set to halt the program after the code has executed the instruction at the breakpoint. The contents of the RAM and registers can be viewed whenever the processor has been halted.

The MPLAB ICD 2 In-Circuit Debugger uses the following function keys to access the main debugging functions:

<F5> Halt
<F6> Reset
<F7> Single Step
<F9> Run

In addition, there are more functions available by right clicking on a line of source code. These functions include the ability to set simple and advanced breakpoints.

2.7 SUMMARY

This chapter has provided a suggested process for using the dsPICDEM™ 2 Development Board to jump start your own application. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM™ 2 Development Board for the dsPIC30F device you select for your application.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for your dsPIC30F device.
- Program the chip with the MPLAB ICD 2.
- View the code execution in program memory and source code.
- Reset, Run, Halt and Single-Step the code.

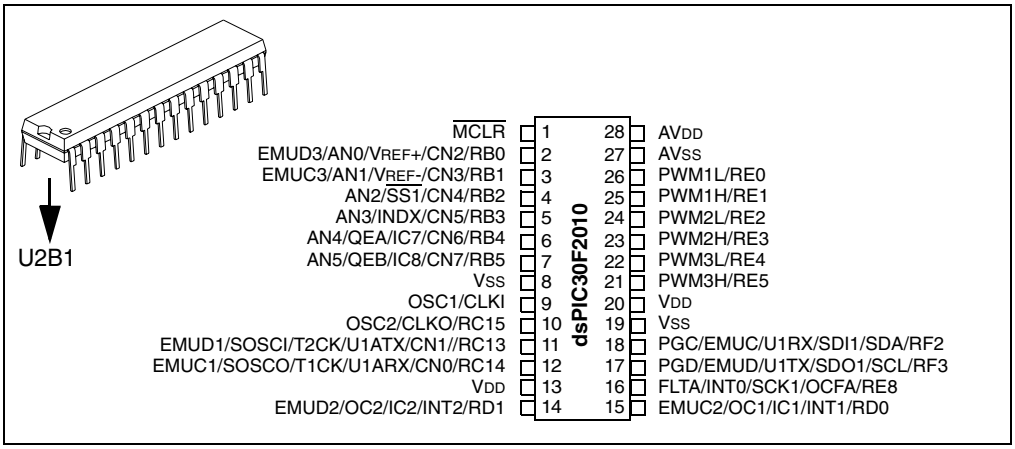
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Chapter 3. Using the dsPIC30F2010

3.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F2010 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F2010 device in a 28-pin SPDIP package, as shown in Figure 3-1. This device provides six 10-bit A/D (500 ksps) channels, a UART, an SPI module, an I^2C™ module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 3-1: 28-PIN SPDIP dsPIC30F2010



3.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F2010 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

3.3 BOARD SETUP FOR THE dsPIC30F2010 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F2010 device to support the dsPIC30F2010 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.

3. Plug the dsPIC30F2010 into socket U2B1.
4. Configure the hardware components as shown in Table 3-1.

TABLE 3-1: dsPIC30F2010 CONFIGURATION SETTINGS

Component	Header		Socket U2B1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 3-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	M ALL ON	17,18	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	M ALL	11	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	M ALL	12	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	M ALL	5	AN3/INDX/CN5/RB3
Potentiometer	H13	M ALL	4	AN2/$\overline{SS1}$/CN4/RB2
Switch S5	H6	M ALL	16	FLTA/INT0/SCK1/OCFA/RE8
Switch S6	H7	M ALL	15	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	M D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	M D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	M28	16	FLTA/INT0/SCK1/OCFA/RE8
LCD - SPI Data*	H1	M28	17	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F2010 (see **Section 3.4 "Device Programming"**).

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3.4 DEVICE PROGRAMMING

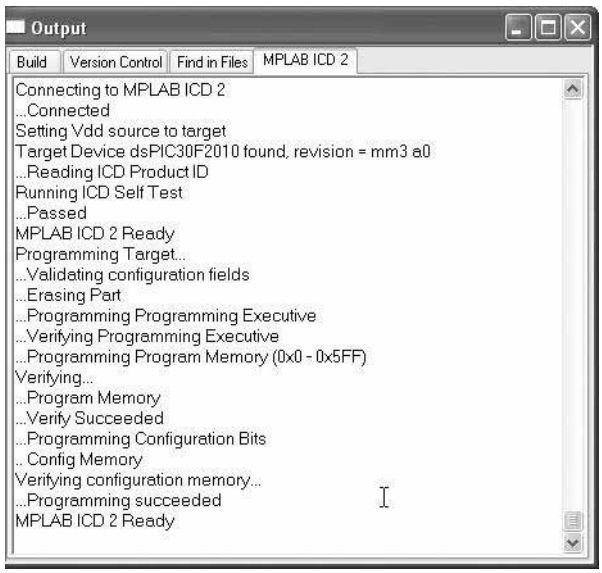
Load the sample application program for the dsPIC30F2010 using this process:

1. Plug the RJ11cable from the MPLAB ICD 2 into the ICD header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F2010 sample project (*File>Open Workspace)* from `path/dsPICDEM 2 Development Kit/Example Software/30F2010/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2 refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to **OFF**. Then set switch S2 to **M ALL**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F2010.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 3-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 3-2: PROGRAMMING THE dsPIC30F2010 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 3.5 "Observing the Sample Application"**).

3.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F2010` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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3.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and peripheral modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F2010 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F2010 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F2010 device that were specified in MPLAB IDE.

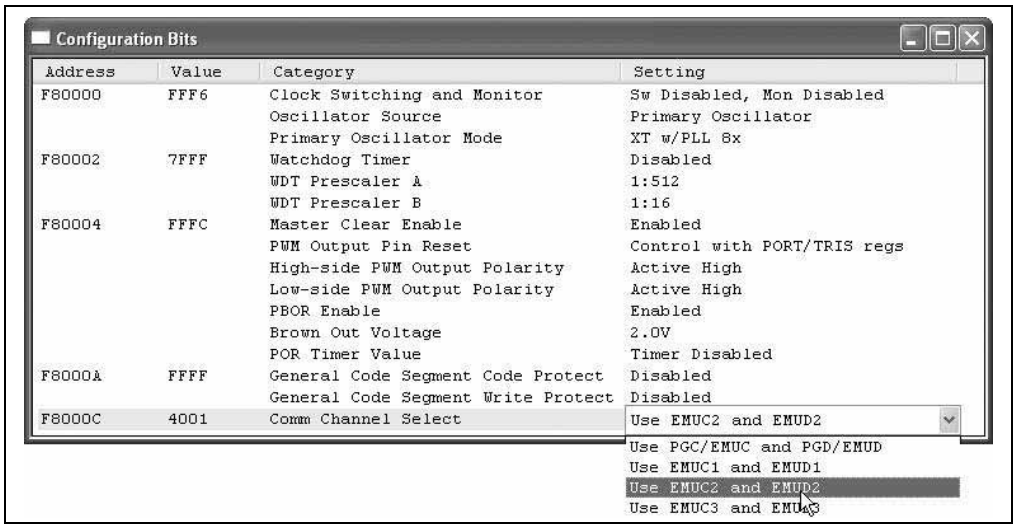
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

3.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 3-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 3-3: CONFIGURATION BITS WINDOW



3.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F2010` folder contains fully annotated code files that you can examine, compare and copy.

3.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F2010 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F2010 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F2010 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

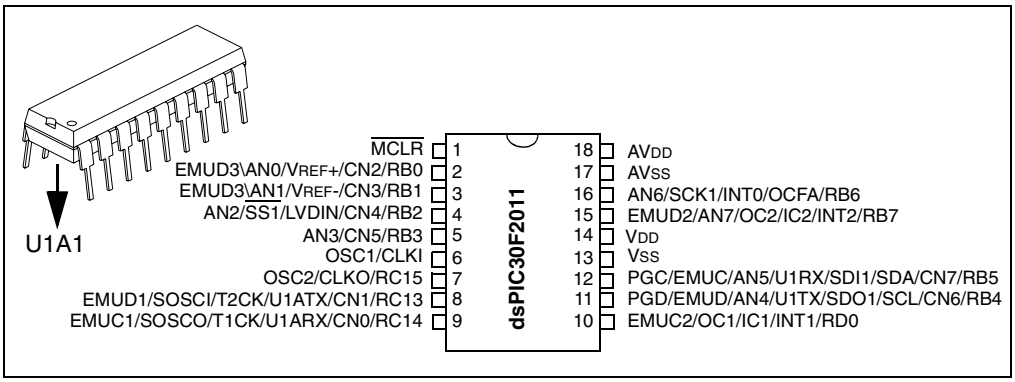
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Chapter 4. Using the dsPIC30F2011

4.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F2011 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F2011 device in an 18-pin PDIP package, as shown in Figure 4-1. This device provides eight 12-bit A/D (100 ksps) channels, a UART, an SPI module, an I^2C module and 12 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 4-1: 18-PIN PDIP dsPIC30F2011



4.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F2011 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit debugging
- Summary

4.3 BOARD SETUP FOR THE dsPIC30F2011 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F2011 device to support the dsPIC30F2011 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F2011 into socket U1C1.

4. Configure the hardware components as shown in Table 4-1.

TABLE 4-1: dsPIC30F2011 CONFIGURATION SETTINGS

Component	Header		Socket U1A1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 4-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 18 ON	11,12	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	No jumper connections
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx *	H4	GP ALL	8	EMUD1/SOSC1/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx *	H4	GP ALL	9	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	Open	—	—
Switch S6	H7	GP 18	10	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	GP D3	2	AN0/V_{REF+}/CN2/RB0
LED D4	H12	GP D4	3	AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	GP 18	16	AN6/SCK1/INT0/OCFA/RB6
LCD - SPI Data*	H1	GP18	11	PGD/EMUD/AN4/U1TX/SDO1/SCL/CN6/RB4

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F2011 (see **Section 4.4 "Device Programming"**).

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4.4 DEVICE PROGRAMMING

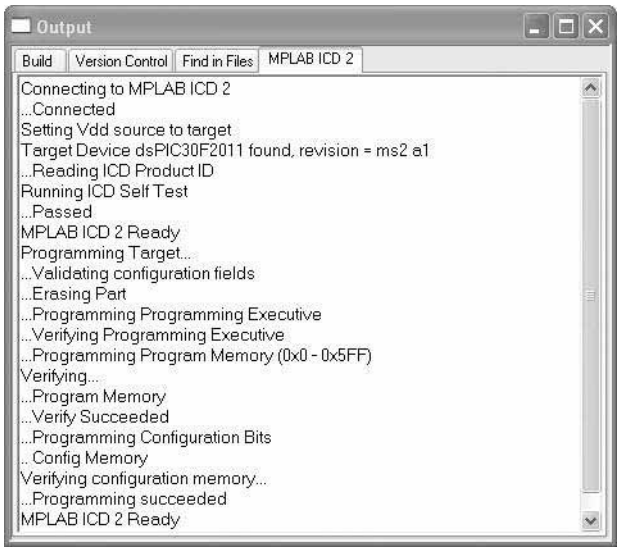
Load the sample application program for the dsPIC30F2011 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F2011 sample project (*File>Open Workspace)* from `path/dsPICDEM 2 Development Kit/Example Software/30F2011/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 18**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F2011.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 4-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 4-2: PROGRAMMING THE dsPIC30F2011 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 4.5 "Observing the Sample Application"**).

4.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F2011` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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4.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F2011 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F2011 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F2011 device that were specified in MPLAB IDE.

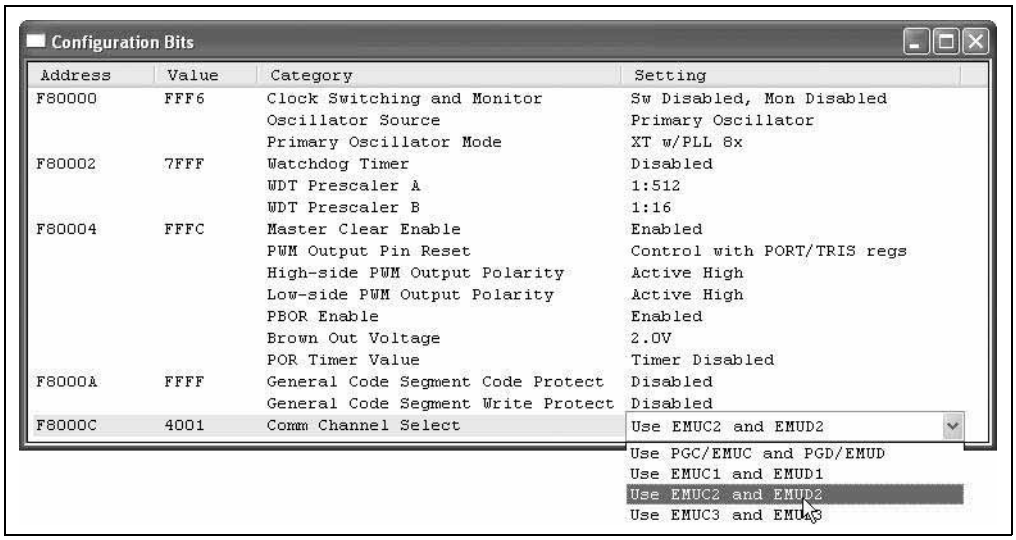
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

4.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 4-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S4 to turn on **EMUC2** and **EMUD2** for **GP 18**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **GP 18** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 4-3: CONFIGURATION BITS WINDOW



4.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F2011` folder contains fully annotated code files that you can examine, compare and copy.

4.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F2011 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F2011 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F2011 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

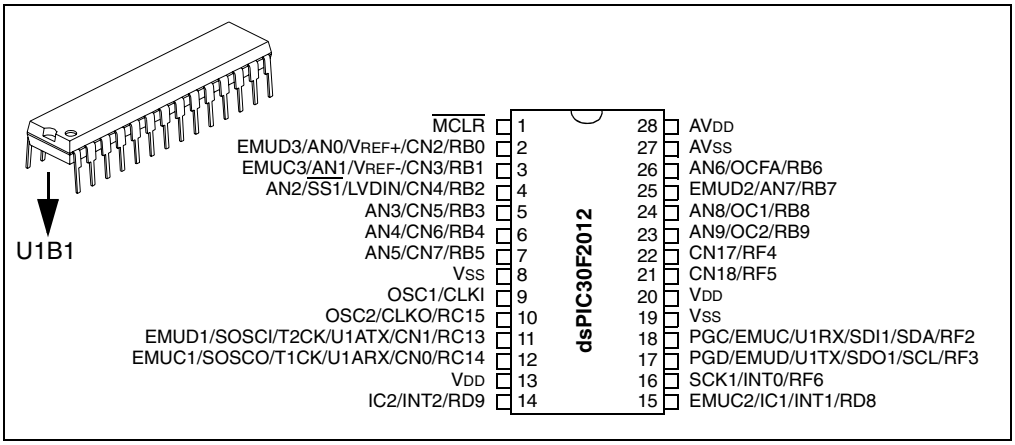
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Chapter 5. Using the dsPIC30F2012

5.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F2012 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F2012 device in an 28-pin, SPDIP package, as shown in Figure 5-1. This device provides ten 12-bit A/D (100 ksps) channels, a UART, an SPI module, an I^2C module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 5-1: 28-PIN SPDIP dsPIC30F2012



5.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F2012 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

5.3 BOARD SETUP FOR THE dsPIC30F2012 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F2012 device to support the dsPIC30F2012 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F2012 into socket U1B1.
4. Configure the hardware components as shown in Table 5-1.

TABLE 5-1: dsPIC30F2012 CONFIGURATION SETTINGS

Component	Header		Socket U1B1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 5-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 28 ON	17,18	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	No jumper connections
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx *	H3	Open	—	—
UART1 Rx *	H3	Open	—	—
Alternate UART1 Tx *	H4	GP ALL	11	EMUD1/SOSC1/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx *	H4	GP ALL	12	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx *	H5	Open	—	—
UART2 Rx *	H5	Open	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	Open	16	—
Switch S6	H7	GP 28	15	EMUC2/IC1/INT1/RD8
LED D3	H12	GP D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	GP D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	GP 40/28	16	SCK1/INT0/RF6
LCD - SPI Data*	H1	GP 40/28	17	PGD/EMUD/UITX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F2012 (see **Section 5.4 "Device Programming"**).

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5.4 DEVICE PROGRAMMING

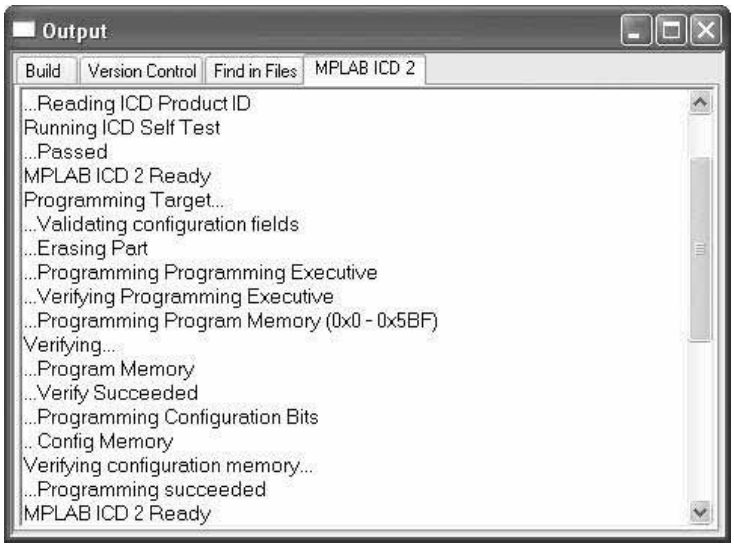
Load the sample application program for the dsPIC30F2012 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F2012 sample project (*File>Open Workspace*) from `path/dsPICDEM 2 Development Kit/Example Software/30F2012/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2 refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 28**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F2012.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 5-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 5-2: PROGRAMMING THE dsPIC30F2012 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 5.5 "Observing the Sample Application"**).

5.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F2012` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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5.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and peripheral modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F2012 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F2012 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F2012 device that were specified in MPLAB IDE.

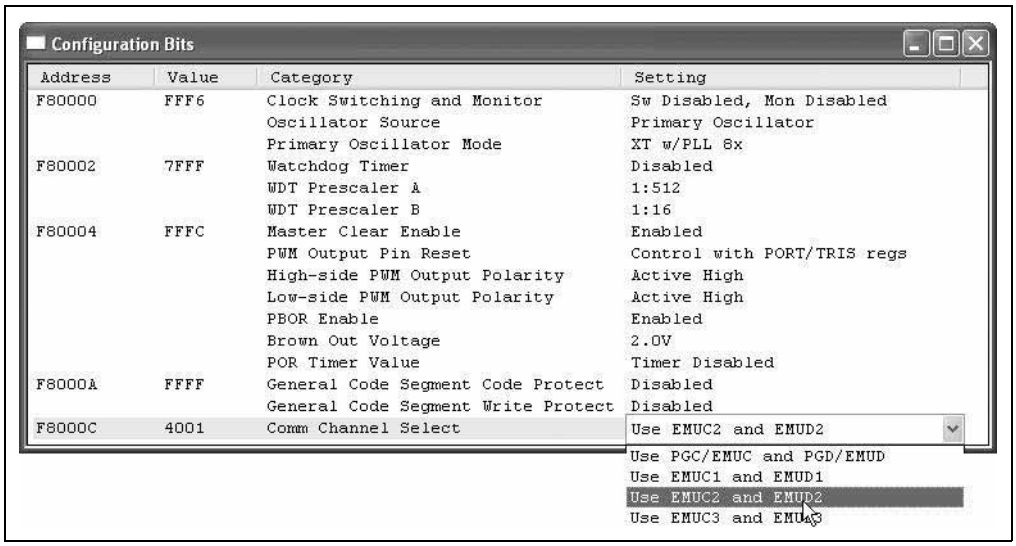
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

5.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 5-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S4 to turn on **EMUC2** and **EMUD2** for **GP 28**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **GP 28** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 5-3: CONFIGURATION BITS WINDOW



5.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F2012` folder contains fully annotated code files that you can examine, compare and copy.

5.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F2012 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F2012 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F2012 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

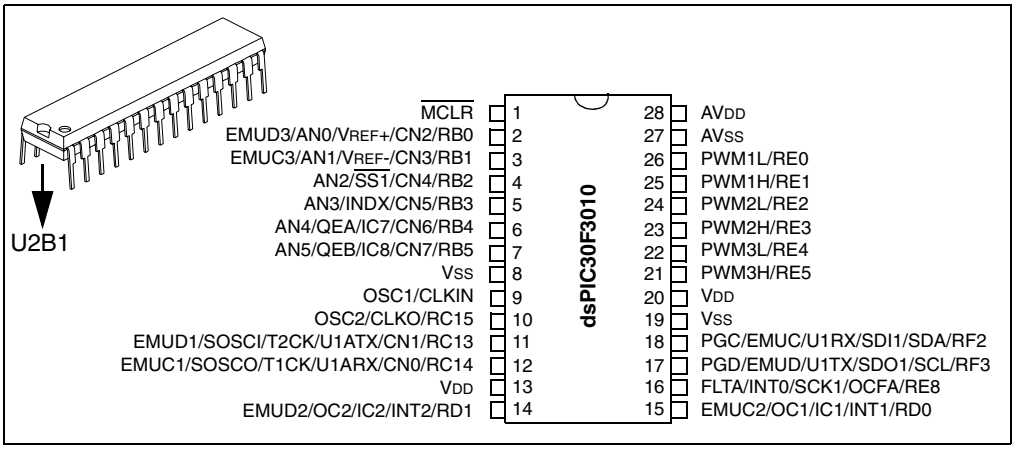
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Chapter 6. Using the dsPIC30F3010

6.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F3010 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F3010 device in a 28-pin SPDIP package, as shown in Figure 6-1. This device provides six 10-bit A/D (500 ksps) channels, a UART, an SPI module, an I^2C™ module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 6-1: 28-PIN SPDIP dsPIC30F3010



6.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F3010 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

6.3 BOARD SETUP FOR THE dsPIC30F3010 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F3010 device to support the dsPIC30F3010 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.

3. Plug the dsPIC30F3010 into socket U2B1.
4. Configure the hardware components as shown in Table 6-1.

TABLE 6-1: dsPIC30F3010 CONFIGURATION SETTINGS

Component	Header		Socket U2B1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 6-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch*	S2	M ALL ON	17,18	PGC and PGD
Selector Switch*	S3	OFF	—	Not used in this configuration
Selector Switch*	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	M ALL	11	EMUD1/SOSC1/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	M ALL	12	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	M ALL	5	AN3/INDX/CN5/RB3
Potentiometer	H13	M ALL	4	AN2/$\overline{SSI}$/CN4/RB2
Switch S5	H6	Open	—	—
Switch S6	H7	M ALL	15	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	M D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	M D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	M 28	16	FLTA/INT0/SCK1/OCFA/RE8
LCD - SPI Data*	H1	M 28	17	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F3010 (see **Section 6.4 "Device Programming"**).

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6.4 DEVICE PROGRAMMING

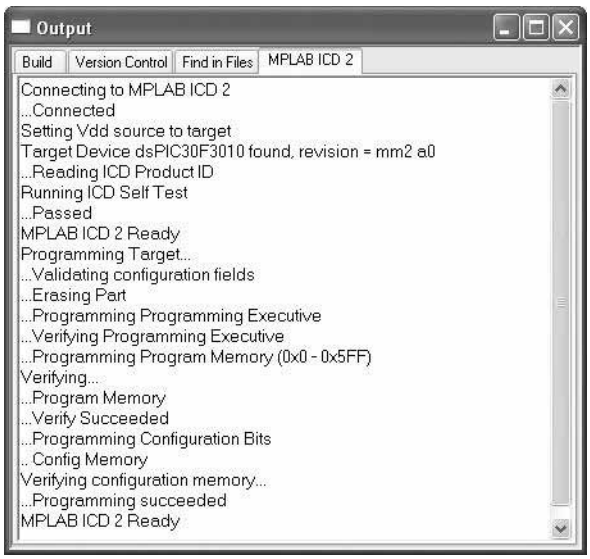
Load the sample application program for the dsPIC30F3010 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F3010 sample project (*File>Open Workspace*) from `path/dsPICDEM 2 Development Kit/Example Software/30F3010/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switch S4 to off. Then set switch S2 to **M ALL**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F3010.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 6-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 6-2: PROGRAMMING THE dsPIC30F3010 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 6.5 "Observing the Sample Application"**).

6.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F3010` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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6.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and peripheral modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F3010 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F3010 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F2010 device that were specified in MPLAB IDE.

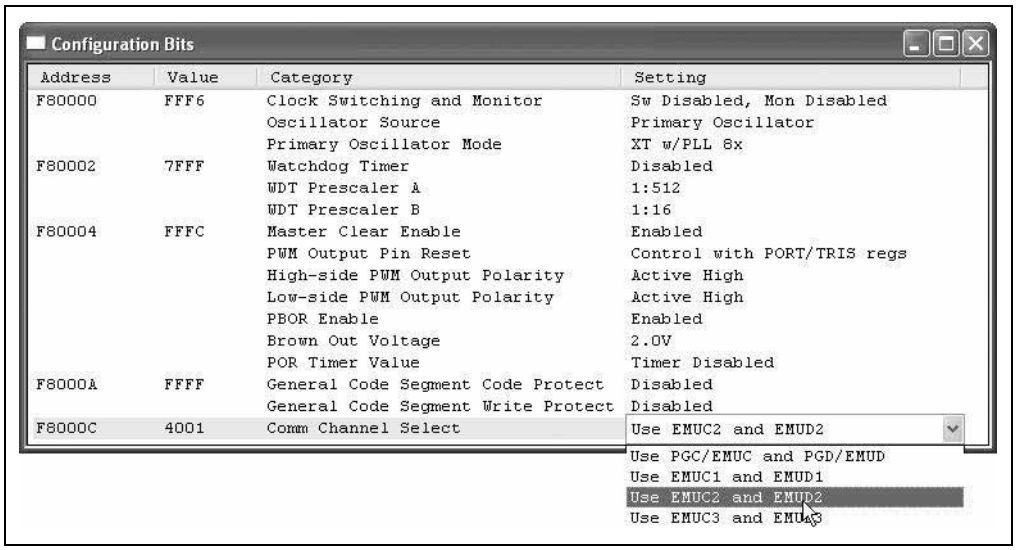
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

6.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 6-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 6-3: CONFIGURATION BITS WINDOW



6.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F3010` folder contains fully annotated code files that you can examine, compare and copy.

6.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F3010 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F3010 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F3010 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

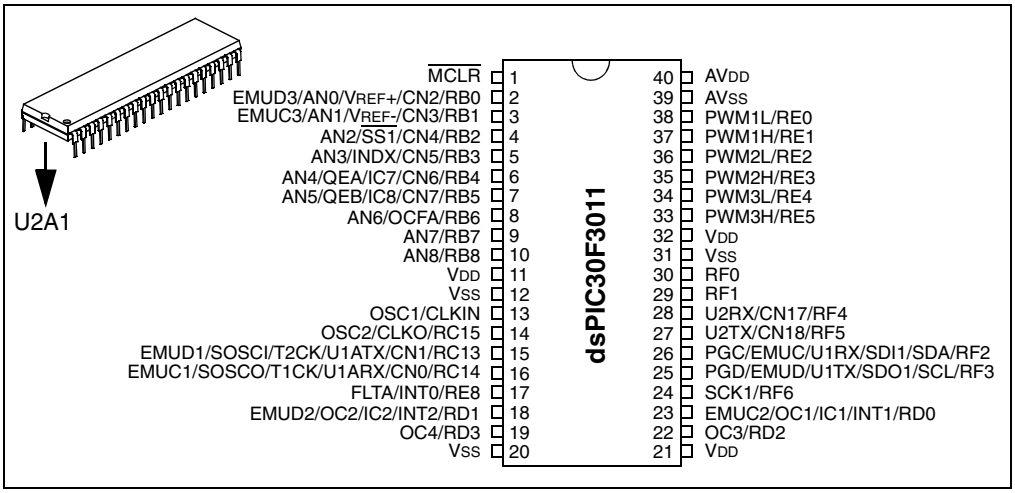
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Chapter 7. Using the dsPIC30F3011

7.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F3011 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F3011 device in a 40-pin PDIP package, as shown in Figure 7-1. This device provides nine 10-bit A/D (500 ksps) channels, two UARTs, an SPI module, an I^2C module and 30 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 7-1: 40-PIN PDIP dsPIC30F3011



7.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F3011 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

7.3 BOARD SETUP FOR THE dsPIC30F3011 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F3011 device to support the dsPIC30F3011 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.

2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F3011 into socket U2A1.
4. Configure the hardware components as shown in Table 7-1.

TABLE 7-1: dsPIC30F3011 CONFIGURATION SETTINGS

Component	Header		Socket U2A1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 7-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	M ALL ON	25,26	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	M ALL	15	EMUD1/SOSCI/T2CL/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	M ALL	16	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	M ALL	5	AN3/INDX/CN5/RB3
Potentiometer	H13	M ALL	4	AN2/$\overline{SS1}$/CN4/RB2
Switch S5	H6	M ALL	17	FLTA/INT0/RE8
Switch S6	H7	M ALL	23	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	M D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	M D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	M 40	24	SCK1/RF6
LCD - SPI Data*	H1	M 40	25	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD.
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F3011 (see **Section 7.4 "Device Programming"**).

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7.4 DEVICE PROGRAMMING

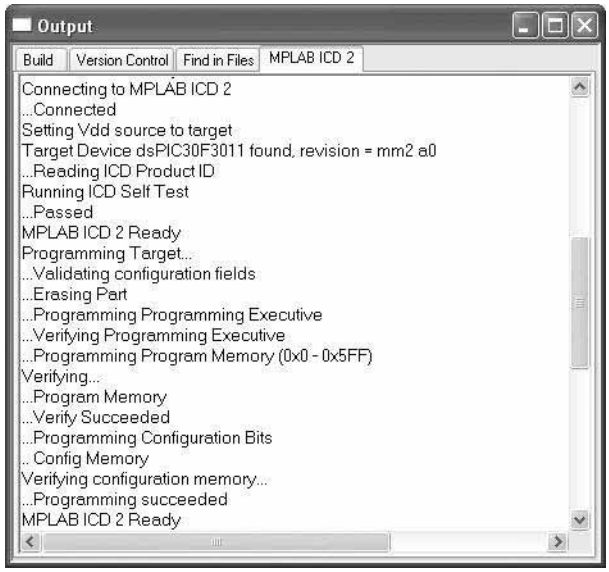
Load the sample application program for the dsPIC30F3011 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F3011 sample project (*File>Open Workspace>* from `path/dsPICDEM 2 Development Kit/Example Software/30F3011/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **M ALL**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F3011.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 7-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 7-2: PROGRAMMING THE dsPIC30F3011 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 7.5 "Observing the Sample Application"**).

7.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F3011` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S5 (**INT0**) and note the affect on D3 and D4.
8. Press S6 (**INT1**) and note the affect on D3 and D4.

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7.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F3011 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F3011 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F3011 device that were specified in MPLAB IDE.

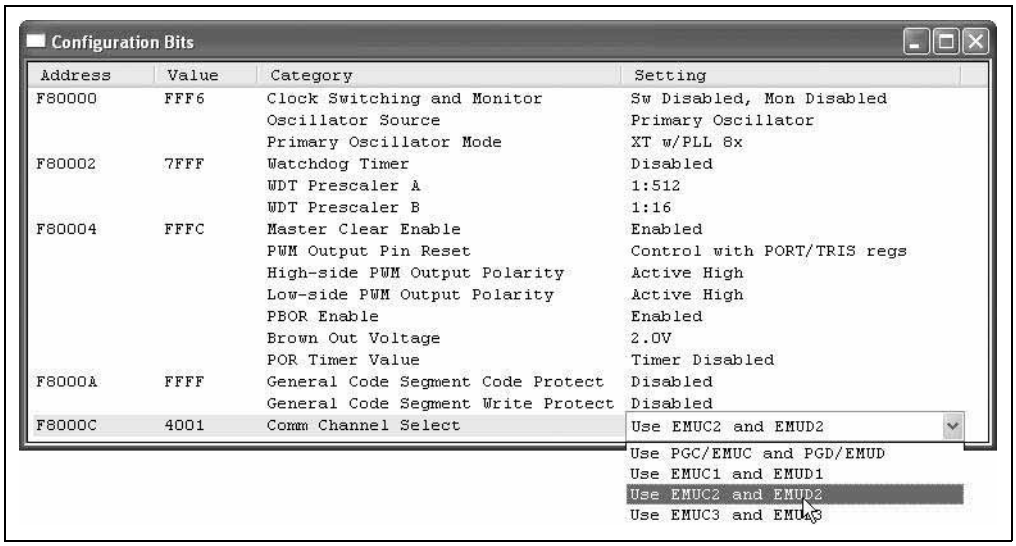
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

7.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 7-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 7-3: CONFIGURATION BITS WINDOW



7.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F3011` folder contains fully annotated code files that you can examine, compare and copy.

7.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F3011 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F3011 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F3011 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

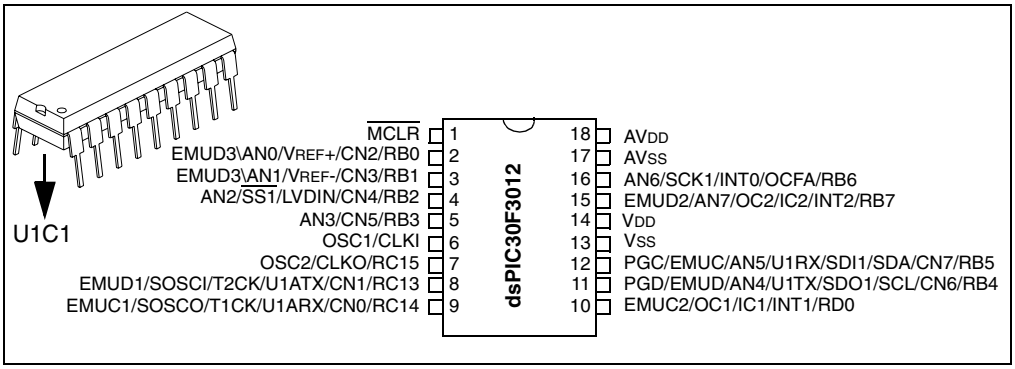
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Chapter 8. Using the dsPIC30F3012

8.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F3012 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F3012 device in an 18-pin PDIP package, as shown in Figure 8-1. This device provides eight 12-bit A/D (100 ksps) channels, a UART, an SPI module, an I^2C module and 12 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 8-1: 18-PIN PDIP dsPIC30F3012



8.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F3012 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

8.3 BOARD SETUP FOR THE dsPIC30F3012 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F3012 device to support the dsPIC30F3012 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F3012 into socket U1C1.
4. Configure the hardware components as shown in Table 8-1.

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TABLE 8-1: dsPIC30F3012 CONFIGURATION SETTINGS

Component	Header		Socket U1C1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 8-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 18 ON	11,12	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	—	—	—
CAN Rx	H2	—	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	GP ALL	8	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	GP ALL	9	UMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	—	—	—
UART2 Rx*	H5	—	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	Open	—	—
Switch S6	H7	GP 18	10	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	GP D3	2	AN0/VREF+/CN2/RB0
LED D4	H12	GP D4	3	AN1/VREF-/CN3/RB1
LCD - SPI™ Clock*	H1	GP 18	16	AN6/SCK1/INT0/OCFA/RB6
LCD - SPI Data*	H1	GP 18	11	PGC/EMUD/AN4/U1TX/SDO1/SCL/CN6/RB4

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD.
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F3012 (see **Section 8.4 "Device Programming"**).

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8.4 DEVICE PROGRAMMING

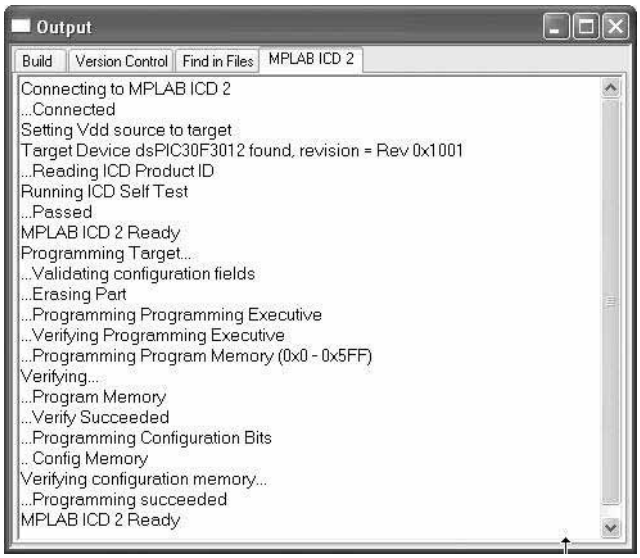
Load the sample application program for the dsPIC30F3012 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F3012 sample project (*File>Open Workspace>[path/dsPIC30F4013 Sample Project])* from `path/dsPICDEM 2 Development Kit/Example Software/30F3012/Demo.mcw`.

Note: For detailed information and procedures on using the MPLAB IDE and ICD 2 refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 18**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F3012.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 8-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 8-2: PROGRAMMING THE dsPIC30F3012 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 8.5 "Observing the Sample Application"**).

8.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F3012` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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8.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and peripheral modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F3012 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F3012 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F3012 device that were specified in MPLAB IDE.

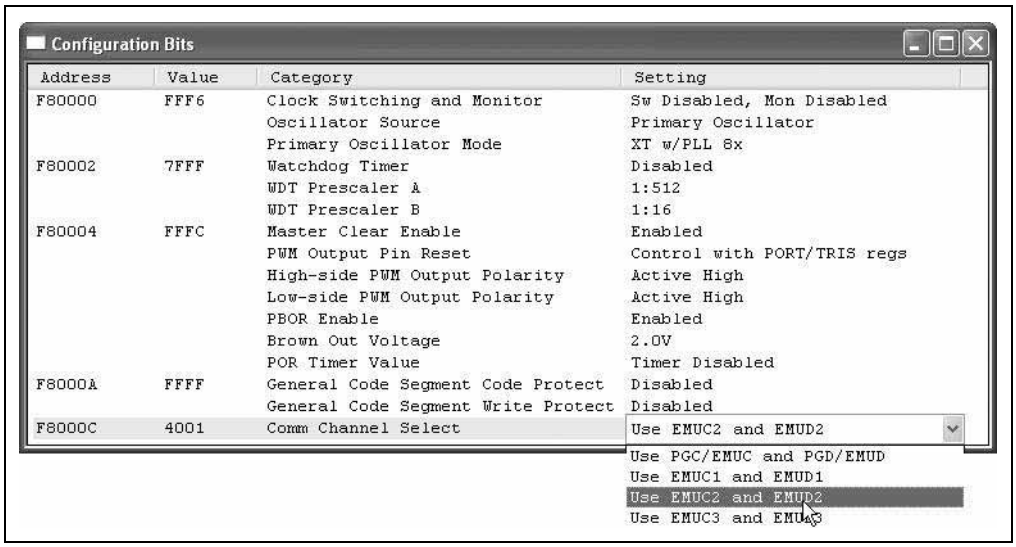
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

8.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 8-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S4 to turn on **EMUC2** and **EMUD2** for GP 18.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **GP 18** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 8-3: CONFIGURATION BITS WINDOW



8.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F3012` folder contains fully annotated code files that you can examine, compare and copy.

8.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F3012 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F3012 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F3012 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

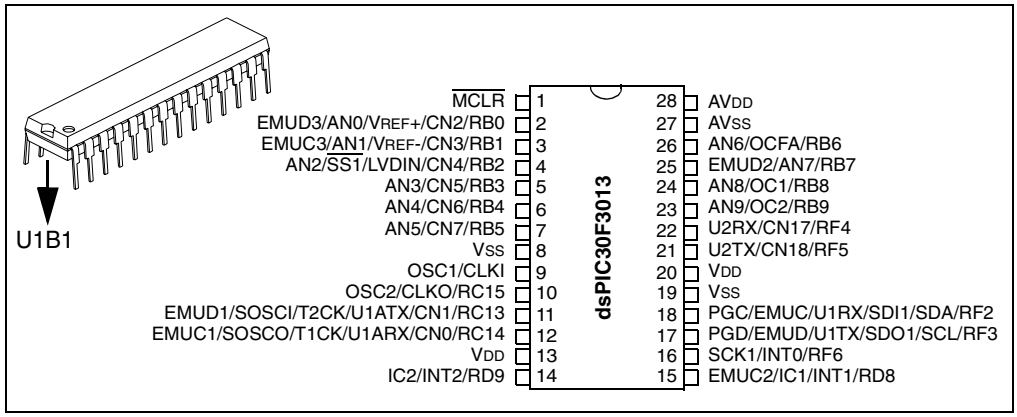
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Chapter 9. Using the dsPIC30F3013

9.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F3013 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F3013 device in a 28-pin SPDIP package, as shown in Figure 9-1. This device provides ten 12-bit A/D (100 ksps) channels, two UARTs, an SPI module, an I^2C module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 9-1: 28-PIN SPDIP dsPIC30F3013



9.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F3013 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

9.3 BOARD SETUP FOR THE dsPIC30F3013 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F3013 device to support the dsPIC30F3013 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F3013 into socket U1B1.

4. Configure the hardware components as shown in Table 9-1.

TABLE 9-1: HARDWARE CONFIGURATION SETTINGS

Component	Header		Socket U1B1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 9-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 28 ON	17,18	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	No jumper connections
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	GP ALL	11	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	GP ALL	12	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	Open	—	—
Switch S6	H7	GP 40/28	15	UMUC2/IC1/INT1/RD8
LED D3	H12	GP D3	2	EMUD3/AN0/VREF+/CN2/RB0
LED D4	H12	GP D4	3	EMUC3/AN1/VREF-/CN3/RB1
LCD - SPI™ Clock*	H1	GP 40/28	16	SCK1/INT0/RF6
LCD - SPI Data*	H1	GP 40/28	17	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD.
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F3013 (see **Section 9.4 "Device Programming"**).

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9.4 DEVICE PROGRAMMING

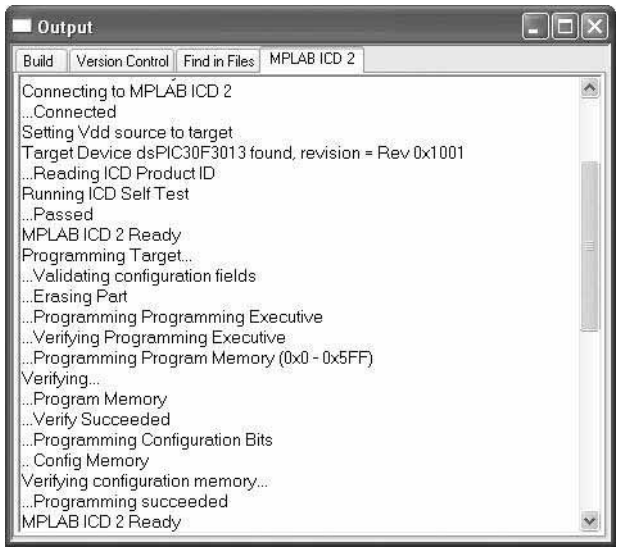
Load the sample application program for the dsPIC30F3013 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F3013 sample project (*File>Open Workspace*) from `path/dsPICDEM 2 Development Kit/Example Software/30F3013/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 28**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F3013.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 9-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 9-2: PROGRAMMING THE dsPIC30F3013 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 9.5 "Observing the Sample Application"**).

9.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F3013` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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9.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F3013 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F3013 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F3013 device that were specified in MPLAB IDE.

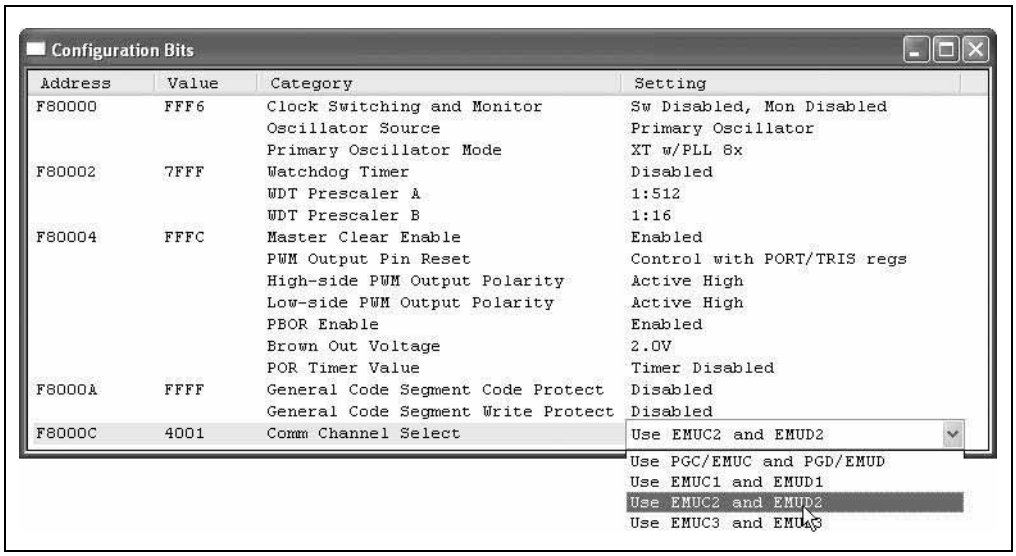
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

9.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 9-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2** for GP 28.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **GP 28** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 9-3: CONFIGURATION BITS WINDOW



9.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F3013` folder contains fully annotated code files that you can examine, compare and copy.

9.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F3013 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F3013 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F3013 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

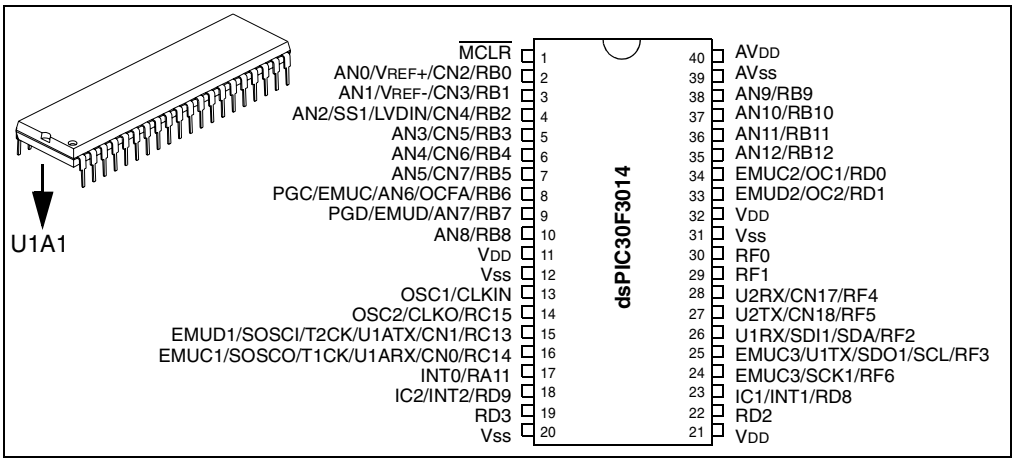
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Chapter 10. Using the dsPIC30F3014

10.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F3014 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F3014 device in a 40-pin PDIP package, as shown in Figure 10-1. This device provides thirteen 12-bit A/D (100 ksps) channels, two UARTs, an SPI module, an I^2C module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 10-1: 18-PIN PDIP dsPIC30F3014



10.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F3014 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

10.3 BOARD SETUP FOR THE dsPIC30F3014 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F3014 device to support the dsPIC30F3014 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.

2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F3014 into socket U1A1.
4. Configure the hardware components as shown in Table 10-1.

TABLE 10-1: HARDWARE CONFIGURATION SETTINGS

Component	Header		Socket U1A1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 10-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 40 ON	8-9	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	GP ALL	15	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	GP ALL	16	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	GP 40/28	17	INT0/RA11
Switch S6	H7	GP 40	23	IC1/INT1/RD8
LED D3	H12	GP D3	2	AN0/V_{REF+}/CN2/RB0
LED D4	H12	GP D4	3	AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	GP 40/28	24	EMUC3/SCK1/RF6
LCD - SPI Data*	H1	GP 40/28	25	EMUC3/U1TX/SDO1/SCL/RF3

* Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F3014 (see **Section 10.4 "Device Programming"**).

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10.4 DEVICE PROGRAMMING

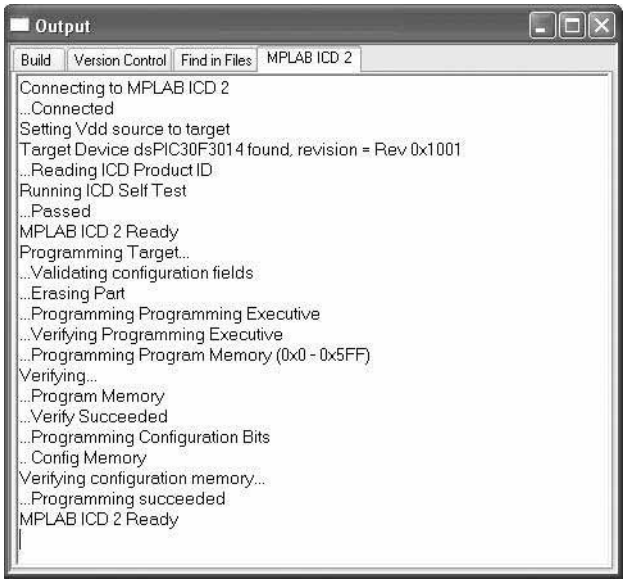
Load the sample application program for the dsPIC30F3014 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F3014 sample project (*File>Open Workspace*) from `path/dsPICDEM 2 Development Kit/Example Software/30F3014/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 40**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F3014.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 10-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 10-2: PROGRAMMING THE dsPIC30F3014 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 10.5 "Observing the Sample Application"**).

10.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F3014` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S5 (**INT0**) and note the affect on D3 and D4.
8. Press S6 (**INT1**) and note the affect on D3 and D4.

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10.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and peripheral modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that the dsPIC30F3014 device be reprogrammed to recognize the MPLAB ICD 2 debugger rather than a programmer.

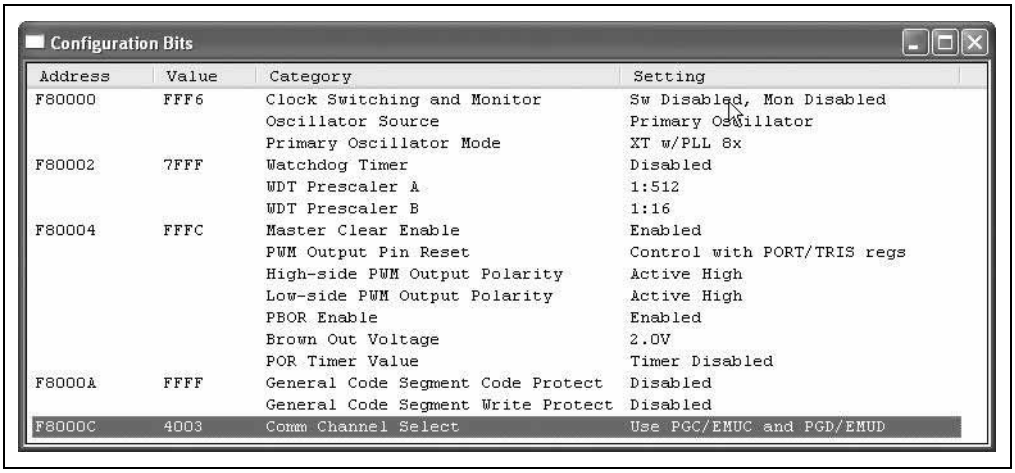
10.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. Reprogram the dsPIC30F device (*Debugger>Program* menu).
3. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

Figure 10-3 shows the configuration bits for this set up.

FIGURE 10-3: CONFIGURATION BITS WINDOW



10.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F3014` folder contains fully annotated code files that you can examine, compare and copy.

10.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F3014 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F3014 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F2010 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

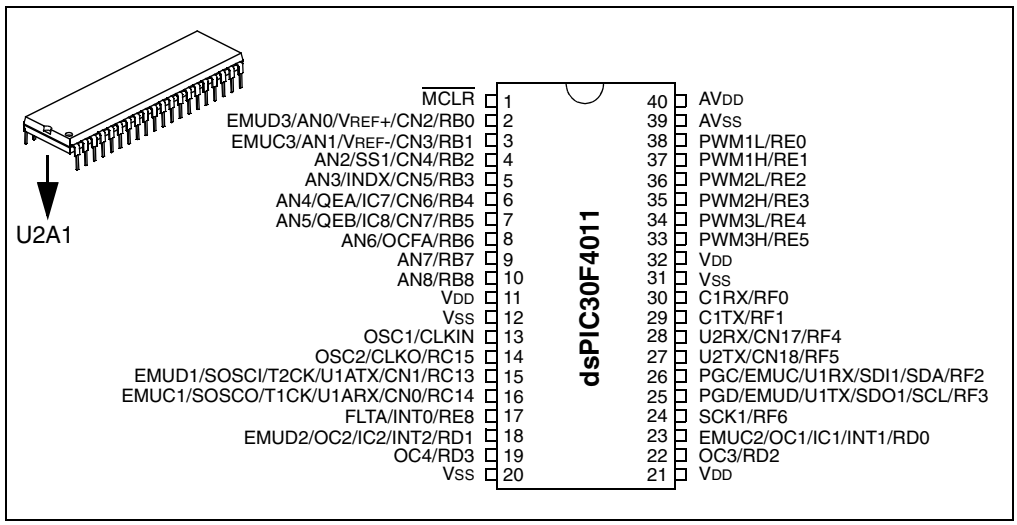
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Chapter 11. Using the dsPIC30F4011

11.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F4011 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F4011 device in a 40-pin PDIP package, as shown in Figure 11-1. This device provides nine 10-bit A/D (500 ksps) channels, two UARTs, an SPI module, an I^2C module, a CAN module and 30 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 11-1: 40-PIN PDIP dsPIC30F4011



11.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F4011 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

11.3 BOARD SETUP FOR THE dsPIC30F4011 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F4011device to support the dsPIC30F4011 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F4011 into socket U2A1.
4. Configure the hardware components as shown in Table 11-1.

TABLE 11-1: dsPIC30F4011 CONFIGURATION SETTINGS

Component	Header		Socket U2A1	
	No.	Setting	Pin	Device Functions (see Figure 11-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	M ALL ON	25,26	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	M ALL	—	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	M ALL	—	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	M ALL	5	AN3/INDX/CN5/RB3
Potentiometer	H13	M ALL	4	AN2/$\overline{SS1}$/CN4/RB2
Switch S5	H6	M ALL	17	FLTA/INT0/SCK1/OCFA/RE8
Switch S6	H7	M ALL	23	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	M D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	M D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	M40	24	FLTA/INT0/SCK1/OCFA/RE8
LCD - SPI Data*	H1	M40	25	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD.
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F4011 (see **Section 11.4 "Device Programming"**).

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11.4 DEVICE PROGRAMMING

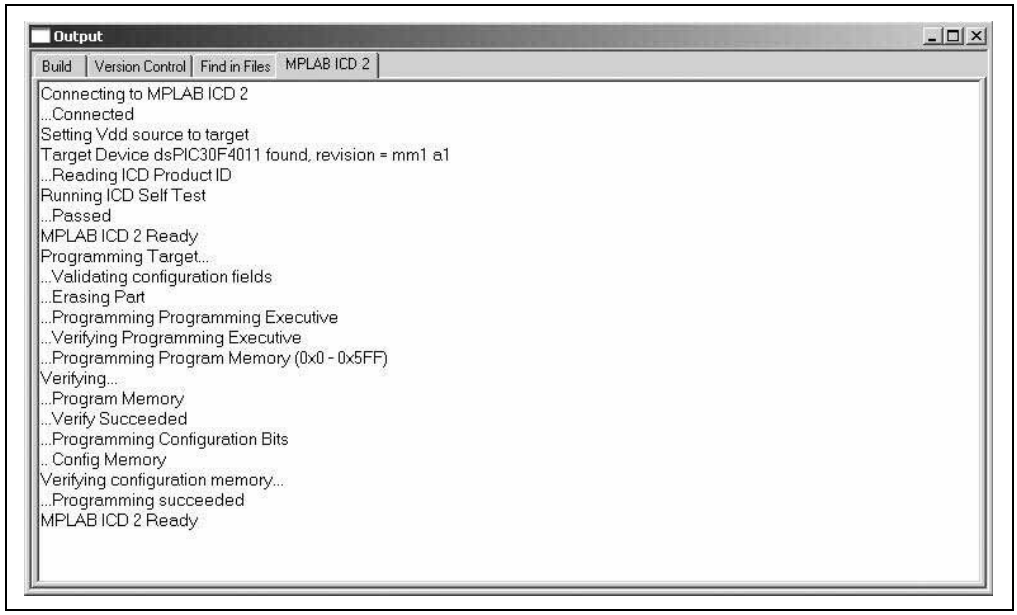
Load the sample application program for the dsPIC30F4011 using this process:

1. Plug the RJ11 cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F4011 sample project (*File>Open Workspace*) from `path\dsPICDEM2 Development Kit\Example Software\30F4011\Demo.mcw`

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2 refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. Program the dsPIC30F4011 (*Programmer>Program*). The Output window (Figure 11-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 11-2: PROGRAMMING THE dsPIC30F4011 DEVICE



6. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 11.5 "Observing the Sample Application"**).

11.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F2010` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S5 (**INT0**) and note the affect on D3 and D4.
8. Press S6 (**INT1**) and note the affect on D3 and D4.

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11.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F4011 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F4011 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F4011 device that were specified in MPLAB IDE.

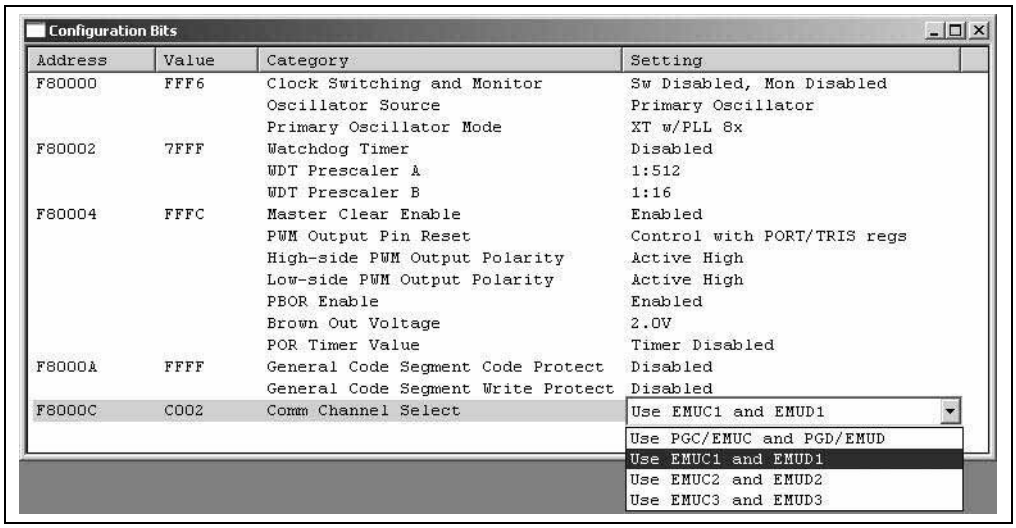
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

11.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 11-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Remove any jumper on header H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 11-3: CONFIGURATION BITS WINDOW



11.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F4011` folder contains fully annotated code files that you can examine, compare and copy.

11.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F4011 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F4011 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F4011 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

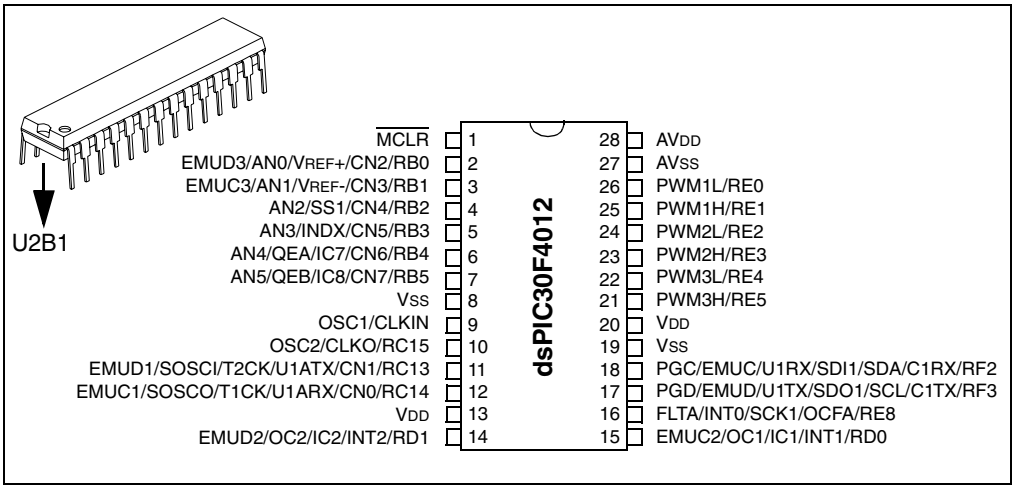
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Chapter 12. Using the dsPIC30F4012

12.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F4012 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F4012 device in a 40-pin PDIP package, as shown in Figure 12-1. This device provides six 10-bit A/D (500 ksps) channels, a UART, an SPI module, an I^2C module, a CAN module and 20 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 12-1: 28-PIN PDIP dsPIC30F4012



12.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F4012 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

12.3 BOARD SETUP FOR THE dsPIC30F4012 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F4012 device to support the dsPIC30F4012 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.

2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F4012 into socket U2B1.
4. Configure the hardware components as shown in Table 12-1.

TABLE 12-1: HARDWARE CONFIGURATION SETTINGS

Component	Header		Socket U2B1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 12-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	M ALL ON	17,18	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	Open	—	—
CAN Rx	H2	Open	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	M ALL	11	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	M ALL	12	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	M ALL	5	AN3/INDX/CN5/RB3
Potentiometer	H13	M ALL	4	AN2/$\overline{SS1}$/CN4/RB2
Switch S5	H6	M ALL	16	FLTA/INT0/SCK1/OCFA/RE8
Switch S6	H7	M ALL	15	EMUC2/OC1/IC1/INT1/RD0
LED D3	H12	M D3	2	EMUD3/AN0/V_{REF+}/CN2/RB0
LED D4	H12	M D4	3	EMUC3/AN1/V_{REF-}/CN3/RB1
LCD - SPI™ Clock*	H1	M28	16	FLTA/INT0/SCK1/OCFA/RE8
LCD - SPI Data*	H1	M28	17	PGD/EMUD/U1TX/SDO1/SCL/RF3

* On this device, multiplexing of various peripherals on the pins does not allow the simultaneous use of:
– Switch S5 and LCD.
– Primary UART1 pins and LCD.
Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F4012 (see **Section 12.4 "Device Programming"**).

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12.4 DEVICE PROGRAMMING

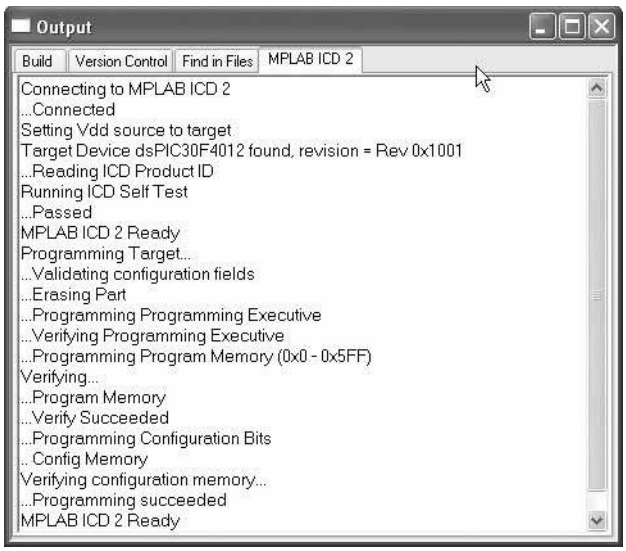
Load the sample application program for the dsPIC30F4012 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F4012 sample project (*File>Open Workspace)* from `path/dsPICDEM 2 Development Kit/Example Software/30F4012/Demo.mcw`

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **M ALL**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F4012.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 12-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 12-2: PROGRAMMING THE dsPIC30F4012 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 12.5 "Observing the Sample Application"**).

12.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F4012` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press S6 (**INT1**) and note the affect on D3 and D4.

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12.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that three changes be made to the sample application setup.

- The dsPIC30F4012 device must be reprogrammed to recognize the MPLAB ICD 2 as a debugger rather than as a programmer.
- MPLAB IDE must be reconfigured to specify the pins on the dsPIC30F4012 device to be used for debugging.
- The dsPICDEM 2 board must be physically reconfigured to ensure that it connects the MPLAB ICD 2 debugger to the pins on the dsPIC30F4012 device that were specified in MPLAB IDE.

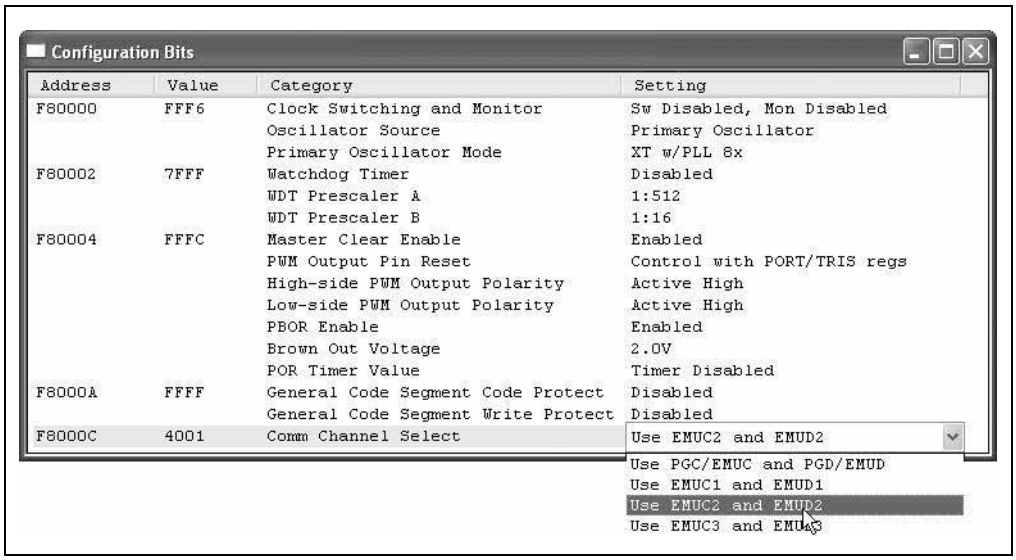
The primary programming and debugging functions (PGC/EMUC, PGD/EMUD) on the dsPIC30F device are multiplexed with other peripheral modules on the device used by the sample application. Thus it is necessary to use an alternate pair of debugging pins (EMUC1/EMUD1, EMUC2/EMUD2 or EMUC3/EMUD3) to examine the baseline code provided in the sample application.

12.6.1 Setting Up MPLAB ICD 2 for Debugging

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. From the *Configure* menu, select *Configuration Bits...* The Configuration Bits window displays the current configuration settings for the device, as shown in Figure 12-3.
3. Change the “Comm Channel Select” parameter to **Use EMUC2 and EMUD2**.
4. On the dsPICDEM 2 board, change the setting on switch S3 to turn on **EMUC2** and **EMUD2**.
5. Remove any jumpers on headers H6 and H7.
6. Reprogram the dsPIC30F device (*Debugger>Program* menu).
7. On the dsPICDEM 2 board, turn off **M ALL** on switch S2.
8. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

FIGURE 12-3: CONFIGURATION BITS WINDOW



12.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F4012` folder contains fully annotated code files that you can examine, compare and copy.

12.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F4012 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F4012 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F4012 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

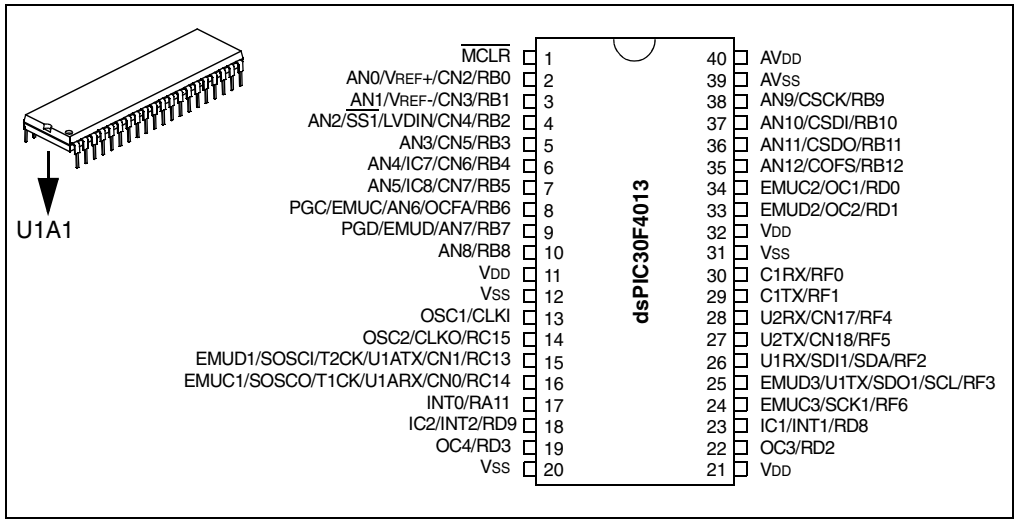
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Chapter 13. Using the dsPIC30F4013

13.1 INTRODUCTION

This chapter assumes you have chosen the dsPIC30F4013 for your application. The dsPICDEM 2 Development Board supports a dsPIC30F4013 device in a 40-pin PDIP package, as shown in Figure 13-1. This device provides thirteen 12-bit A/D (100 ksps) channels, two UARTs, an SPI module, an I^2C module, a CAN module and 30 I/O pins. A sample application program provides a software baseline for building your own embedded solution.

FIGURE 13-1: 40-PIN PDIP dsPIC30F4013



13.2 HIGHLIGHTS

This chapter discusses:

- Board Setup for the dsPIC30F4013 Sample Application
- Device Programming
- Observing the Sample Application
- In-Circuit Debugging
- Summary

13.3 BOARD SETUP FOR THE dsPIC30F4013 SAMPLE APPLICATION

The dsPICDEM 2 Development Board supports dsPIC30F devices that have multiple peripheral devices multiplexed on some pins. Therefore, the jumper set up of various headers depends on which of the dsPIC30F peripherals are used by the application. This section demonstrates how the board is set up for the dsPIC30F4013 device to support the dsPIC30F4013 example software in the dsPICDEM 2 Development Kit CD.

Follow these steps to configure the hardware on the dsPICDEM 2 Development Board for the sample application.

1. Disconnect the power source.
2. Remove any dsPIC30Fxxxx device currently plugged into the dsPICDEM 2 Development Board.
3. Plug the dsPIC30F4013 into socket U1A1.
4. Configure the hardware components as shown in Table 13-1.

TABLE 13-1: HARDWARE CONFIGURATION SETTINGS

Component	Header		Socket U1A1	
	No.	Jumper Setting	Pin	Device Functions (see Figure 13-1)
Jumper JP1	JP1	Jumper	—	5 VDC jumper installed
Jumper JP2	JP2	Jumper	—	5 VDC jumper installed
Selector Switch	S2	GP 40 ON	8-9	PGC and PGD
Selector Switch	S3	OFF	—	Not used in this configuration
Selector Switch	S4	OFF	—	Not used in this configuration
PGM U3	H11	Open	—	—
CAN Tx	H2	GP ALL	—	—
CAN Rx	H2	GP ALL	—	—
UART1 Tx*	H3	Open	—	—
UART1 Rx*	H3	Open	—	—
Alternate UART1 Tx*	H4	GP ALL	15	EMUD1/SOSCI/T2CK/U1ATX/CN1/RC13
Alternate UART1 Rx*	H4	GP ALL	16	EMUC1/SOSCO/T1CK/U1ARX/CN0/RC14
UART2 Tx*	H5	Open	—	—
UART2 Rx*	H5	Open	—	—
Temperature Sensor	H10	GP ALL	5	AN3/CN5/RB3
Potentiometer	H13	GP ALL	4	AN2/$\overline{SS1}$/LVDIN/CN4/RB2
Switch S5	H6	GP 40/28	17	INT0/RA11
Switch S6	H7	GP 40	23	IC1/INT1/RD8
LED D3	H12	GP D3	2	AN0/V_{REF}+/CN2/RB0
LED D4	H12	GP D4	3	AN1/V_{REF}-/CN3/RB1
LCD - SPI™ Clock*	H1	GP 40/28	24	EMUC3/SCK1/RF6
LCD - SPI Data*	H1	GP 40/28	25	EMUD3/U1TX/SDO1/SCL/RF3

* Since only one DB-9 connector is provided for RS-232 communication, you can select either UART1 (primary or alternate pins) or UART2, but not both.

5. Connect the RS-232 cable from the PC to the **UART** connector (J2).
6. Reapply power to the **DC IN** connector (J4). The **PWR ON** LED should illuminate.
7. Load the sample application program for the dsPIC30F4013 (see **Section 13.4 "Device Programming"**).

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13.4 DEVICE PROGRAMMING

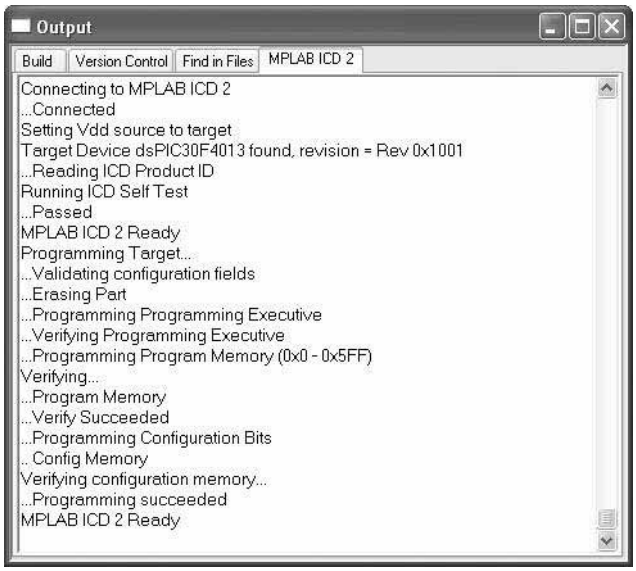
Load the sample application program for the dsPIC30F4013 using this process:

1. Plug the RJ11 (telephone) cable from the MPLAB ICD 2 into the **ICD** header (J1). Make sure the USB cable from the MPLAB ICD 2 is connected to your PC.
2. Start MPLAB IDE.
3. Open the dsPIC30F4013 sample project (*File>Open Workspace*) from `path/dsPICDEM 2 Development Kit/Example Software/30F4013/Demo.mcw`.

> **Note:** For detailed information and procedures on using the MPLAB IDE and ICD 2, refer to **Chapter 2 "Getting Started"**.

4. Build the sample project in MPLAB IDE (*Project>Build All)*.
5. On the dsPICDEM™ 2 board set all positions on switches S3 and S4 to off. Then set switch S2 to **GP 40**. The MPLAB ICD 2 is now connected to the PGC and PGD pins on the dsPIC30F4013.
6. Download the sample application (*Programmer>Program*). The Output window (Figure 13-2) displays the status as the download occurs and indicates when the programming has succeeded.

FIGURE 13-2: PROGRAMMING THE dsPIC30F4013 DEVICE



7. Disconnect the MPLAB ICD 2 cable from the ICD header. The program is now ready to run (see **Section 13.5 "Observing the Sample Application"**).

13.5 OBSERVING THE SAMPLE APPLICATION

1. Press **RESET ALL**. The program begins to run.
2. Set up a HyperTerminal session on the PC to run with these parameters:

Port Setting	Value
Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

   As a shortcut, you can launch the `Hyperterminal_RS232_dsPICDEM2.ht` file in the `dsPICDEM 2 Development Kit/Example Software/30F4013` folder.
3. See information on LCD. Note that the HyperTerminal displays the same information.
4. Adjust temperature and note LCD and HyperTerminal readings.
5. Adjust potentiometer and note LCD and HyperTerminal readings.
6. Observe the rate at which LEDs D3 and D4 blink.
7. Press **INT0** (S5) and note the affect on D3 and D4.
8. Press **INT1** (S6) and note the affect on D3 and D4.

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13.6 IN-CIRCUIT DEBUGGING

The sample application program is intended to illustrate how the processor and I/O modules handle the functionality provided on the dsPICDEM 2 Development Board. The MPLAB ICD 2 In-Circuit Debugger was used to program the sample application into the dsPIC30F device. You can also use the MPLAB ICD 2 In-Circuit Debugger to examine this baseline code to determine specific applicability to your application.

The examination process requires that the dsPIC30F4013 device be reprogrammed to recognize the MPLAB ICD 2 debugger rather than a programmer.

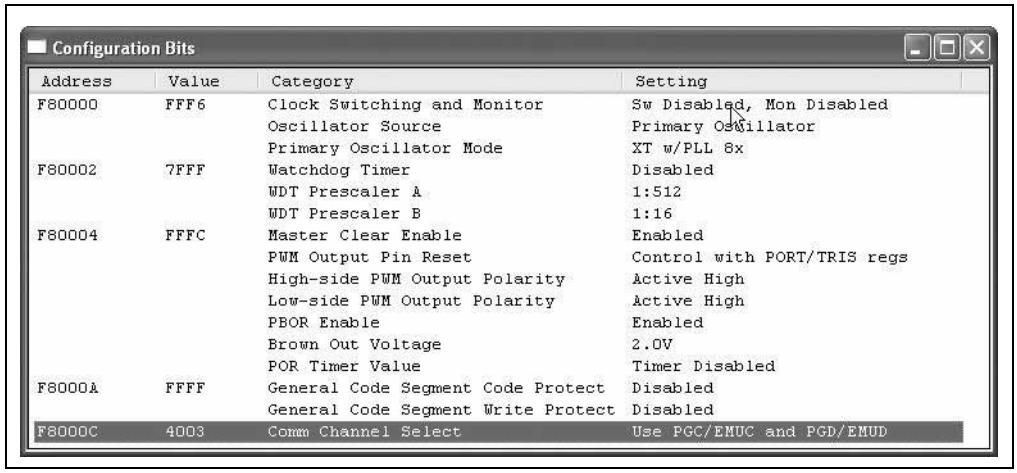
13.6.1 Setting Up MPLAB ICD 2 to Examine Code

To change MPLAB ICD 2 from a programmer to a debugger:

1. From the *Debugger* menu, click *Select Tool>MPLAB ICD 2* to designate the MPLAB ICD 2 as the debug tool in MPLAB IDE.
2. Reprogram the dsPIC30F device (*Debugger>Program* menu).
3. Reset the program and run it. From the *Debugger* menu, select *Reset>Processor Reset*. Then select *Debugger>Run*.

Figure 13-3 shows the configuration bits for this set up.

FIGURE 13-3: CONFIGURATION BITS WINDOW



13.6.2 Examining the Code

After the application has been reprogrammed to use the MPLAB ICD 2 as a debugger, you can use MPLAB IDE to run, halt and step the program. You can set breakpoints to halt the program and examine the actual code at any point. You can also examine the contents of the RAM and registers whenever the processor is halted.

Refer to **Section 2.3 "Getting Started"** for an overview of the sample application. Flowcharts illustrate each of these processes:

- Startup and initialization
- Main loop processing
- A/D conversion processing
- External interrupt processing

The `dsPICDEM 2 Development Kit/Example Software/30F4013` folder contains fully annotated code files that you can examine, compare and copy.

13.7 SUMMARY

This chapter has provided specific instructions for using the dsPICDEM 2 Development Board with a dsPIC30F4013 device. If you have reviewed this process, you should be able to:

- Configure the dsPICDEM 2 Development Board for the dsPIC30F4013 device.
- Set up MPLAB IDE to use the MPLAB ICD 2 In-Circuit Debugger.
- Locate the sample application for the dsPIC30F4013 device.
- Program the chip with the MPLAB ICD 2.
- Examine the sample application and identify applicable code for your embedded solution.

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Chapter 14. Hardware

14.1 HARDWARE OVERVIEW

This chapter describes the dsPICDEM™ 2 Development Board hardware, which features the components shown in Figure 14-1.

FIGURE 14-1: dsPICDEM™ 2 DEVELOPMENT BOARD

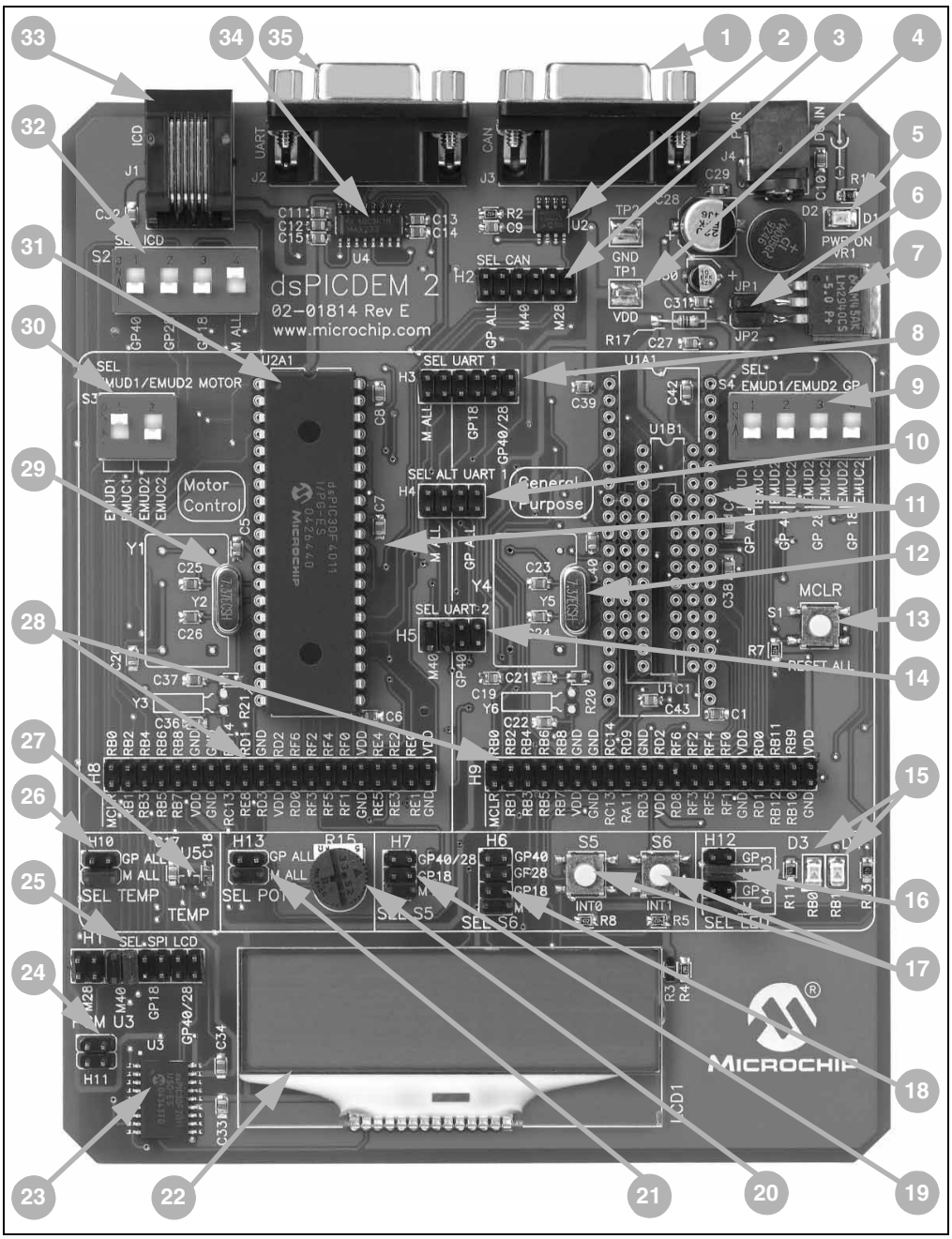


TABLE 14-1: dsPICDEM™ 1.1 DEVELOPMENT BOARD HARDWARE

No.	Hardware Element	No.	Hardware Element
1	CAN Port (see Section 14.1.6)	19	Switch S6 header (see Section 14.1.8)
2	CAN Transceiver (see Section 14.1.6)	20	Analog Potentiometer (see Section 14.1.12)
3	CAN Header (see Section 14.1.6)	21	Analog Potentiometer Header (see Section 14.1.12)
4	External Power Supply Inputs (see Section 14.1.1)	22	LCD Graphic Display (see)
5	Power On LED (see Section 14.1.1)	23	SPI™ Controller for LCD (see Section 14.1.5)
6	Power Supply jumpers (see Section 14.1.1)	24	SPI™ Programming Header (see Section 14.1.5)
7	Voltage Regulator (see Section 14.1.1)	25	LCD Controller Header (see Section 14.1.5)
8	UART 1 Header (see Section 14.1.7)	26	Temperature Sensor Header (see Section 14.1.11)
9	DIP Switch, debug selector for general purpose device sockets (see Section 14.1.4)	27	Temperature Sensor (see Section 14.1.11)
10	Alternate UART 1 header (see Section 14.1.7)	28	External Connection Headers (see Section 14.1.10)
11	Device Headers, concentric sockets for dsPIC30F devices (see Section 14.1.2)	29	Crystal Oscillator, for motor control devices (see Section 14.1.3)
12	Crystal Oscillator, for General Purpose Devices (see Section 14.1.3)	30	DIP Switch, Debug Selector for motor control device sockets (see Section 14.1.4)
13	Reset Pushbutton Switch (see Section 14.1.13)	31	dsPIC30F4011 Device (see Section 14.1.2)
14	UART 2 header (see Section 14.1.7)	32	Programming Selector DIP Switch (see Section 14.1.4)
15	Output LEDs (see Section 14.1.9)	33	ICD Connector (see Section 14.1.4)
16	LED Header (see Section 14.1.9)	34	UART Transceiver (seeSection 14.1.7)
17	Pushbutton Switches S5 and S6 (see Section 14.1.8)	35	RS-232 Serial Port (see Section 14.1.7)
18	Switch S5 header (see Section 14.1.8)		

14.1.1 Power Supply

The dsPICDEM™ 2 Development Board may be powered by a +9V AC/DC wall adapter. A DC voltage regulator is provided so as to regulate the +9V input from the wall adaptor and supply +5V to V_{DD} and AV_{DD} pins on the dsPIC30F device. In order to supply power to the board from a wall adaptor, the jumpers JP1 and JP2 need to be installed and power should be supplied via the J4 jack. The PWR ON LED, D1 will illuminate if the power has been applied to the board appropriately.

The schematics of the power supply circuits are shown in **Figure A-8: "dsPICDEM™ 2 Development Board Schematic (Sheet 7 of 7)"**.

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14.1.2 dsPIC30F Device Sockets

The left side of the dsPICDEM 2 Development Board includes sockets (U2B1 and U2A1) for 28 and 40-pin devices, respectively, in the Motor Control family. The right side of the board includes sockets (U1C1, U1B1 and U1A1) for 18, 28 and 40-pin devices, respectively, in the dsPIC30F General Purpose and Sensor family of devices. These sockets are concentrically arranged headers that allow supported devices in DIP packages to be plugged directly into the development board.

Table 14-2 lists the devices accommodated by each socket.

TABLE 14-2: DEVICE/SOCKET LOCATIONS

Header Label	dsPIC30F Devices Accommodated
General Purpose and Sensor Family	
U1A1	dsPIC30F3014, 4013
U1B1	dsPIC30F2012, 3013
U1C1	dsPIC30F2011, 3012
Motor Control Family	
U2A1	dsPIC30F3011, 4011
U2B1	dsPIC30F2010, 3010,4012

The schematic for the general purpose and sensor device sockets is shown in **Figure A-2: "dsPICDEM™ 2 Development Board Schematic (Sheet 1 of 7)"**. The schematic for the motor control device socket is shown in **Figure A-3: "dsPICDEM™ 2 Development Board Schematic (Sheet 2 of 7)"**.

14.1.3 Oscillators

Device clocking is provided by on-board crystal oscillators. A 7.3728 MHz crystal oscillator(Y2) provides a system clock for the Motor Control family of devices. Another 7.3728 MHz crystal oscillator (Y5) provides a system clock for the General Purpose and Sensor family of devices.

Through-holes and pads are provided for a user-furnished watch-type crystal and two capacitors (Y3 and Y6) connected across pins SOSC1 and SOSC2 on the dsPIC30F device. Such crystals may be used for real-time clock operation.

External clock connections are available for motor control devices at Y1 and general purpose and sensor devices at Y4.

The schematics showing resistor and capacitor values for all oscillator options are provided in **Figure A-6: "dsPICDEM™ 2 Development Board Schematic (Sheet 5 of 7)"**

14.1.4 Programming/Debugging

An RJ11 header has been provided on the dsPICDEM 2 Development Board in order to interface with device programmers and debuggers like MPLAB ICD 2 and PRO MATE™ 3. DIP switches in S2, S3 and S4 are provided to connect the PRO MATE 3 or MPLAB ICD 2 In-Circuit Debugger to the programming and debugging pins on the installed dsPIC30F device.

Switches within S2 should always be used to designate the device being programmed by MPLAB ICD2. These switches connect the clock and data lines from ICD 2 to the Programming and Default Debugging channels (PGC/EMUC and PGD/EMUD) on the dsPIC30F device. In some instances, users may find that their application uses certain peripherals multiplexed on either the PGC/EMUC or the PGD/EMUD pins. In such cases, they may avail of alternate debugging channels, EMUC1 & EMUD1 or EMUC2 & EMUD2 or EMUC3 & EMUD3. The dsPICDEM 2 Development Board supports the

EMUC1 & EMUD1 pin-pair, as well as the EMUC2 & EMUD2 pin-pair, for alternate debugging channels. This functionality has been provided by the DIP switches in S3 (for Motor Control family) and S4 (for Sensor and General-Purpose families).

Table 14-3 shows the various alternate debugging channel options available to the user. These switches are represented in the schematics in **Figure A-5: "dsPICDEM™ 2 Development Board Schematic (Sheet 4 of 7)"**.

TABLE 14-3: PROGRAMMING/DEBUGGING PIN SELECTION

Switch	Position	Label	Function(1)
S2	1	GP 40	Connects ICD to programming pins on the 40-pin dsPIC30F device in the general purpose socket (U1A1)
	2	GP 28	Connects ICD to programming pins on the 28-pin dsPIC30F device in the general purpose socket (U1B1)
	3	GP 18	Connects ICD to programming pins on the 18-pin dsPIC30F device in the general purpose socket (U1C1)
	4	M ALL	Connects ICD to programming pins on the dsPIC30F device in either motor control socket
S3	1	EMUD1 EMUC1	Connects ICD to debug pins EMUD1 and UMUC1 on the dsPIC30F device in either motor control socket
	2	EMUD2 EMUC2	Connects ICD to debug pins EMUD2 and UMUC2 on the dsPIC30F device in either motor control socket
S4	1	GP ALL EMUD1 GP ALL EMUC1	Connects ICD to debug pins EMUD1 and EMUC1 on the dsPIC30F device in any general purpose socket
	2	GP 40 EMUD2 GP 40 EMUC2	Connects ICD to debug pins EMUD2 and EMUC2 on the 40-pin dsPIC30F device in general purpose socket U1A1
	3	GP 28 EMUD2 GP 28 EMUC2	Connects ICD to debug pins EMUD2 and EMUC2 on the 28-pin dsPIC30F device in general purpose socket U1B1
	4	GP 18 EMUD2 GP 18 EMUC2	Connects ICD to debug pins EMUD2 and EMUC2 on the 18-pin dsPIC30F device in general purpose socket U1C1

Note 1: Indicates the path established when that switch is in the ON position. All other switches must be in the OFF position.

14.1.5 LCD

The LCD supports 2 rows and 16 columns of ASCII-text characters and is controlled by a dsPIC30F2011 device. The dsPIC30F devices may write ASCII character data and cursor position information via an SPI interface to the LCD controller. Header H1 connects the SPI pins (SCK1 and SDO1) on the dsPIC30F device to the LCD controller. A pair of jumpers should be installed on H1 to connect any one of the following to the LCD:

- 28-pin device on U2B1
- 40-pin device on U2A1
- 18-pin device on U1C1
- 28/40-pin device on U1A1 or U1B1

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The LCD Controller accesses the LCD via a 4-pin parallel port and a 3-pin control line. For a detailed description of the communication protocol, see **Appendix B. "Writing to LCD"**. The schematics for the LCD connections on the board are provided in **Figure A-4: "dsPICDEM™ 2 Development Board Schematic (Sheet 3 of 7)"**.

14.1.6 CAN Port

An MCP2551 Controller Area Network transceiver is provided on the dsPICDEM 2 Development Board. The CAN RXD and TXD lines of the MCP2551 are connected to the C1RX and C1TX pins on the dsPIC30F device by installing a jumper on header H2. CAN-bus signals (CANH and CANL) are available on DB9 connector J3. Three devices supported by the dsPICDEM 2 board feature a CAN module. These are dsPIC30F4011, dsPIC30F4012 and dsPIC30F4013. The header H2 should have jumpers installed on the M40 option for using the CAN module on the 30F4011 device, jumpers installed on the M28 option for the 30F4012 device and jumpers installed on the GP ALL option for the 30F4013 device. The schematic of the CAN port is shown in **Figure A-4: "dsPICDEM™ 2 Development Board Schematic (Sheet 3 of 7)"**.

14.1.7 RS-232 Port

A MAX232 transceiver is provided on the dsPICDEM 2 development board for enabling RS-232 communication. The transceiver interfaces a DB9 connector J2 and the UART Transmit and Receive pins on the active dsPIC30F via headers H3, H4 or H5. Header H3 enables a connection between the transceiver and the primary UART1 pins, U1TX and U1RX, on the active dsPIC30F device. Header H4 enables a connection between the transceiver and the alternate UART1 pins, U1ATX and U1ARX, on the active dsPIC30F device. H5 enables a connection between the transceiver and the UART2 pins, U2TX and U2RX, on the active dsPIC30F device. At any time, only one of the three headers, H3, H4 and H5, may be populated with jumpers.

The schematic of the RS-232 circuits is shown in **Figure A-5: "dsPICDEM™ 2 Development Board Schematic (Sheet 4 of 7)"**. Table 14-4 lists the connections set up by each header pin position

TABLE 14-4: UART HEADER SETTINGS

Header(1)	Pin Position(2)	Function(3)
H3	M ALL	Connects the UART transceiver to the UART 1 module in the dsPIC30F device in either motor control socket.
	GP 18	Connects the UART transceiver to the UART 1 module in the 18-pin dsPIC30F device in general purpose socket U1C1.
	GP 40/28	Connects the UART transceiver to the UART 1 module in the 28 or 40-pin dsPIC30F device in general purpose socket U1A1 or U1B1.
H4	M ALL	Connects the UART transceiver to the alternate pins for the UART 1 module in the dsPIC30F device in either motor control socket.
	GP ALL	Connects the UART transceiver to the alternate pins for the UART 1 module in the dsPIC30F device in any general purpose socket.
H5	M 40	Connects the UART transceiver to the UART 2 module of the 40-pin dsPIC30F motor control device in socket U2A1.
	GP 40	Connects the UART transceiver to the UART 2 module of the 40-pin dsPIC30F general purpose device in socket U1A1.

Note 1: Headers are mutually exclusive. Only one header can be used at a time.

2: Pin position is the pair of pins with the indicated label.

3: Indicates the path established when jumper is installed in that position.

14.1.8 External Interrupt Switches

Switches S5 and S6 can be connected to the external interrupt pins, INT0 and INT1, respectively on all supported dsPIC30F devices. Switches S5 and S6 are connected to the dsPIC DSC device through headers H6 and H7, respectively. The signal lines are normally pulled up to +5V DC through 4.7 kOhm resistors. Pressing the switch will short the line to ground.

Table 14-4 lists the connections set up by the jumper positions on headers H6 and H7.

TABLE 14-5: EXTERNAL INTERRUPT HEADER SETTINGS

Header(1)	Pin Position	Function(2)
H6	GP 40	Connects switch S5 to Port pin RA11of the 40-pin dsPIC30F device in general purpose socket U1A1 to signify external interrupt INT0.
	GP 28	Connects switch S5 to Port pin RF6 of the 28-pin dsPIC30F device in general purpose socket U1B1 to signify external interrupt INT0.
	GP 18	Connects switch S5 to Port pin RB6 of the 18-pin dsPIC30F device in general purpose socket U1C1 to signify external interrupt INT0.
	M ALL	Connects switch S5 to Port pin RE8 of the dsPIC30F device in either motor control socket to signify external interrupt INT0.
H7	GP 40/28	Connects switch S6 to Port pin RD8 of the 28 or 40-pin dsPIC30F device in general purpose socket U1B1 or U1A1 to signify external interrupt INT1.
	GP 18	Connects switch S6 to Port pin RD0 of the 18-pin dsPIC30F device in general purpose socket U1C1 to signify external interrupt INT1.
	M ALL	Connects switch S6 to Port pin RD0 of the dsPIC30F device in either motor control socket to signify external interrupt INT0.

Note 1: Header H6 selects switch S5 (INT0). Header H7 selects switch S6 (INT1).

2: Indicates the path established when jumper is installed in that position.

The schematic of the pushbutton switches and selection headers that comprise the simulated external interrupt circuits is shown in **Figure A-7: "dsPICDEM™ 2 Development Board Schematic (Sheet 6 of 7)"**.

14.1.9 LED Indicators

Two LEDs D3 and D4 are provided on the dsPICDEM 2 Development Board. These may be useful in monitoring the status of your application. The LEDs, D3 and D4, are connected to port pins, RB0 and RB1, on the dsPIC30F devices, respectively. These LEDs will illuminate if a high signal is fed to them, but will turn off on a low signal. Header H12 is used to connect the LEDs, D3 and D4, into the circuit. If the jumper is installed to connect the GP pins, the LED is connected to the General Purpose and Sensor family device sockets (U1A1, U1B1 and U1C1). If the jumper on H12 is installed to connect the M ALL pins, the LED is connected to the motor control device sockets (U2A1 and U2B1).

The schematic of the LED indicator circuits is shown in **Figure A-7: "dsPICDEM™ 2 Development Board Schematic (Sheet 6 of 7)"**.

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14.1.10 External Connection Headers

Two 40-pin headers, H8 and H9, allow the user to connect hardware external to the dsPICDEM 2 Development Board into the circuit.

The schematic of the external connection headers is shown in **Figure A-6: "dsPICDEM™ 2 Development Board Schematic (Sheet 5 of 7)"**.

14.1.11 Analog Temperature Sensor

Temperature sensor, U5, is a -40°C to +125°C linear output TC1047A connected to analog channel AN3 of the dsPIC30F device through header H10. The header H10 allows the temperature sensor output to be fed to dsPIC30F devices in the Motor Control family (M ALL position) or the General Purpose and Sensor family (GP ALL position). The output of the temperature sensor is fed directly to the dsPIC DSC device. The output voltage range for the TC1047A is typically 750 mV at +25°C. The TC1047A exhibits a typical 10 mV/C voltage slope.

The schematic of the temperature sensor is shown in **Figure A-6: "dsPICDEM™ 2 Development Board Schematic (Sheet 5 of 7)"**

14.1.12 Analog Potentiometer

Potentiometer, R15, is connected to analog channel, AN2, of the dsPIC30F devices via header H13. The voltage output range for the potentiometer is between 0VDC and V_{DD} (+5VDC). The voltage source is provided by VR1 or TP1. The header, H13, allows the potentiometer output to be fed to dsPIC30F devices in the Motor Control family (M ALL position) or the General Purpose and Sensor family (GP ALL position)

The schematic of the analog potentiometer circuit is shown in **Figure A-6: "dsPICDEM™ 2 Development Board Schematic (Sheet 5 of 7)"**.

14.1.13 Reset Switch

The Reset switch (S1) is connected to the $\overline{MCLR}$ pin on all device sockets, as well as the LCD and LCD controller (dsPIC30F2011). The Reset switch circuit is shown in **Figure A-7: "dsPICDEM™ 2 Development Board Schematic (Sheet 6 of 7)"**.

NOTES:

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Appendix A. Hardware Drawings and Schematics

A.1 INTRODUCTION

This Appendix provides a layout drawing of the printed circuit board followed by schematics for the dsPICDEM™ 2 Development Board.

FIGURE A-1: dsPICDEM™ 2 DEVELOPMENT BOARD LAYOUT

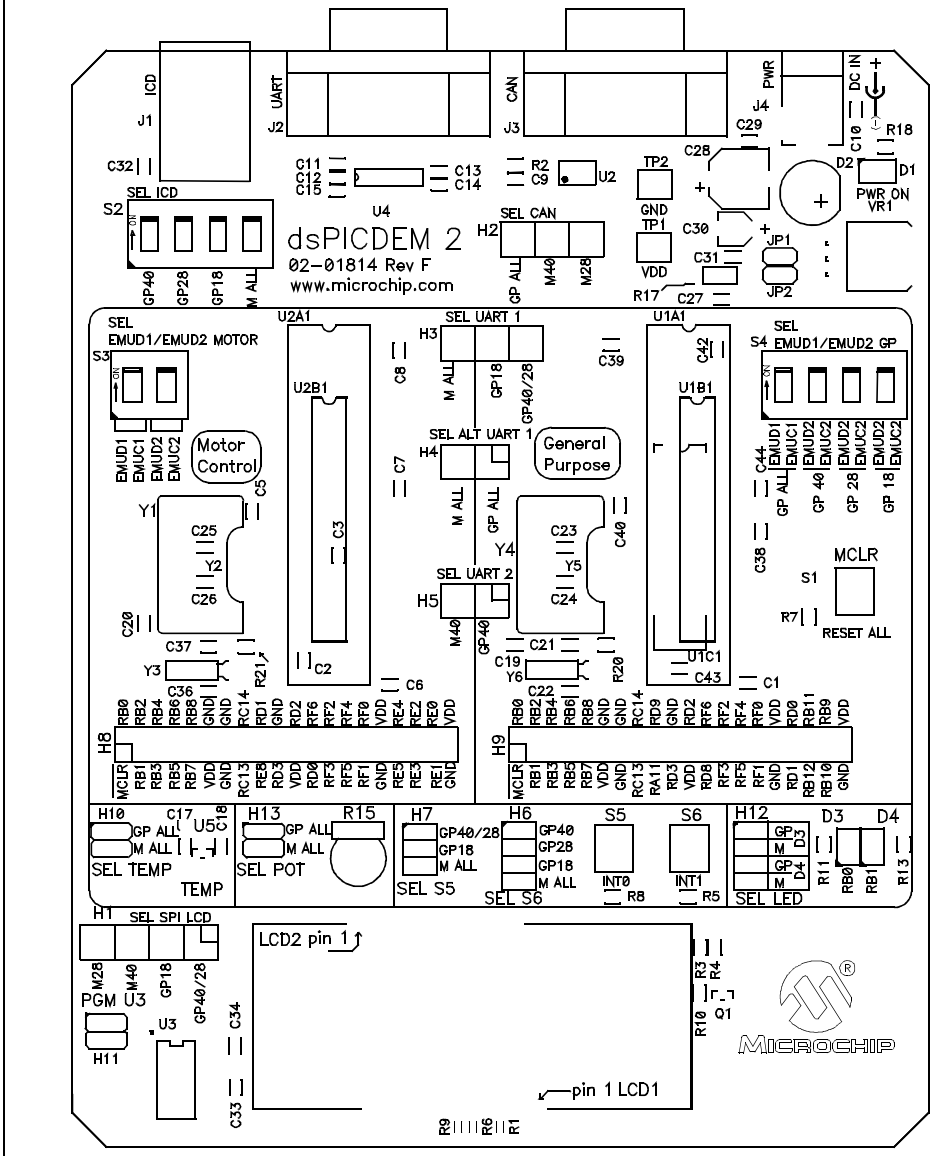
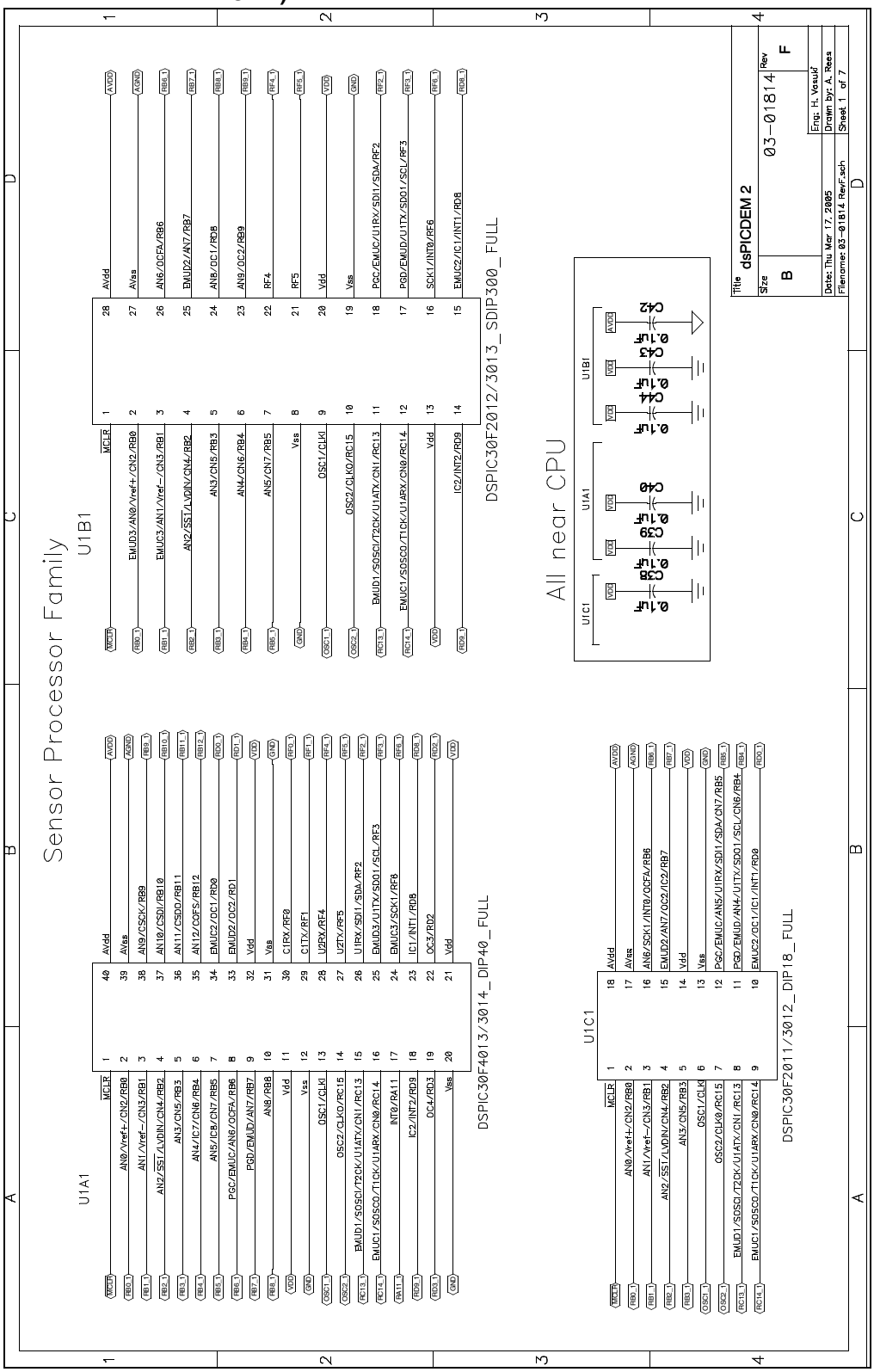


FIGURE A-2: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 1 OF 7)



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FIGURE A-3: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 2 OF 7)

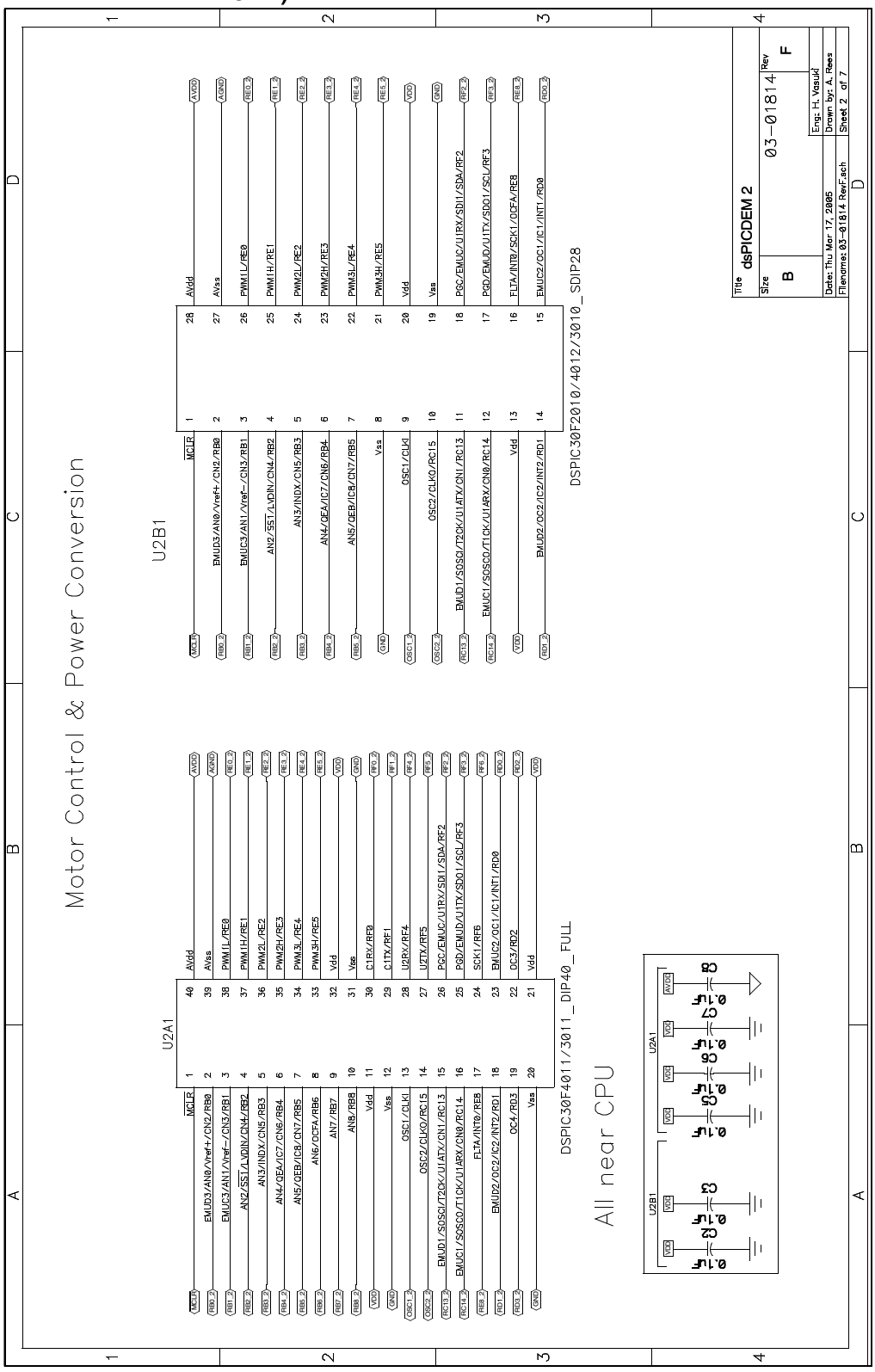
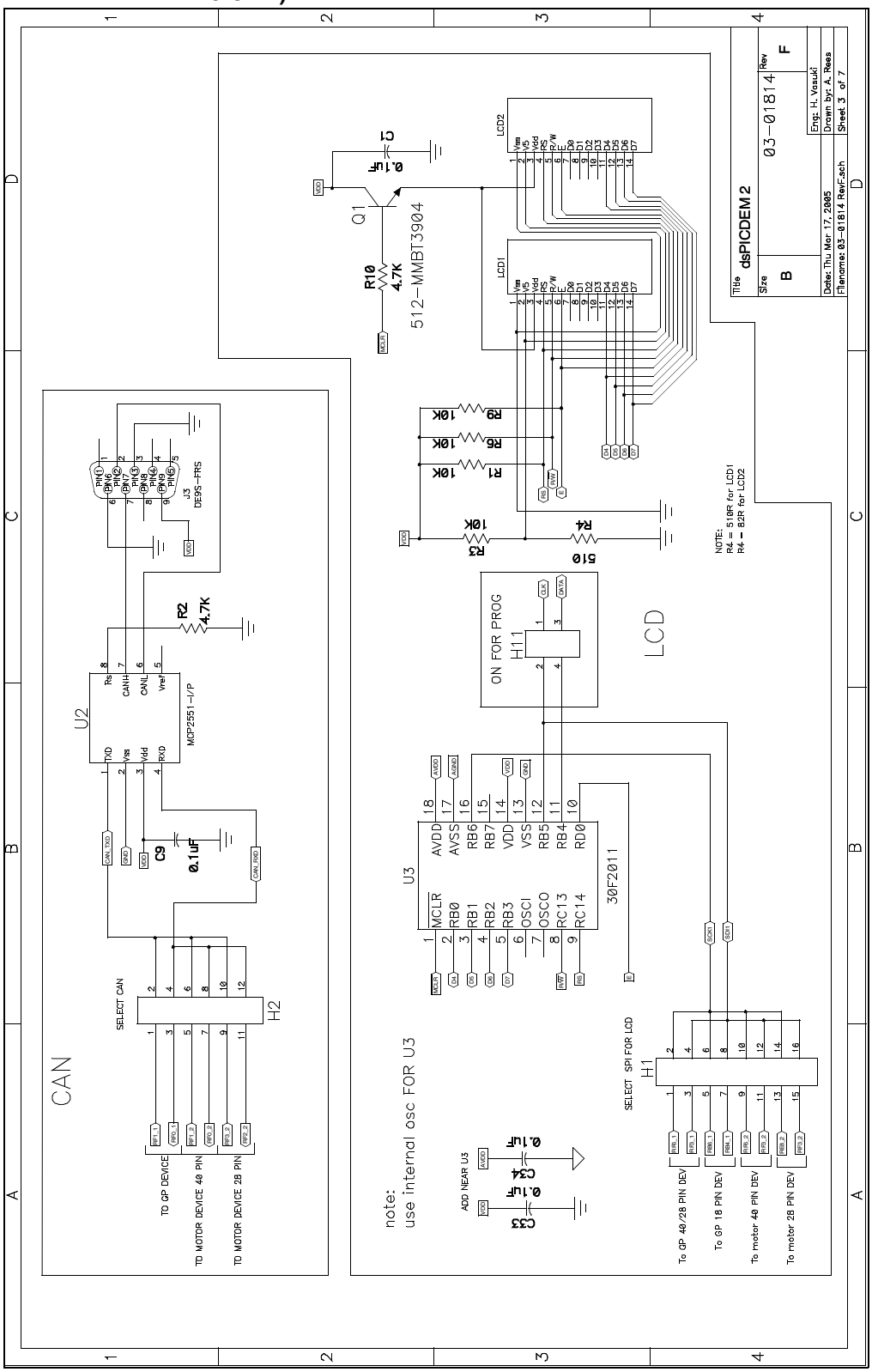


FIGURE A-4: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 3 OF 7)



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FIGURE A-5: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 4 OF 7)

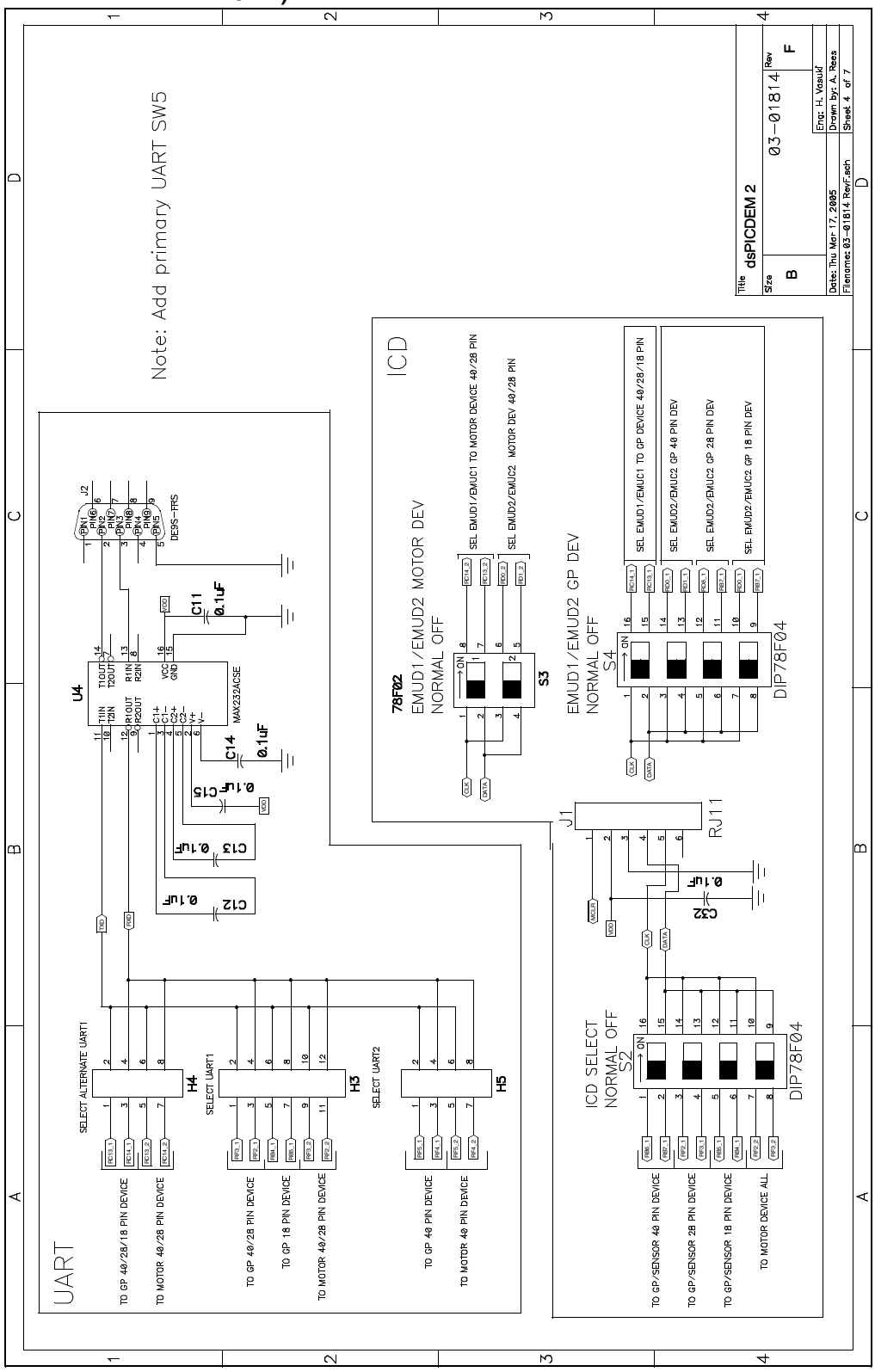
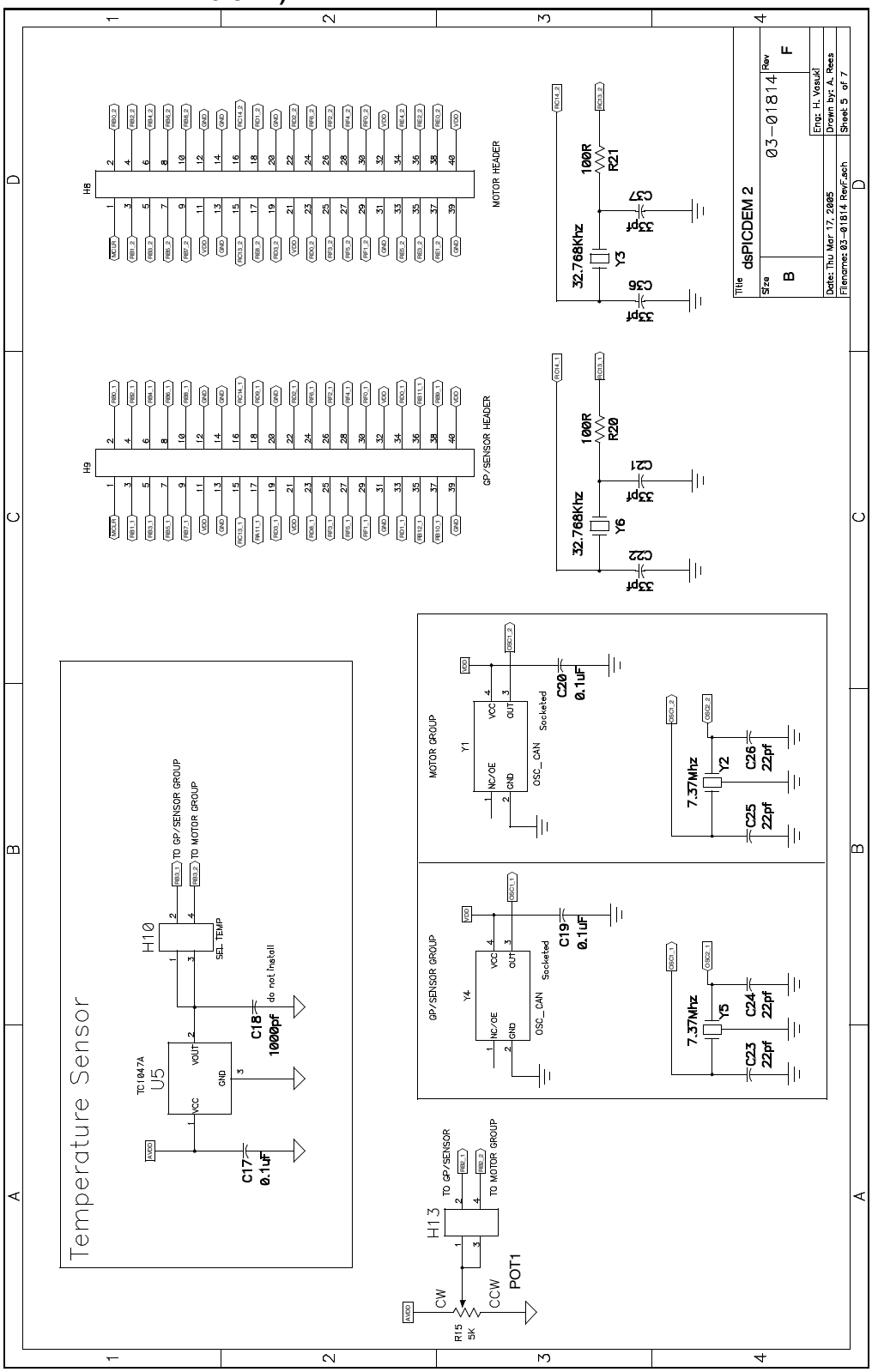


FIGURE A-6: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 5 OF 7)



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FIGURE A-7: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 6 OF 7)

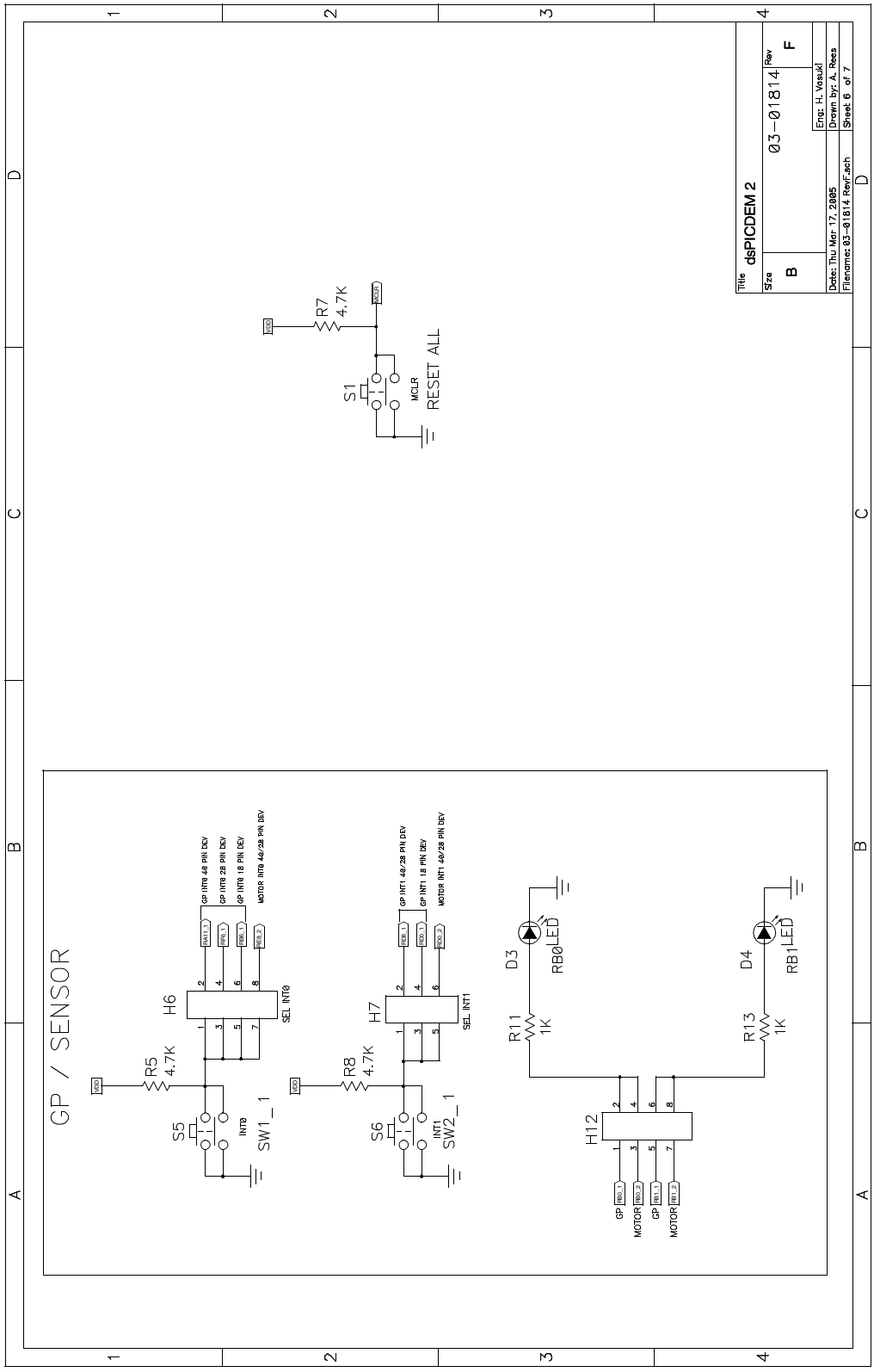
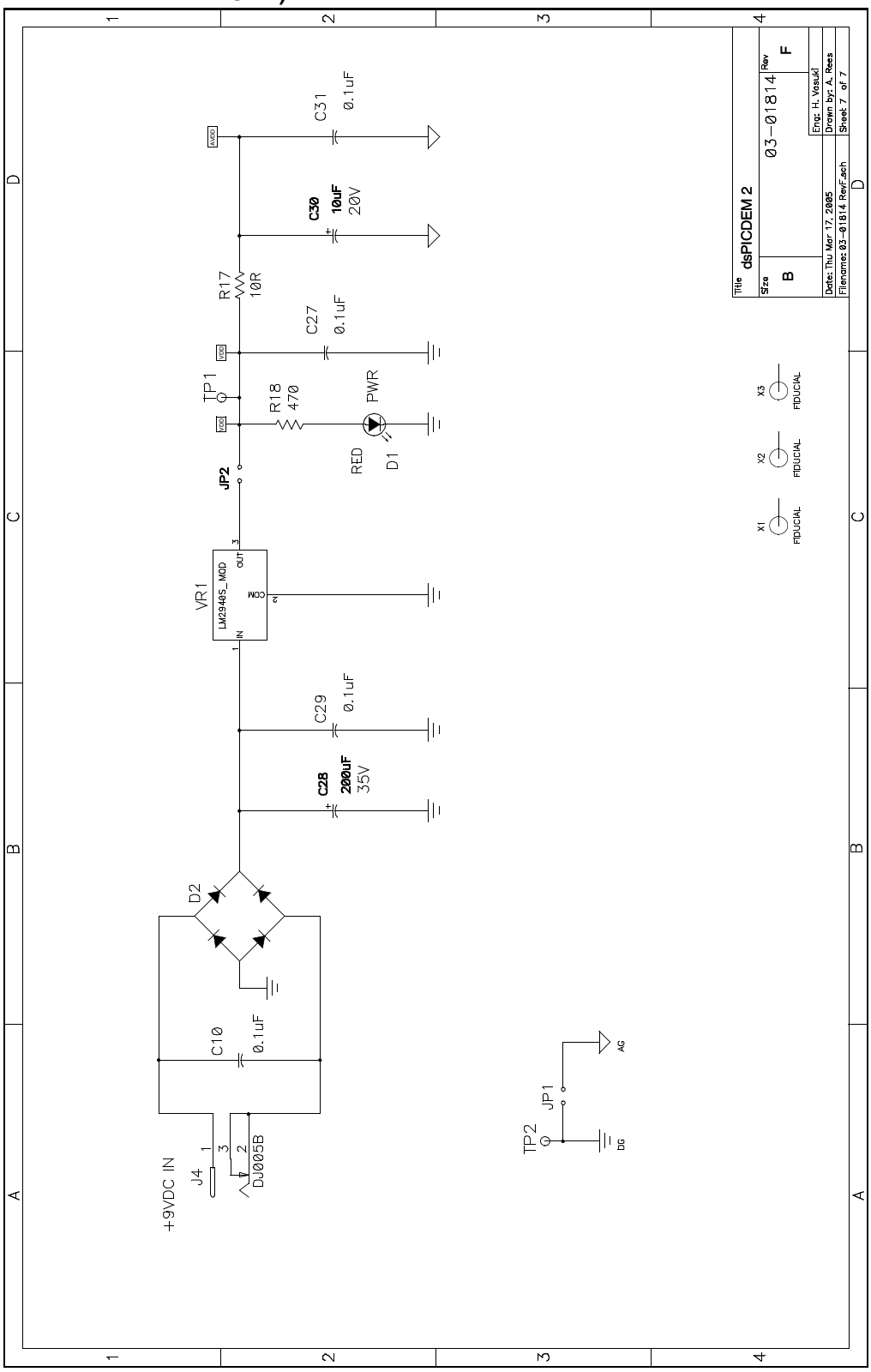


FIGURE A-8: dsPICDEM™ 2 DEVELOPMENT BOARD SCHEMATIC (SHEET 7 OF 7)



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Appendix B. Writing to LCD

B.1 OVERVIEW

A 2x16 ASCII-text LCD is provided on the dsPICDEM2 Development Board. dsPIC30F devices installed on the dsPICDEM2 development board may use this LCD to display characters. The interface to the LCD is via a 2-wire Serial Peripheral Interface (SPI™). dsPIC30F devices may send serial clock and data signals on 2 pins to the dsPIC30F2011 device that controls the 2x16 LCD.

B.2 LCD HARDWARE SETUP

To enable communication between your dsPIC30F device and the dsPIC30F2011 LCD controller, simply jumper the appropriate pair of pins on the header H1.For example, in order to enable communication between the dsPIC30F2010 device and the LCD, jumpers on the pin-pair labelled "M28" need to be installed on header H1.

B.3 LCD SOFTWARE SPECIFICATION

The following power-up sequence should be observed by the user's application firmware when writing characters to the LCD:

1. After any reset operation wait 500 milliseconds to allow the LCD to begin normal operation. The cursor on the LCD will be positioned at the top row on the left-most column.
2. Configure SPI1 module on your dsPIC30F device to operate in 8-bit Master mode. The serial clock may be set for any frequency up to 1 MHz.
3. To write an ASCII character to the LCD at the location pointed to by the cursor, load the SPIBUF register with the ASCII character byte.
4. After the character is displayed on the LCD, the cursor is automatically relocated to the next position on the LCD.
5. To reposition the cursor to another column on any of the two rows, write the address of the desired location to the SPIBUF register. Addresses in the first row of the LCD range from 0x80 to 0x8F, while addresses on the second row range from 0xC0 through 0xCF.
6. After 16 characters are written to the first row on the LCD, it is necessary for the user's application to write the address 0xC0 of the second row to the SPIBUF in order to roll the cursor over to the second row.
7. The user application must wait for a minimum of 5 milliseconds between writing two successive characters in the first row of the LCD.
8. The user application must wait for a minimum of 250 microseconds after writing an address byte.
9. The user application must wait for a minimum of 250 microseconds between writing two successive characters in the second row of the LCD.

B.4 LCD FIRMWARE PROGRAMMING:

The LCD firmware resident on the dsPIC30F2011 device may be reprogrammed at any time using the MPLAB IDE project and workspace provided in this folder.

In order to reprogram the firmware, the following steps need to be performed in sequence:

1. All switches on blocks S2, S3, and S4 should be turned OFF.
2. All jumpers on header H1 should be removed.
3. Install jumpers on header H11.
4. Connect MPLAB ICD 2 Programming Header to the dsPICDEM 2 Development Board at J1.
5. Install jumpers JP1 and JP2 and supply power to the board at J4.
6. Open the MPLAB IDE workspace from the folder:
   path/dsPICDEM 3 Development Kit/LCD Controller/
7. Build the project. *Project>>Build All*
8. Download the hex file into the dsPIC30F2011 device. *Programmer>>Program*
9. Remove jumpers from headee H11.

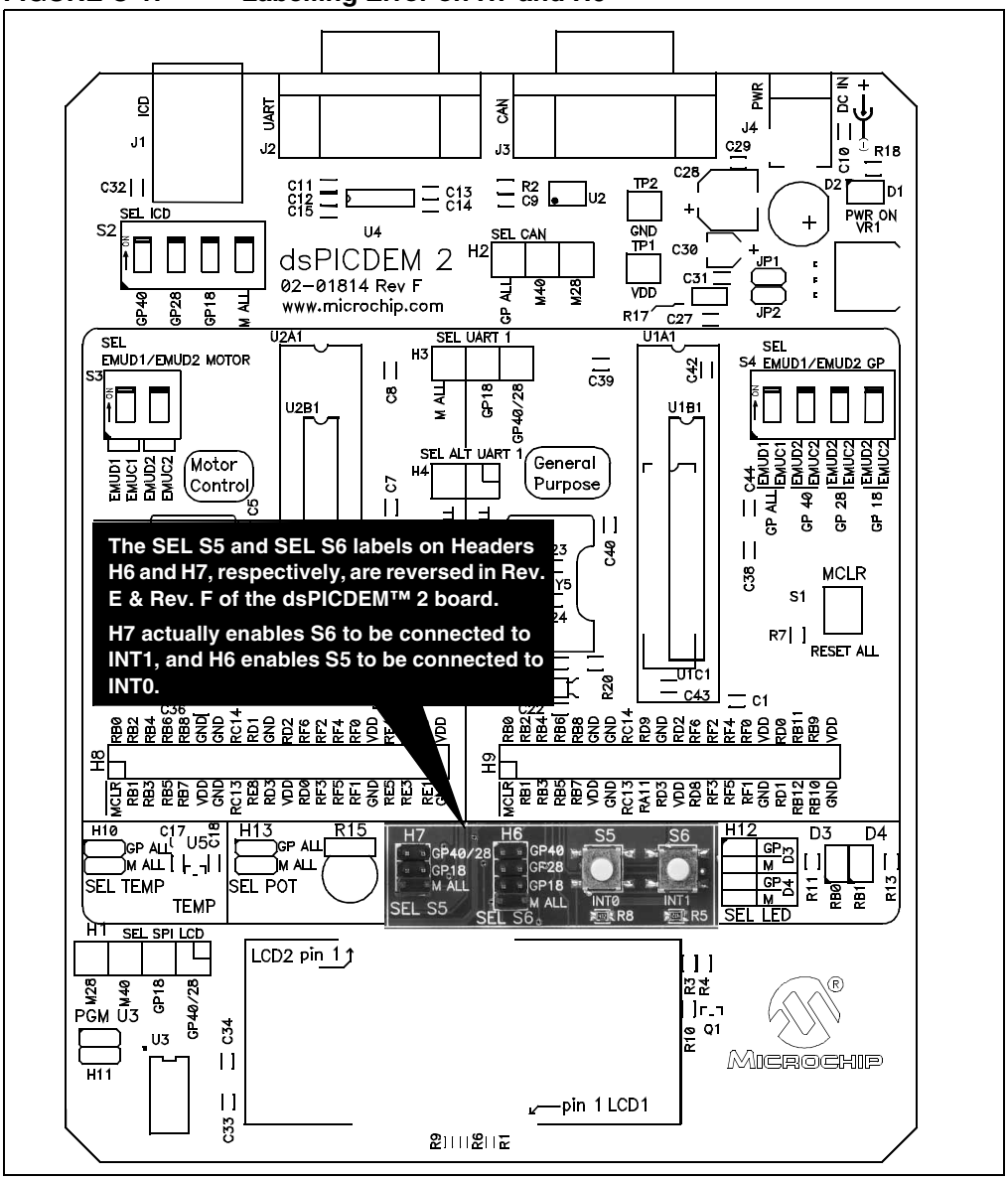
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Appendix C. Board Errata

C.1 H7 AND H6 LABELLING ERROR

This Appendix illustrates and explains a labeling error on Revisions E and F of the dsPICDEM 2 printed circuit board (see Figure C-1). The SEL S6 and SEL S7 labels on Headers H6 and H7, respectively, are reversed. H7 actually enables S6 to be connected to INT1, and H6 enables S5 to be connected to INT0.

FIGURE C-1: Labelling Error on H7 and H6



Notes:

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Index

A

Alternate UART1 header 88
Analog Pot Header 88
Analog Potentiometer 88

B

Board Configuration
  For dsPIC30F2010 ...21, 45, 51, 57, 63, 69, 75, 81
  For dsPIC30F2011 27
  For dsPIC30F2012 33
  For dsPIC30F3010 39
Build Project 19

C

CAN Connector 88
CAN Header 88
CAN Transceiver 88
Code Debugging 20
Crystal Oscillator
  For General Purpose Devices 88
  For Motor Control Devices 88
Customer Notification Service 5
Customer Support 6

D

Debug Selector DIP Switch 88
Demonstration Programs 14
Development Board
  Devices Supported 8
  Features
    Analog and Digital Inputs 11
    CAN Interface 7, 10
    Device Clocking 11
    Digital Outputs 11
    External Connections 11
    ICD 2 and ICE4000 Connections 10
    LCD 7
    Multiple Sockets 7, 9
    Power Supply Circuit 10
    RS-232 Interface 7, 10
    Sensor and Switches 7
  Layout 95
  Photograph 8
  Schematic 96
Documentation
  Conventions 3
  Layout 1
dsPIC30F Device Headers 88
dsPIC30F4011 Device 88

E

External Connection Headers 88
External Power Supply Inputs 88

F

Free Software Foundation 5

G

Getting Started Process 13
  Debugging 20
  Out-of-the-Box Demo 16
  Programming 19
GNU Language Tools 5

H

Hardware Components
  Alternate UART 1 header 88
  Analog Pot Header 88
  Analog Potentiometer 88
  CAN Connector 88
  CAN Header 88
  CAN Transceiver 88
  Crystal Oscillator for General Purpose & Sensor Devices 88
  Crystal Oscillator for Motor Control Devices 88
  Debug Selector DIP Switch 88
  dsPIC30F Device Headers 88
  dsPIC30F4011 Device 88
  External Connection Headers 88
  External Power Supply Inputs 88
  LCD Controller 88
  LCD Controller Header 88
  LCD Graphic Display 88
  LED Selection Header 88
  Output LEDs 88
  Power On LED 88
  Power Supply jumpers 88
  Programming Selector DIP Switch 88
  Programming/Debugging Connector 88
  Reset Switch 88, 93
  RS-232 Serial Port 88
  SPI programming header 88
  Switch S5 header 88
  Switch S6 header 88
  Temperature Sensor 88
  UART 1 header 88
  UART 2 header 88
  UART Transceiver 88
  voltage regulator 88

Headers
Analog Potentiometer 88
CAN 88
External Connection 88
LCD Controller 88
LED Selection 88
Host System Environment 12

I

Internet Address 5

K

Kit Contents 7

L

LCD Controller 88
LCD Controller Header 88
LCD Graphic Display 88
LED Selection Header 88

M

Make Project 19
Microchip Internet Web Site 5
MPLAB IDE User's Guide 5

O

Out-of-the-Box Demo 16
Output LEDs 88

P

Power On LED 88
Power Supply jumpers 88
Programming Selector DIP Switch 88
Programming/Debugging Connector 88

R

Recommended Reading 4
Reset Switch 88, 93
RS-232 Serial Port 88

S

Sample Application
For dsPIC30F2010 21
For dsPIC30F2011 27
For dsPIC30F2012 33
For dsPIC30F3010 39
For dsPIC30F3011 45
For dsPIC30F3012 51
For dsPIC30F3013 57
For dsPIC30F3014 63
For dsPIC30F4011 69
For dsPIC30F4012 75
For dsPIC30F4013 81
Sample Application Programs 13
Sample Application Projects 12
SPI programming header 88
Switch S5 header 88
Switch S6 header 88

T

Temperature Sensor 88
Temperature Sensor header
Hardware Components
Temperature Sensor header 88

U

UART Transceiver 88
UART1 header 88
UART2 header 88

V

voltage regulator 88

W

Warranty Registration 4
WWW Address 5

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Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8676-6200
Fax: 86-28-8676-6599

China - Fuzhou
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Fax: 86-591-8750-3521

China - Hong Kong SAR
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Fax: 852-2401-3431

China - Shanghai
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Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Shunde
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China - Qingdao
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