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dsPICDEM™ MCHV Development System User's Guide

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

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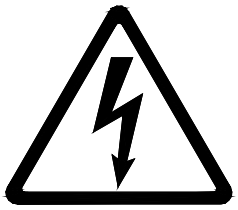
QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

dsPICDEM™ MCHV DEVELOPMENT SYSTEM USER'S GUIDE

Safety Notice

The safety notices and operating instructions provided should be adhered to, to avoid a safety hazard. If in any doubt, consult your supplier.



WARNING – This system must be earthed (grounded) at all times.

CAUTION – The system should not be installed, operated, serviced or modified except by qualified personnel who understand the danger of electric shock hazards and have read and understood the user instructions. Any service or modification performed by the user is done at the user's own risk and voids all warranties.

WARNING – The output terminals are NOT isolated from the incoming AC mains supply and may be at up to 410V with respect to ground, regardless of the input mains supply voltage applied. These terminals are live during operation AND for five minutes after disconnection from the supply. Do not attempt to access the terminals or remove the cover during this time.

WARNING – The unit may obtain power through the output terminals if these are connected to a rotating motor acting as a generator. If this is the case, then the previous warning also applies (i.e., the output terminals are live when connected to the generator and for five minutes after the generator has been stopped). Note that this case can arise even when the unit has been disconnected from the incoming AC mains supply.

CAUTION – If a motor is connected to the output of this unit, the frame should be connected to the output protective ground terminal provided. Particular care should be taken to mechanically guard such a motor, bearing in mind that unexpected behavior is likely to result from the process of code development.

CAUTION – For continued protection against the risk of fire, replace the fuse with one of the same type only (i.e., Fast Act Fuse 15A/250 V).

- **The system is intended for evaluation and development purposes and should only be operated in a normal laboratory environment as defined by IEC 61010-1:2001.**
- **Clean with a dry cloth only.**
- **Operate flat on a bench, do not move during operation and do not block the ventilation holes.**
- **The system should not be operated without all the supplied covers fully secured in place.**
- **The system should not be connected or operated if there is any apparent damage to the unit.**
- **The unit is designed to be connected to the AC mains supply via a standard non-locking plug. As the unit has no mains switch, this plug constitutes the means of disconnection from the supply and thus the user must have unobstructed access to this plug during operation.**

dsPICDEM™ MCHV DEVELOPMENT SYSTEM USER'S GUIDE

Table of Contents

NOTES:

dsPICDEM™ MCHV DEVELOPMENT SYSTEM 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.

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 preface contains general information that will be useful to know before using the dsPICDEM™ Motor Control High-Voltage (MCHV) Development System. Topics discussed in this preface 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 user's guide describes how to use the dsPICDEM™ MCHV Development System. The document is organized as follows:

- **Chapter 1. "Introduction"** – This chapter introduces the dsPICDEM™ MCHV Development System and provides a brief overview of its features.
- **Chapter 2. "Getting Started"** – This chapter provides information on getting started with the dsPICDEM™ MCHV Development System.
- **Chapter 3. "Running the Demonstration"** – This chapter describes the demonstration software that is preloaded on the dsPIC33F device that accompanies the dsPICDEM™ MCHV Development System.
- **Chapter 4. "Hardware"** – This chapter describes the hardware on the dsPICDEM™ MCHV Development System.
- **Appendix A. "Board Layout and Schematics"** – This appendix provides diagrams of the hardware layout, as well as schematic diagrams for the dsPICDEM™ MCHV Development System.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly braces and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

WARRANTY REGISTRATION

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

RECOMMENDED READING

This user's guide describes how to use the dsPICDEM™ MCHV Development System. The device-specific data sheets contain current information on programming the specific microcontroller or digital signal controller devices. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

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

This user's guide is a comprehensive guide that describes installation and features of Microchip's MPLAB Integrated Development Environment (IDE), as well as the editor and simulator functions in the MPLAB IDE environment.

Readme Files

For the latest information on using other tools, read the tool-specific Readme files in the Readme subdirectory of the MPLAB IDE installation directory. The Readme files contain updated information and known issues that may not be included in this user's guide.

MPASM™ Assembler, MPLINK™ Object Linker, MPLIB™ Object Librarian User's Guide (DS33014)

This user's guide describes how to use the Microchip MPASM Assembler, the MPLINK Object Linker and the MPLIB Object Librarian.

dsPIC33FJ12MC202 PIM Information Sheet (DS70314)

This document provides device specific information for the dsPIC33FJ12MC202 PIM device. The dsPIC33FJ12MC202 is a high-performance 16-bit digital signal controller within a small 28-pin 6x6 mm QFN package.

dsPIC33FJ32MC204 PIM Information Sheet (DS70316)

This document provides device specific information for the dsPIC33FJ32MC204 PIM device. The dsPIC33FJ32MC204 is a high-performance 16-bit digital signal controller within a small 44-pin QFN package.

dsPIC33FJ128MC804 PIM Information Sheet (DS70326)

This document provides device specific information for the dsPIC33FJ128MC804 PIM device. The dsPIC33FJ128MC804 is a high-performance 16-bit digital signal controller within a small 44-pin QFN package.

dsPIC33FJ256MC710 PIM Information Sheet (DS70564)

This document provides device specific information for the dsPIC33FJ256MC710 PIM device. The dsPIC33FJ256MC710 is a high-performance 16-bit digital signal controller within a 100-pin TQFP package.

dsPIC33FJ12MC201/202 Data Sheet (DS70265)

This data sheet contains device specific information for the dsPIC33FJ12MC201/202 Digital Signal Controller (DSC) Devices. The dsPIC33F devices contain extensive Digital Signal Processor (DSP) functionality with a high performance 16-bit microcontroller (MCU) architecture.

dsPIC33FJ32MC202/204 and dsPIC33FJ16MC304 Data Sheet (DS70283)

This data sheet provides device specific information for the dsPIC33FJ32MC202/204 and dsPIC33FJ16MC304 motor control family of devices.

dsPIC33FJ32MC302/304, dsPIC33FJ64MCX02/X04, and dsPIC33FJ128MCX02/X04 Data Sheet (DS70291)

This data sheet contains device specific information for the dsPIC33FJ32MC302/304, dsPIC33FJ64MCX02/ X04, and dsPIC33FJ128MCX02/X04 motor control family of devices.

dsPIC33FJXXXMCX06/X08/X10 Data Sheet (DS70287)

This data sheet contains device specific information for the dsPIC33FJXXXMCX06/X08/X10 motor control family of devices.

To obtain any of these documents, 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

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (June 2009)

This is the initial released revision of this document.

NOTES:

Chapter 1. Introduction

1.1 OVERVIEW

The Microchip dsPICDEM™ MCHV Development System is intended to aid the user in the rapid evaluation and development of a wide variety of motor control applications using a dsPIC® Digital Signal Controller (DSC). This development system is targeted to control Brushless DC (BLDC) motors, Permanent Magnet Synchronous Motors (PMSM), and AC Induction Motors (ACIM) in sensor or sensorless operation.

This flexible and cost-effective tool can be configured in different ways for use with Microchip's specialized Motor Control DSCs. The dsPICDEM™ MCHV Development System supports the dsPIC33F Motor Control device family, and offers a mounting option to connect either a 28-pin SOIC device or a generic 100-pin Plug-In Module (PIM).

The system has a three-phase power module device that contains the motor inverter and the gate driver's circuitry. The circuit drives a BLDC, PMSM, or ACIM motor using different control techniques without requiring any additional hardware. It also has Power Factor Correction (PFC) circuitry in order to provide a full set of tools used in motor control applications. Figure 1-1 provides a photograph of the dsPICDEM™ MCHV Development System. A block diagram that shows the main components of the system is provided in Figure 1-2.

The rated continuous output current from the inverter is 6.5A (RMS). This allows up to approximately 2 kVA output when running from a 208V to 230V single-phase input voltage in a maximum 30ºC (85ºF) ambient temperature environment. Therefore, the system is ideally suited for running a standard 3-Phase Induction Motor of up to 1.4 kW (1.8 HP) rating or a slightly higher rated industrial servo-motor. The power module is capable of driving other types of motors and electrical loads that do not exceed the maximum power limit and are predominantly inductive. Furthermore, single-phase loads can be driven using one or two of the inverter outputs.

The unit is capable of operating from 90V up to a maximum of 265V. A more detailed explanation of power limitations is provided in **Chapter 4. "Hardware"**.

Note:	It is recommended to carefully read the hardware section mentioned above before attempting to use the system.

FIGURE 1-1: dsPICDEM™ MCHV DEVELOPMENT SYSTEM

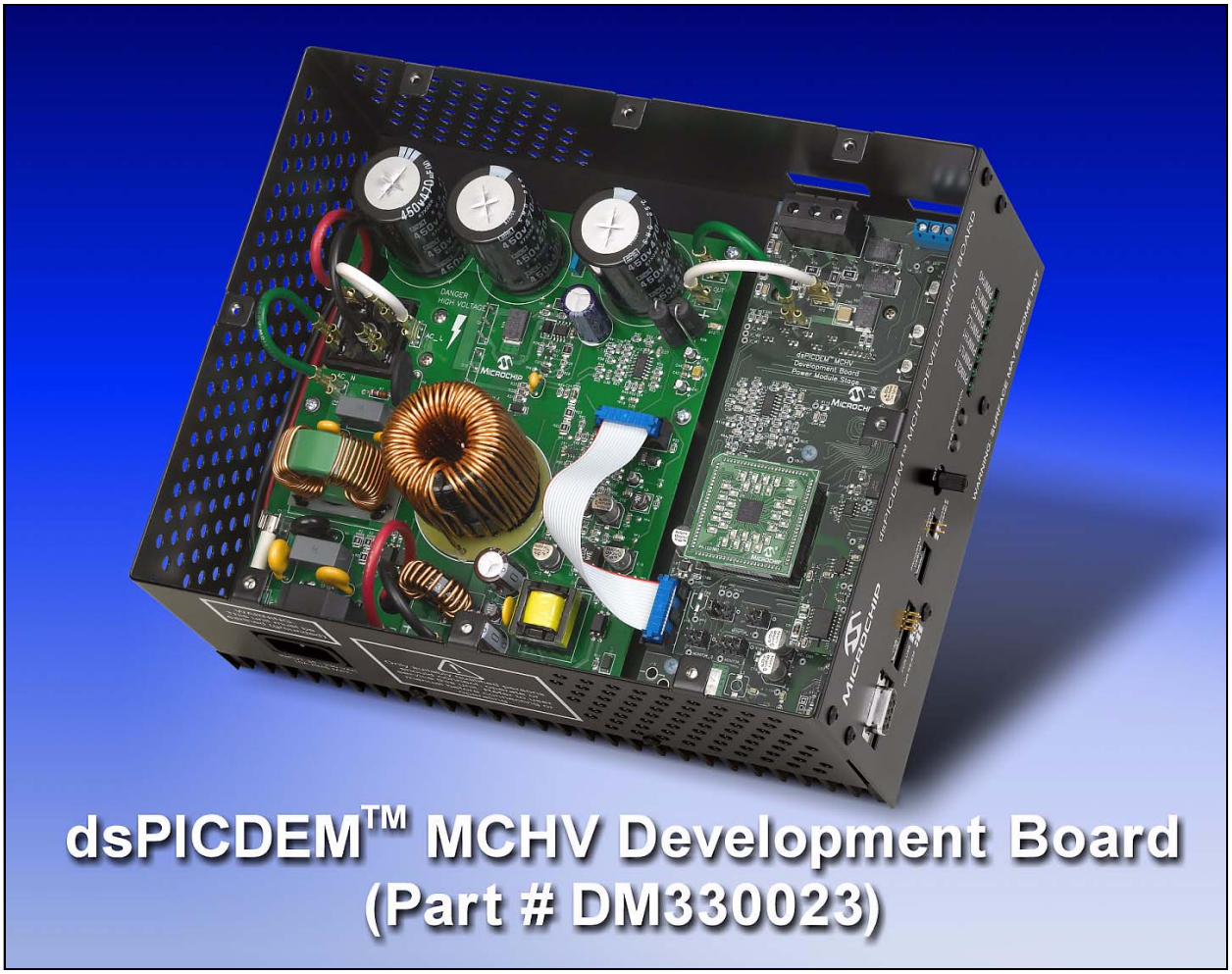
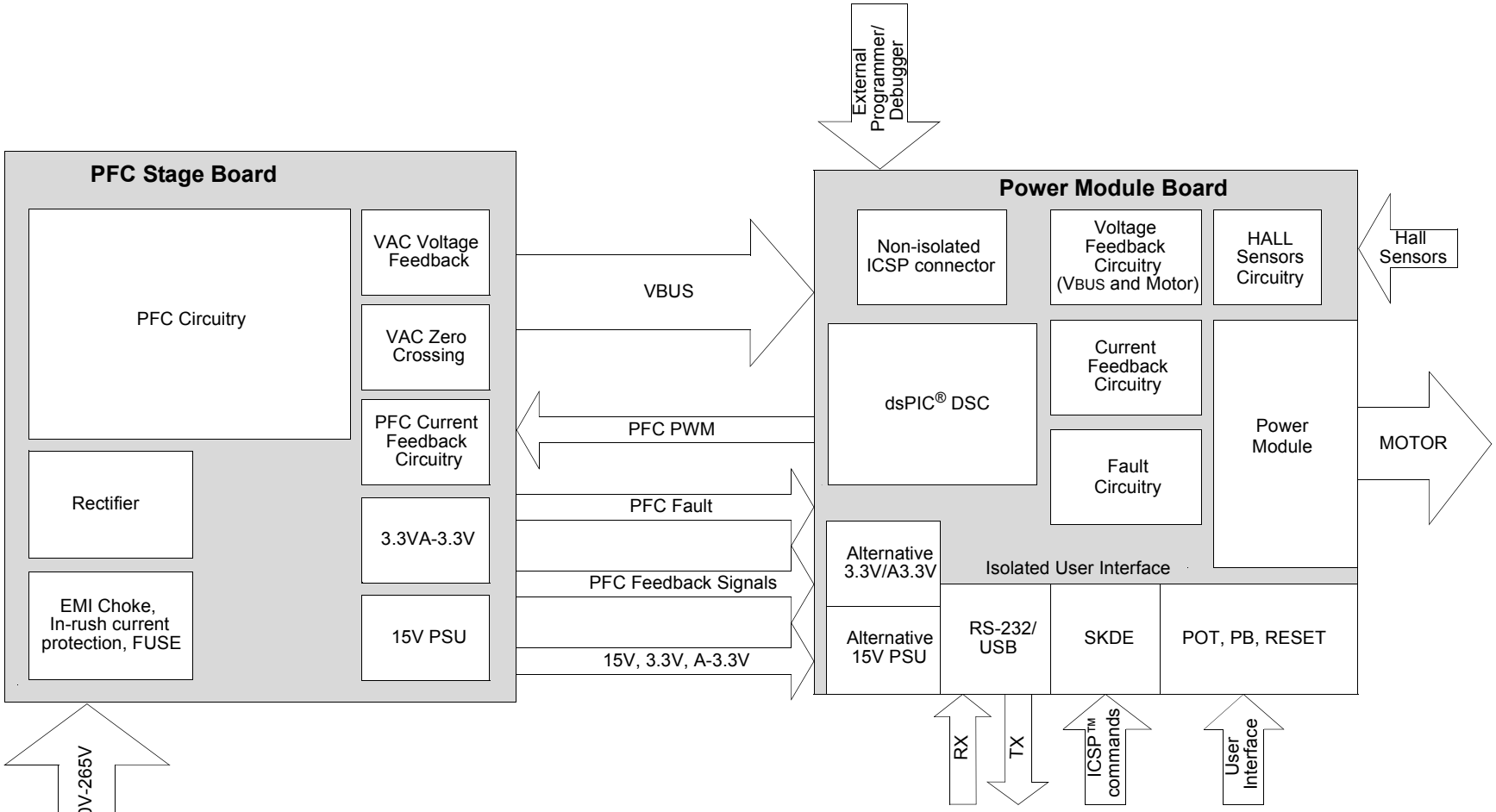


FIGURE 1-2: SYSTEM BLOCK DIAGRAM



1.1.1 Features

The following are some of the key features of the dsPICDEM™ MCHV Development System.

Supported Devices:

- 28-pin to 100-pin dsPIC33FJXXXMC202 PIM (MA330014) with a dsPIC33F Motor Control device (U11) socket
- 44-pin to 100-pin dsPIC33FJXXXMCX04 PIM (MA330017 and MA330018) with a dsPIC33F Motor Control device (U11) socket
- 100-pin to 100-pin dsPIC33FJXXXMCX10 PIM (MA330013) with a dsPIC33F Motor Control device (U11) socket
- dsPIC33FJ12MC202 Motor Control device in a SOIC package (U12) footprint

Motor Control Interfaces:

- Three-phase inverter bridge with a power rating of 400V/6.5A (J17)
- Hall sensors/Quadrature Encoder Interface (QEI) for sensored motor control algorithms (J9)
- Phase voltage feedback for sensorless BLDC operation
- DC bus current sense resistor for single shunt vector control
- Phase current sense resistor for dual shunt vector control
- Overcurrent protection

Input/Output Control Switches:

- One isolated push button (S1)
- Isolated reset push button (RESET)
- Isolated 10 kΩ potentiometer (POT1)
- LED indicator for PWM outputs

Isolated Communication Ports:

- UART communication via USB (J6)
- UART communication via RS-232 (J8)

Built-In Isolated Programmer/Debugger (J20):

- Starter Kit-type programmer/debugger (daughter card)

Power Supply Connectors:

- Power Tab Fast-On connectors (BP1 and BP2) for the power stage
- Auxiliary 24V power input connector (J15) for the dsPIC DSC device and low-power circuitry (non-populated)
- Auxiliary 15V and 3.3V regulators for regulating auxiliary power supply (non-populated)

Programming Connectors:

- ICSP™ connector for programming a dsPIC DSC device (J18), non-isolated
- ICSP connector for programming the PIC18LF2450 USB module to the UART Bridge (J1), isolated
- ICSP connector for programming the Starter Kit Programmer/Debugger (SKDE), isolated PIC18F67J50 (J4)

Power Factor Corrector:

- Maximum input voltage 90 VAC-265 VAC
- Current Feedback circuitry
- VAC input voltage sensing
- Zero-crossing detection
- DC bus sensing
- Overcurrent protection (The maximum power available is specified in **Section 4.3 “Electrical Specifications”**.)

Built-In Power Supplies:

- 15V power supply, maximum power available 11W
- 3.3V power supply, maximum power available 2W

Additional Protection Circuitry:

- 250 VAC/15A fuse
- In-rush current limiter
- EMI filter

NOTES:

Chapter 2. Getting Started

2.1 BOARD COMPONENTS

The dsPICDEM™ MCHV Development System comprises two stages:

- PFC Stage

  The first stage is integrated by the Power Factor Correction (PFC) circuitry, the full-bridge rectifier, the 15V power supply, and the 3.3V power supply.

- Power Module Stage

  The second stage is the power module board. This board contains the dsPIC DSC connector, the isolated user interface connectors, and the motor drive.

Figure 2-1 shows an interior view of the system.

FIGURE 2-1: dsPICDEM™ MCHV DEVELOPMENT SYSTEM

2.2 USER INTERFACE

The dsPICDEM™ MCHV Development System has the following components to interact with the user. Figure 2-2 shows a photograph of the front of the system.

- Input/Output Control Switches (Figure 2-2):
  - One isolated push button (**S1**)
  - Isolated reset push button (**RESET**)
  - Isolated 10 kΩ potentiometer (**POT1**)
  - LED indicator for PWM outputs
- PWM Outputs (Figure 2-2)
  - Enable and disable jumpers (**J7**)
- Isolated Communication Ports (Figure 2-2):
  - UART communication via USB (**J6**)
  - UART communication via RS-232 (**J8**)
  - Communication Ports Selector (**J2, J3**)
- Built-In Isolated Programmer/Debugger (Figure 2-2)
  - Starter Kit type programmer/debugger (**J20**)
- Motor Connectors (Figure 2-3):
  - Three-phase inverter bridge connector with a power rating of 400V/6.5A (**J17**)
  - Hall sensors/Quadrature encoder interface for sensored motor control algorithms (**J9**)
- Power Supply Connector (Figure 2-4)
  - AC power inlet specified for 40VAC-220VAC 10Amps max (**J1**)

FIGURE 2-2: dsPICDEM™ MCHV DEVELOPMENT SYSTEM (FRONT)

FIGURE 2-3: dsPICDEM™ MCHV DEVELOPMENT SYSTEM (LEFT SIDE)

FIGURE 2-4: dsPICDEM™ MCHV DEVELOPMENT SYSTEM (RIGHT SIDE)

2.3 CONNECTING THE SYSTEM

CAUTION
The user must be aware of the operating procedures outlined below and ensure that they are followed. Failure to do so may result in damage to the system.

2.3.1 Power Connections

It is recommended that cables used for the power connections should be terminated with blue or red insulated crimp terminals. If crimp terminals are not used, care should be taken to ensure that stray strands of wire do not short to adjacent terminals or the enclosure. If possible, all wires should be stripped and tinned with solder before connecting to the dsPICDEM™ MCHV Development System terminals.

For the AC mains supply input, standard double-insulated, 3-core flex cable should be used with a minimum current rating of 10A (1 mm^2 18 AWG). A computer power cable can be used.

> **Note:** The system is designed for installation category II. Therefore, the incoming mains cable should be wired into a standard non-locking 2-pin in addition with a earth ground type plug.

The recommended output cable size is 1.0 to 1.5 mm^2 (18-16 AWG) and it should have a 600V rating. This cable should also be double insulated or have a protective ground screen. Access to the terminal screws is provided via holes in the lid of the enclosure. A slotted screwdriver should be used.

> **Note:** The user should only access the power terminals when the system is fully discharged (see the **"Safety Notice"** on page iii).

Figure 2-6 provides the locations of all connectors. Corresponding tables that describe each connection are provided in the relevant section.

FIGURE 2-5: dsPICDEM™ MCHV DEVELOPMENT SYSTEM CONNECTIONS

The power connections are listed in Table 2-1.

TABLE 2-1: POWER CONNECTIONS

Number	Name	Type
1	Neutral	Input
2	Earth Ground	Input
3	Live (Fused)	Input
4	Motor Phase 1 (M1)	Output
5	Motor Phase 2 (M2)	Output
6	Motor Phase 3 (M3)	Output
7	Hall Sensor A (HA)	Input
8	Hall Sensor B (HB)	Input
9	Hall Sensor C (HC)	Input
10	Hall Sensors, 5V power supply terminal	Output
11	Hall Sensors, Ground terminal	Output

2.3.2 Host/Communication Connections

A mini-USB-to-USB certified cable and a standard DB9 male-to-female cable should be used to connect the dsPICDEM™ MCHV Development System to the host computer.

The communication port connectors are listed in Table 2-2. Refer to Figure 2-5 for their exact location.

TABLE 2-2: COMMUNICATION PORT CONNECTORS

Number	Name	Type
12	USB-to-UART connector	Input/Output
13	RS-23- to-UART connector	Input/Output
14	USB connector for the Starter Kit programmer/debugger	Input/Output
15	Non-isolated ICSP™ connector for device programming/debugging	Input/Output

2.3.2.1 CONNECTION SEQUENCE

The recommended connection sequence is listed below. The user should ensure that the following sequence is met before connecting the system to the mains, a motor and a host computer.

Note: Before making any connection, verify that the system is not powered and it is fully discharged. The system is completed discharged when the red LED D13 is OFF.

1. Connect the motor terminals R, Y, and B (also known as RWB or 123 or ABC) to the connection nodes M1, M2, and M3 (4, 5, and 6 in Figure 2-5), respectively.
2. Follow the next steps if position sensors are utilized to control the motor. If not, proceed to step 3.
   a) If the motor position is sensed with Hall Sensors, connect the terminals A, B, and C to the connection nodes HA, HB, and HC (7, 8, and 9 in Figure 2-5), respectively. Also, connect the positive terminal +5V to the connection node +5V and the ground terminal to the connection node GND (10 and 11 in Figure 2-5).
   b) If the motor position is sensed with a Quadrature Encoder, connect the terminals phase A, phase B, and Index to the connection nodes HA, HB, and HC (7, 8, and 9 in Figure 2-5), respectively.

3. Connect the communication ports.
   a) If R-S32 communication is used, connect the DB9 male connector to the RS-232 port. Connect the other end to the host PC (12 in Figure 2-5).
   b) If USB communication is used, connect the mini-USB male terminal to the mini-USB female connector labeled "USB" (12 in Figure 2-5). Connect the other end to the host PC.

Note: The Microchip serial emulator driver (`mchpcdc.inf`) should be installed on you PC in order to activate the USB-to-Serial emulator. The emulator driver is contained in the CD shipped with the dsPICDEM™ MCHV Development System.

4. Connect the SKDE cable. Connect the USB cable to the mini USB female connector labeled "Program/Debug" (14 in Figure 2-5). Connect the USB male terminal to the USB ports of the host PC.

Note: The built-in programmer/debugger is supported in MPLAB IDE 8.33 or higher.

5. Power Cord connection. Make sure the power cord is disconnected from the AC mains before connecting the female terminal of the power cable to the AC input connector (1, 2, and 3 in Figure 2-53) of the dsPICDEM™ MCHV Development System.

Note: The unit is designed to be connected to the AC mains supply via a standard non-locking plug. As the unit has no mains switch, this plug constitutes the means of disconnection from the supply. Therefore, the user must have unobstructed access to this plug during operation.

2.4 POWER SEQUENCES

The user should ensure that the following power sequences are adhered to.

2.4.1 Power-up Sequence

The unit is powered-up when the power cable is connected to the AC mains. To verify that the unit is powered make sure that the LEDs D6, D13, D17 and D18 are ON.

Note: The unit is designed to be connected to the AC mains supply via a standard non-locking plug. As the unit has no mains switch, this plug constitutes the means of disconnection from the supply and thus the user must have unobstructed access to this plug during operation.

2.4.2 Power-down Sequence

1. Stop firing all power devices by removing the PWM OUTPUTS shunt jumper.
2. Turn OFF the incoming AC supply by disconnecting the power cord from the mains.
3. Wait until the red DC bus LED indicator (D13) located next to the DC bus P connector has gone out (this will take 5 minutes or less).

2.4.3 Programming/Debugging an Application Code Using the Built-in Starter Kit Programmer/Debugger

The MPLAB Starter Kit Programmer/Debugger for the dsPICDEM™ MCHV Development System may be used with MPLAB IDE, the free integrated development environment, which is available from Microchip's web site (www.microchip.com). MPLAB IDE allows the Starter Kit to be used as an in-circuit debugger as well as a programmer for the following devices.

- dsPIC33FJ12MC202
- dsPIC33FJ32MC204
- dsPIC33FJ128MC804
- dsPIC33FJ256MC710

In-circuit debugging allows you to run, examine and modify your program for the device embedded in the Starter Kit hardware. This greatly assists you in debugging your firmware and hardware together.

Special Starter Kit software interacts with the MPLAB IDE application to run, stop, and single-step through programs. Breakpoints can be set and the processor can be reset. Once the processor is stopped, the register's contents can be examined and modified.

For more information on how to use MPLAB IDE, reference the following documentation:

- *"MPLAB IDE User's Guide"* (DS51519)
- *"MPLAB IDE Quick Start Guide"* (DS51281)
- MPLAB IDE Online Help

2.4.4 Setting Up an Application for Debug

To prepare the application for debug:

1. Launch MPLAB IDE, and then open the application project. The related workspace will be open. For information on projects and workspaces, see the MPLAB IDE documentation mentioned at the beginning of this chapter.
2. Select *Project>Build All* to build the application code. The build's progress will be visible in the **Build** tab of the Output window.