dsPIC® DSC Signal Board User's Guide

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EU Declaration of Conformity

This declaration of conformity is issued by the manufacturer.
The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the dsPIC® DSC Signal Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- 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 the dsPIC DSC Signal Board as a development tool to emulate and debug firmware on a target board. This user's guide is composed of the following chapters:

- **Chapter 1. "Introduction"** provides the features and functions of the dsPIC DSC Signal Board.
- **Chapter 2. "Board Interface Description"** describes the dsPIC DSC Signal Board input and output interfaces.
- **Chapter 3. "Hardware Description"** provides the hardware descriptions of the dsPIC DSC Signal Board.
- **Appendix A. "Schematics and Layout"** provides board layouts and detailed schematics of the dsPIC DSC Signal Board.
- **Appendix B. "Electrical Specifications"** provides the electrical specifications of the dsPIC DSC Signal Board.
- **Appendix C. "Design Calculations"** provides the design calculations of the dsPIC DSC Signal Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
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
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
`Plain Courier New`	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
`Italic Courier New`	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`
Notes	A Note presents information that we want to re-emphasize, either to help you avoid a common pitfall or to make you aware of operating differences between some device family members. A Note can be in a box, or when used in a table or figure, it is located at the bottom of the table or figure.	**Note:** This is a standard note box. **CAUTION** **This is a caution note.** **Note 1:** This is a note used in a table.

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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 starter kit. The following Microchip documents are available and recommended as supplemental reference resources.

MPLAB® X IDE User's Guide (DS50002027)

This user's guide is a comprehensive guide that describes installation and features of Microchip's MPLAB X Integrated Development Environment (IDE), as well as the editor and simulator functions in the MPLAB X 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 X IDE installation directory. The Readme files contain updated information and known issues that may not be included in this user's guide.

MPLAB® XC16 Assembler, Linker and Utilities User's Guide (DS52106)

This user's guide describes how to use GNU language tools to write code for 16-bit applications.

MPLAB XC16 C Compiler User's Guide (DS50002071)

This user's guide describes how to use the 16-bit MPLAB XC16 C Compiler. Please visit www.microchip.com/compilers for more information.

dsPIC33EV256GM106 5V Motor Control Plug-In Module (PIM) Information Sheet (DS50002225)

This information sheet provides information specific to the dsPIC33EV256GM106 5V Motor Control Plug-In Module (PIM).

dsPIC33EP512GM710 Plug-In Module (PIM) Information Sheet for Single-Dual Motor Control (DS50002216)

This information sheet provides information specific to the dsPIC33EP512GM710 Plug-In Module (PIM) for Single-Dual Motor Control.

Motor Control 10-24V Driver Board (Dual/Single) User's Guide (DS50002261)

This user's guide describes how to use Microchip's Motor Control 10-24V Driver Board (Dual/Single).

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at http://www.microchip.com. This web site makes files and information easily available to customers. Accessible by most Internet browsers, the web site contains the following information:

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listings
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listings of seminars and events; and listings of Microchip sales offices, distributors and factory representatives

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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools
- **Emulators** – The latest information on the Microchip in-circuit emulator, MPLAB REAL ICE™
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3
- **MPLAB X IDE** – The latest information on Microchip MPLAB X IDE, the Windows® Integrated Development Environment for development systems tools
- **Programmers** – The latest information on Microchip programmers including the PICkit™ 3 development programmer

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 (April 2014)

This is the initial release of this document.

Chapter 1. Introduction

1.1 OVERVIEW

This chapter describes the features and functions of the dsPIC® DSC Signal Board.

The dsPIC DSC Signal Board is a general purpose development board which provides the dsPIC DSC signal connections to application boards, along with user interfaces. The board supports both +3.3V and +5V operated devices for various applications. The board has some frequently used user interface features, along with two major connectors: a 120-pin connector and a 60-pin connector to enable connection to plug-in boards. The 120-pin connector is connected to all PIM header pins, power supply signals and various grounds. The 60-pin connector allows expansion for communication, enhanced interfacing and light power applications.

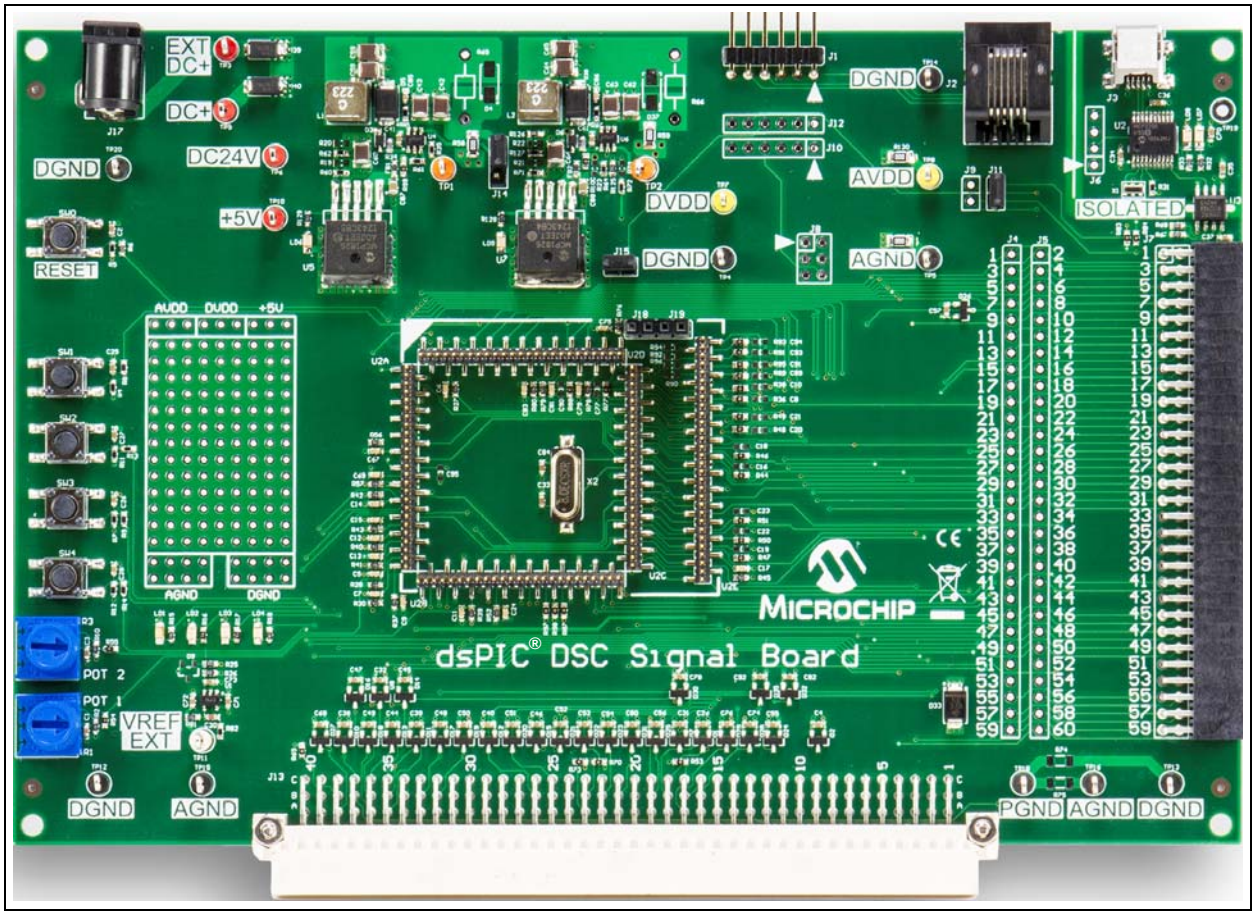
1.2 dsPIC DSC SIGNAL BOARD FEATURES

The dsPIC DSC Signal Board is shown in Figure 1-1. The board includes these key features:

- Interfaces:
  - 120-pin power board interface connector for power application board (J13)
  - 60-pin expansion connector for add-on boards (J7)
  - 30-pin connector for signal monitoring or expansion (J4)
  - 30-pin connector for signal monitoring or expansion (J5)
  - 100/105-pin PIM header (U2A, U2B, U2C, U2D, U2E) support microcontroller and dsPIC DSC's Plug-in Module (PIM) with internal or external op amp configuration
- User Interfaces:
  - Reset push button (SW0)
  - Four push buttons (SW1-SW4)
  - Two 10 kΩ potentiometers (POT1 and POT2)
  - Four LED indicators for debugging (LD1-LD4)
  - Two power-on status LEDs (LD5, LD6)
  - Two LED indicators for USB communications (LD7, LD8)
- Communication Ports:
  - UART communication through USB (isolated) (J3)
  - SPI interface (J8)
  - PICkit™ serial analyzer (SPI protocol) interface (J10)
  - PICkit serial analyzer interface (I^2C™ protocol) (J12)
- Power Supply Connectors:
  - 24V power input connector (J17)
- Programming Connectors:
  - ICSP™ connector for programming the dsPIC DSC or microcontroller (J1)
  - RJ11 connector for programming the dsPIC DSC or microcontroller (J2)

- Test Points:
  - 20 test points (TP1-TP20) provided on the board for debugging and measurement
- Power:
  - DC+, EXT DC+, DC24V, +5V, DV_{DD}, AV_{DD}
- Ground:
  - Digital Ground (DGND), Analog Ground (AGND), Power Ground (PGND)

FIGURE 1-1: dsPIC® DSC SIGNAL BOARD



1.3 FUNCTIONS

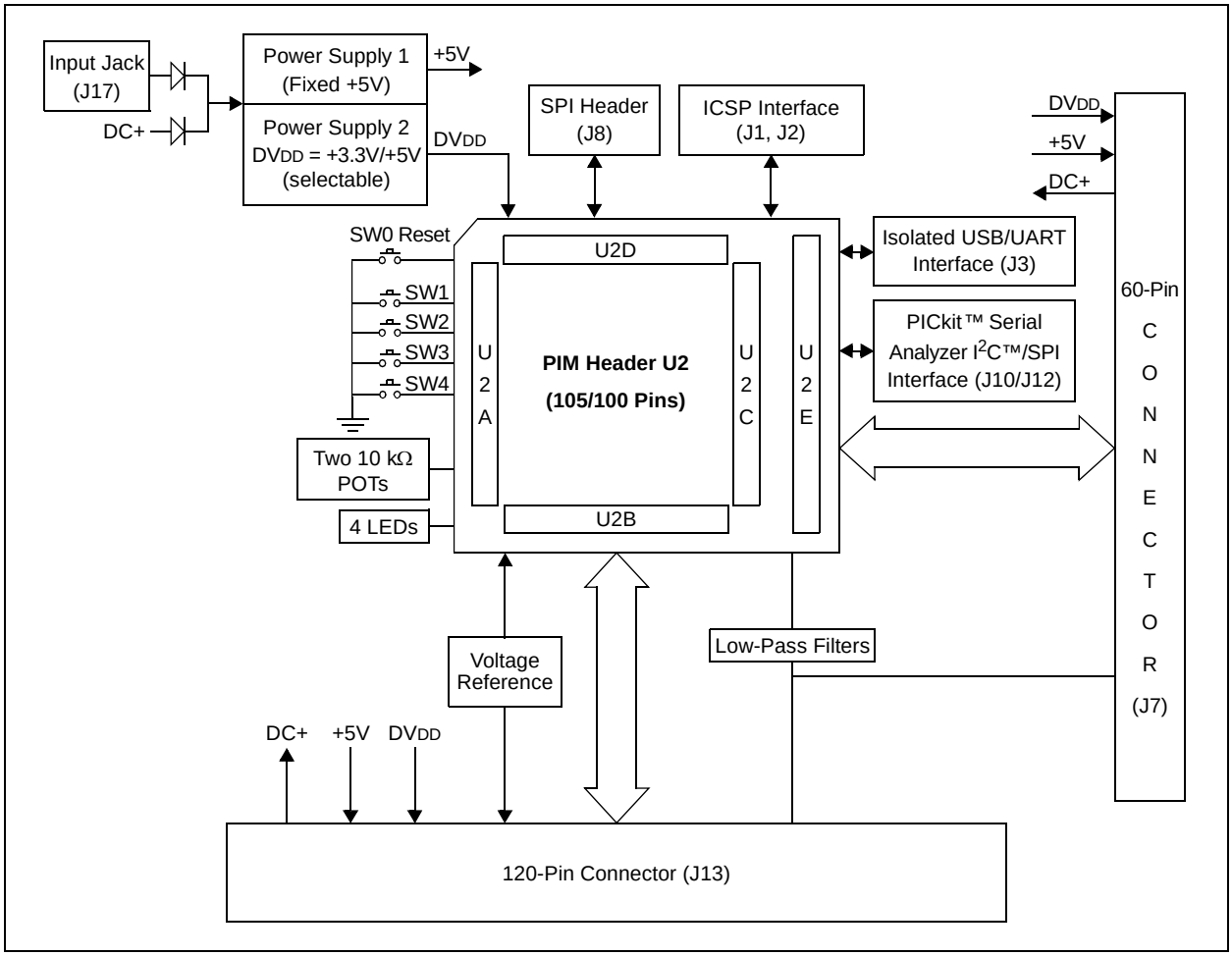
The dsPIC DSC Signal Board has the following functions:

- Supports application power boards connected to the J13 and J7 connectors
- Experiments with functionality of devices on the PIM header
- Provides on-board user interface-like switches, LEDs and potentiometers
- Communicates with a host computer or external device through isolated USB, I^2C and SPI interfaces
- Provides auxiliary power supply (DV_{DD} = +3.3V or +5V) to various devices used on the dsPIC DSC Signal Board, as well as plug-in boards
- Provides a prototyping area for user circuit development or implementation

1.4 BLOCK DIAGRAM

A simplified block diagram of the dsPIC DSC Signal Board is shown in Figure 1-2.

FIGURE 1-2: dsPIC® DSC SIGNAL BOARDBLOCK DIAGRAM



NOTES:

Chapter 2. Board Interface Description

2.1 INTRODUCTION

This chapter provides a more detailed description of the input and output interfaces of the dsPIC® DSC Signal Board.

2.2 HIGHLIGHTS

This chapter covers the following topics:

- Board Connectors and Headers
- User Interface Hardware
- Board Test Points

2.3 BOARD CONNECTORS AND HEADERS

The dsPIC DSC Signal Board contains various connectors and headers.

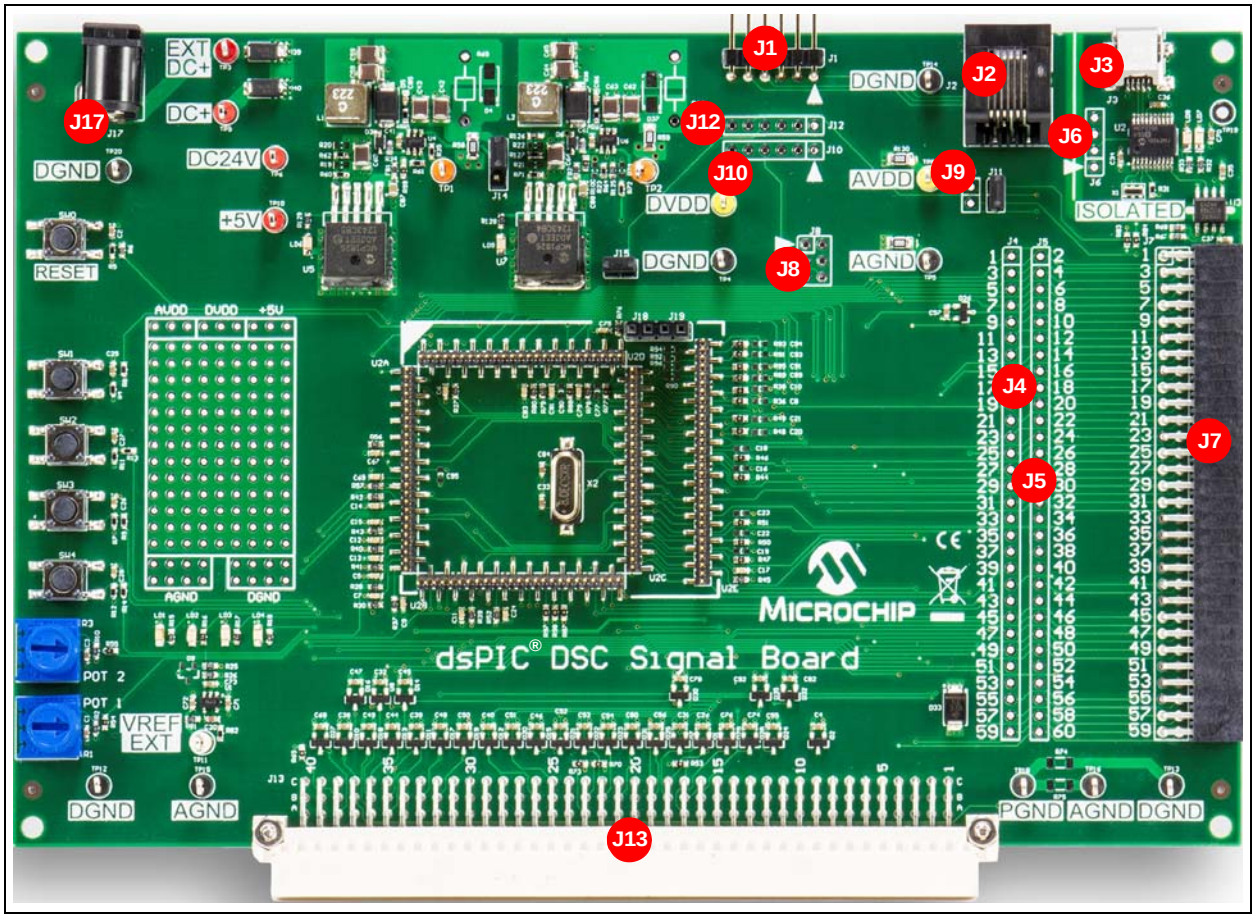
The on-board hardware connectors are provided in Table 2-1. Figure 2-1 shows different on-board connectors.

TABLE 2-1: BOARD CONNECTORS

Designator	Number of Pins	Description
J1	6	ICSP™ connector for programming a dsPIC® DSC or microcontroller
J2	6	RJ11, 6-pin connector for programming a dsPIC DSC or microcontroller
J3	5	Isolated USB interface port
J4	30	Odd number pin connection from connector, J7(1)
J5	30	Even number pin connection from connector, J7(1)
J6	4	Isolated UART interface
J7	60	Connector for expansion board interface(1)
J8	6	Header for SPI interface
J9	2	UART TX/RX inputs
J10	6	Header for PICkit™ serial analyzer (SPI interface)
J12	6	Header for PICkit serial analyzer (I^2C™ interface)
J13	120	Power board interface connector for application boards
J17	2	Input power supply connector (24V)

Note 1: See Table 2-12 and Table 2-14 for connection details.

FIGURE 2-1: dsPIC® DSC SIGNAL BOARD CONNECTORS



The on-board headers and connectors are described in the following sections:

- PIM Header
- PICkit Programming Header (J1)
- MPLAB ICD 3 or REAL ICE™ In-Circuit Emulator Connector (J2)
- Isolated USB Interface (J3)
- Alternate USB/UART Interface (J6)
- SPI Interface Connector (J8)
- Additional UART TX/RX Inputs (J9)
- PICkit Serial Analyzer SPI Interface
- Input Power Connector (J17)
- Power Board Interface Connector (J13)
- Expansion Board Connector (J4, J5 and J7)

2.3.1 PIM Header

The dsPIC DSC Signal Board has been designed to accommodate detachable Plug-in Modules (PIMs). The board supports 105-pin PIMs and it is also backward compatible with some of the 100-pin PIMs. The PIM pinout and function on the dsPIC DSC Signal Board, and the respective connectors are provided in Table 2-2.

TABLE 2-2: dsPIC® DSC SIGNAL BOARD PIM PINOUT FUNCTIONALITY

PIM Pin #	Signal Name	Functional Description	Filter	Connectors			
				J13	J7	J4	J5
1	PIM:01_PWR:B8_EXP:01	Debug LED 1	No	B8	01	01	—
2	DV_{DD}	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
3	PIM:03_PWR:A8_EXP:49	—	No	A8	49	49	—
4	PIM:04_PWR:C7_EXP:02	—	No	C7	02	—	02
5	PIM:05_PWR:B7_EXP:03	—	No	B7	03	03	—
6	PIM:06_PWR:A7_EXP:04	—	No	A7	04	—	04
7	PIM:07_PWR:C6_EXP:05	—	No	C6	05	05	—
8	PIM:08_PWR:B6_EXP:06	—	No	B6	06	—	06
9	PIM:09_PWR:A6_EXP:07	—	No	A6	07	07	—
10	PIM:10_PWR:C5	—	No	C5	—	—	—
11	PIM:11_PWR:B5_EXP:08_FLT	—	Yes	B5	08	—	08
12	PIM:12_PWR:A5_EXP:09	—	No	A5	09	09	—
13	PIM:13 ($\overline{MCLR}$)	Device Master Clear ($\overline{MCLR}$)	No	—	25	25	—
14	PIM:14_PWR:A38_FLT	—	Yes	A38	—	—	—
15	DGND	Digital Ground	—	—	—	—	—
16	DV_{DD}	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
17	PIM:17_PWR:C37_FLT	—	Yes	C37	—	—	—
18	PIM:18_PWR:B37_EXP:55	—	No	B37	55	55	—
19	PIM:19_PWR:A37_EXP:10	—	No	A37	10	—	10
20	PIM:20_PWR:C36_FLT	—	Yes	C36	—	—	—
21	PIM:21_PWR:B36_FLT	—	Yes	B36	—	—	—
22	PIM:22_PWR:A36_FLT	—	Yes	A36	—	—	—
23	PIM:23_PWR:C35_EXP:11_FLT	Potentiometer 2	Yes	C35	11	11	—
24	PIM:24_PWR:B35_FLT	—	Yes	B35	—	—	—
25	PIM:25_PWR:A35_FLT	—	Yes	A35	—	—	—
26	PIM:26_PWR:C34_EXP:41	Device Programming Clock Line (PGC)	No	C34	41	41	—
27	PIM:27_PWR:B34_EXP:42	Device Programming Data Line (PGD)	No	B34	42	—	42
28	PIM:28_PWR:A34	Reference Voltage (V_{REF})	No	A34	—	—	—
29	PIM:29_PWR:C33_EXP:12	—	No	C33	12	—	12
30	AV_{DD}	Analog Voltage (+3.3V/+5V)	—	—	—	—	—
31	AGND	Analog Ground	—	—	—	—	—
32	PIM:32_PWR:B33_EXP:13_FLT	Potentiometer 1	Yes	B33	13	13	—

Note 1: Signal PIM:69 has two functions. This signal is connected to Switch S1 and the PICkit™ serial analyzer header, J12. When connector J15 is open, PIM:69 is connected to the PICkit serial analyzer I^2C™ interface. However, when connector J15 is shorted, PIM:69 is connected to switch SW1.

2: Signal PIM:49 has two functions. This signal is connected to the UART Transmit Pin 6 of the digital isolator, U3, and the PICkit serial analyzer header, J12. When connector J11 is open, PIM:49 is connected to the PICkit serial analyzer I^2C interface. However, when connector J11 is shorted, PIM:49 is connected to the TX pin of the digital isolator, U3.

TABLE 2-2: dsPIC® DSC SIGNAL BOARD PIM PINOUT FUNCTIONALITY (CONTINUED)

PIM Pin #	Signal Name	Functional Description	Filter	Connectors			
				J13	J7	J4	J5
33	PIM:33_PWR:A33_EXP:14	Debug LED 3	No	A33	14	—	14
34	PIM:34_PWR:C32_EXP:15	Debug LED 4	No	C32	15	15	—
35	PIM:35_PWR:B32_FLT	—	Yes	B32	—	—	—
36	DGND	Digital Ground	—	—	—	—	—
37	DVDD	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
38	PIM:38_PWR:A32_EXP:16	—	No	A32	16	—	16
39	PIM:39_PWR:C31_EXP:17	—	No	C31	17	17	—
40	PIM:40_PWR:B31_EXP:18	Push Button SW3	No	B31	18	—	18
41	PIM:41_PWR:A31_EXP:56	Push Button SW4	No	A31	56	—	56
42	PIM:42_PWR:C29	—	No	C29	—	—	—
43	PIM:43_PWR:B29	—	No	B29	—	—	—
44	PIM:44_PWR:A29	—	No	A29	—	—	—
45	DGND	Digital Ground	—	—	—	—	—
46	DVDD	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
47	PIM:47_PWR:C28_EXP:19	—	No	C28	19	19	—
48	PIM:48_PWR:B28_EXP:20	—	No	B28	20	—	20
49	PIM:49_PWR:A28_EXP:21(2)	UART Receive/I2C PICkit Interface	No	A28	21	21	—
50	PIM:50_PWR:C27_EXP:22	UART Transmit	No	C27	22	—	22
51	PIM:51_PWR:B27_EXP:58	—	No	B27	58	—	58
52	PIM:52_PWR:A27_EXP:59	—	No	A27	59	59	—
53	PIM:53_PWR:C26	—	No	C26	—	—	—
54	PIM:54_PWR:B26_FLT	—	Yes	B26	—	—	—
55	PIM:55_PWR:A26_FLT	—	Yes	A26	—	—	—
56	PIM:56_PWR:C25_FLT	—	Yes	C25	—	—	—
57	PIM:57_PWR:B25_FLT	—	Yes	B25	—	—	—
58	PIM:58_PWR:A25	—	No	A25	—	—	—
59	PIM:59_PWR:B24_EXP:57	Debug LED 2	No	B24	57	57	—
60	PIM:60_PWR:A24_EXP:60	—	No	A24	60	—	60
61	PIM:61_PWR:C23_EXP:24	—	No	C23	24	—	24
62	DVDD	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
63	PIM:63 (OSC1)	Crystal Oscillator In (OSC1)	—	—	—	—	—
64	PIM:64 (OSC2)	Crystal Oscillator Out (OSC2)	—	—	—	—	—
65	DGND	Digital Ground	—	—	—	—	—
66	PIM:66_PWR:C22_FLT	—	Yes	C22	—	—	—
67	PIM:67_PWR:B22_FLT	—	Yes	B22	—	—	—
68	PIM:68_PWR:A22	—	No	A22	—	—	—
69	PIM:69_PWR:A15_EXP:28_FLT_PICkit(1)	Push Button SW1/I2C PICkit Interface	Yes	A15	28	—	28
70	PIM:70_PWR:A21	—	No	A21	—	—	—

Note 1: Signal PIM:69 has two functions. This signal is connected to Switch S1 and the PICkit™ serial analyzer header, J12. When connector J15 is open, PIM:69 is connected to the PICkit serial analyzer I2C™ interface. However, when connector J15 is shorted, PIM:69 is connected to switch SW1.

2: Signal PIM:49 has two functions. This signal is connected to the UART Transmit Pin 6 of the digital isolator, U3, and the PICkit serial analyzer header, J12. When connector J11 is open, PIM:49 is connected to the PICkit serial analyzer I2C interface. However, when connector J11 is shorted, PIM:49 is connected to the TX pin of the digital isolator, U3.

TABLE 2-2: dsPIC® DSC SIGNAL BOARD PIM PINOUT FUNCTIONALITY (CONTINUED)

PIM Pin #	Signal Name	Functional Description	Filter	Connectors			
				J13	J7	J4	J5
71	PIM:71_PWR:B19_FLT	—	Yes	B19	—	—	—
72	PIM:72_PWR:A19	—	No	A19	—	—	—
73	PIM:73_PWR:C18_FLT	—	Yes	C18	—	—	—
74	PIM:74_PWR:B18_FLT	—	Yes	B18	—	—	—
75	DGND	Digital Ground		-	—	—	—
76	PIM:76_PWR:B17_FLT	—	Yes	B17	—	—	—
77	PIM:77_PWR:A17_FLT	—	Yes	A17	—	—	—
78	PIM:78_PWR:C16_EXP:26	PICkit SPI Interface Data Out	No	C16	26	—	26
79	PIM:79_PWR:B16_FLT	—	Yes	B16	—	—	—
80	PIM:80_PWR:A16_EXP:27	—	No	A16	27	27	—
81	PIM:81_PWR:C15_FLT	—	Yes	C15	—	—	—
82	PIM:82_PWR:B15	—	No	B15	—	—	—
83	PIM:83_PWR:B21_FLT	—	Yes	B21	—	—	—
84	PIM:84_PWR:C14_EXP:29_FLT	Push Button SW2	Yes	C14	29	29	—
85	PIM:85_PWR:B14	—	No	B14	—	—	—
86	DV_{DD}	Digital Voltage (+3.3V/+5V)	—	—	—	—	—
87	PIM:87_PWR:A14_EXP:30	PICkit SPI Clock	No	A14	30	—	30
88	PIM:88_PWR:C13_EXP:31	PICkit SPI Interface Data In	No	C13	31	31	—
89	PIM:89_PWR:B13	—	No	B13	—	—	—
90	PIM:90_PWR: A13	—	No	A13	—	—	—
91	PIM:91_PWR:C12_EXP:32	PICkit SPI Interface CS	No	C12	32	—	32
92	PIM:92_PWR:B12	—	No	B12	—	—	—
93	PIM:93_PWR:A12_EXP:46	—	No	A12	46	—	46
94	PIM:94_PWR:C11_EXP:45	—	No	C11	45	45	—
95	PIM:95_PWR:B11	—	No	B11	—	—	—
96	PIM:96_PWR:A11	—	No	A11	—	—	—
97	PIM:97_PWR:C9_EXP:23_FLT	—	Yes	C9	23	23	—
98	PIM:98_PWR:B9_EXP:48	—	No	B9	48	—	48
99	PIM:99_PWR:A9_EXP:47	—	No	A9	47	47	—
100	PIM:100_PWR:C8_EXP:50	—	No	C8	50	—	50
101	PIM:101	Reference Voltage (V_{REF})	No	C24	—	—	—
102	PIM:102	Reference Voltage (V_{REF})	No	C21	—	—	—
103	PIM:103	Reference Voltage (V_{REF})	No	C19	—	—	—
104	PIM:104	Reference Voltage (V_{REF})	No	A18	—	—	—
105	PIM:105_PWR:C17	—	No	C17	—	—	—

Note 1: Signal PIM:69 has two functions. This signal is connected to Switch S1 and the PICkit™ serial analyzer header, J12. When connector J15 is open, PIM:69 is connected to the PICkit serial analyzer I^2C™ interface. However, when connector J15 is shorted, PIM:69 is connected to switch SW1.

2: Signal PIM:49 has two functions. This signal is connected to the UART Transmit Pin 6 of the digital isolator, U3, and the PICkit serial analyzer header, J12. When connector J11 is open, PIM:49 is connected to the PICkit serial analyzer I^2C interface. However, when connector J11 is shorted, PIM:49 is connected to the TX pin of the digital isolator, U3.

2.3.2 PICkit Programming Header (J1)

A 6-pin header J1 connects the MPLAB PICkit 3 development programmer to the dsPIC DSC or microcontroller for programming and debugging (see Table 2-3).

TABLE 2-3: PICkit™ PROGRAMMING HEADER (J1) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	PIM:13 ($\overline{MCLR}$)	Device Master Clear ($\overline{MCLR}$)
2	DV_{DD}	Digital Supply Voltage
3	DGND	Digital Ground
4	PIM:27_PWR:B34_EXP:42	Device Programming Data Line (PGD)
5	PIM:26_PWR:C34_EXP:41	Device Programming Clock Line (PGC)
6	No Connection	—

2.3.3 MPLAB ICD 3 or REAL ICE™ In-Circuit Emulator Connector (J2)

An RJ11 female connector J2 connects the MPLAB In-Circuit Debugger/Emulator (MPLAB ICD 3 or REAL ICE) to the dsPIC DSC or microcontroller for programming and debugging (see Table 2-4).

TABLE 2-4: MPLAB® ICD 3/REAL ICE™ CONNECTOR (J2) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	PIM:13 ($\overline{MCLR}$)	Device Master Clear ($\overline{MCLR}$)
2	DV_{DD}	Digital Supply Voltage
3	DGND	Digital Ground
4	PIM:27_PWR:B34_EXP:42	Device Programming Data Line (PGD)
5	PIM:26_PWR:C34_EXP:41	Device Programming Clock Line (PGC)
6	No Connection	—

2.3.4 Isolated USB Interface (J3)

The dsPIC DSC Signal Board uses an on-board MCP2200 device (see U2 in Figure A-3) as a bridge between the UART and USB (see Table 2-5).

TABLE 2-5: ISOLATED USB INTERFACE (J3) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
0	No Connection	Body Connection
1	5V_USB	USB +5V DC
2	USB_N	USB Data-
3	USB_P	USB Data+
4	No Connection	—
5	GND_USB	USB Ground

2.3.5 Alternate USB/UART Interface (J6)

A 4-pin header J6 provides a provision to bypass the MCP2200 device (see U3 in Figure A-3) and connect an alternate UART/USB interface device (see Table 2-6).

TABLE 2-6: ALTERNATE USB/UART INTERFACE (J6) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	5V_USB	USB +5V DC
2	MCP2200_RX	Isolated UART Receive
3	MCP2200_TX	Isolated UART Transmit
4	GND_USB	USB Ground

2.3.6 SPI Interface Connector (J8)

A 6-pin header J8 provides the connection for the Serial Peripheral Interface (SPI) communication (see Table 2-7).

TABLE 2-7: SPI INTERFACE CONNECTOR (J8) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	DV_{DD}	Digital Supply Voltage
2	DGND	Digital Ground
3	DGND	Digital Ground
4	PIM:87_PWR:A14_EXP:30	SPI Clock
5	PIM:91_PWR:C12_EXP:32	SPI Interface $\overline{CS}$
6	PIM:88_PWR:C13_EXP:31	SPI Interface Data

2.3.7 Additional UART TX/RX Inputs (J9)

A 2-pin header, J9, connects the input of the digital isolator, ADUM1201CRZ (see U3 in Figure A-3). Connector J9 can be used to connect external provided UART signals TX/RX (see Table 2-8).

TABLE 2-8: ADDITIONAL UART TX/RX INPUTS (J9) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	PIM:49_PWR:A28_EXP:21	UART Receive
2	PIM:50_PWR:C27_EXP:22	UART Transmit

2.3.8 PICkit Serial Analyzer SPI Interface

A 6-pin header J10 connects the PICkit serial analyzer to a dsPIC DSC or microcontroller supporting SPI protocol (see Table 2-9).

TABLE 2-9: PICkit™ SERIAL ANALYZER SPI INTERFACE (J10) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	PIM:91_PWR:C12_EXP:32	PICkit SPI Interface $\overline{CS}$
2	DV_{DD}	Digital Supply Voltage
3	DGND	Digital Ground
4	PIM:88_PWR:C13_EXP:31	PICkit SPI Interface Data In
5	PIM:87_PWR:A14_EXP:30	PICkit SPI Clock
6	PIM:78_PWR:C16_EXP:26	PICkit SPI Interface Data Out

2.3.9 PICkit Serial Analyzer I²C Interface (J12)

A 6-pin header J12 connects the MPLAB PICkit serial analyzer to a dsPIC DSC or microcontroller supporting I²C protocol (see Table 2-10).

TABLE 2-10: PICkit™ SERIAL ANALYZER I²C INTERFACE (J12) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	No Connection	—
2	DVDD	Digital Supply Voltage
3	DGND	Digital Ground
4	PIM:69_PWR:A15_EXP:28_FLT_PICkit	PICkit I²C™ Interface Serial Data
5	PIM:49_PWR:A28_EXP:21	PICkit I²C Interface Serial Clock Interface
6	No Connection	—

2.3.10 Input Power Connector (J17)

The dsPIC DSC Signal Board receives the input from a 9V-24V power supply. It is connected to the board through connector J17 (see Table 2-11).

TABLE 2-11: INPUT POWER CONNECTOR (J17) PIN DESCRIPTION

Pin #	Signal Name	Pin Description
1	EXT DC+	Input Supply Voltage
3	DGND	Digital Ground
3	DGND	Digital Ground

2.3.11 Power Board Interface Connector (J13)

A 120-pin interface connector, J13, is used to interface the dsPIC DSC Signal Board with the dedicated power application board. All the signals from the PIM header are routed to this connector. It also has a connection to the input DC bus, supply voltages (+3.3V/+5V) and op amp reference signals.

Table 2-12 and Table 2-13 describe the J13 connector on-board pin functions. In Table 2-12, the J13 connector pins are tabulated in order of their number, whereas in Table 2-13, signals on connector J13 are grouped according to their functionality.

TABLE 2-12: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT

Connector J13	Signal Name	PIM Connection/Functional Description	PIM Pin
A1	DC+	Input DC Bus Voltage	—
B1	DC+	Input DC Bus Voltage	—
C1	DC+	Input DC Bus Voltage	—
A2	PGND	Power Ground	—
B2	PGND	Power Ground	—
C2	PGND	Power Ground	—
A3	+5V	Fixed +5V	—
B3	+5V	Fixed +5V	—
C3	AGND	Analog Ground	—
A4	AV_{DD}(4)	Analog Voltage (+3.3V/+5V)	—
B4	AV_{DD}(4)	Analog Voltage (+3.3V/+5V)	—
C4	AGND	Analog Ground	—
A5	PIM:12_PWR:A5_EXP:09	Direct Connection	12
B5	PIM:11_PWR:B5_EXP:08	Filter Signal	11
C5	PIM:10_PWR:C5	Direct Connection	10
A6	PIM:09_PWR:A6_EXP:07	Direct Connection	9
B6	PIM:08_PWR:B6_EXP:06	Direct Connection	8
C6	PIM:07_PWR:C6_EXP:05	Direct Connection	7
A7	PIM:06_PWR:A7_EXP:04	Direct Connection	6
B7	PIM:05_PWR:B7_EXP:03	Direct Connection	5
C7	PIM:04_PWR:C7_EXP:02	Direct Connection	4
A8	PIM:03_PWR:A8_EXP:49	Direct Connection	3
B8	PIM:01_PWR:B8_EXP:01	Direct Connection – Debug LED(1)	1
C8	PIM:100_PWR:C8_EXP:50	Direct Connection	100
A9	PIM:99_PWR:A9_EXP:47	Direct Connection	99
B9	PIM:98_PWR:B9_EXP:48	Direct Connection	98
C9	PIM:97_PWR:C9_EXP:23	Filter Signal	97
A10	DGND	Digital Ground	—
B10	DGND	Digital Ground	—
C10	DGND	Digital Ground	—
A11	PIM:96_PWR:A11	Direct Connection	96

Note 1: Direct connection identifies the connection between the J13 connector pins and PIM pins that do not have an analog filter at their input.

2: Filter signal identifies the connection between the J13 connector pins and PIM pins that have an analog filter.

3: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

4: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

TABLE 2-12: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (CONTINUED)

Connector J13	Signal Name	PIM Connection/Functional Description	PIM Pin
B11	PIM:95_PWR:B11	Direct Connection	95
C11	PIM:94_PWR:C11_EXP:45	Direct Connection	94
A12	PIM:93_PWR:A12_EXP:46	Direct Connection	93
B12	PIM:92_PWR:B12	Direct Connection	92
C12	PIM:91_PWR:C12_EXP:32	Direct Connection – PICkit™ SPI Interface $\overline{CS}$	91
A13	PIM:90_PWR: A13	Direct Connection	90
B13	PIM:89_PWR:B13	Direct Connection	89
C13	PIM:88_PWR:C13_EXP:31	Direct Connection – PICkit SPI Interface Data In	88
A14	PIM:87_PWR:A14_EXP:30	Direct Connection – PICkit SPI Clock	87
B14	PIM:85_PWR:B14	Direct Connection	85
C14	PIM:84_PWR:C14_EXP:29	Filter Signal – Push Button SW2	84
A15	PIM:69_PWR:A15_EXP:28	Filter Signal – Push Button SW1/I^2C™ PICkit Interface	69
B15	PIM:82_PWR:B15	Direct Connection	82
C15	PIM:81_PWR:C15	Filter Signal	81
A16	PIM:80_PWR:A16_EXP:27	Direct Connection	80
B16	PIM:79_PWR:B16	Filter Signal	79
C16	PIM:78_PWR:C16_EXP:26	Direct Connection – PICkit SPI Interface Data Out	78
A17	PIM:77_PWR:A17	Filter Signal	77
B17	PIM:76_PWR:B17	Filter Signal	76
C17	PIM:105_PWR:C17	Direct Connection	105
A18	PIM:104_PWR:A18	Direct Connection – Reference Voltage (V_{REF})	104
B18	PIM:74_PWR:B18	Filter Signal	74
C18	PIM:73_PWR:C18	Filter Signal	73
A19	PIM:72_PWR:A19	Direct Connection	72
B19	PIM:71_PWR:B19	Filter Signal	71
C19	PIM:103_PWR:C19	Direct Connection – Reference Voltage (V_{REF})	103
A20	DGND	Digital Ground	—
B20	DGND	Digital Ground	—
C20	DGND	Digital Ground	-
A21	PIM:70_PWR:A21	Direct Connection	70
B21	PIM:83_PWR:B21	Filter Signal	83
C21	PIM:102_PWR:C21	Direct Connection – Reference Voltage (V_{REF})	102
A22	PIM:68_PWR:A22	Direct Connection	68
B22	PIM:67_PWR:B22	Filter Signal	67
C22	PIM:66_PWR:C22	Filter Signal	66
A23	DGND	Through 0Ω Resistor (R73)	—
B23	DGND	Through 0Ω Resistor (R70)	—
C23	PIM:61_PWR:C23_EXP:24	Direct Connection	61
A24	PIM:60_PWR:A24_EXP:60	Direct Connection	60
B24	PIM:59_PWR:B24_EXP:57	Direct Connection – Debug LED(2)	59

Note 1: Direct connection identifies the connection between the J13 connector pins and PIM pins that do not have an analog filter at their input.

2: Filter signal identifies the connection between the J13 connector pins and PIM pins that have an analog filter.

3: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

4: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

TABLE 2-12: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (CONTINUED)

Connector J13	Signal Name	PIM Connection/Functional Description	PIM Pin
C24	PIM:101_PWR:C24	Direct Connection – Reference Voltage (VREF)	101
A25	PIM:58_PWR:A25	Direct Connection	58
B25	PIM:57_PWR:B25	Filter Signal	57
C25	PIM:56_PWR:C25	Filter Signal	56
A26	PIM:55_PWR:A26	Filter Signal	55
B26	PIM:54_PWR:B26	Filter Signal	54
C26	PIM:53_PWR:C26	Direct Connection – UART Transmit	53
A27	PIM:52_PWR:A27_EXP:59	Direct Connection	52
B27	PIM:51_PWR:B27_EXP:58	Direct Connection	51
C27	PIM:50_PWR:C27_EXP:22	Direct Connection	50
A28	PIM:49_PWR:A28_EXP:21	Direct Connection – UART Receive/I2C™ PICkit™ Interface	49
B28	PIM:48_PWR:B28_EXP:20	Direct Connection	48
C28	PIM:47_PWR:C28_EXP:19	Direct Connection	47
A29	PIM:44_PWR:A29	Direct Connection	44
B29	PIM:43_PWR:B29	Direct Connection	43
C29	PIM:42_PWR:C29	Direct Connection	42
A30	DGND	Digital Ground	—
B30	DGND	Digital Ground	—
C30	DGND	Digital Ground	—
A31	PIM:41_PWR:A31_EXP:56	Direct Connection – Push Button SW4	41
B31	PIM:40_PWR:B31_EXP:18	Direct Connection – Push Button SW3	40
C31	PIM:39_PWR:C31_EXP:17	Direct Connection	39
A32	PIM:38_PWR:A32_EXP:16	Direct Connection	38
B32	PIM:35_PWR:B32	Filter Signal	35
C32	PIM:34_PWR:C32_EXP:15	Direct Connection – Debug LED 4	34
A33	PIM:33_PWR:A33_EXP:14	Direct Connection – Debug LED 3	33
B33	PIM:32_PWR:B33_EXP:13	Filter Signal – Potentiometer 1	32
C33	PIM:29_PWR:C33_EXP:12	Direct Connection	29
A34	PIM:28_PWR:A34	Direct Connection – Reference Voltage (VREF)	28
B34	PIM:27_PWR:B34_EXP:42	Direct Connection – Device Programming Data Line (PGD)	27
C34	PIM:26_PWR:C34_EXP:41	Direct Connection – Device Programming Clock Line (PGC)	26
A35	PIM:25_PWR:A35	Filter Signal	25
B35	PIM:24_PWR:B35	Filter Signal	24
C35	PIM:23_PWR:C35_EXP:11	Filter Signal – Potentiometer 2	23
A36	PIM:22_PWR:A36	Filter Signal	22
B36	PIM:21_PWR:B36	Filter Signal	21
C36	PIM:20_PWR:C36	Filter Signal	20
A37	PIM:19_PWR:A37_EXP:10	Direct Connection	19
B37	PIM:18_PWR:B37-EXP:55	Direct Connection	18
C37	PIM:17_PWR:C37	Filter Signal	17

Note 1: Direct connection identifies the connection between the J13 connector pins and PIM pins that do not have an analog filter at their input.

2: Filter signal identifies the connection between the J13 connector pins and PIM pins that have an analog filter.

3: DVDD voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

4: AVDD voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

TABLE 2-12: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (CONTINUED)

Connector J13	Signal Name	PIM Connection/Functional Description	PIM Pin
A38	PIM:14_PWR:A38	Filter Signal	14
B38	DGND	Through 0Ω Resistor (R69)	—
C38	DGND	Digital Ground	—
A39	DGND	Digital Ground	—
B39	DGND	Digital Ground	—
C39	DGND	Digital Ground	—
A40	DV_{DD}(3)	Digital Voltage (+3.3V/+5V)	—
B40	DV_{DD}(3)	Digital Voltage (+3.3V/+5V)	—
C40	DV_{DD}(3)	Digital Voltage (+3.3V/+5V)	—

Note 1: Direct connection identifies the connection between the J13 connector pins and PIM pins that do not have an analog filter at their input.

2: Filter signal identifies the connection between the J13 connector pins and PIM pins that have an analog filter.

3: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

4: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

TABLE 2-13: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (GROUPED BY FUNCTIONALITY)

Connector J13	Signal Name	Functional Description	PIM Pin
Power Supply Signals			
C3	AGND	Analog Ground	—
C4	AGND	Analog Ground	—
B4	AV_{DD}	Analog Voltage (+3.3V/+5V)	—
A4	AV_{DD}	Analog Voltage (+3.3V/+5V)	—
A10	DGND	Digital Ground	—
B10	DGND	Digital Ground	—
C10	DGND	Digital Ground	—
A20	DGND	Digital Ground	—
B20	DGND	Digital Ground	—
C20	DGND	Digital Ground	—
A30	DGND	Digital Ground	—
B30	DGND	Digital Ground	—
C30	DGND	Digital Ground	—
C38	DGND	Digital Ground	—
A39	DGND	Digital Ground	—
B39	DGND	Digital Ground	—
C39	DGND	Digital Ground	—
A40	DV_{DD}	Digital Voltage (+3.3V/+5V)	—
B40	DV_{DD}	Digital Voltage (+3.3V/+5V)	—
C40	DV_{DD}	Digital Voltage (+3.3V/+5V)	—
A3	+5V	Fixed +5V	—
B3	+5V	Fixed +5V	—
A1	DC+	Input DC Bus Voltage	—
B1	DC+	Input DC Bus Voltage	—
C1	DC+	Input DC Bus Voltage	—
A2	PGND	Power Ground	—
B2	PGND	Power Ground	—
C2	PGND	Power Ground	—
C24	PIM:101_PWR:C24	Reference Voltage (V_{REF})	101
A18	PIM:104_PWR:A18	Reference Voltage (V_{REF})	104
C19	PIM:103_PWR:C19	Reference Voltage (V_{REF})	103
C21	PIM:102_PWR:C21	Reference Voltage (V_{REF})	102
A34	PIM:28_PWR:A34	Reference Voltage (V_{REF})	28

TABLE 2-13: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (GROUPED BY FUNCTIONALITY) (CONTINUED)

Connector J13	Signal Name	Functional Description	PIM Pin
Filter Signals			
B5	PIM:11_PWR:B5_EXP:08	Filter Signal	11
C9	PIM:97_PWR:C9_EXP:23	Filter Signal	97
C15	PIM:81_PWR:C15	Filter Signal	81
B16	PIM:79_PWR:B16	Filter Signal	79
A17	PIM:77_PWR:A17	Filter Signal	77
B17	PIM:76_PWR:B17	Filter Signal	76
B18	PIM:74_PWR:B18	Filter Signal	74
C18	PIM:73_PWR:C18	Filter Signal	73
B19	PIM:71_PWR:B19	Filter Signal	71
B21	PIM:83_PWR:B21	Filter Signal	83
B22	PIM:67_PWR:B22	Filter Signal	67
C22	PIM:66_PWR:C22	Filter Signal	66
B25	PIM:57_PWR:B25	Filter Signal	57
A26	PIM:55_PWR:A26	Filter Signal	55
B26	PIM:54_PWR:B26	Filter Signal	54
B32	PIM:35_PWR:B32	Filter Signal	35
A35	PIM:25_PWR:A35	Filter Signal	25
B35	PIM:24_PWR:B35	Filter Signal	24
C25	PIM:56_PWR:C25	Filter Signal	56
A36	PIM:22_PWR:A36	Filter Signal	22
B36	PIM:21_PWR:B36	Filter Signal	21
C36	PIM:20_PWR:C36	Filter Signal	20
C37	PIM:17_PWR:C37	Filter Signal	17
A38	PIM:14_PWR:A38	Filter Signal	14
B33	PIM:32_PWR:B33_EXP:13	Filter Signal – Potentiometer 1	32
C35	PIM:23_PWR:C35_EXP:11	Filter Signal – Potentiometer 2	23
A15	PIM:69_PWR:A15_EXP:28	Filter Signal – Push Button SW1/I^2C™ PICkit™ Interface	69
C14	PIM:84_PWR:C14_EXP:29	Filter Signal – Push Button SW2	84

TABLE 2-13: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (GROUPED BY FUNCTIONALITY) (CONTINUED)

Connector J13	Signal Name	Functional Description	PIM Pin
Non-Filter Signals			
A14	PIM:87_PWR:A14_EXP:30	Direct Connection – PICkit™ SPI Clock	87
C12	PIM:91_PWR:C12_EXP:32	Direct Connection – PICkit SPI Interface $\overline{CS}$	91
C13	PIM:88_PWR:C13_EXP:31	Direct Connection – PICkit SPI Interface Data In	88
B8	PIM:01_PWR:B8_EXP:01	Direct Connection – Debug LED 1	1
B24	PIM:59_PWR:B24_EXP:57	Direct Connection – Debug LED 2	59
A33	PIM:33_PWR:A33_EXP:14	Direct Connection – Debug LED 3	33
C32	PIM:34_PWR:C32_EXP:15	Direct Connection – Debug LED 4	34
A5	PIM:12_PWR:A5_EXP:09	Direct Connection	12
C34	PIM:26_PWR:C34_EXP:41	Direct Connection – Device Programming Clock Line (PGC)	26
B34	PIM:27_PWR:B34_EXP:42	Direct Connection – Device Programming Data Line (PGD)	27
C16	PIM:78_PWR:C16_EXP:26	Direct Connection – PICkit SPI Interface Data Out	78
B31	PIM:40_PWR:B31_EXP:18	Direct Connection – Push Button SW3	40
A31	PIM:41_PWR:A31_EXP:56	Direct Connection – Push Button SW4	41
A28	PIM:49_PWR:A28_EXP:21	Direct Connection – UART Receive/I^2C™ PICkit Interface	49
C26	PIM:53_PWR:C26	Direct Connection – UART Transmit	53
C5	PIM:10_PWR:C5	Direct Connection	10
A6	PIM:09_PWR:A6_EXP:07	Direct Connection	9
B6	PIM:08_PWR:B6_EXP:06	Direct Connection	8
C6	PIM:07_PWR:C6_EXP:05	Direct Connection	7
A7	PIM:06_PWR:A7_EXP:04	Direct Connection	6
B7	PIM:05_PWR:B7_EXP:03	Direct Connection	5
C7	PIM:04_PWR:C7_EXP:02	Direct Connection	4
A8	PIM:03_PWR:A8_EXP:49	Direct Connection	3
C8	PIM:100_PWR:C8_EXP:50	Direct Connection	100
A9	PIM:99_PWR:A9_EXP:47	Direct Connection	99
B9	PIM:98_PWR:B9_EXP:48	Direct Connection	98
A11	PIM:96_PWR:A11	Direct Connection	96
B11	PIM:95_PWR:B11	Direct Connection	95
C11	PIM:94_PWR:C11_EXP:45	Direct Connection	94
A12	PIM:93_PWR:A12_EXP:46	Direct Connection	93
B12	PIM:92_PWR:B12	Direct Connection	92
A13	PIM:90_PWR: A13	Direct Connection	90
B13	PIM:89_PWR:B13	Direct Connection	89
B14	PIM:85_PWR:B14	Direct Connection	85
B15	PIM:82_PWR:B15	Direct Connection	82
A16	PIM:80_PWR:A16_EXP:27	Direct Connection	80
A19	PIM:72_PWR:A19	Direct Connection	72
A21	PIM:70_PWR:A21	Direct Connection	70
A22	PIM:68_PWR:A22	Direct Connection	68
A24	PIM:60_PWR:A24_EXP:60	Direct Connection	60
A25	PIM:58_PWR:A25	Direct Connection	58
A27	PIM:52_PWR:A27_EXP:59	Direct Connection	52

TABLE 2-13: dsPIC® DSC SIGNAL BOARD J13 CONNECTOR PINOUT (GROUPED BY FUNCTIONALITY) (CONTINUED)

Connector J13	Signal Name	Functional Description	PIM Pin
B27	PIM:51_PWR:B27_EXP:58	Direct Connection	51
C27	PIM:50_PWR:C27_EXP:22	Direct Connection	50
B28	PIM:48_PWR:B28_EXP:20	Direct Connection	48
C28	PIM:47_PWR:C28_EXP:19	Direct Connection	47
A29	PIM:44_PWR:A29	Direct Connection	44
B29	PIM:43_PWR:B29	Direct Connection	43
C29	PIM:42_PWR:C29	Direct Connection	42
C31	PIM:39_PWR:C31_EXP:17	Direct Connection	39
A32	PIM:38_PWR:A32_EXP:16	Direct Connection	38
C33	PIM:29_PWR:C33_EXP:12	Direct Connection	29
A37	PIM:19_PWR:A37_EXP:10	Direct Connection	19
B37	PIM:18_PWR:B37-EXP:55	Direct Connection	18
C23	PIM:61_PWR:C23_EXP:24	Direct Connection	61
C17	PIM:105_PWR:C17	Direct Connection	105
Not Connected			
A23	DGND	Through 0Ω Resistor (R73)	—
B23	DGND	Through 0Ω Resistor (R70)	—
B38	DGND	Through 0Ω Resistor (R69)	—

2.3.12 Expansion Board Connector (J4, J5 and J7)

A 60-pin connector permits connection of the dsPIC DSC Signal Board to an expansion board, which can be used for improved user interface, CAN and LIN/J2602 communication. Table 2-14 provides the PIM signals, DC bus and supply voltages connected to 60 pins. All odd numbered pin connections of the connector J7 are also routed to the 30-pin header, J4. All even numbered pin connections of connector J7 are also routed to a 30-pin header, J5.

TABLE 2-14: dsPIC® DSC SIGNAL BOARD CONNECTORS, J7, J4 AND J5 PINOUT

Connector J7	Signal Name	Functional Description	Header J4	Header J5	PIM Pin
1	PIM:01_PWR:B8_EXP:01	Direct Connection – Debug LED 1	1	—	1
2	PIM:04_PWR:C7_EXP:02	Direct Connection	—	2	4
3	PIM:05_PWR:B7_EXP:03	Direct Connection	3	—	5
4	PIM:06_PWR:A7_EXP:04	Direct Connection	—	4	6
5	PIM:07_PWR:C6_EXP:05	Direct Connection	5	—	7
6	PIM:08_PWR:B6_EXP:06	Direct Connection	—	6	8
7	PIM:09_PWR:A6_EXP:07	Direct Connection	7	—	9
8	PIM:11_PWR:B5_EXP:08	Filter Signal	—	8	11
9	PIM:12_PWR:A5_EXP:09	Direct Connection	9	—	12
10	PIM:19_PWR:A37_EXP:10	Direct Connection	—	10	19
11	PIM:23_PWR:C35_EXP:11	Filter Signal – Potentiometer 2	11	—	23
12	PIM:29_PWR:C33_EXP:12	Direct Connection	—	12	29
13	PIM:32_PWR:B33_EXP:13	Potentiometer 1	13	—	32
14	PIM:33_PWR:A33_EXP:14	Direct Connection – Debug LED 3	—	14	33
15	PIM:34_PWR:C32_EXP:15	Direct Connection – Debug LED 4	15	—	34
16	PIM:38_PWR:A32_EXP:16	Direct Connection	—	16	38
17	PIM:39_PWR:C31_EXP:17	Direct Connection	17	—	39
18	PIM:40_PWR:B31_EXP:18	Direct Connection – Push Button SW3	—	18	40
19	PIM:47_PWR:C28_EXP:19	Direct Connection	19	—	47
20	PIM:48_PWR:B28_EXP:20	Direct Connection	—	20	48
21	PIM:49_PWR:A28_EXP:21	Direct Connection – UART Receive/I^{2}C™ PICkit™ Interface	21	—	49
22	PIM:50_PWR:C27_EXP:22	Direct Connection – UART Transmit	—	22	50
23	PIM:97_PWR:C9_EXP:23	Filter Signal	23	—	97
24	PIM:61_PWR:C23_EXP:24	Direct Connection	—	24	61
25	PIM:13 ($\overline{\text{MCLR}}$)	Direct Connection – Device Master Clear ($\overline{\text{MCLR}}$)	25	—	13
26	PIM:78_PWR:C16_EXP:26	Direct Connection – PICkit SPI Interface Data Out	—	26	78
27	PIM:80_PWR:A16_EXP:27	Direct Connection	27	—	80
28	PIM:69_PWR:A15_EXP:28	Filter Signal – Push Button SW1/I^{2}C PICkit Interface	—	28	69
29	PIM:84_PWR:C14_EXP:29	Filter Signal – Push Button SW2	29	—	84
30	PIM:87_PWR:A14_EXP:30	Direct Connection – PICkit SPI Clock	—	30	87
31	PIM:88_PWR:C13_EXP:31	Direct Connection – PICkit SPI Interface Data In	31	—	88
32	PIM:91_PWR:C12_EXP:32	Direct Connection – PICkit SPI Interface $\overline{\text{CS}}$	—	32	91
33	DGND	Digital Ground	33	—	—

Note 1: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

2: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

TABLE 2-14: dsPIC® DSC SIGNAL BOARD CONNECTORS, J7, J4 AND J5 PINOUT (CONTINUED)

Connector J7	Signal Name	Functional Description	Header J4	Header J5	PIM Pin
34	DGND	Digital Ground	—	34	—
35	DC+	Input DC Bus Voltage	35	—	—
36	DC+	Input DC Bus Voltage	—	36	—
37	DGND	Digital Ground	37	—	—
38	DGND	Digital Ground	—	38	—
39	+5V	Fixed +5V	39	—	—
40	+5V	Fixed +5V	—	40	—
41	PIM:26_PWR:C34_EXP:41	Direct Connection – Device Programming Clock Line (PGC)	41	—	26
42	PIM:27_PWR:B34_EXP:42	Direct Connection – Device Programming Data Line (PGD)	—	42	27
43	DV_{DD}(1)	Digital Voltage (+3.3/+5V)	43	—	—
44	DV_{DD}(1)	Digital Voltage (+3.3/+5V)	—	44	—
45	PIM:94_PWR:C11_EXP:45	Direct Connection	45	—	94
46	PIM:93_PWR:A12_EXP:46	Direct Connection	—	46	93
47	PIM:99_PWR:A9_EXP:47	Direct Connection	47	—	99
48	PIM:98_PWR:B9_EXP:48	Direct Connection	—	48	98
49	PIM:03_PWR:A8_EXP:49	Direct Connection	49	—	3
50	PIM:100_PWR:C8_EXP:50	Direct Connection	—	50	100
51	AGND	Analog Ground	51	—	—
52	AGND	Analog Ground	—	52	—
53	AV_{DD}(2)	Analog Voltage (+3.3/+5V)	53	—	—
54	AV_{DD}(2)	Analog Voltage (+3.3/+5V)	—	54	—
55	PIM:18_PWR:B37-EXP:55	Direct Connection	55	—	18
56	PIM:41_PWR:A31_EXP:56	Direct Connection – Push Button SW4	—	56	41
57	PIM:59_PWR:B24_EXP:57	Direct Connection – Debug LED 2	57	—	59
58	PIM:51_PWR:B27_EXP:58	Direct Connection	—	58	51
59	PIM:52_PWR:A27_EXP:59	Direct Connection	59	—	52
60	PIM:60_PWR:A24_EXP:60	Direct Connection	—	60	60

Note 1: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

2: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

2.4 USER INTERFACE HARDWARE

2.4.1 Board Jumpers

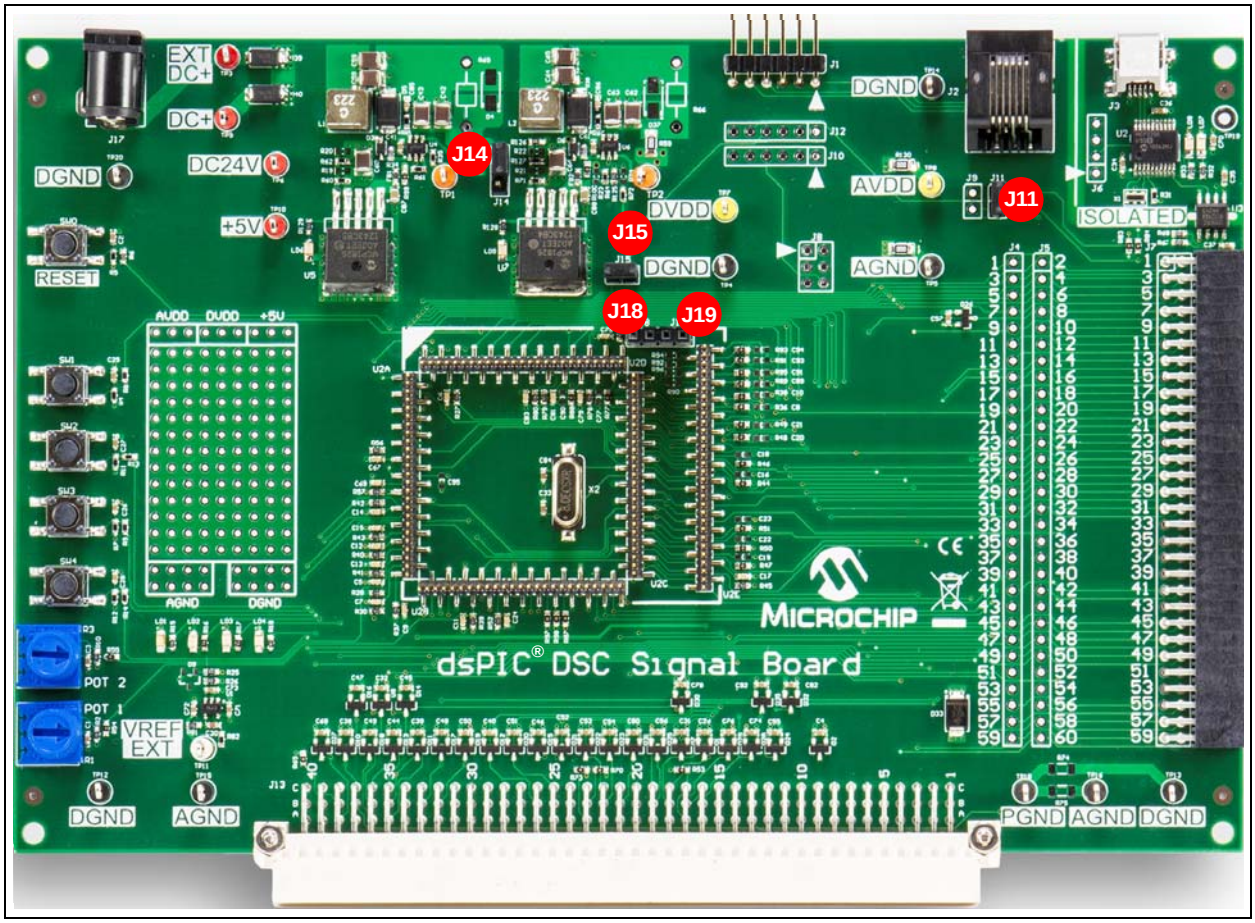
The dsPIC DSC Signal Board has five jumpers.The on-board jumpers are provided in Table 2-15. Figure 2-2 shows the jumper positions.

TABLE 2-15: dsPIC® DSC SIGNAL BOARD JUMPERS

Jumper Designator	Number of Pins	Jumper Description
J11	2	If shorted, it connects the TX signal between the PIM and isolator, U3 (see Figure A-3)
J14	3	Position 1-2: Enables Power Supply 1 for fixed +5V Position 2-3: Disables Power Supply 1 for fixed +5V
J15	2	If shorted, it connects the signal between the PIM and push button, SW1
J18	2	If the jumpers J18 and J19 are shorted on the PIM, then the output of Power Supply 2 is +5V; if the connectors J18 and J19 are open, then the output is +3.3V(1)
J19	2	If the jumpers J18 and J19 are shorted on the PIM, then the output of Power Supply 2 is +5V; if the connectors J18 and J19 are open, then the output is +3.3V(1)

Note 1: J18 and J19 must be in the same position for proper operation of the power supply circuit.

FIGURE 2-2: dsPIC® DSC SIGNAL BOARD JUMPERS



2.4.2 Push Buttons, LEDs and Potentiometers

The dsPIC DSC Signal Board has the following push buttons, LEDs and potentiometers:

- Device Reset Push Button (SW0)
- Four Push Buttons (SW1-SW4)
- Two Potentiometers (POT1, POT2)
- Two Power-on Status LEDs (LD5 and LD6)
- Four LEDs for Debugging (LD1-LD4)
- Two LED Indicators for USB Communications (LD7 and LD8)

Table 2-16 and Table 2-17 provide the LED indicators, push buttons and potentiometers. Figure 2-3 shows the positions of the on-board push buttons, LEDs and potentiometers.

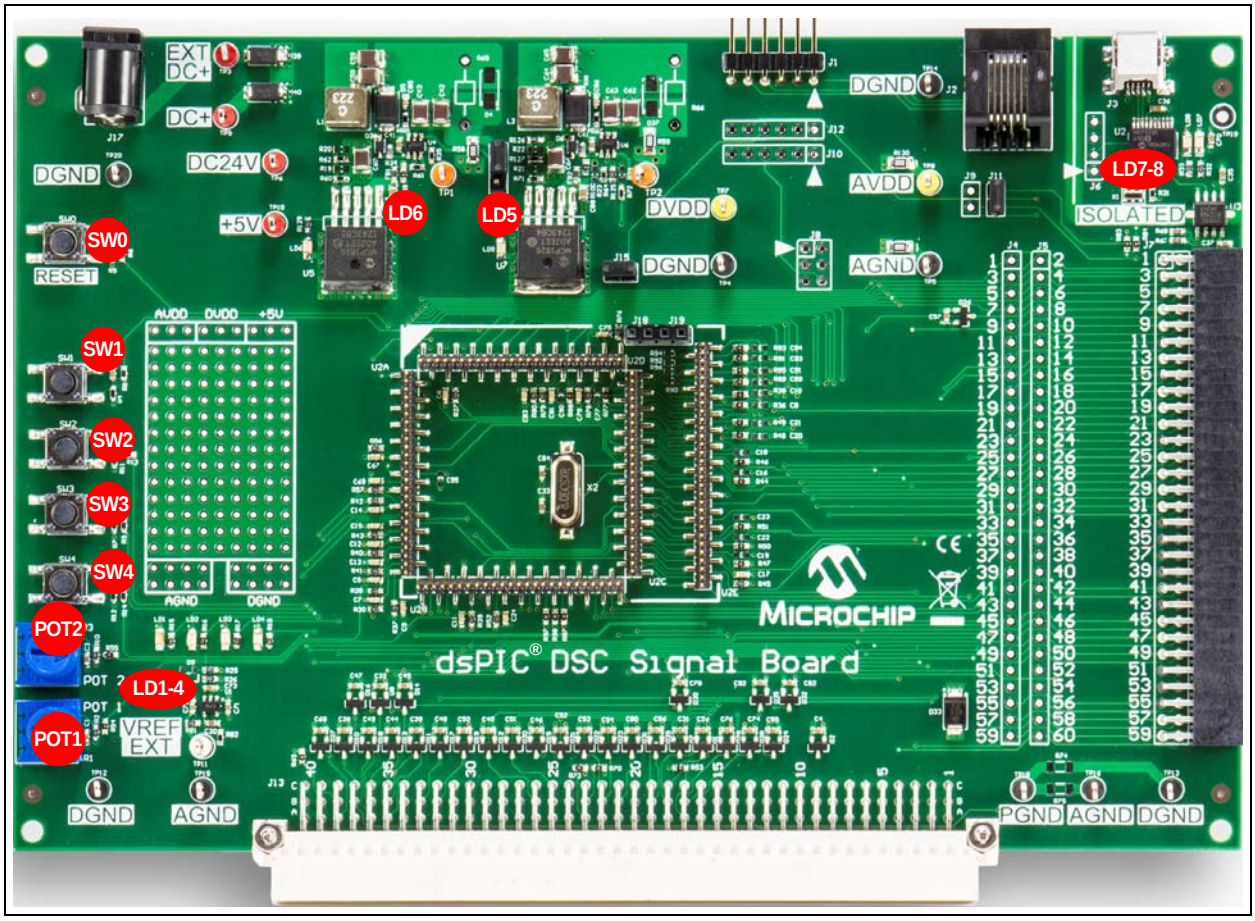
TABLE 2-16: LED INDICATORS

Label	Hardware Element Description
LD1-LD4	LEDs are used for debugging
LD5	Power-on status LED indicates the status of Power Supply 2 (DV_{DD})
LD6	Power-on status LED indicates the status of Power Supply 1 (+5V)
LD7	USB transmit indication
LD8	USB receive indication

TABLE 2-17: PUSH BUTTONS AND POTENTIOMETERS

Label	Hardware Element Description
SW0	Push button to reset the target device
SW1-SW4	General purpose push buttons; when momentarily pressed, the switch connects the respective PIM pin to ground
POT1, POT2	10 kΩ potentiometer

FIGURE 2-3: dsPIC® DSC SIGNAL BOARD USER INTERFACE



2.5 BOARD TEST POINTS

There are several test points on the dsPIC DSC Signal Board that can be used to check various signals. Table 2-18 provides the on-board test points. Figure 2-4 shows the dsPIC DSC Signal Board test points.

TABLE 2-18: TEST POINTS

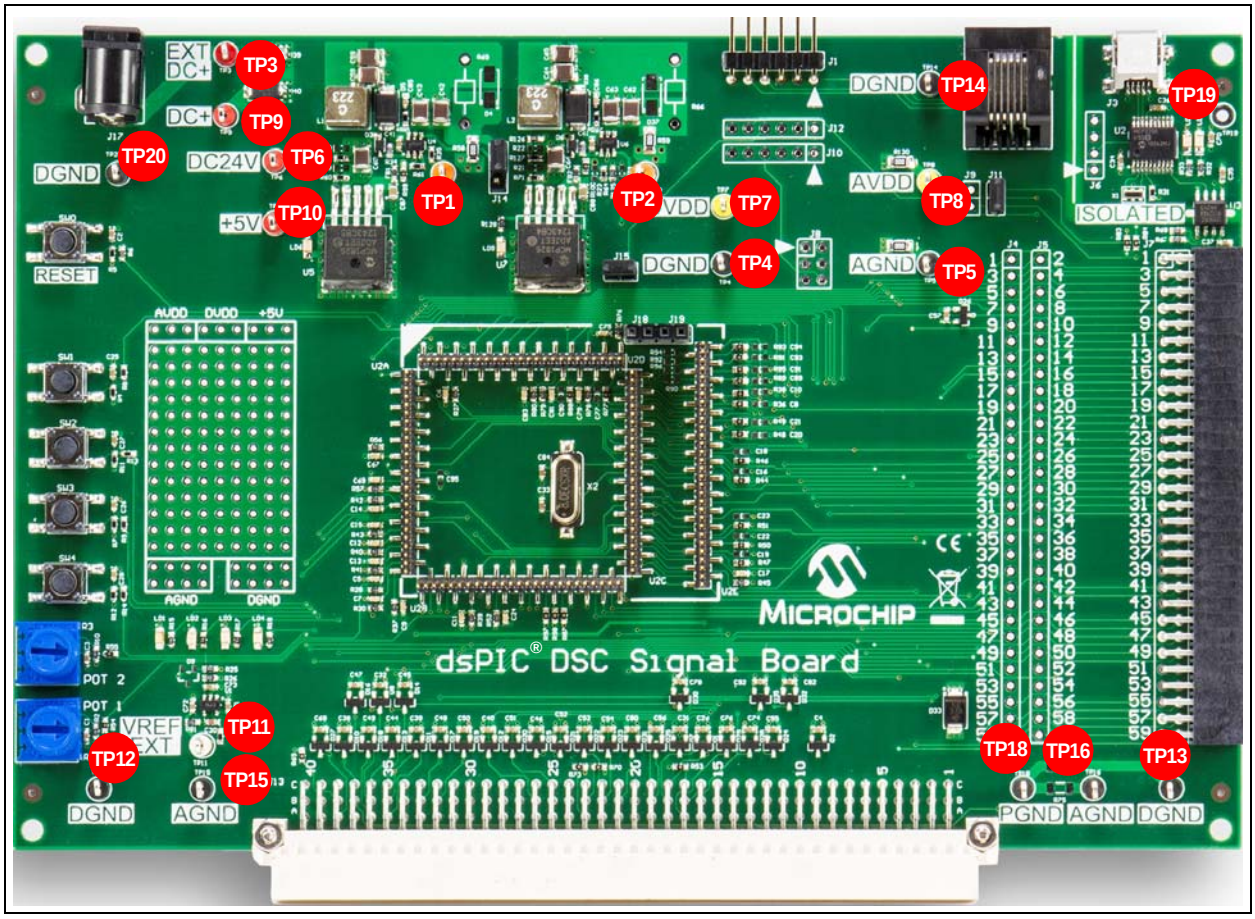
Test Points	Signal Name	Description
TP1	—	Output of Buck Converter, U4 (MCP16301)
TP2	—	Output of Buck Converter, U6 (MCP16301)
TP3	EXT DC+	Input Bus Voltage Connected to Connector J17
TP4	DGND	Digital Ground
TP5	AGND	Analog Ground
TP6	DC24V	DC Bus Voltage
TP7	DV_{DD}(1)	Digital Supply Voltage (+3.3V/+5V)
TP8	AV_{DD}(2)	Analog Supply Voltage (+3.3V/+5V)
TP9	DC+	Input Bus Voltage Connector to Connectors J13 and J7
TP10	+5V	Fixed +5V DC Voltage
TP11	V_{REF}(3)	Half the Analog Supply Voltage, AV_{DD}, for Reference to Op Amps
TP12, TP13, TP14, TP20	DGND	Digital Ground
TP15, TP16	AGND	Analog Ground
TP18	PGND	Power Ground
TP19	GND_USB	USB Ground

Note 1: DV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

2: AV_{DD} voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

3: V_{REF} voltage level is configured as either +1.65V or +2.5V based on AV_{DD}.

FIGURE 2-4: dsPIC® DSC SIGNAL BOARD TEST POINTS



NOTES:

Chapter 3. Hardware Description

3.1 INTRODUCTION

This chapter provides a more detailed description of the hardware features of the dsPIC® DSC Signal Board.

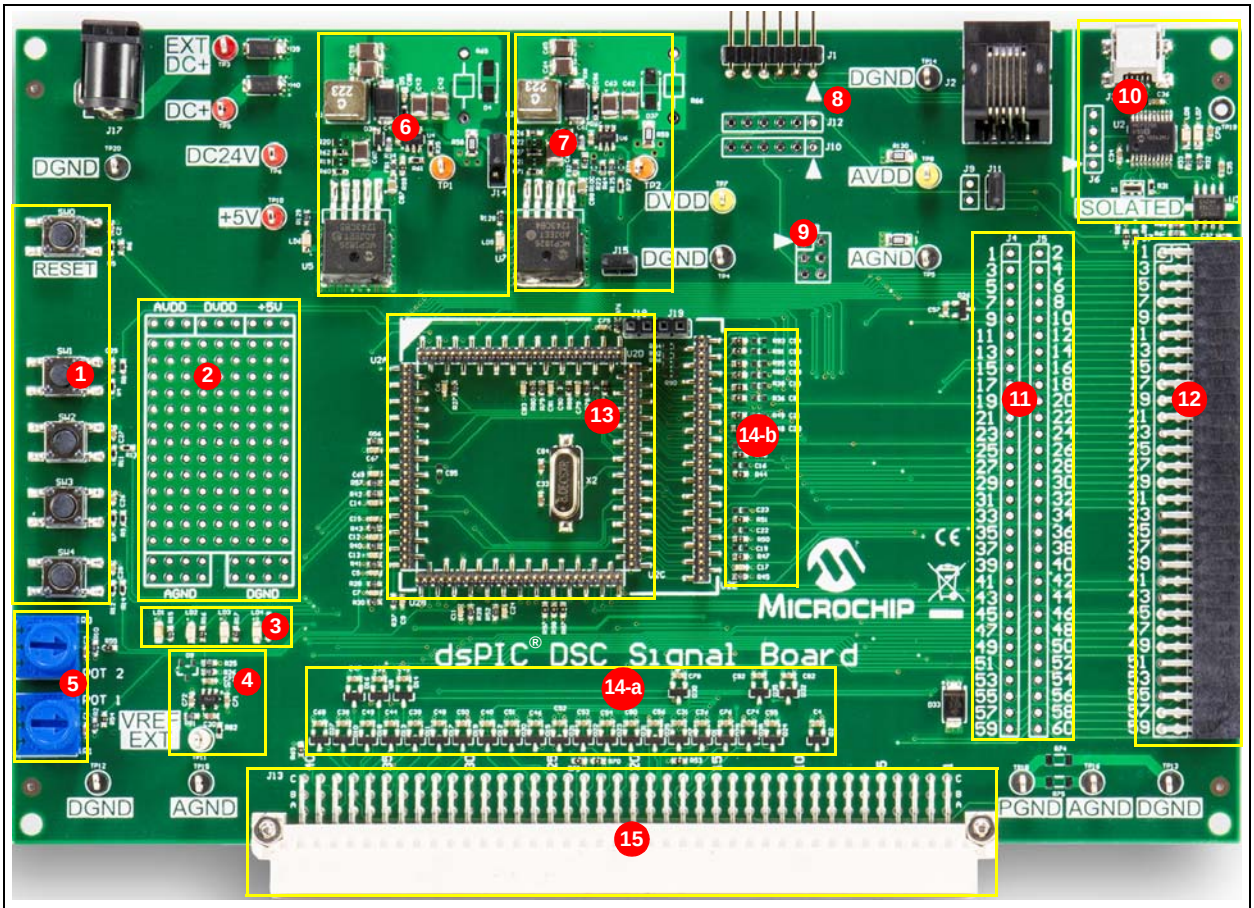
3.2 HIGHLIGHTS

This chapter covers the following topics:

- Power Supply Circuit
- Voltage Reference Circuit
- Isolated USB Interface
- PIM Header Signals
- Supply Voltage and Ground Connection

The hardware sections of the dsPIC DSC Signal Board are shown in Figure 3-1.

FIGURE 3-1: dsPIC® DSC SIGNAL BOARD HARDWARE SECTIONS



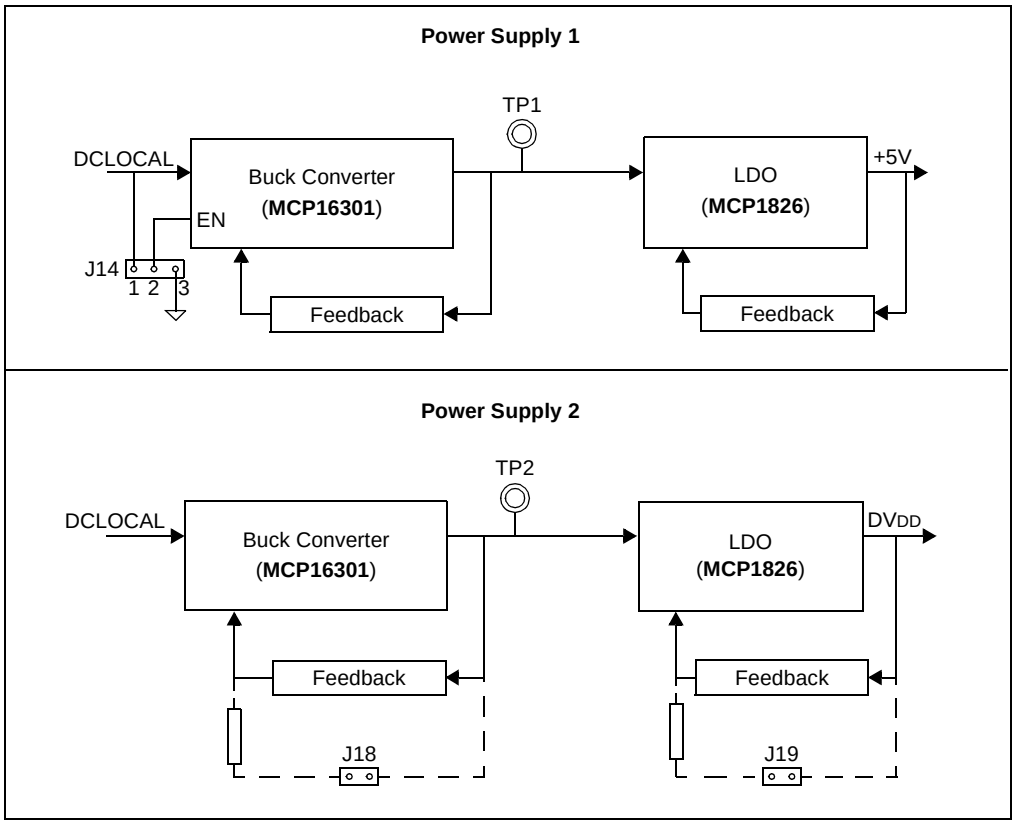
Legend:

1	Switches	2	Prototyping Area
3	General Purpose LEDs	4	Voltage Reference Circuit
5	Potentiometers	6	Power Supply 1 (fixed +5V)
7	Power Supply 2 (+3.3/+5V selectable)	8	PICkit™/ICD Interface
9	SPI Interface	10	USB/UART Isolated Interface
11	Header J4/J5 for Expansion Board	12	60-Pin Expansion Board Connector for Add-on Boards (J7)
13	100/105 PIM Header	14-a	Analog Input Signal Conditioning
14-b	Analog Input Signal Conditioning	15	120-Pin Power Board Interface Connector for Application Boards (J13)

3.3 POWER SUPPLY CIRCUIT

The dsPIC DSC Signal Board has two power supply circuits: Power Supply 1 and Power Supply 2 (see Figure 3-2) with identical topology. Power Supply 1 has a fixed +5V output, while the output of Power Supply 2 can be switched between +3.3V/+5V, depending on the dsPIC DSC or microcontroller used.

FIGURE 3-2: POWER SUPPLY CIRCUIT ARCHITECTURE



Input for the power supply circuits is provided either through power connector jack J17, or through pins of connectors J13 and J7 with a DC+ signal. The power supply circuit has these key features:

- High efficiency
- Low ripple output
- Snubber circuit or ferrite bead provided to minimize switching noise

The power supply provides power to these components:

- A dsPIC DSC or microcontroller device, an isolator (ADUM1201CRZ) and the reference voltage circuit for op amps receives +3.3V/+5V power from Power Supply 2
- J13 and J7 connector pins with a digital voltage (DV_{DD}) signal receive power from Power Supply 2 (see Note 1)
- J13 and J7 connector pins with a fixed +5V signal receive power from Power Supply 2 (see Note 1)

Note 1: For the power connector jack J17, a 24V power supply (AC002013) is recommended.

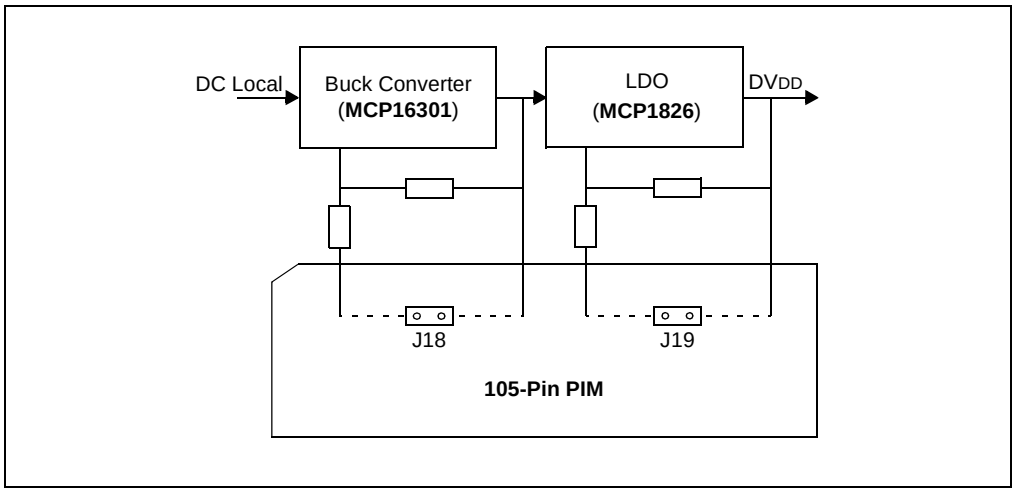
2: When the dsPIC DSC Signal Board is used with Microchip's Motor Control 10-24V Driver Board (Dual/Single), the connection of a power supply to the dsPIC DSC Signal Board is optional.

The output of a fixed +5V power supply circuit can be disabled using jumper J14. When Pins 1-2 on the connector J14 are connected, Power Supply 1 is enabled with a fixed +5V DC output voltage. However, when Pins 2-3 are connected, Power Supply 2 is disabled (see Note 2).

3.3.1 Power Supply 2 Output Selection

The Power Supply 2 is interfaced with the PIM through connectors J18 and J19 (see Figure 3-3). When connectors J18 and J19 are short-circuited on the PIM, it generates +5V DC. When connectors J18 and J19 are open-circuited on the PIM, +3.3V DC is generated.

FIGURE 3-3: POWER SUPPLY 2 WITH CONNECTION ON PIM



3.4 VOLTAGE REFERENCE CIRCUIT

The reference voltage is generated on the dsPIC DSC Signal Board. It is half the output of Power Supply 2 (+1.65V or +2.5V) depending upon AVDD. The reference circuit is built around an MCP6021 op amp (see Figure 3-4) and connects to several PIM header pins (see Table 2-2). The reference voltage is also connected to connector J13 (see Table 2-12).

Figure 3-4 shows the circuit used to obtain the voltage reference signal which is half the magnitude of the AVDD. The resistors R25 and R26 form the voltage divider circuit and generate a voltage equal to half of the analog voltage (AVDD). Op Amp U1 MCP6021 is used as the buffer. The resistors R81, R82 and C30 form a compensation circuit to drive capacitive loads, where C30 acts as a high-frequency feedback path and R81 is used as a feedback path for low-frequency signals.

FIGURE 3-4: VOLTAGE REFERENCE SIGNAL GENERATION CIRCUIT

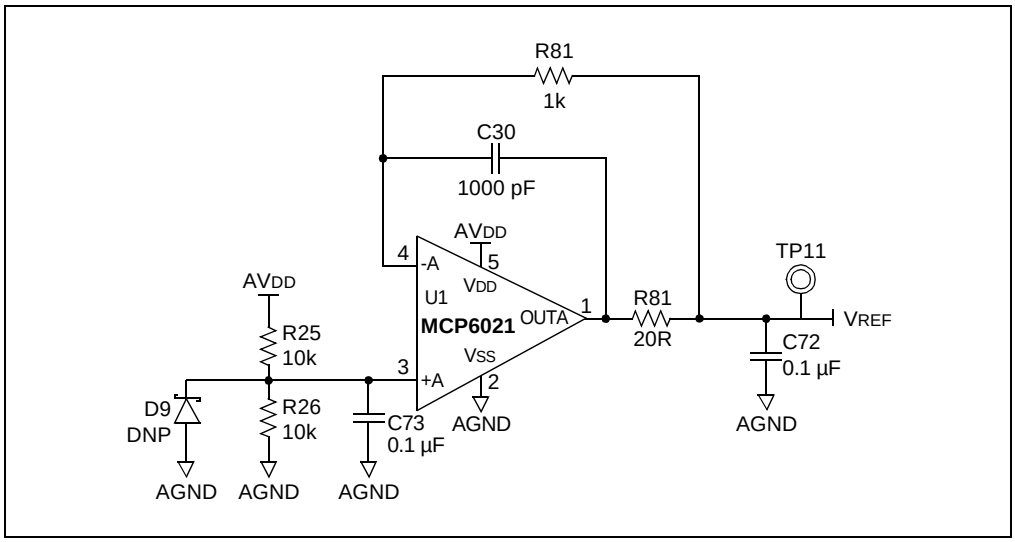


Figure 3-5 shows that the reference voltage to the PIM can be supplied in two ways. It can be supplied by the circuit on the dsPIC DSC Signal Board (see Figure 3-4) or it can also be supplied externally from the J13 connector pins. The reference voltage selection can be made by populating one of the two resistors: RINT or REXT. Table 3-1 provides the list of resistors used to connect the reference signal.

FIGURE 3-5: VOLTAGE REFERENCE SIGNAL ROUTING

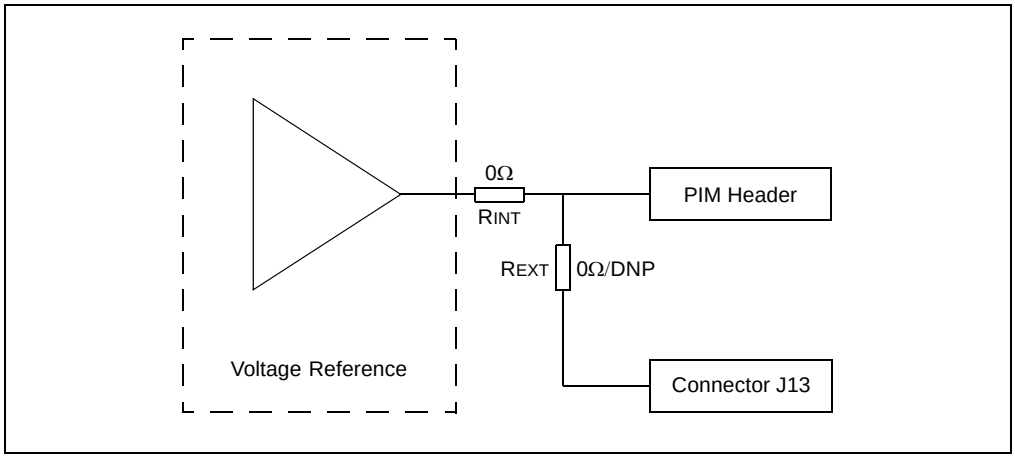


TABLE 3-1: RESISTOR TO SELECT VOLTAGE REFERENCE SOURCE

PIM Header	J13 Connector	RINT Designator	REXT Designator
PIM:101	PIM:101_PWR:C24	R89	R90
PIM:102	PIM:102_PWR:C21	R95	R96
PIM:103	PIM:103_PWR:C19	R91	R92
PIM:104	PIM:104_PWR:A18	R93	R94

3.5 ISOLATED USB INTERFACE

The dsPIC DSC Signal Board uses an on-board MCP2200 interface as a bridge between the UART and USB. The connector J3 is a mini USB header used to connect a PC USB cable. The USB is isolated from the dsPIC DSC using a two-channel digital isolator (ADUM1201CRZ).

FIGURE 3-6: USB-UART CONNECTION SETUP

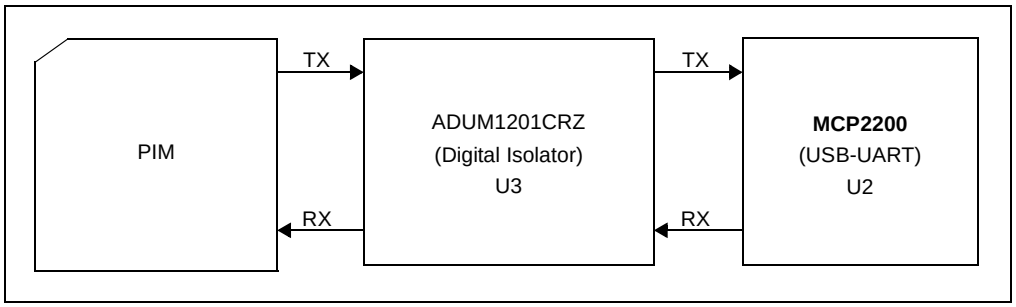


Figure 3-6 shows that the UART signal used for the USB interface is isolated through the ADUM1201CRZ isolator. The MCP2200 is a USB-to-UART serial converter, which enables USB connectivity in applications that have a UART interface. The USB-UART connection setup can support a baud rate of up to 1 Mbps.

3.6 PIM HEADER SIGNALS

3.6.1 Signal Nomenclature

The dsPIC DSC signals use the following naming convention (except for auxiliary power supply pins):

PIM:xx_PWR:yy_EXP:zz[_FLT]

where:

PIM:xx indicates that the signal originates at PIM Pin Number xx

PWR:yy indicates that the signal is connected to Pin yy of the power board interface connector (J13)

EXP:zz indicates that the signal is connected to Pin zz of the expansion board connector (J7)

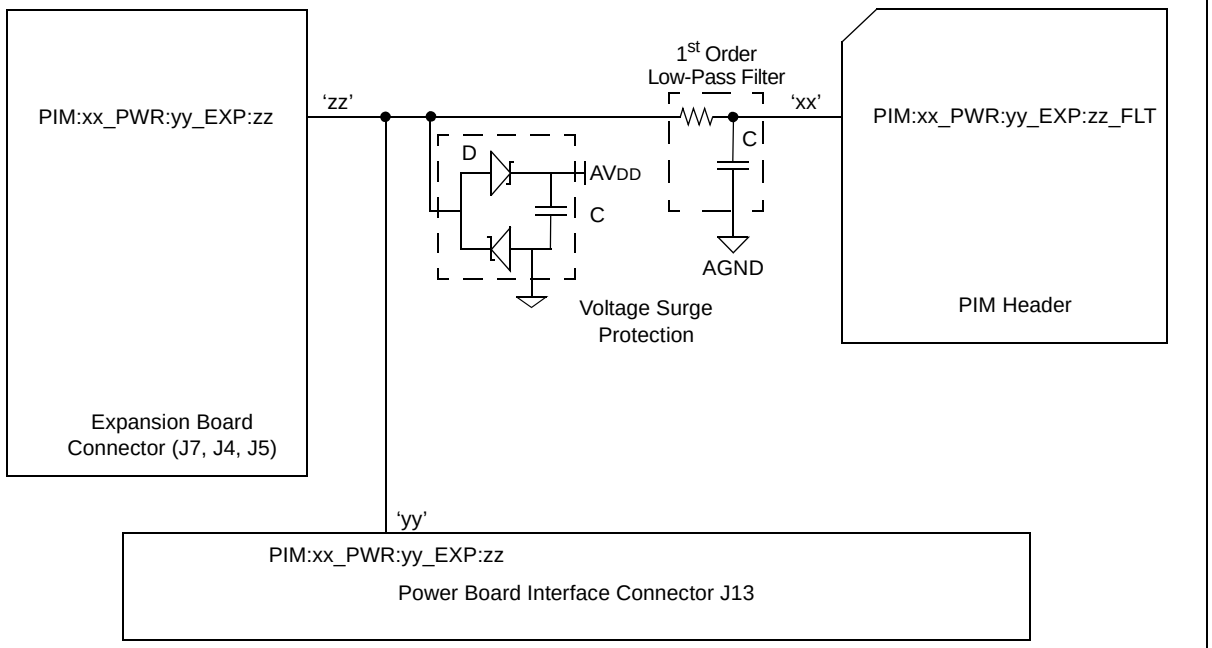
[_FLT]: if present, indicates that the signal between the connector J13 and the PIM is filtered (see Figure 3-7 to Figure 3-10 for different connection topologies).

3.6.2 Analog Input Signal Conditioning

The PIM pins are connected to the power board interface connector J13 and the expansion board connector J7 by the following four possible topologies:

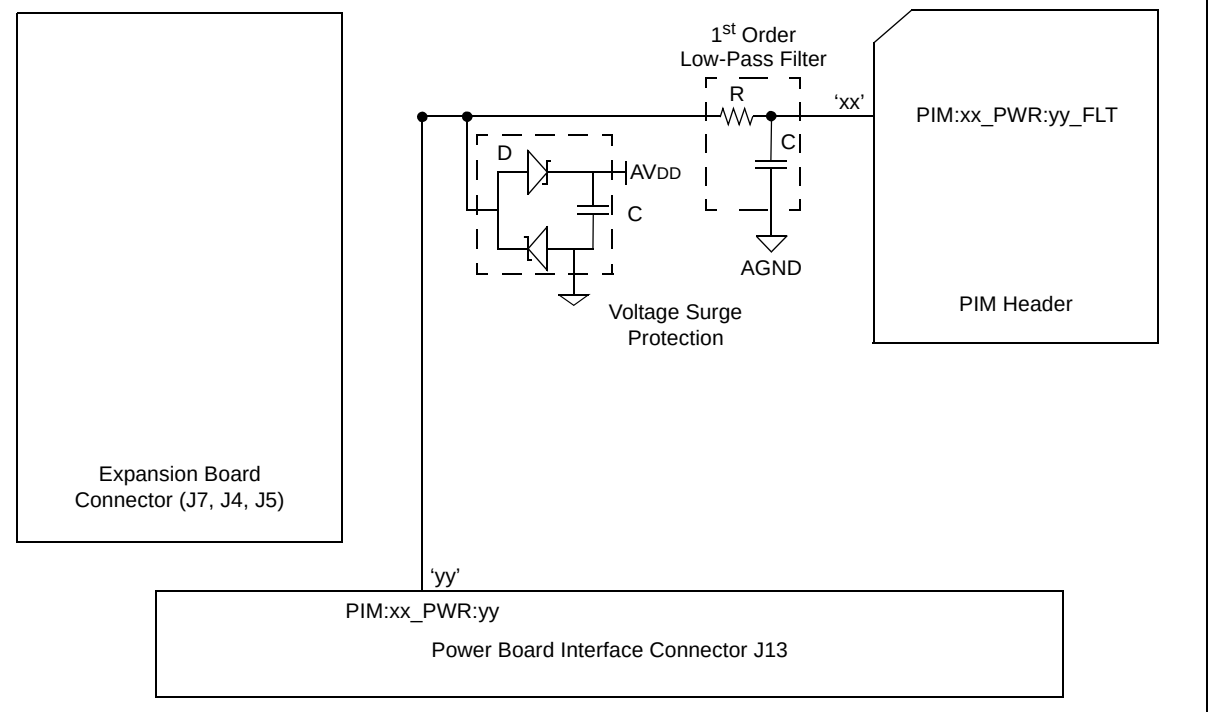
- Topology 1: In this topology, there is a first order low-pass filter and voltage surge protection diodes between the PIM header and the connectors. Figure 3-7 shows the connection between the PIM header and the connectors J13, J7, J4 and J5.
- Topology 2: In this topology, there is a first order low-pass filter and voltage surge protection diodes between the PIM header and the connectors. Figure 3-8 shows the connection between the PIM header and the connector J13. These signals are not connected to connectors J7, J4 and J5.
- Topology 3: In this topology, there is no connection for a first order filter. Figure 3-9 shows the direct connection between the PIM header and the connectors J13, J7, J4 and J5.
- Topology 4: In this topology, there is no connection for a first order filter. Figure 3-10 shows the direct connection between the PIM header and the connector J13. These signals are not connected to connectors J7, J4 and J5.

FIGURE 3-7: TOPOLOGY 1



Note: The signal connected to the PIM has the same name of the signal at the connector, with an added "_FLT" suffix to indicate that the signal is filtered. The 1st order low-pass filter is implemented in hardware; however, the user can remove the components or change their values to better fit the application requirements.

FIGURE 3-8: TOPOLOGY 2



Note: The signal connected to the PIM has the same name of the signal at the connector, with an added "_FLT" suffix to indicate that the signal is filtered. The 1st order low-pass filter is implemented in hardware; however, the user can remove the components or change their values to better fit the application requirements.

FIGURE 3-9: TOPOLOGY 3

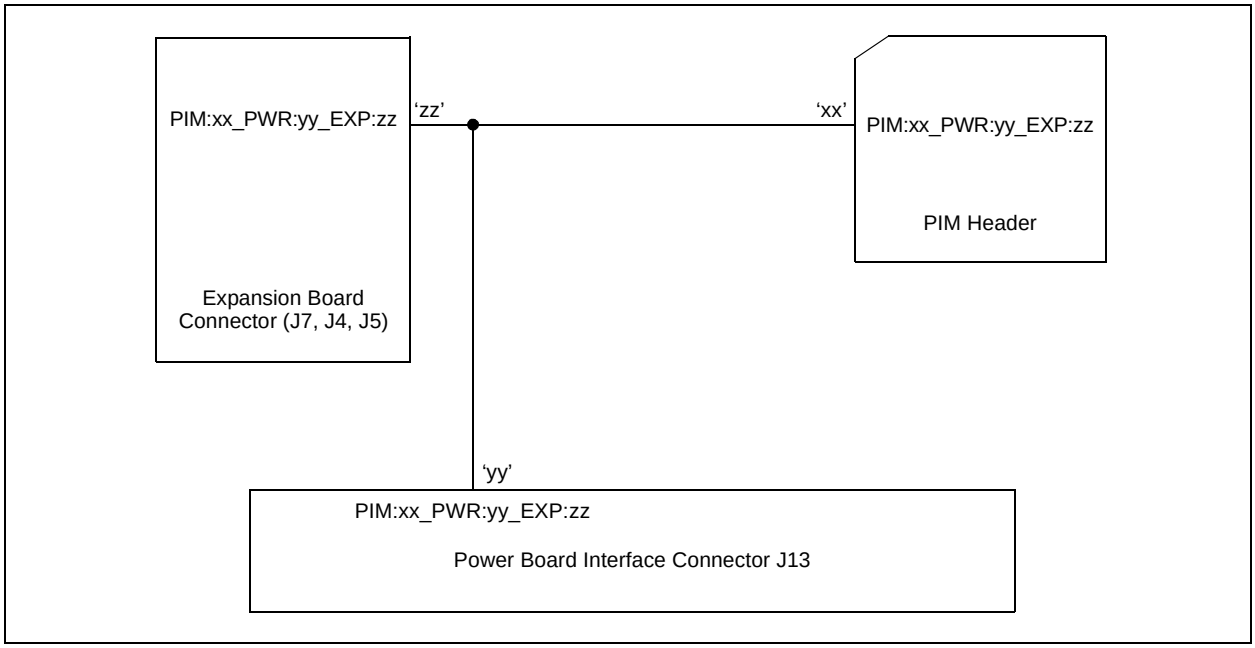
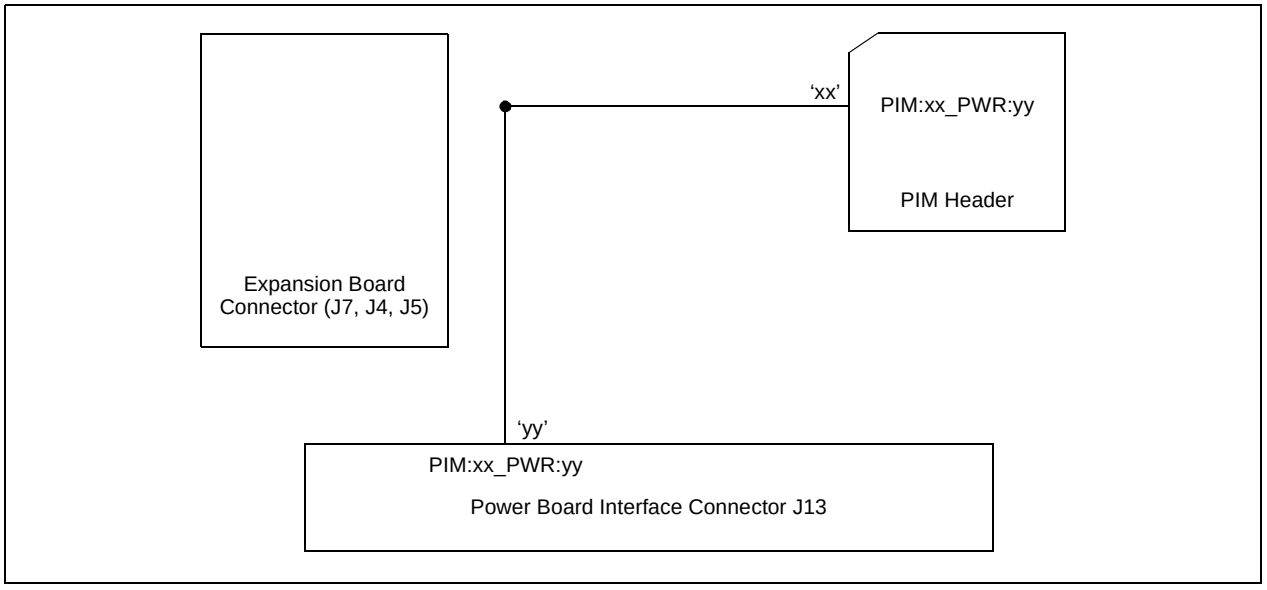


FIGURE 3-10: TOPOLOGY 4



Diode D (BAS 40-04 with 40V blocking voltage), shown in Figure 3-7 and Figure 3-8, is used for transient and ESD protection. The 1st order low-pass filter, shown in Figure 3-7 and Figure 3-8, is used to attenuate high-frequency noise. The cutoff frequency for this filter is given by Equation 3-1.

EQUATION 3-1: FIRST ORDER LOW-PASS FILTER CUTOFF FREQUENCY

$$Cutoff\ Frequency = \frac{1}{2\pi RC} \cong 340\ kHz$$

Where:

R = 1 kΩ and C = 470 pF

3.7 SUPPLY VOLTAGE AND GROUND CONNECTION

The dsPIC DSC Signal Board has three separate grounds: Digital Ground (DGND), Analog Ground (AGND) and Power Ground (PGND). All three grounds can be connected by populating the resistors R74 and R75 (see Figure 3-11). DGND and AGND are connected through R29 (0Ω) by default. The Analog Voltage (AV_{DD}) is derived from DV_{DD} through R130 (0Ω), see Figure 3-12.

Note: PGND is expected to be connected to DGND and AGND on application boards. To avoid ground loops, PGND is not connected to AGND and DGND on the dsPIC DSC Signal Board.

FIGURE 3-11: GROUND INTERCONNECTION

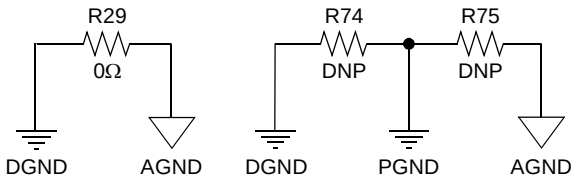
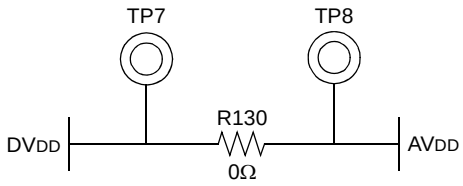


FIGURE 3-12: CONNECTION OF AV_{DD} TO DV_{DD}



Appendix A. Schematics and Layout

A.1 INTRODUCTION

This chapter provides detailed technical information on the dsPIC® DSC Signal Board.

A.2 BOARD SCHEMATICS AND LAYOUT

The following are the dsPIC DSC Signal Board schematics and layout:

- Figure A-1: dsPIC DSC Signal Board schematics (Sheet 1 of 5)
- Figure A-2: dsPIC DSC Signal Board schematics (Sheet 2 of 5)
- Figure A-3: dsPIC DSC Signal Board schematics (Sheet 3 of 5)
- Figure A-4: dsPIC DSC Signal Board schematics (Sheet 4 of 5)
- Figure A-5: dsPIC DSC Signal Board schematics (Sheet 5 of 5)
- Figure A-6: dsPIC DSC Signal Board layout

FIGURE A-1: ds**PIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 1 OF 5)**

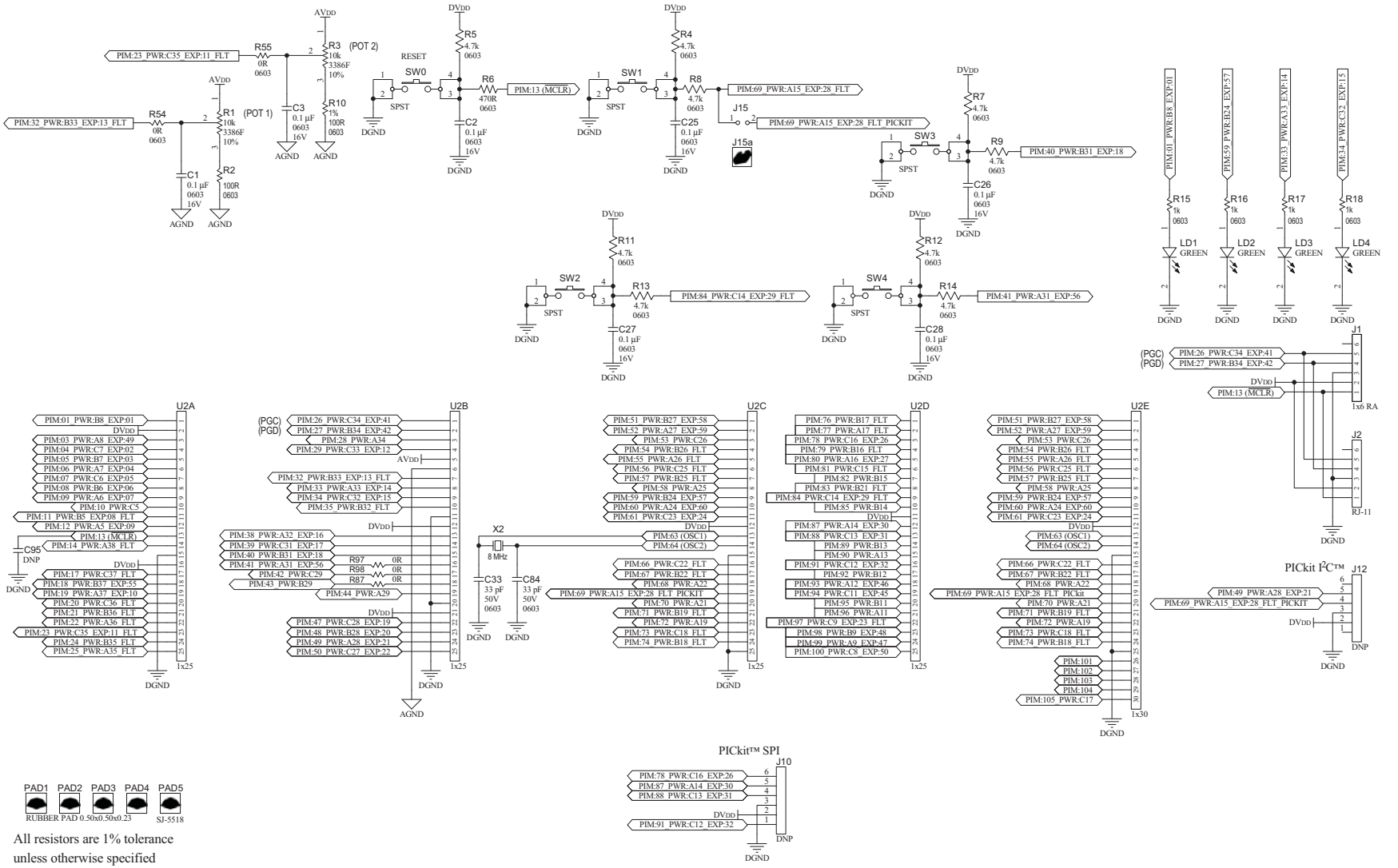


FIGURE A-2: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 2 OF 5)

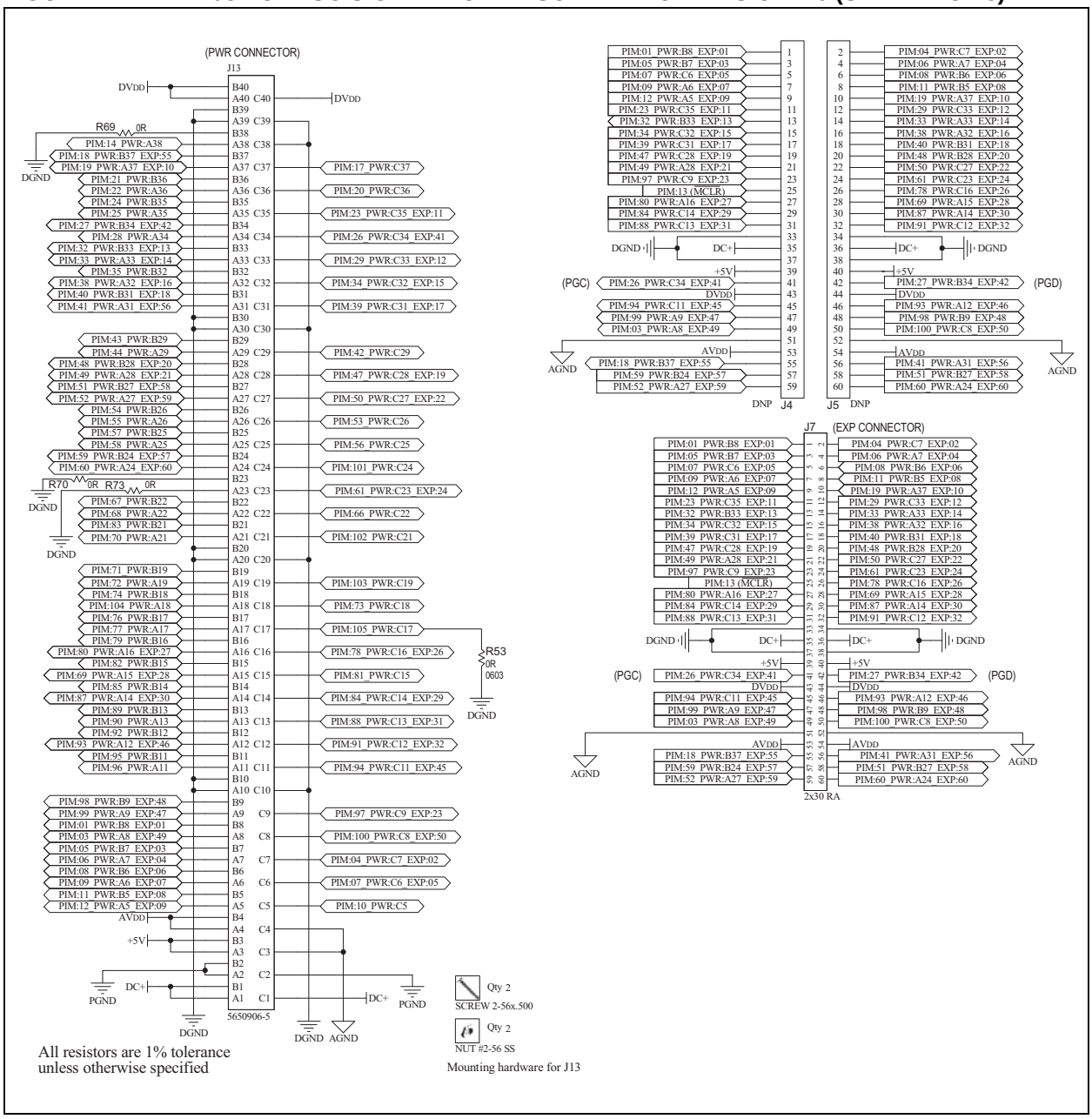


FIGURE A-3: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 3 OF 5)

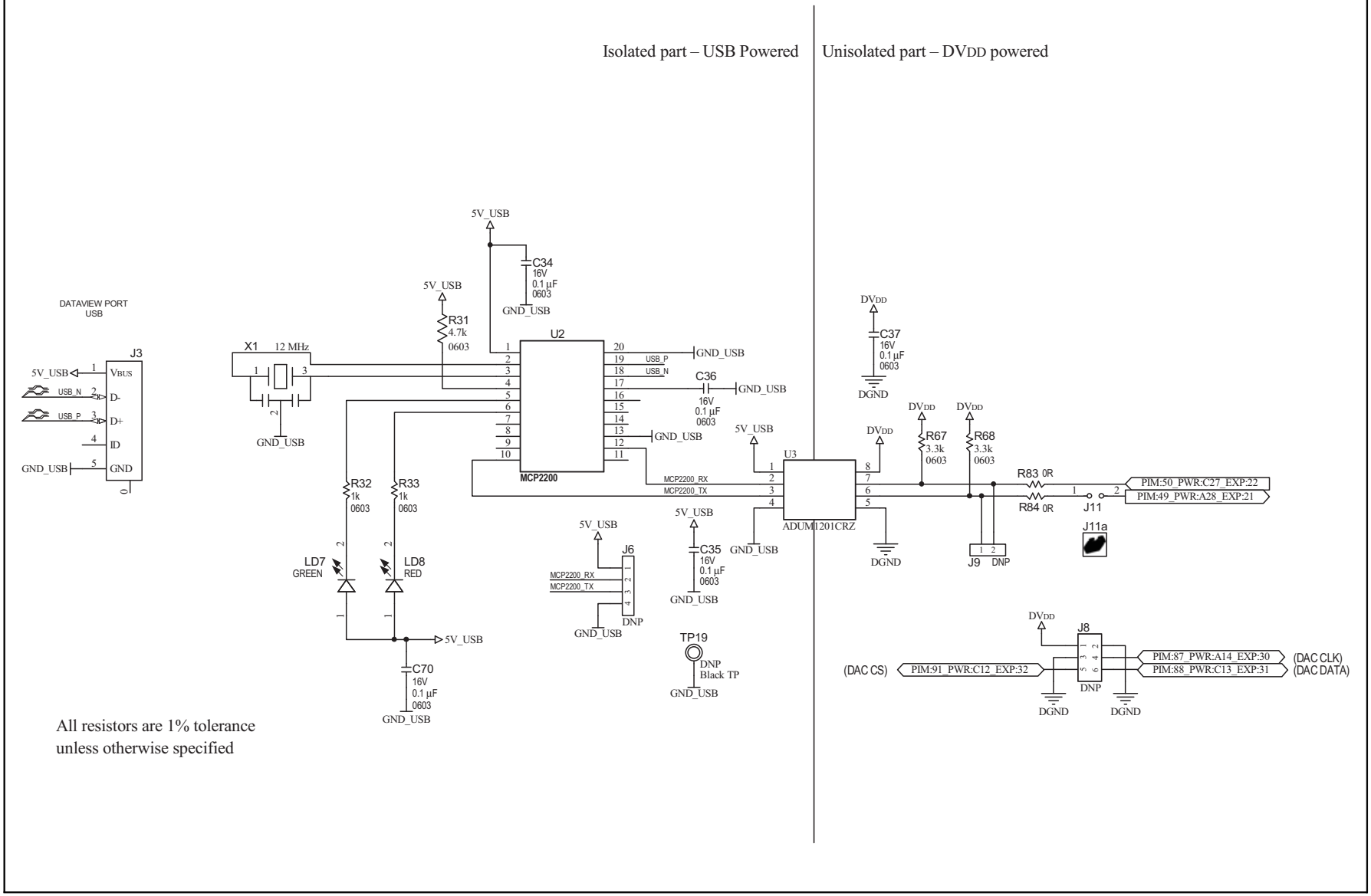


FIGURE A-4: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 4 OF 5)

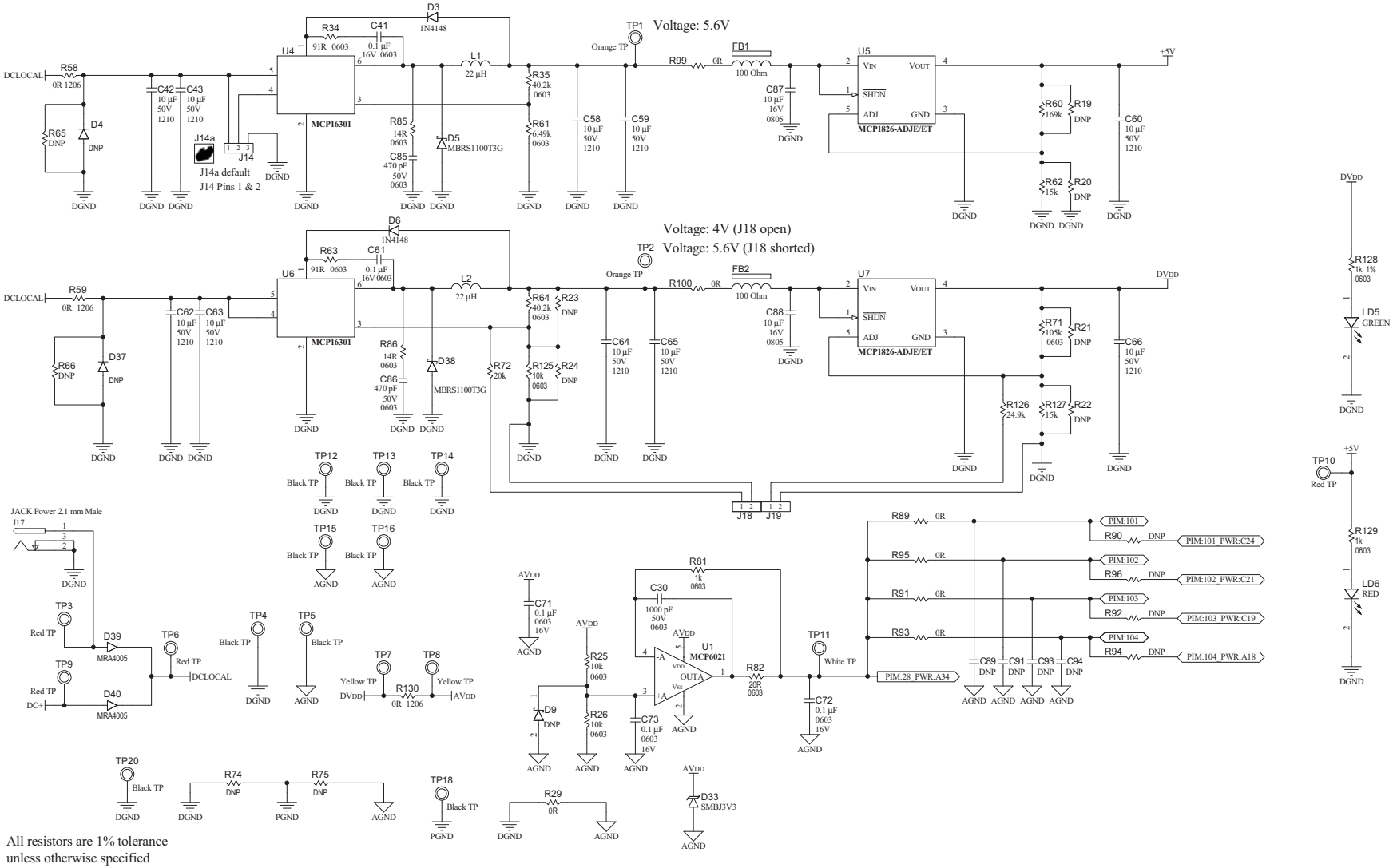
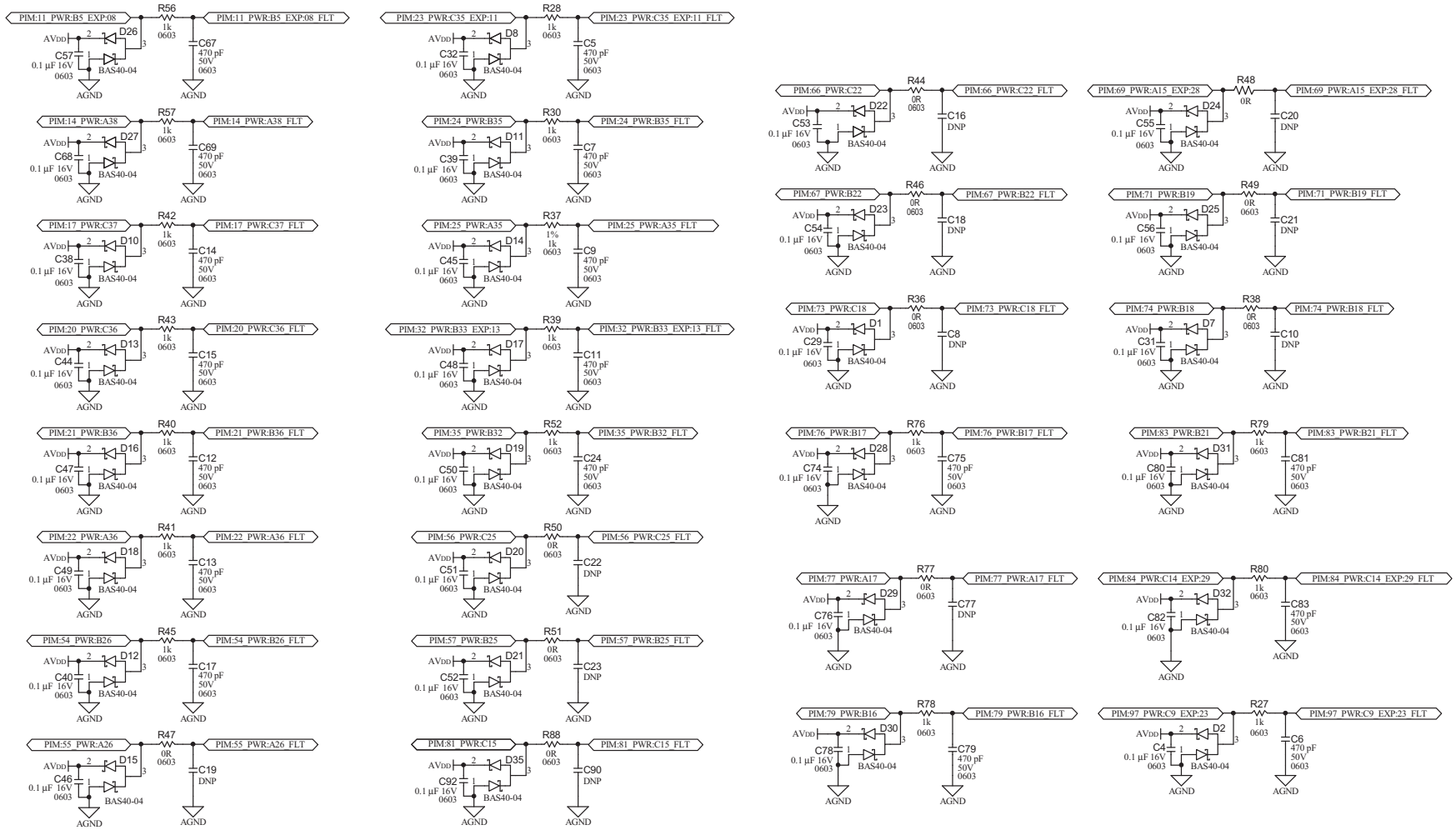
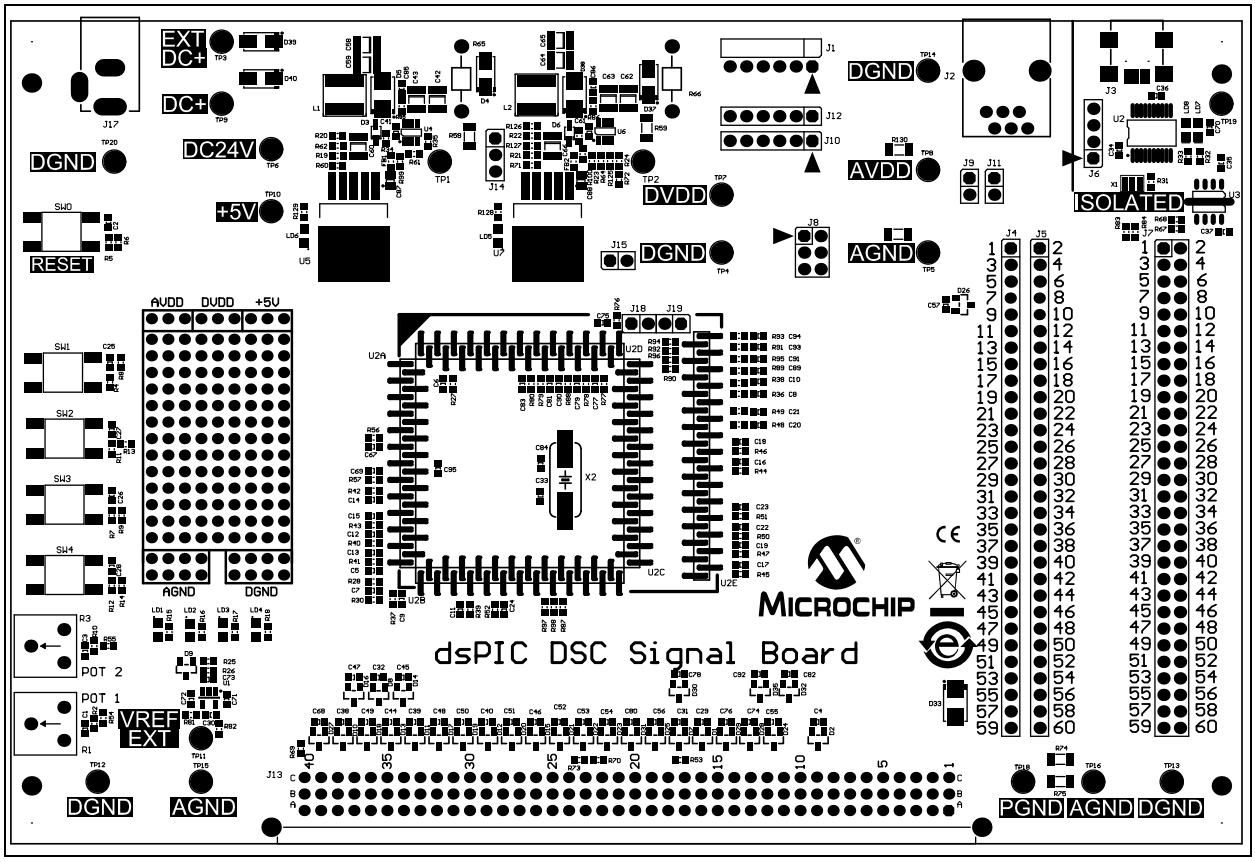


FIGURE A-5: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 5 OF 5)



All resistors are 1% tolerance
unless otherwise specified

FIGURE A-6: ds**PIC®** **DSC SIGNAL BOARD LAYOUT**



NOTES:

Appendix B. Electrical Specifications

B.1 INTRODUCTION

This chapter provides the electrical specifications of the dsPIC® DSC Signal Board (see Table B-1).

TABLE B-1: ELECTRICAL SPECIFICATIONS

Parameter	Operating Range
Input DC Voltage	10V-24V ±10% (9V-26.4V)
Input DC Voltage (Connector J17)	24V
Operating Temperature	Ambient +25°C
Output Power Supply 1	5V ±0.5% (4.975V-5.025V)
Output Power Supply 2	3.3V ±0.5% (3.316V-3.283V) or 5V ±0.5% (4.975V-5.025V)
Current from Power Supply 1 (Fixed +5V)	0-600 mA
Current from Power Supply 2 (+3.3V or +5V)	0-600 mA

NOTES:

Appendix C. Design Calculations

C.1 INTRODUCTION

This chapter provides detailed information on the Power Supply 1 and Power Supply 2 design. Power Supply 1 has a fixed output of +5V, whereas the output of Power Supply 2 is configurable. Power Supply 1 and Power Supply 2 have the same power supply circuits. Power Supply 2 also has a parallel resistor RPIM in its feedback circuit for reconfiguring the output voltage.

C.2 DESIGN OF POWER SUPPLY CIRCUIT

The power supply circuit is designed in the following two stages:

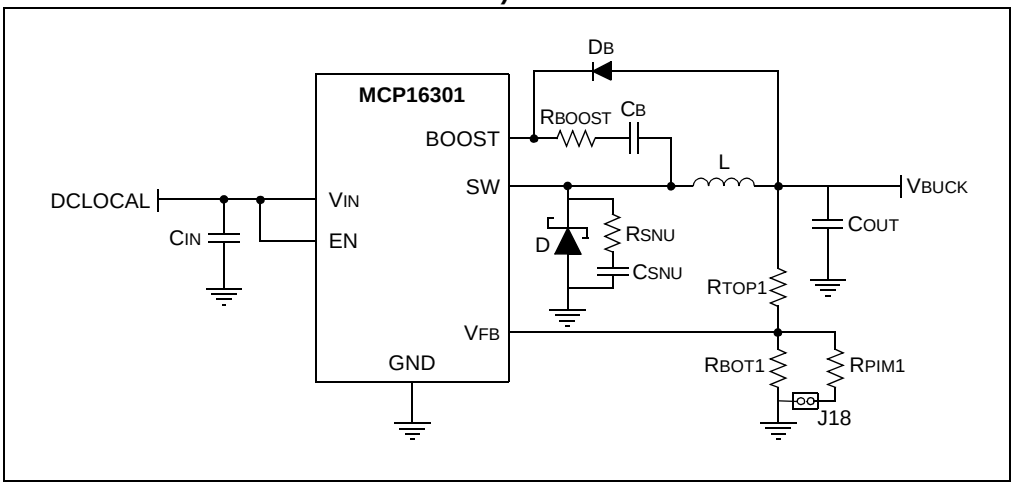
1. First Stage of Power Supply Circuit Design
2. Second Stage of Power Supply Circuit Design

C.2.1 First Stage of Power Supply Circuit Design

The first stage of the power supply is a synchronous step-down converter (see Figure C-1). The Stage 1 power supply has the following specifications:

- Input Voltage (DC+) = 9V-26.4V
- Output Voltage (V_{BUCK}) = 4V when Connector J18 is open
- Output Voltage (V_{BUCK}) = 5.6V when Connector J18 is connected

FIGURE C-1: STAGE 1 POWER SUPPLY (APPLICATION CIRCUIT AROUND MCP16301)



The component values used in this circuit are listed in Table C-1, and were chosen using Equation C-1 with V_{FB} = 0.8V and K = 0.22V/µH.

EQUATION C-1:

$$R_{TOP1} = R_{BOT1} \times \left(\frac{V_{BUCK}}{V_{FB}} - 1 \right)$$

$$K = V_{BUCK} / L$$

TABLE C-1: STAGE 1 POWER SUPPLY COMPONENT VALUES

Designator	Power Supply 1	Power Supply 2
RTOP1	R35 = 40.2 kΩ	R64 = 40.2 kΩ
RBOT1	R61 = 6.49 kΩ	R125 = 10 kΩ
RPIM1	—	R72 = 20 kΩ
L	L1 = 22 µH	L2 = 22 µH
CB	C41 = 0.1 µF(1)	C61 = 0.1 µF(1)
CIN	C42 = C43 = 10 µF(1)	C62 = C63 = 10 µF(1)
COUT	C58 = C59 = 10 µF(1)	C64 = C65 = 10 µF(1)
VBUCK	5.6V	+4V (J18 open) +5.6V (J18 shorted)

Note 1: These components are selected based on recommendations from the *"MCP16301/H High-Voltage Input Integrated Switch Step-Down Regulator Data Sheet"* (DS20005004).

A low forward drop Schottky diode is used for freewheeling diode D. The average diode current is calculated using Equation C-2. Based on these calculations, a MBRS1100T3G Schottky diode is selected.

EQUATION C-2:

$$I_{D(AVG)} = \left(1 - \frac{V_{BUCK}}{DCLOCAL} \right) \times I_{OUT}$$

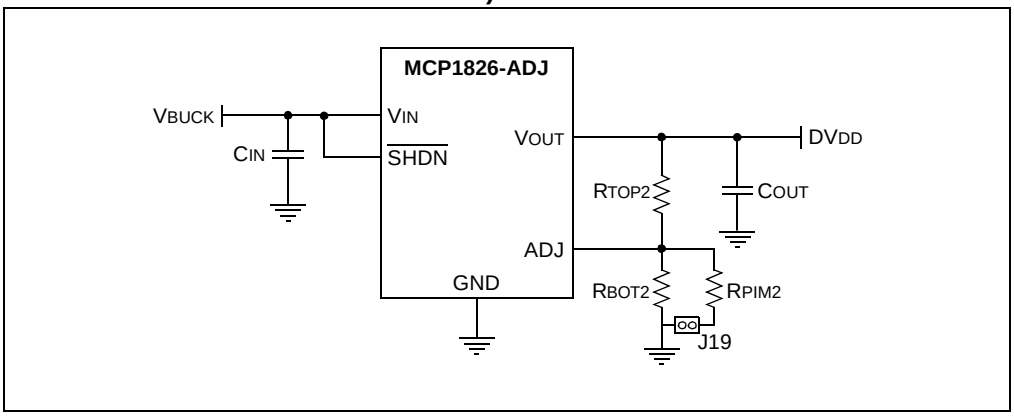
A standard 1N4148 ultra-fast diode for boost diode DB was selected based on recommendations from the *"MCP16301/H High-Voltage Input Integrated Switch Step-Down Regulator Data Sheet"* (DS20005004). For more information about the snubber circuits, RSNU and CSNU, and series boost resistor, RBOOST, refer to *AN1466,* "*Reduction of the High-Frequency Switching Noise in the MCP16301 High-Voltage Buck Converter*" (DS01466) application note.

C.2.2 Second Stage of Power Supply Circuit Design

The second stage of the power supply is designed around a Low Dropout (LDO) MCP1826 (see Figure C-2). The second stage of the power supply has the following specifications:

- Input Voltage (V_{BUCK}) = +4V (J18 is open) or +5.6V (J18 is shorted)
- Output Voltage (DV_{DD}) = +3.3V when connector, J19, is open
- Output Voltage (DV_{DD}) = +5V when connector, J19, is connected

FIGURE C-2: STAGE 2 POWER SUPPLY (APPLICATION CIRCUIT AROUND MCP1826)



If V_{ADJ} = 0.41V, then by using Equation C-3, the user can configure the component values as provided in Table C-2 for the application circuit shown in Figure C-2.

EQUATION C-3:

$$DVDD = V_{ADJ} \times \left(\frac{R_{TOP2} + R_{BOT2}}{R_{BOT2}} \right)$$

TABLE C-2: STAGE 2 POWER SUPPLY COMPONENT VALUES

Designator	Power Supply 1	Power Supply 2
R_{TOP2}	R60 = 169 kΩ	R71 = 40.2 kΩ
R_{BOT2}	R61 = 6.49 kΩ	R127 = 10 kΩ
R_{PIM2}	—	R126 = 20 kΩ
V_{OUT}	5 V	+3.3V (J19 open) +5V (J19 shorted)
C_{IN}	C87 = 10 µF(1)	C88 = 10 µF(1)
C_{OUT}	C60 = 10 µF(1)	C66 = 10 µF(1)

Note 1: These components are selected based on the recommendations from the *"MCP1826/MCP1826S 1000 mA, Low-Voltage, Low Quiescent Current LDO Regulator Data Sheet"* (DS22057).

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