



**Motor Control Interface
PICtail™ Plus Daughter Board
User's Guide**

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MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD

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MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD

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. For the latest documentation available, refer to our web site (www.microchip.com).

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 “DSXXXXA”, where “XXXX” 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 is useful to know before using the Motor Control Interface PICtail Plus Daughter Board.

Items discussed in this chapter include:

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

ABOUT THIS GUIDE

This document describes how to use the Motor Control Interface PICtail Plus Daughter 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 Motor Control Interface PICtail Plus Daughter Board and provides a brief description of the hardware.
- **Chapter 2. “Hardware Overview”** – This chapter describes the Motor Control Interface PICtail Plus Daughter Board hardware.
- **Appendix A. “Board Layout and Schematics”** – This appendix illustrates the Motor Control Interface PICtail Plus Daughter Board layout and provides hardware schematic diagrams.
- **Appendix B. “Bill of Materials (BOM)”** – This appendix provides a list of the components used in the Motor Control Interface PICtail Plus Daughter Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> 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	<u><i>File>Save</i></u>
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	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets []	Optional arguments	mcc18 [options] <i>file</i> [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

It is recommended that you 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 Motor Control Interface PICtail Plus Daughter Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Explorer 16 Development Board User's Guide (DS51589)

Consult this document for details on how to use the Explorer 16 Development Board kit for 16-bit digital signal controller families, which include the dsPIC33F General Purpose and Motor Control devices.

dsPICDEM™ MC1L 3-Phase Low Voltage Power Module User's Guide (DS70097)

This document provides details on how to use the 3-Phase Low Voltage Power Module for a wide variety of low voltage AC and DC motor control applications using the dsPIC digital signal controller.

dsPICDEM™ MC1H 3-Phase High Voltage Power Module User's Guide (DS70096)

This document provides details on how to use the 3-Phase High Voltage Power Module for a wide variety of high voltage AC and DC motor control applications using the dsPIC digital signal controller.

dsPIC33F Family Data Sheet (DS70165)

Consult this document for detailed information on dsPIC33F digital signal controllers. Reference information found in this data sheet includes:

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

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

This manual is a software developer's reference for all of Microchip's 16-bit digital signal controllers. It describes the instruction set detail and also provides general information to assist in developing software for dsPIC devices.

Readme Files

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

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

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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, MPLAB ICE 4000 and REAL ICE™ in-circuit emulator
- **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 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 2007)

This is the initial released version of this document.

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NOTES:

Chapter 1. Introduction

The Motor Control Interface PICtail Plus Daughter Board acts as an interface between Microchip's Explorer 16 Development Board and the 3-phase power modules.

This chapter introduces and provides an overview of the Motor Control Interface PICtail Plus Daughter Board. Topics covered include:

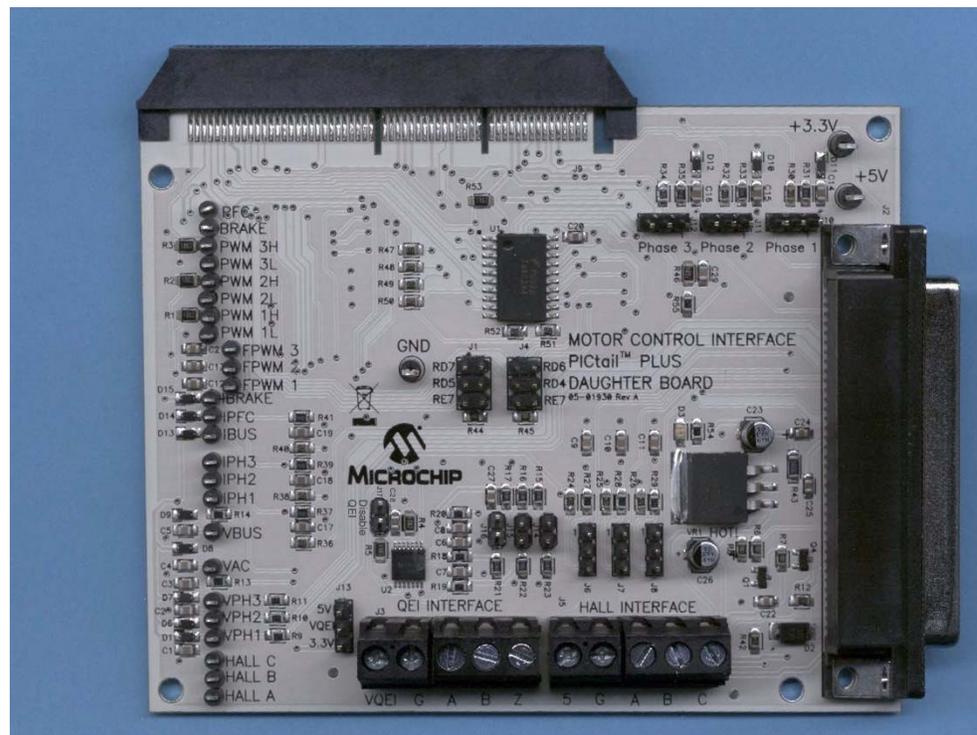
- Overview
- Interface Card Features
- Interface Card Setup

1.1 OVERVIEW

The Motor Control Interface PICtail Plus Daughter Board is a bridge board that connects the Explorer 16 Development Board to the 3-phase power modules, and is used in motor control applications involving the dsPIC33F family of motor control devices.

Figure 1-1 shows the Motor Control Interface PICtail Plus Daughter Board. It draws power at 9V from the Explorer 16 Development Board and carries control signals from the Explorer 16 Development board to the 3-phase power modules. In addition, it carries feedback signals of the motor from the 3-phase power modules to the Explorer 16 Development Board. Test points are provided on the card to monitor and measure different analog signals to and from the motor.

FIGURE 1-1: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD



1.2 INTERFACE CARD FEATURES

1.2.1 Input/Output Control

The following connectors carry the input and output control and feedback signals to and from the Motor Control Interface PICtail Plus Daughter Board. For details, refer to Figure 2-1.

- 120-pin Signal Connector (J9)
- 37-pin D-Type Signal Connector (J2)
- Quadrature Encoder Interface Connector (J3)
- Hall Sensor Interface Connector (J5)

1.2.2 Test Points

There are 25 test points (TP1 to TP25) available on the Motor Control Interface PICtail Plus Daughter Board to monitor and probe various motor control signals. For details, refer to Figure 2-4.

1.2.3 Board Power

The Motor Control Interface PICtail Plus Daughter Board takes input power at 9V DC from the Explorer 16 Development Board through the 120-pin signal connector (J9). This input is regulated by the voltage regulator (VR1) for providing a 5V regulated output to drive the various signals, required by the 3-phase power modules or to pull up inputs to the Motor Control Interface PICtail Plus Daughter Board.

1.3 INTERFACE CARD SETUP

Figure 1-2 shows the Motor Control Interface PICtail Plus Daughter Board connected to the Explorer 16 Development Board, 3-Phase Low Voltage Power Module, MPLAB ICD 2 and Brushless DC (BLDC) Motor.

FIGURE 1-2: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD SETUP



TABLE 1-1: INTERFACE CARD SETUP

No.	Description
1	Motor Control Interface PICtail Plus Daughter Board
2	3-Phase Low Voltage Power Module
3	MPLAB ICD 2
4	Explorer 16 Development Board
5	BLDC Motor

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Chapter 2. Hardware Overview

This chapter describes the following topics for the Motor Control Interface PICtail Plus Daughter Board:

- Hardware Components
- Hardware Functionality
- Jumpers
- Test Points

2.1 HARDWARE COMPONENTS

Figure 2-1 shows the hardware elements of the Motor Control Interface PICtail Plus Daughter Board.

FIGURE 2-1: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD HARDWARE COMPONENTS

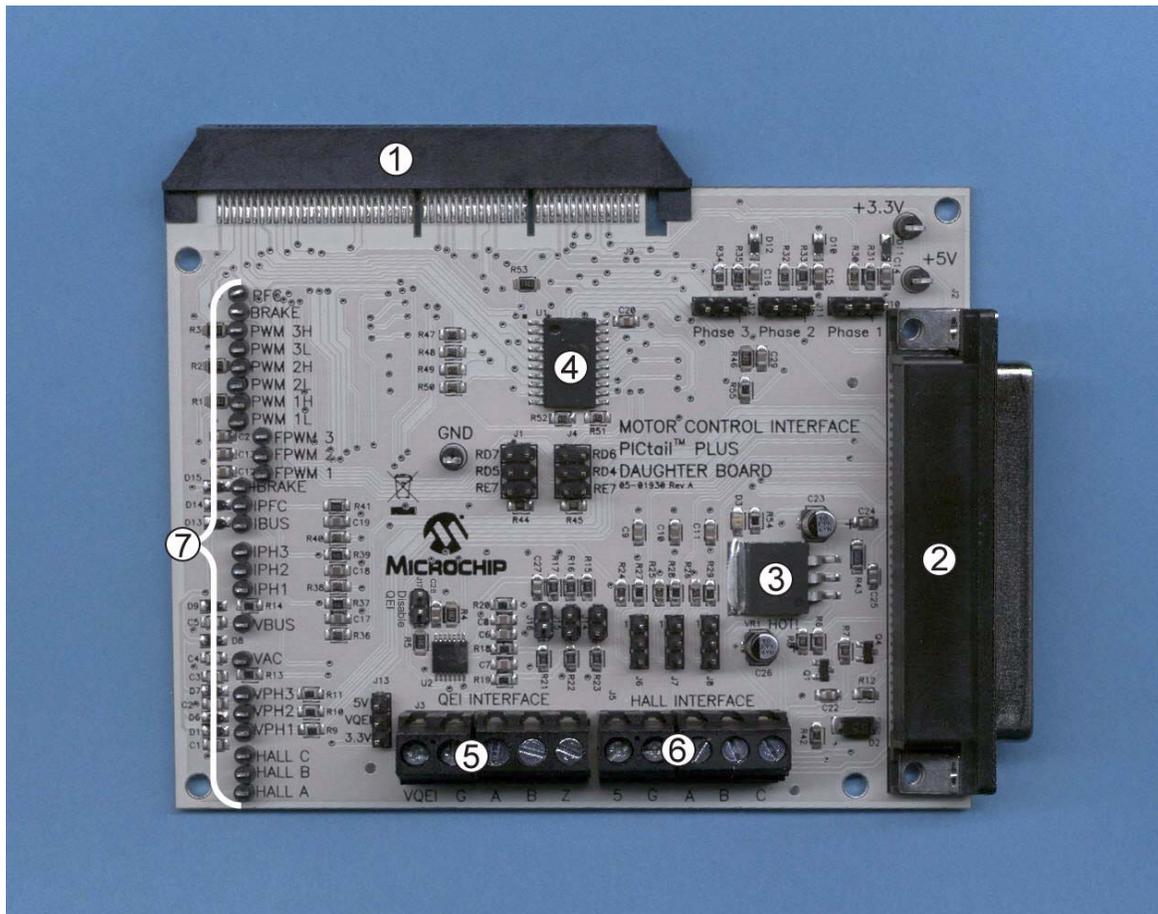


TABLE 2-1: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD HARDWARE COMPONENTS

No.	Description
1	120-pin Signal Connector (J9)
2	37-pin D-Type Signal Connector (J2)
3	5V Voltage Regulator (VR1)
4	Octal Buffer/Line Driver (U1)
5	Quadrature Encoder Interface (QE1) Connector (J3)
6	Hall Sensor Interface Connector (J5)
7	25 Test Points (TP1 - TP25)

2.2 HARDWARE FUNCTIONALITY

The functionality of the hardware elements and circuits in the Motor Control Interface PICtail Plus Daughter Board are described in the following sections.

2.2.1 120-pin Signal Connector (J9)

The 120-pin Signal Connector carries signals from the I/O pins of the dsPIC device to the Motor Control Interface PICtail Plus Daughter Board. It also carries the feedback signals from the motor through the Motor Control Interface PICtail Plus Daughter Board to the input pins of the dsPIC device.

The 120-pin Signal Connector handles the following signals:

- 9V DC input to the Motor Control Interface PICtail Plus Daughter Board
- PWM signals from the dsPIC device to the Motor Control Interface PICtail Plus Daughter Board
- Voltage feedback signals from the Motor Control Interface PICtail Plus Daughter Board to the analog channels
- Current feedback signals from the Motor Control Interface PICtail Plus Daughter Board to the analog channels
- Encoder pulse from the Motor Control Interface PICtail Plus Daughter Board to the dsPIC Quadrature Encoder Interface (QE1) module input pins
- Hall sensor feedback from the Motor Control Interface PICtail Plus Daughter Board to the dsPIC Input Capture module input pins
- Fault signal communication

2.2.2 37-pin D-Type Signal Connector (J2)

The 37-pin D-type Signal Connector connects the Motor Control Interface PICtail Plus Daughter Board to the 3-phase power modules. The Signal connector (J2) handles the following signals to or from the Motor Control Interface PICtail Plus Daughter Board:

- PWM signals to the 3-phase power modules
- Voltage feedback signals from the 3-phase power modules
- Current feedback signals from the 3-phase power modules
- Fault signal communication

2.2.3 5V Voltage Regulator (VR1)

An LM2940 5V Voltage Regulator (VR1) takes an input of 9V DC and provides a 5V DC regulated output to drive the various interface signals.

2.2.4 Octal Buffer/Line Driver (U1)

A 74AC244 Octal Buffer and Line Driver with a 3-STATE Outputs device drives the dsPIC PWM and Output Compare outputs to the Motor Control Interface PICtail Plus Daughter Board. This device can handle an output current of up to 24 mA, as well as the PWM signals and Change Notification signals.

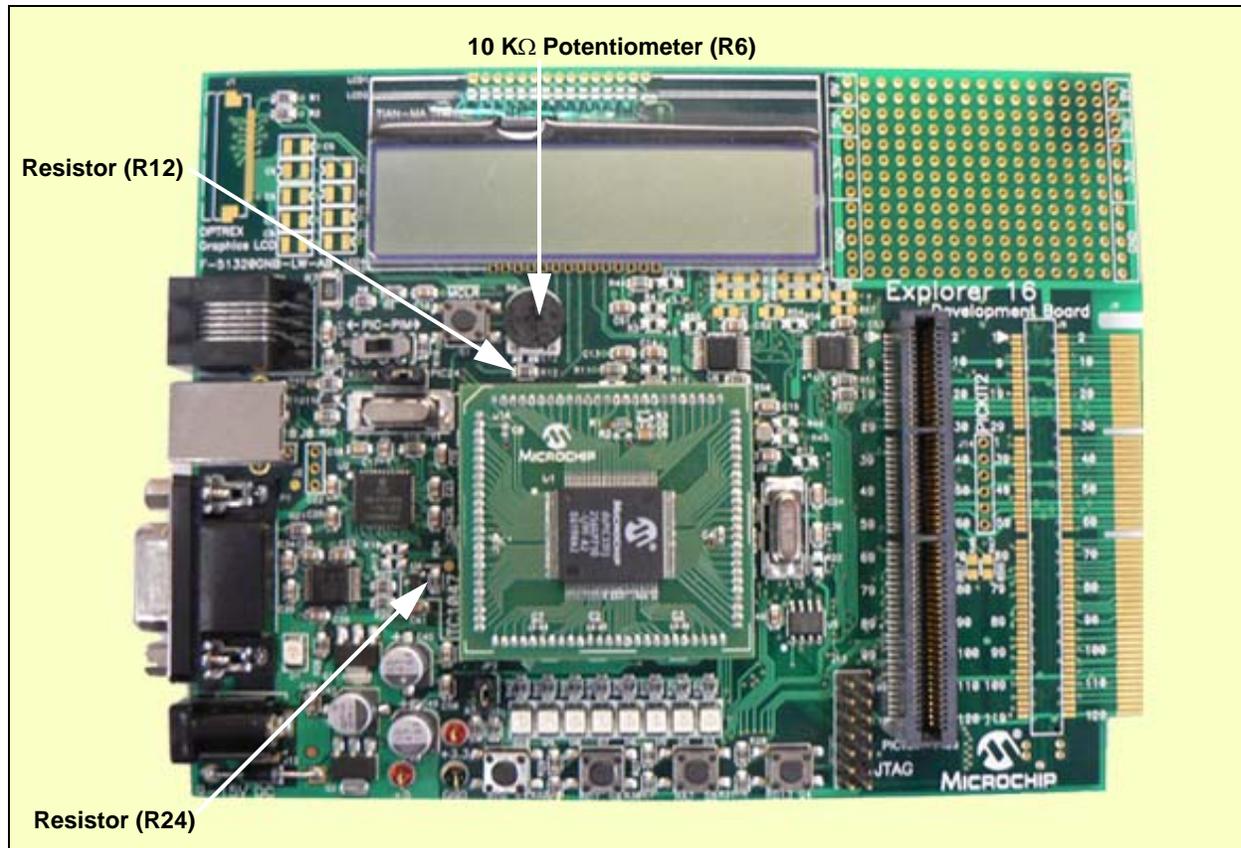
Note: Pull down resistors (1 K Ω or 4.7 K Ω) are provided at all the input pins of the line driver (U1) on the Motor Control Interface PICtail Plus Daughter Board. This is because the LCD on the Explorer 16 Development Board is connected in parallel with some of the PWM pins.

2.2.5 Quadrature Encoder Interface (QEI)

When an incremental encoder senses the speed and position of the rotor, the QEI signals QA, QB, and QZ are taken as feedback from the encoder. These QEI signals are routed to the Motor Control Interface PICtail Plus Daughter Board. They are also taken as feedback to the dsPIC device through the input pins.

Note: Figure 2-2 shows that the Explorer 16 Development Board has a 10 K Ω potentiometer (R6), which is connected to the analog channel AN5. This channel is also used for the QEI phase B input (QB). If the motor system involves an encoder feedback and QEI is to be used, the R12 resistor must be unsoldered and removed. The R24 resistor must be removed if index pulse (QZ) is used for the QEI. After removing R12, the potentiometer (R6) cannot be used any more. Removing R24 disconnects the temperature sensor to dsPIC.

FIGURE 2-2: EXPLORER 16 DEVELOPMENT BOARD



2.2.6 Hall Sensor Interface

The output of the Hall Effect Sensors is taken as feedback from the Motor Control Interface PICtail Plus Daughter Board through the Hall Interface circuit. These signals are carried to the Input Capture pins IC1, IC2 and IC3 of the dsPIC device through the 120-pin Signal Connector (J9).

Three test points – Hall A, Hall B, and Hall C – are available on the Motor Control Interface PICtail Plus Daughter Board to monitor the three Hall Sensor output signals.

2.2.7 Low-Pass Filtering Circuit

To aid in monitoring the PWM signals, there are three low-pass filters provided on the Motor Control Interface PICtail Plus Daughter Board. These can be used to filter the PWM signals PM11, PM12 and PM13 going to the top switches of the inverter. The filter outputs FPWM1, FPWM2 and FPWM3 are provided at the test points TP23, TP24 and TP25 respectively. These test points can be used to monitor the PWM outputs.

2.2.8 Fault Reset Circuit

On occurrence of any kind of fault (i.e., overcurrent, overvoltage, etc.) in the motor control application, the 3-phase power modules generates a fault signal output to a dsPIC33F device and inhibits the PWM pulses to the insulated gate bi-polar transistor (IGBT) switches.

To recover from a fault, the dsPIC33F device drives an I/O pin (FAULT_RESET) and clears the fault condition in the 3-phase power modules.

2.2.9 Voltage Feedback

The following voltages are taken as feedback from the 3-phase power modules through the 37-pin D-Type Signal Connector (J2) to the Motor Control Interface PICtail Plus Daughter Board.

- Phase voltages VPH1, VPH2 and VPH3
- Rectifier output voltage |VAC|
- DC bus voltage VBUS

These voltages are available at the test points TP4, TP5, TP6, TP7 and TP8. These test points measure and monitor the voltages.

Multiplexing logic on the Explorer 16 Development Board allows RS-232 and SPI signals to be “crossed over” to interconnect the two boards. The analog channels AN12, AN13, and AN14, are used for feedback of Phase 1, Phase 2, and Phase 3 voltages respectively. However, these three voltage feedback signals also control the crossover multiplexers.

If voltage sensing is to be used, it may be necessary to remove resistors R50, R51, and R52, as well as components U6 and U7 from the Explorer 16 Development Board.

2.2.10 Current Feedback

The following currents are taken as feedback from the 3-phase power modules through the D-Type Signal Connector (J2) to the Motor Control Interface PICtail Plus Daughter Board:

- Phase 1, Phase 2, and Phase 3 currents
- DC Bus Current
- PFC (Power Factor Correction) Current
- Brake Chopper Shunt Current

These currents are available at the test points TP9-TP14. These test points measure and monitor the currents.

2.3 JUMPERS

Figure 2-3 shows the jumpers present on the Motor Control Interface PICtail Plus Daughter Board.

FIGURE 2-3: JUMPER LOCATIONS

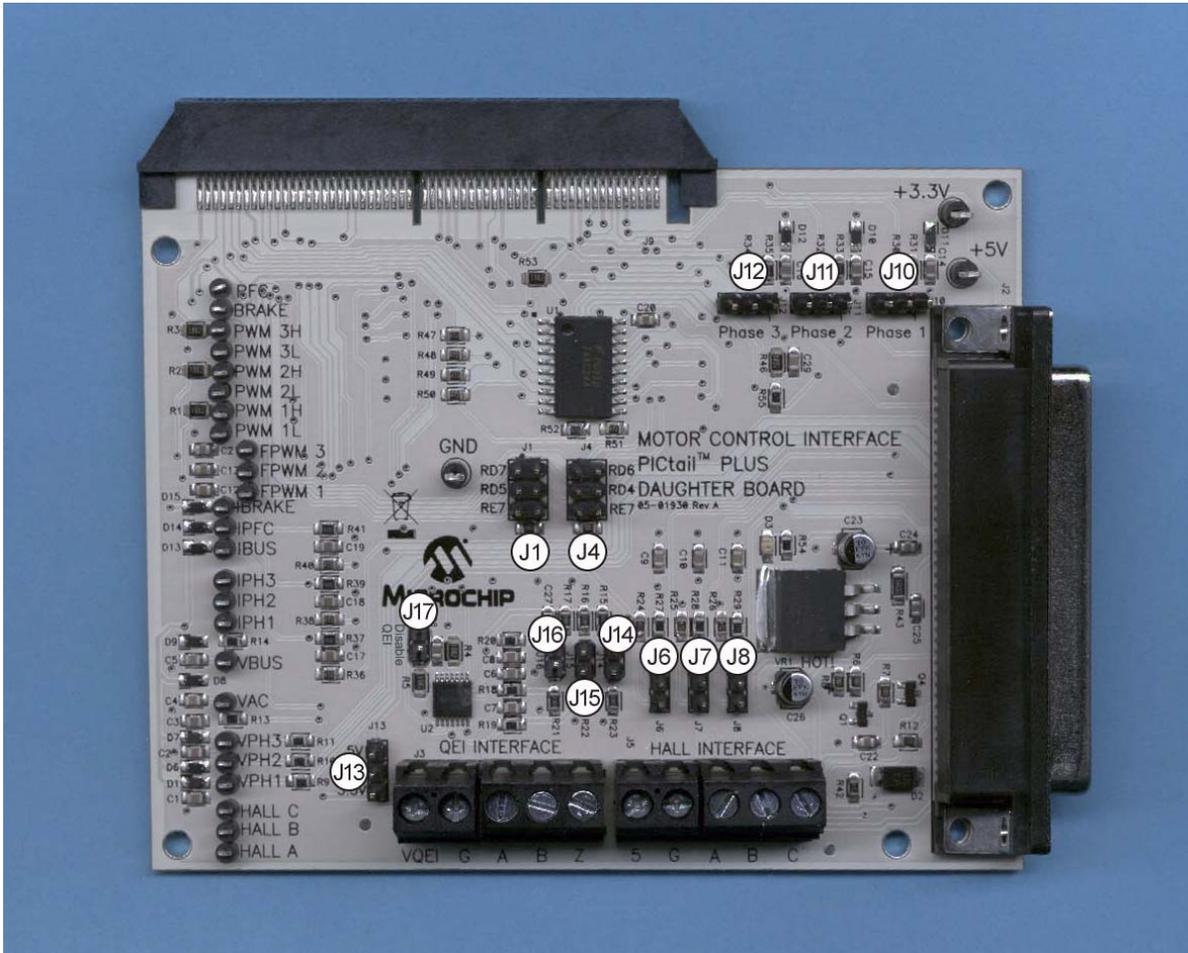


TABLE 2-2: JUMPER DESCRIPTION

Name	Description
J14	Pull-up select for QEI signal QZ ON: QEI Interface pin QZ pulled up to VQEI OFF: QEI Interface pin QZ pulled down to ground
J15	Pull-up select for QEI signal QB ON: QEI Interface pin QB pulled up to VQEI OFF: QEI Interface pin QB pulled down to ground
J16	Pull-up select for QEI signal QA ON: QEI Interface pin QA pulled up to VQEI OFF: QEI Interface pin QA pulled down to ground
J17	Disable QEI ON: QA, QB and QZ signals are high impedance OFF: QA, QB and QZ signals are enabled
J1	Trigger Source Select for Brake Chopper Circuit Pins 1-2: OC7 output is used to trigger the Brake Chopper circuit (TP21) Pins 3-4: OC5 output is used to trigger the Brake Chopper circuit (TP21) Pins 5-6: PWM4H output is used to trigger the Brake Chopper circuit (TP21)
J4	Trigger Source Select for PFC Circuit Pins 1-2: OC8 output is used to trigger the PFC circuit (TP22) Pins 3-4: OC6 output is used to trigger the PFC circuit (TP22) Pins 5-6: PWM4H output is used to trigger the PFC circuit (TP22)
J6	Zero Crossing/Hall Sensor Feedback Signal Select (TP1) Position 1-2: Zero crossing signal of R phase taken as feedback (PM7) Position 2-3: Hall Sensor signal HA taken as feedback (PM7)
J7	Zero Crossing/Hall Sensor Feedback Signal Select (TP2) Position 1-2: Zero crossing signal of Y phase taken as feedback (PM25) Position 2-3: Hall Sensor signal HB taken as feedback (PM25)
J8	Zero Crossing/Hall Sensor Feedback Signal Select (TP3) Position 1-2: Zero crossing signal of B phase taken as feedback (PM6) Position 2-3: Hall Sensor signal HC taken as feedback (PM6)
J10	Phase Current Feedback Select for R Phase (TP11) Position 1-2: R phase current from Hall sensor is taken as feedback (E11) Position 2-3: R phase current from R shunt resistor is taken as feedback (E11)
J11	Phase Current Feedback Select for Y Phase (TP10) Position 1-2: Y phase current from Hall sensor is taken as feedback (E12) Position 2-3: Y phase current from Y shunt resistor is taken as feedback (E12)
J12	Phase Current Feedback Select for B Phase (TP9) Position 1-2: B phase current from Hall sensor is taken as feedback (E1) Position 2-3: B phase current from B shunt resistor is taken as feedback (E1)
J13	Voltage Select for VQEI Position 1-2: QEI is a 5V interface Position 2-3: QEI is a 3.3V interface

2.4 TEST POINTS

Figure 2-4 shows the test points on the Motor Control Interface PICtail Plus Daughter Board.

FIGURE 2-4: TEST POINT LOCATIONS

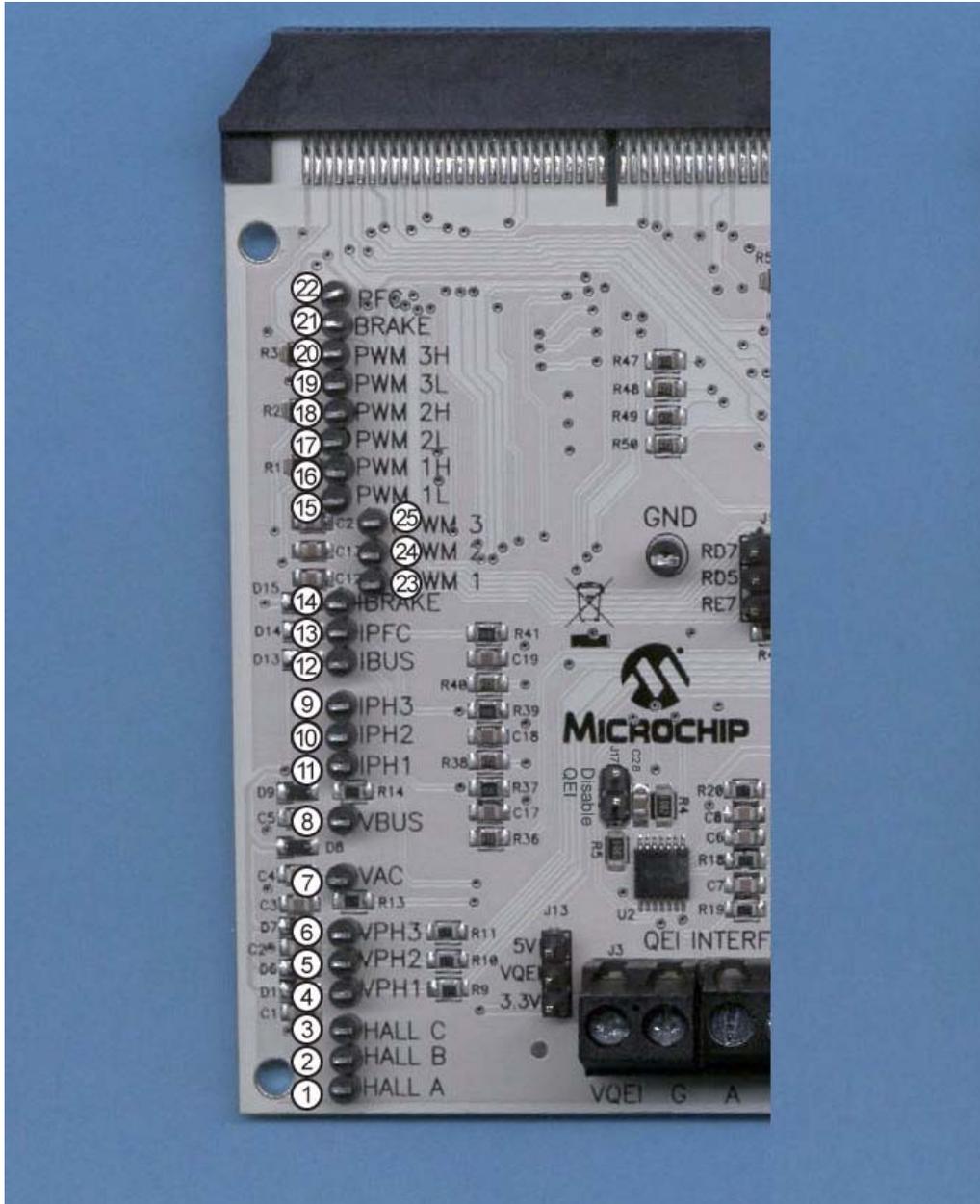


Table 2-3 lists and describes the test points of the Motor Control Interface PICtail Plus Daughter Board.

TABLE 2-3: TEST POINTS

Number	Test Point	Signal	Net Name
1	TP1	Hall Sensor A Feedback Signal	Hall A
2	TP2	Hall Sensor B Feedback Signal	Hall B
3	TP3	Hall Sensor C Feedback Signal	Hall C
4	TP4	Phase 1 Voltage Feedback	VPH1
5	TP5	Phase 2 Voltage Feedback	VPH2
6	TP6	Phase 3 Voltage Feedback	VPH3
7	TP7	Rectifier Output Voltage Feedback	VAC
8	TP8	DC Bus Voltage Feedback	VBUS
9	TP11	Phase 1 Current Feedback	IPH3
10	TP10	Phase 2 Current Feedback	IPH2
11	TP9	Phase 3 Current Feedback	IPH1
12	TP12	DC Bus Current Feedback	IBUS
13	TP13	PFC Current Feedback	IPFC
14	TP14	Brake Chopper Shunt Current Feedback	IBRAKE
15	TP15	PWM Signal for Phase 1, Bottom Switch	PWM1L
16	TP16	PWM Signal for Phase 1, Top Switch	PWM1H
17	TP17	PWM Signal for Phase 2, Bottom Switch	PWM2L
18	TP18	PWM Signal for Phase 2, Top Switch	PWM2H
19	TP19	PWM Signal for Phase 3, Bottom Switch	PWM3L
20	TP20	PWM Signal for Phase 3, Top Switch	PWM3H
21	TP21	PWM Signal for Brake Chopper	BRAKE
22	TP22	PWM Signal for PFC Circuit	PFC
23	TP23	Filtered PWM Signal of Phase 1, Top Switch	FPWM1
24	TP24	Filtered PWM Signal of Phase 2, Top Switch	FPWM2
25	TP25	Filtered PWM Signal of Phase 3, Top Switch	FPWM3

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NOTES:

Appendix A. Board Layout and Schematics

This appendix provides printed circuit board layout drawings and schematics for the Motor Control Interface PICtail Plus Daughter Board.

A.1 BOARD LAYOUT

FIGURE A-1: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD LAYOUT

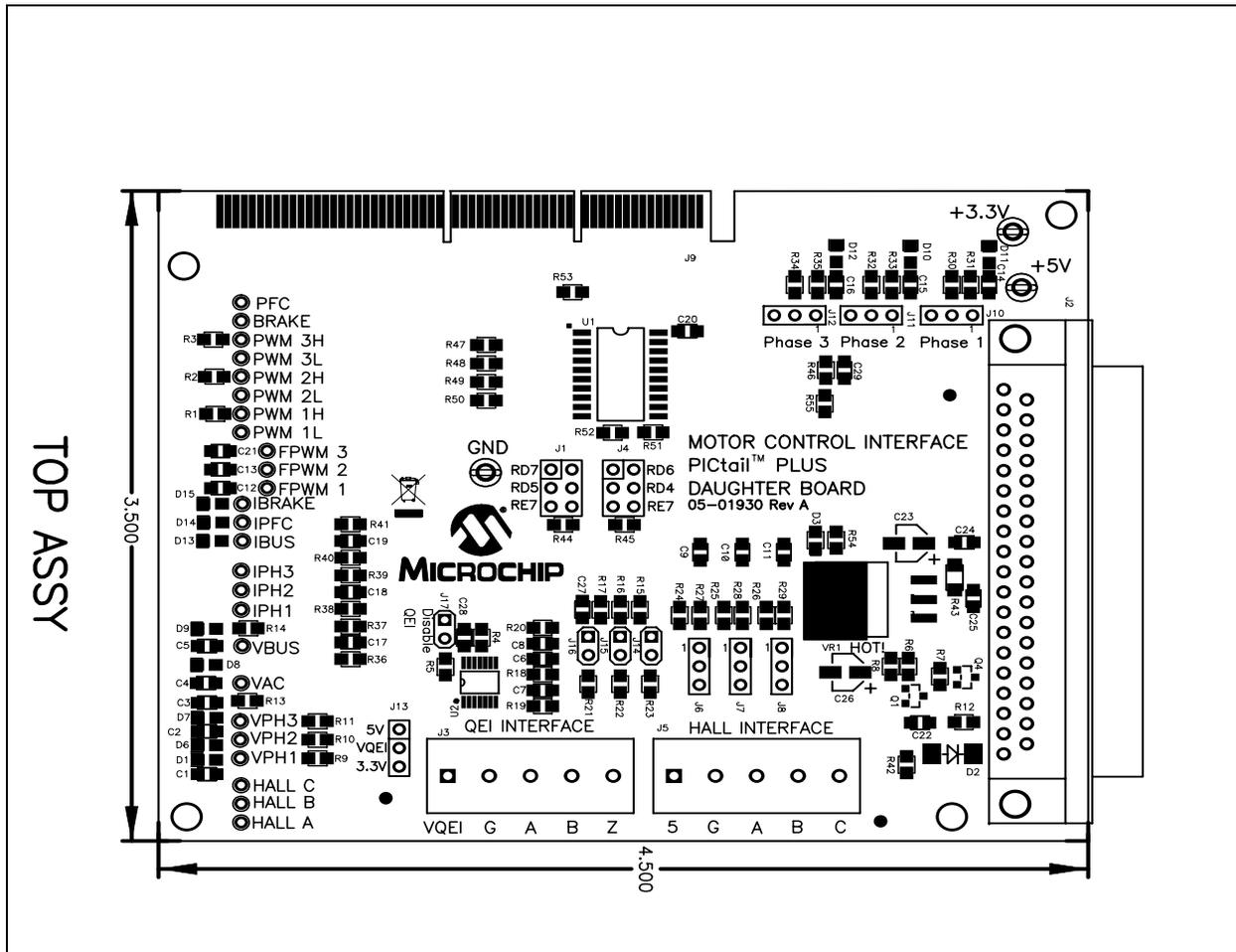


FIGURE A-3: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD SCHEMATIC (SHEET 2 OF 3)

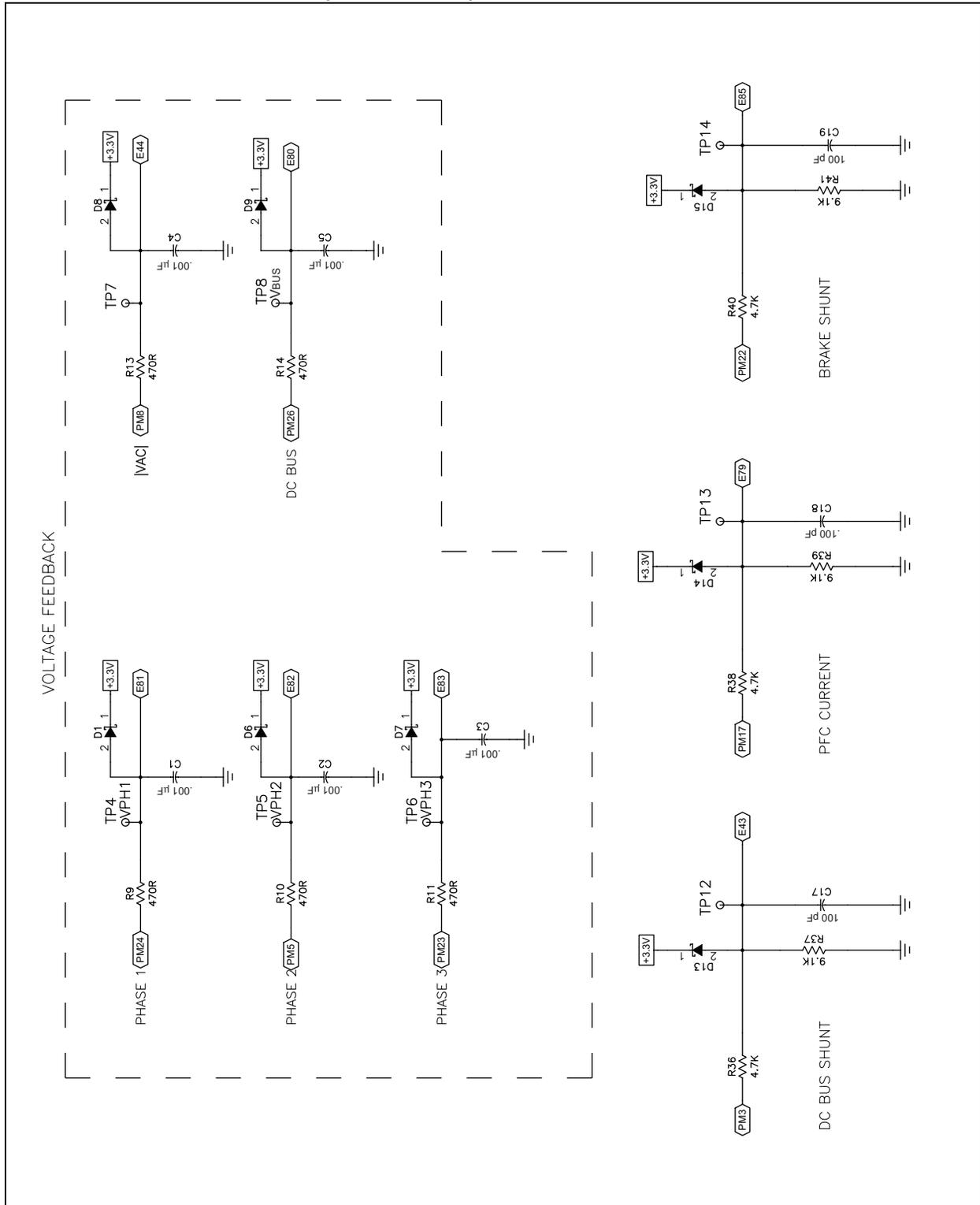
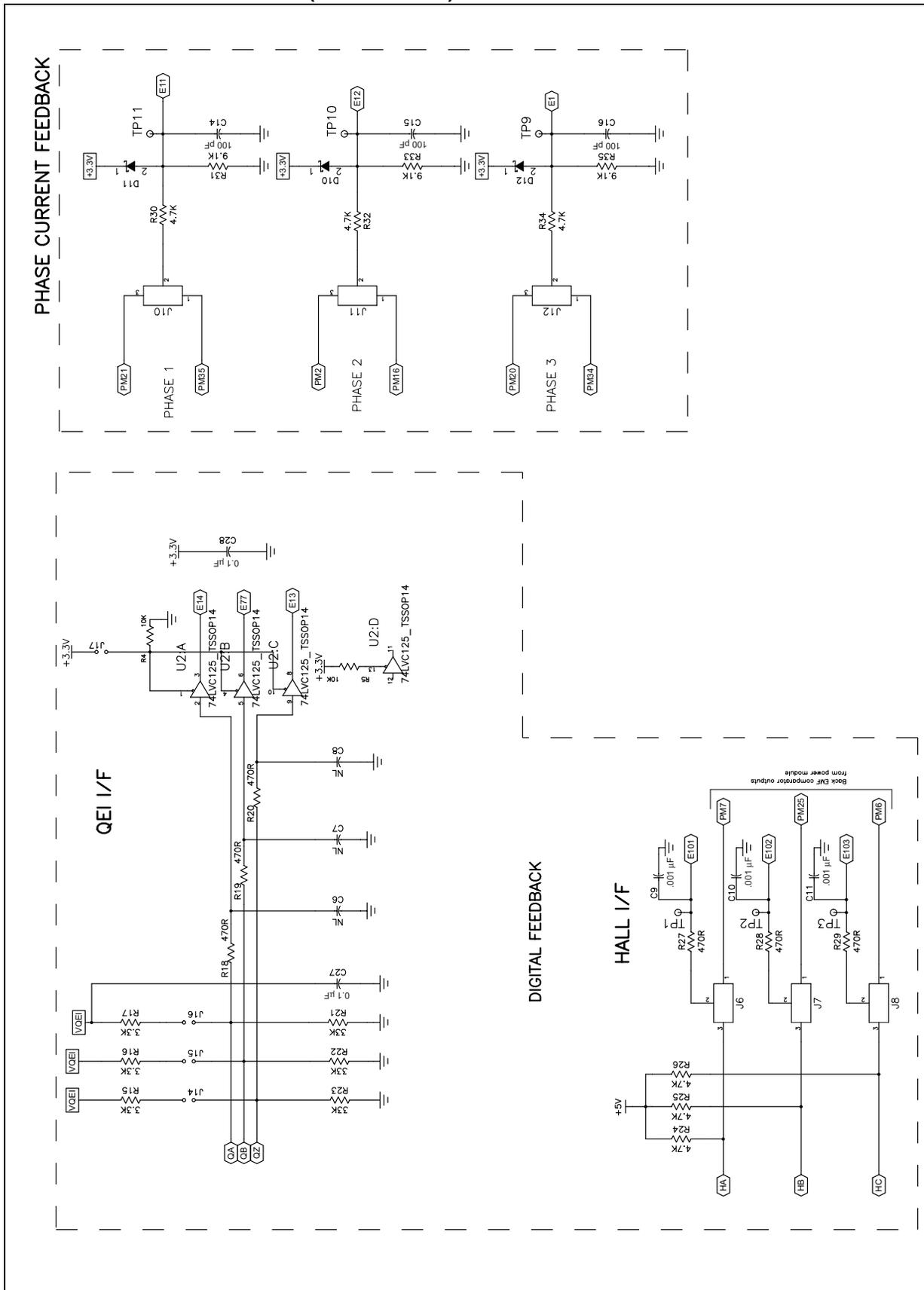


FIGURE A-4: MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD SCHEMATIC (SHEET 3 OF 3)





MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD

Appendix B. Bill of Materials (BOM)

B.1 BILL OF MATERIALS

TABLE B-1: BILL OF MATERIALS

Qty	Component Name	Ref	Value	Description	Vendor	Vendor P/N
1	1N4001_SMT	D2	1N4001	SMT Silicon Rectifier, 1A, 50V	Digi-Key	S1A
1	2N3904-SOT23-MOD	Q1	2N3904	PNP Transistor		
1	2N3906-SOT23-MOD	Q4	2N3906	NPN Transistor		
1	3PHDR	J13			Jameco	109575
2	5PHDR-200	J3		5 Pin Screw Terminal 5mm pitch_R/A	Digi-Key	RT Angle
	5PHDR-200	J5		5 Pin Screw Terminal 5mm pitch_R/A	Digi-Key	RT Angle
1	74ACT244	U1			Digi-Key	74ACT244SC-ND
1	74LVT125_TSSOP	U2			Digi-Key	568-2311-1-ND
11	CAP0805	C1	.001 μ F	Capacitor		
		C2				
		C3				
		C4				
		C5				
		C6				
		C7				
		C8				
		C9				
		C10				
		C11				
3	CAP0805	C12	0.1 μ F	Capacitor		
		C13				
		C21				
6	CAP0805	C22	0.1 μ F	Capacitor		
		C20				
		C24				
		C25				
		C27				
6	CAP0805	C14	100 pF	Capacitor		
		C15				
		C16				
		C17				
		C18				
		C19				

Motor Control Interface PICtail™ Plus Daughter Board User's Guide

TABLE B-1: BILL OF MATERIALS (CONTINUED)

Qty	Component Name	Ref	Value	Description	Vendor	Vendor P/N
1	CAP_VS_A	C26	10 µF/25	Elect. SMT Polarized Capacitor	Digi-Key	PCE3403CT-ND
1	CAP_VS_A	C23	10 µF 25V	Elect. SMT Polarized Capacitor	Digi-Key	PCE3403CT-ND
1	CNN-DB37-FEM-RA-PTH	J2			Digi-Key	337F-ND
3	DIODE-SMT_SCHOTTKY_0805	D10			Digi-Key	B0540WSDICT-ND
		D11				
		D12				
7	DIODE-SMT_SCHOTTKY_0805	D1			Digi-Key	B0540WSDICT-ND
		D6				
		D7				
		D9				
		D13				
		D14				
		D15				
1	DIODE-SMT_SCHOTTKY_0805	D8			Digi-Key	B0540WSDICT-ND
3	FIDUCIAL	X1				
		X2				
		X3				
2	HDR2X3	J1		2x3 .1 header		
		J4				
4	JUMPER	J14		Jumper	Jameco	108337
		J15				
		J16				
		J17				
1	LED-0805	D3	Power	Green Light Emitting Diode		
1	LM2940S_MOD	VR1	LM2940			
1	MEC1-160-EDGE-SOCKET	J9			Samtec	MEC1-160-02-F-D-EM2
3	RES0805	R6	1K	Resistor		
		R7				
		R8				
2	RES0805	R44	1K	Resistor		
		R45				
3	RES0805	R15	3.3K	Resistor		
		R16				
		R17				

TABLE B-1: BILL OF MATERIALS (CONTINUED)

Qty	Component Name	Ref	Value	Description	Vendor	Vendor P/N
16	RES0805	R24	4.7K	Resistor		
		R25				
		R26				
		R30				
		R32				
		R34				
		R36				
		R38				
		R40				
		R42				
		R47				
		R48				
		R49				
		R50				
R51						
R52						
6	RES0805	R31	9.1K	Resistor		
		R33				
		R35				
		R37				
		R39				
		R41				
6	RES0805	R1	10K	Resistor		
		R2				
		R3				
		R4				
		R5				
		R46				
		R53				
1	RES0805	R12	10R	Resistor		
3	RES0805	R21	33K	Resistor		
		R22				
		R23				
12	RES0805	R9	470R	Resistor		
		R10				
		R11				
		R13				
		R14				
		R18				
		R19				
		R20				
		R27				
		R28				
		R29				
		R54				
		R55				

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TABLE B-1: BILL OF MATERIALS (CONTINUED)

Qty	Component Name	Ref	Value	Description	Vendor	Vendor P/N
1	RES1206	R43	1R	Resistor		
6	SIP_3_MOD	J6			Jameco	109575
		J7				
		J8				
		J10				
		J11				
		J12				
1	TP-60R38	TP21	BRAKE		Digi-Key	5001K-ND
1	TP-60R38	TP23	FPWM 1		Digi-Key	5001K-ND
1	TP-60R38	TP24	FPWM 2		Digi-Key	5001K-ND
1	TP-60R38	TP25	FPWM 3		Digi-Key	5001K-ND
1	TP-60R38	TP1	HALL A		Digi-Key	5001K-ND
1	TP-60R38	TP2	HALL B		Digi-Key	5001K-ND
1	TP-60R38	TP3	HALL C		Digi-Key	5001K-ND
1	TP-60R38	TP14	IBRAKE		Digi-Key	5001K-ND
1	TP-60R38	TP12	IBUS		Digi-Key	5001K-ND
1	TP-60R38	TP13	IPFC		Digi-Key	5001K-ND
1	TP-60R38	TP11	IPH1		Digi-Key	5001K-ND
1	TP-60R38	TP10	IPH2		Digi-Key	5001K-ND
1	TP-60R38	TP9	IPH3		Digi-Key	5001K-ND
1	TP-60R38	TP22	PFC		Digi-Key	5001K-ND
1	TP-60R38	TP16	PWM 1H		Digi-Key	5001K-ND
1	TP-60R38	TP15	PWM 1L		Digi-Key	5001K-ND
1	TP-60R38	TP18	PWM 2H		Digi-Key	5001K-ND
1	TP-60R38	TP17	PWM 2L		Digi-Key	5001K-ND
1	TP-60R38	TP20	PWM 3H		Digi-Key	5001K-ND
1	TP-60R38	TP19	PWM 3L		Digi-Key	5001K-ND
1	TP-60R38	TP7	VAC		Digi-Key	5001K-ND
1	TP-60R38	TP8	VBUS		Digi-Key	5001K-ND
1	TP-60R38	TP4	VPH1		Digi-Key	5001K-ND
1	TP-60R38	TP5	VPH2		Digi-Key	5001K-ND
1	TP-60R38	TP6	VPH3		Digi-Key	5001K-ND
1	TP-106	TP28	+3.3V		Digi-Key	5011K-ND
1	TP-106	TP27	+5V		Digi-Key	5011K-ND
1	TP-106	TP26	GND		Digi-Key	5011K-ND



MOTOR CONTROL INTERFACE PICtail™ PLUS DAUGHTER BOARD

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