



# **dsPIC<sup>®</sup> DSC Signal Board User's Guide**

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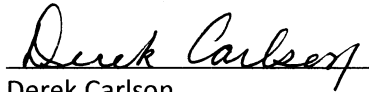
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA



Derek Carlson

VP Development Tools

16-July-2013  
Date

# dsPIC<sup>®</sup> DSC Signal Board

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## Table of Contents

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|                                                |           |
|------------------------------------------------|-----------|
| <b>Preface .....</b>                           | <b>7</b>  |
| <b>Chapter 1. Introduction</b>                 |           |
| 1.1 Overview .....                             | 11        |
| 1.2 dsPIC DSC Signal Board Features .....      | 11        |
| 1.3 Functions .....                            | 12        |
| 1.4 Block Diagram .....                        | 13        |
| <b>Chapter 2. Board Interface Description</b>  |           |
| 2.1 Introduction .....                         | 15        |
| 2.2 Highlights .....                           | 15        |
| 2.3 Board Connectors and Headers .....         | 15        |
| 2.4 User Interface Hardware .....              | 33        |
| 2.5 Board Test Points .....                    | 36        |
| <b>Chapter 3. Hardware Description</b>         |           |
| 3.1 Introduction .....                         | 39        |
| 3.2 Highlights .....                           | 39        |
| 3.3 Power Supply Circuit .....                 | 41        |
| 3.4 Voltage Reference Circuit .....            | 43        |
| 3.5 Isolated USB Interface .....               | 44        |
| 3.6 PIM Header Signals .....                   | 45        |
| 3.7 Supply Voltage and Ground Connection ..... | 48        |
| <b>Appendix A. Schematics and Layout</b>       |           |
| A.1 Introduction .....                         | 49        |
| A.2 Board Schematics and Layout .....          | 49        |
| <b>Appendix B. Electrical Specifications</b>   |           |
| B.1 Introduction .....                         | 57        |
| <b>Appendix C. Design Calculations</b>         |           |
| C.1 Introduction .....                         | 59        |
| C.2 Design of Power Supply Circuit .....       | 59        |
| <b>Worldwide Sales and Service .....</b>       | <b>62</b> |

# dsPIC<sup>®</sup> DSC Signal Board

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NOTES:



# dsPIC<sup>®</sup> DSC SIGNAL BOARD USER'S GUIDE

## Preface

### NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site ([www.microchip.com](http://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<sup>®</sup> 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<sup>®</sup> 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                                                                                                                                                                                                                                                                                     | <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&gt;Save</i></u>                                  |
| Bold characters                                  | A dialog button                                                                                                                                                                                                                                                                                      | Click <b>OK</b>                                             |
|                                                  | A tab                                                                                                                                                                                                                                                                                                | Click the <b>Power</b> 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'                                                   |
| <i>Italic Courier New</i>                        | 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)<br>{ ...<br>}                              |
| 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. | <div><b>Note:</b> This is a standard note box.</div>        |
|                                                  |                                                                                                                                                                                                                                                                                                      | <div><b>CAUTION</b></div>                                   |
|                                                  |                                                                                                                                                                                                                                                                                                      | <div><b>This is a caution note.</b></div>                   |
|                                                  |                                                                                                                                                                                                                                                                                                      | <b>Note 1:</b> 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](http://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).

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- **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:

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- 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.

### Revision B (May 2014)

- Note added to [Figure C-1](#).
- Note reference added to [Section C.2.1 “First Stage of Power Supply Circuit Design”](#) in [Appendix C. “Design Calculations”](#).
- Changes in values made to [Table C-2](#).

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## Chapter 1. Introduction

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### 1.1 OVERVIEW

This chapter describes the features and functions of the dsPIC<sup>®</sup> 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

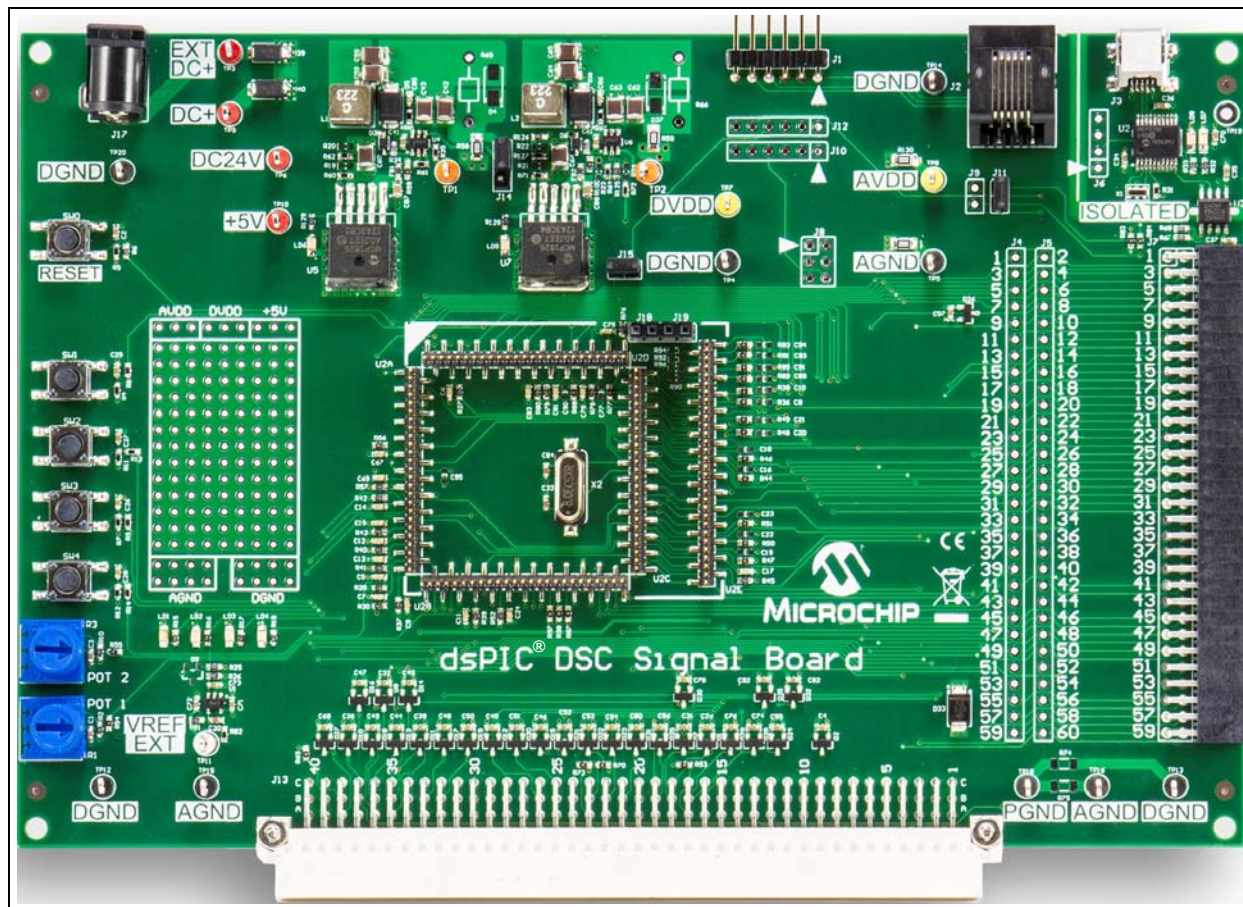
The dsPIC DSC Signal Board is shown in [Figure 1-1](#). The board includes these key features:

- 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 k $\Omega$  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<sup>™</sup> serial analyzer (SPI protocol) interface (J10)
  - PICkit serial analyzer interface (I<sup>2</sup>C<sup>™</sup> protocol) (J12)
- Power Supply Connectors:
  - 24V power input connector (J17)
- Programming Connectors:
  - ICSP<sup>™</sup> 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<sub>DD</sub>, AV<sub>DD</sub>
- Ground:
  - Digital Ground (DGND), Analog Ground (AGND), Power Ground (PGND)

**FIGURE 1-1: dsPIC<sup>®</sup> DSC SIGNAL BOARD**



## 1.3 FUNCTIONS

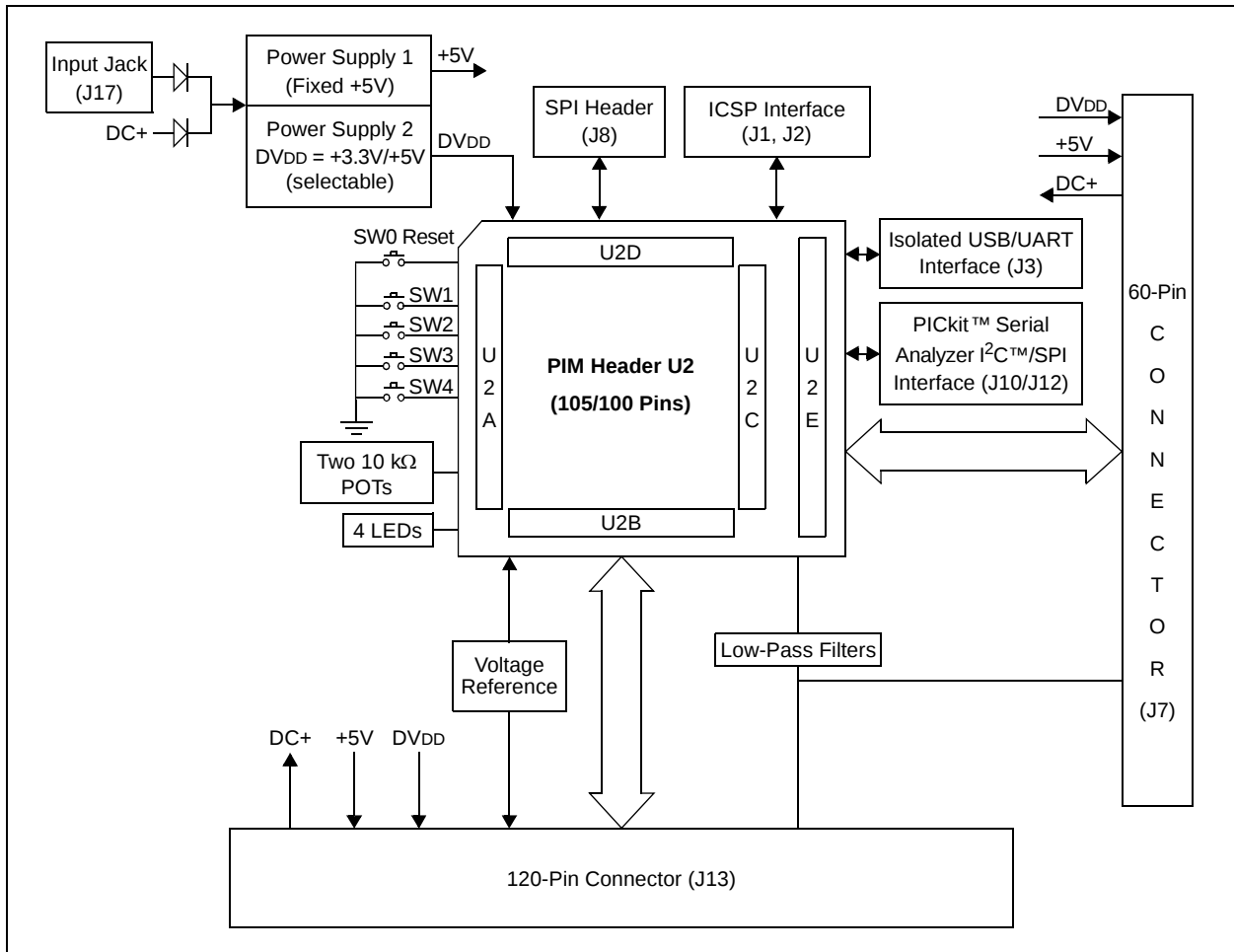
The dsPIC DSC Signal Board has the following functions:

- 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<sup>2</sup>C and SPI interfaces
- Provides auxiliary power supply (DVDD = +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 BOARD BLOCK DIAGRAM**



# dsPIC<sup>®</sup> DSC Signal Board

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## Chapter 2. Board Interface Description

### 2.1 INTRODUCTION

This chapter provides a more detailed description of the input and output interfaces of the dsPIC<sup>®</sup> 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 <sup>™</sup> connector for programming a dsPIC <sup>®</sup> 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 <sup>(1)</sup>                             |
| J5         | 30             | Even number pin connection from connector, J7 <sup>(1)</sup>                            |
| J6         | 4              | Isolated UART interface                                                                 |
| J7         | 60             | Connector for expansion board interface <sup>(1)</sup>                                  |
| J8         | 6              | Header for SPI interface                                                                |
| J9         | 2              | UART TX/RX inputs                                                                       |
| J10        | 6              | Header for PICKit <sup>™</sup> serial analyzer (SPI interface)                          |
| J12        | 6              | Header for PICKit serial analyzer (I <sup>2</sup> C <sup>™</sup> 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.

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# Board Interface Description

## 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         | DVDD                      | 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 (MCLR)             | Device Master Clear (MCLR)          | No     | —          | 25 | 25 | —  |
| 14        | PIM:14_PWR:A38_FLT        | —                                   | Yes    | A38        | —  | —  | —  |
| 15        | DGND                      | Digital Ground                      | —      | —          | —  | —  | —  |
| 16        | DVDD                      | 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 (VREF)            | No     | A34        | —  | —  | —  |
| 29        | PIM:29_PWR:C33_EXP:12     | —                                   | No     | C33        | 12 | —  | 12 |
| 30        | AVDD                      | 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<sup>2</sup>C™ 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<sup>2</sup>C interface. However, when connector J11 is shorted, PIM:49 is connected to the TX pin of the digital isolator, U3.

# dsPIC® DSC Signal Board

**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 <sup>(2)</sup>            | UART Receive/I <sup>2</sup> C 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 <sup>(1)</sup> | Push Button SW1/I <sup>2</sup> C 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 I<sup>2</sup>C™ 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<sup>2</sup>C interface. However, when connector J11 is shorted, PIM:49 is connected to the TX pin of the digital isolator, U3.

# Board Interface Description

**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        | DVDD                      | 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 (VREF)      | No     | C24        | —  | —  | —  |
| 102       | PIM:102                   | Reference Voltage (VREF)      | No     | C21        | —  | —  | —  |
| 103       | PIM:103                   | Reference Voltage (VREF)      | No     | C19        | —  | —  | —  |
| 104       | PIM:104                   | Reference Voltage (VREF)      | 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<sup>2</sup>C™ 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<sup>2</sup>C 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 (MCLR)         | Device Master Clear (MCLR)          |
| 2     | DVDD                  | 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 (MCLR)         | Device Master Clear (MCLR)          |
| 2     | DVDD                  | 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     | DVDD                  | 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     | DVDD                  | 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 I<sup>2</sup>C Interface (J12)

A 6-pin header J12 connects the MPLAB PICKit serial analyzer to a dsPIC DSC or microcontroller supporting I<sup>2</sup>C protocol (see [Table 2-10](#)).

**TABLE 2-10: PICKit™ SERIAL ANALYZER I<sup>2</sup>C 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 I <sup>2</sup> C™ Interface Serial Data           |
| 5     | PIM:49_PWR:A28_EXP:21            | PICKit I <sup>2</sup> C 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       |

# Board Interface Description

## 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            | AVDD <sup>(4)</sup>   | Analog Voltage (+3.3V/+5V)                   | —       |
| B4            | AVDD <sup>(4)</sup>   | 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 <sup>(1)</sup> | 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:** 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.

# dsPIC® DSC Signal 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 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 <sup>2</sup> C™ 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 (VREF)                       | 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 (VREF)                       | 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 (VREF)                       | 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 <sup>(2)</sup>                       | 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:** 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.

# Board Interface Description

**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/I <sup>2</sup> C™ 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.

# dsPIC® DSC Signal 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           | DVDD <sup>(3)</sup> | Digital Voltage (+3.3V/+5V)           | —       |
| B40           | DVDD <sup>(3)</sup> | Digital Voltage (+3.3V/+5V)           | —       |
| C40           | DVDD <sup>(3)</sup> | 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:** 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.

# Board Interface Description

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

| Connector J13               | Signal Name     | Functional Description      | PIM Pin |
|-----------------------------|-----------------|-----------------------------|---------|
| <b>Power Supply Signals</b> |                 |                             |         |
| C3                          | AGND            | Analog Ground               | —       |
| C4                          | AGND            | Analog Ground               | —       |
| B4                          | AVDD            | Analog Voltage (+3.3V/+5V)  | —       |
| A4                          | AVDD            | 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                         | DVDD            | Digital Voltage (+3.3V/+5V) | —       |
| B40                         | DVDD            | Digital Voltage (+3.3V/+5V) | —       |
| C40                         | DVDD            | 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 (VREF)    | 101     |
| A18                         | PIM:104_PWR:A18 | Reference Voltage (VREF)    | 104     |
| C19                         | PIM:103_PWR:C19 | Reference Voltage (VREF)    | 103     |
| C21                         | PIM:102_PWR:C21 | Reference Voltage (VREF)    | 102     |
| A34                         | PIM:28_PWR:A34  | Reference Voltage (VREF)    | 28      |

# dsPIC® DSC Signal Board

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

| Connector J13         | Signal Name           | Functional Description                                              | PIM Pin |
|-----------------------|-----------------------|---------------------------------------------------------------------|---------|
| <b>Filter Signals</b> |                       |                                                                     |         |
| 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 <sup>2</sup> C™ PICkit™ Interface | 69      |
| C14                   | PIM:84_PWR:C14_EXP:29 | Filter Signal – Push Button SW2                                     | 84      |

# Board Interface Description

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

| Connector J13             | Signal Name           | Functional Description                                              | PIM Pin |
|---------------------------|-----------------------|---------------------------------------------------------------------|---------|
| <b>Non-Filter Signals</b> |                       |                                                                     |         |
| 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 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 <sup>2</sup> C™ 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      |

# dsPIC® DSC Signal Board

**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     |
| <b>Not Connected</b> |                       |                           |         |
| A23                  | DGND                  | Through 0Ω Resistor (R73) | —       |
| B23                  | DGND                  | Through 0Ω Resistor (R70) | —       |
| B38                  | DGND                  | Through 0Ω Resistor (R69) | —       |

# Board Interface Description

## 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 <sup>2</sup> 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 (MCLR)         | Direct Connection – Device Master Clear (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 <sup>2</sup> 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 $\overline{CS}$             | —         | 32        | 91      |
| 33           | DGND                  | Digital Ground                                                       | 33        | —         | —       |

**Note 1:** DVDD voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

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

# dsPIC® DSC Signal 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           | DVDD <sup>(1)</sup>   | Digital Voltage (+3.3/+5V)                              | 43        | —         | —       |
| 44           | DVDD <sup>(1)</sup>   | 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           | AVDD <sup>(2)</sup>   | Analog Voltage (+3.3/+5V)                               | 53        | —         | —       |
| 54           | AVDD <sup>(2)</sup>   | 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:** DVDD voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

**2:** AVDD 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

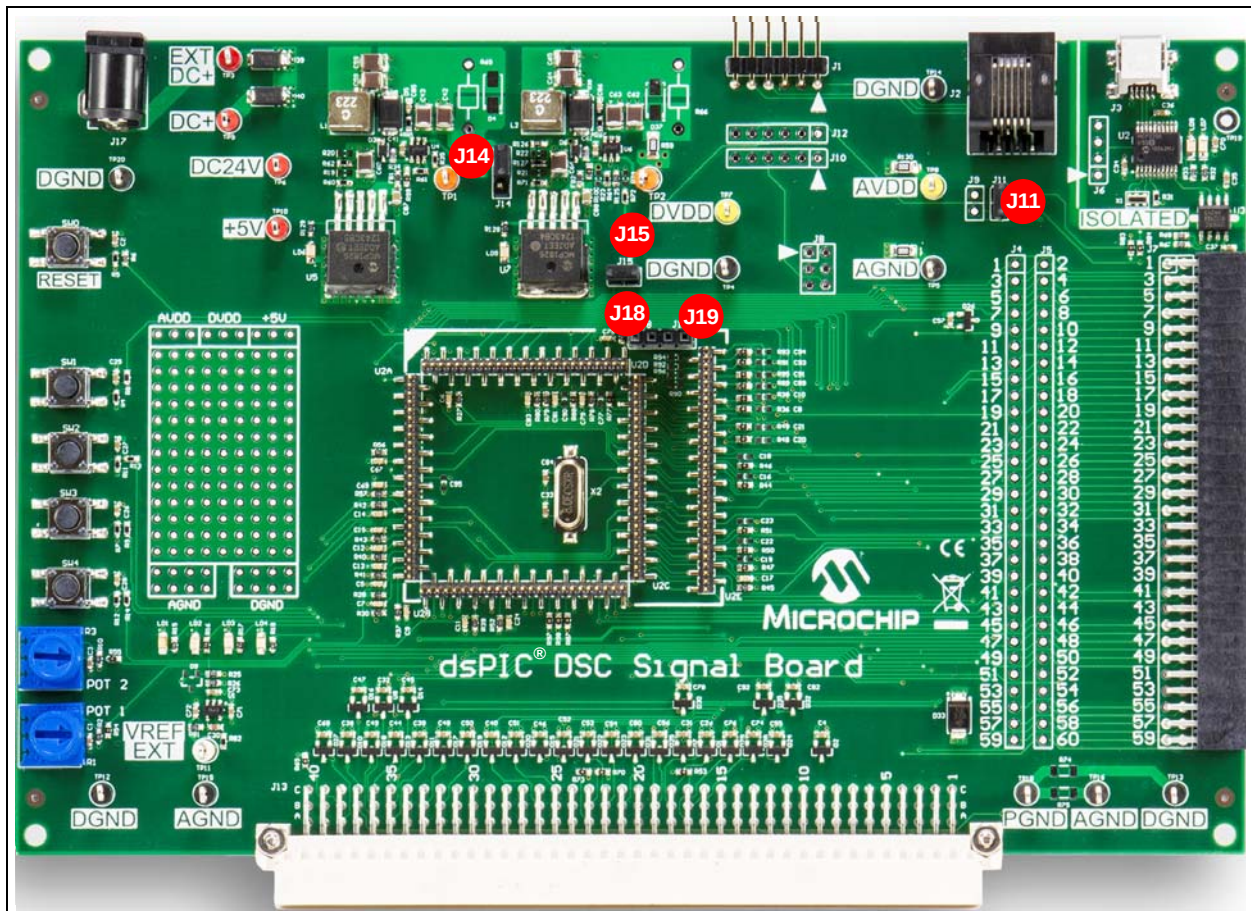
The dsPIC DSC Signal Board has five jumpers. The on-board jumpers are provided in Table 2-15. Figure 2-2 shows the jumper positions.

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<br>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 <sup>(1)</sup> |
| 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 <sup>(1)</sup> |

**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**

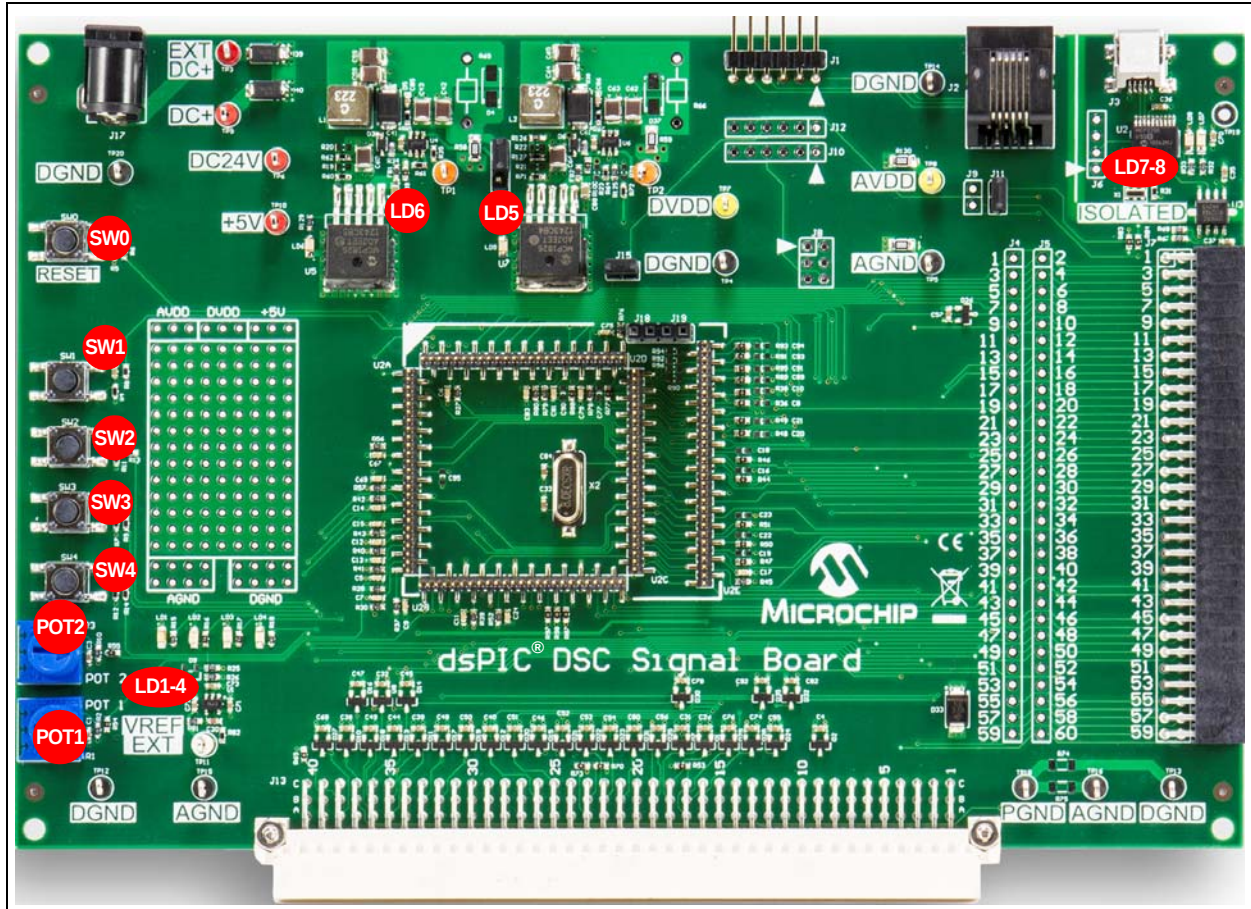
| Label   | Hardware Element Description                                      |
|---------|-------------------------------------------------------------------|
| LD1-LD4 | LEDs are used for debugging                                       |
| LD5     | Power-on status LED indicates the status of Power Supply 2 (DVDD) |
| 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 k $\Omega$ potentiometer                                                                                  |

# Board Interface Description

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                       | DVDD <sup>(1)</sup> | Digital Supply Voltage (+3.3V/+5V)                             |
| TP8                       | AVDD <sup>(2)</sup> | Analog Supply Voltage (+3.3V/+5V)                              |
| TP9                       | DC+                 | Input Bus Voltage Connector to Connectors J13 and J7           |
| TP10                      | +5V                 | Fixed +5V DC Voltage                                           |
| TP11                      | VREF <sup>(3)</sup> | Half the Analog Supply Voltage, AVDD, for Reference to Op Amps |
| TP12, TP13,<br>TP14, TP20 | DGND                | Digital Ground                                                 |
| TP15, TP16                | AGND                | Analog Ground                                                  |
| TP18                      | PGND                | Power Ground                                                   |
| TP19                      | GND_USB             | USB Ground                                                     |

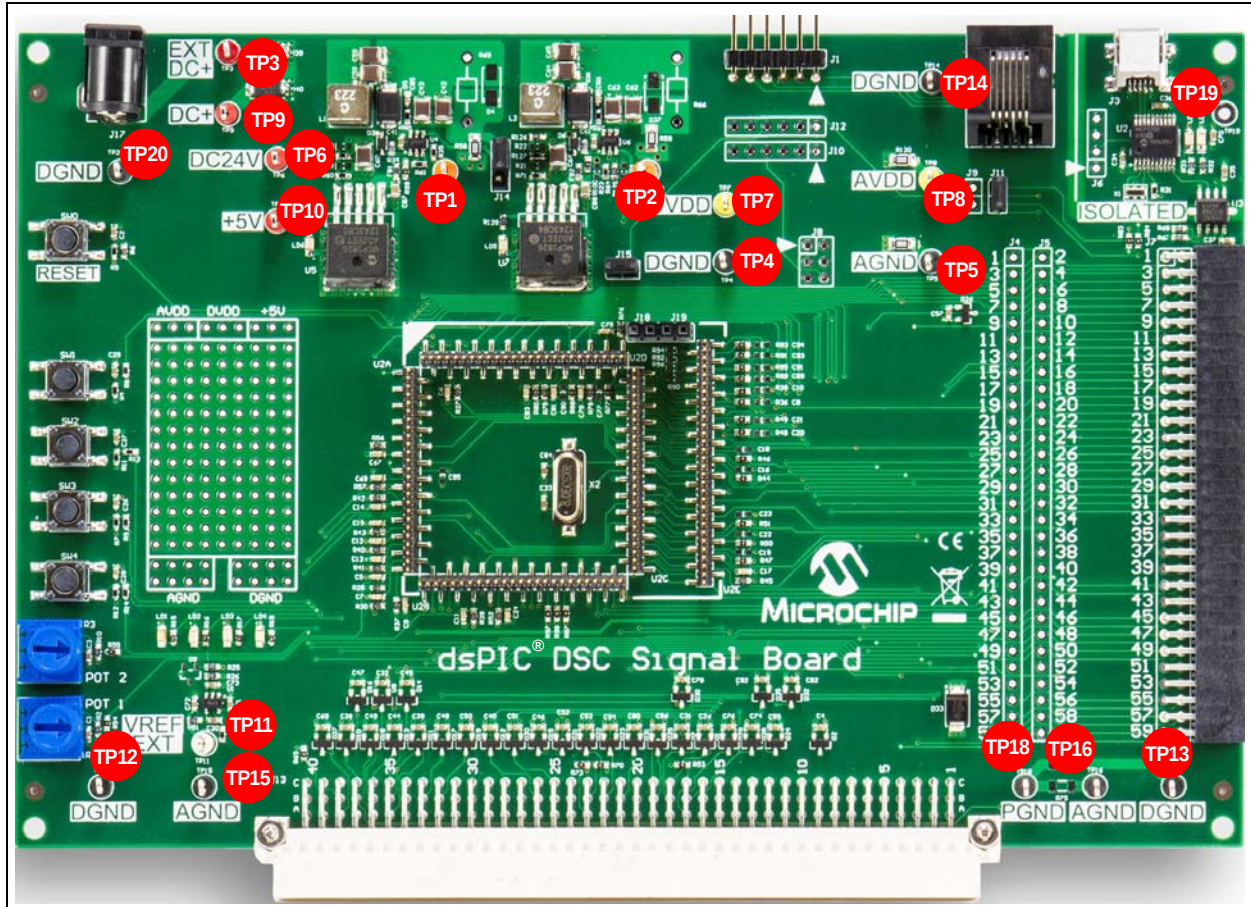
**Note 1:** DVDD voltage level is configured as either +3.3V or +5V by the PIM plugged into the board.

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

**3:** VREF voltage level is configured as either +1.65V or +2.5V based on AVDD.

# Board Interface Description

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



# dsPIC<sup>®</sup> DSC Signal Board

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NOTES:

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## **Chapter 3. Hardware Description**

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### **3.1 INTRODUCTION**

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

### **3.2 HIGHLIGHTS**

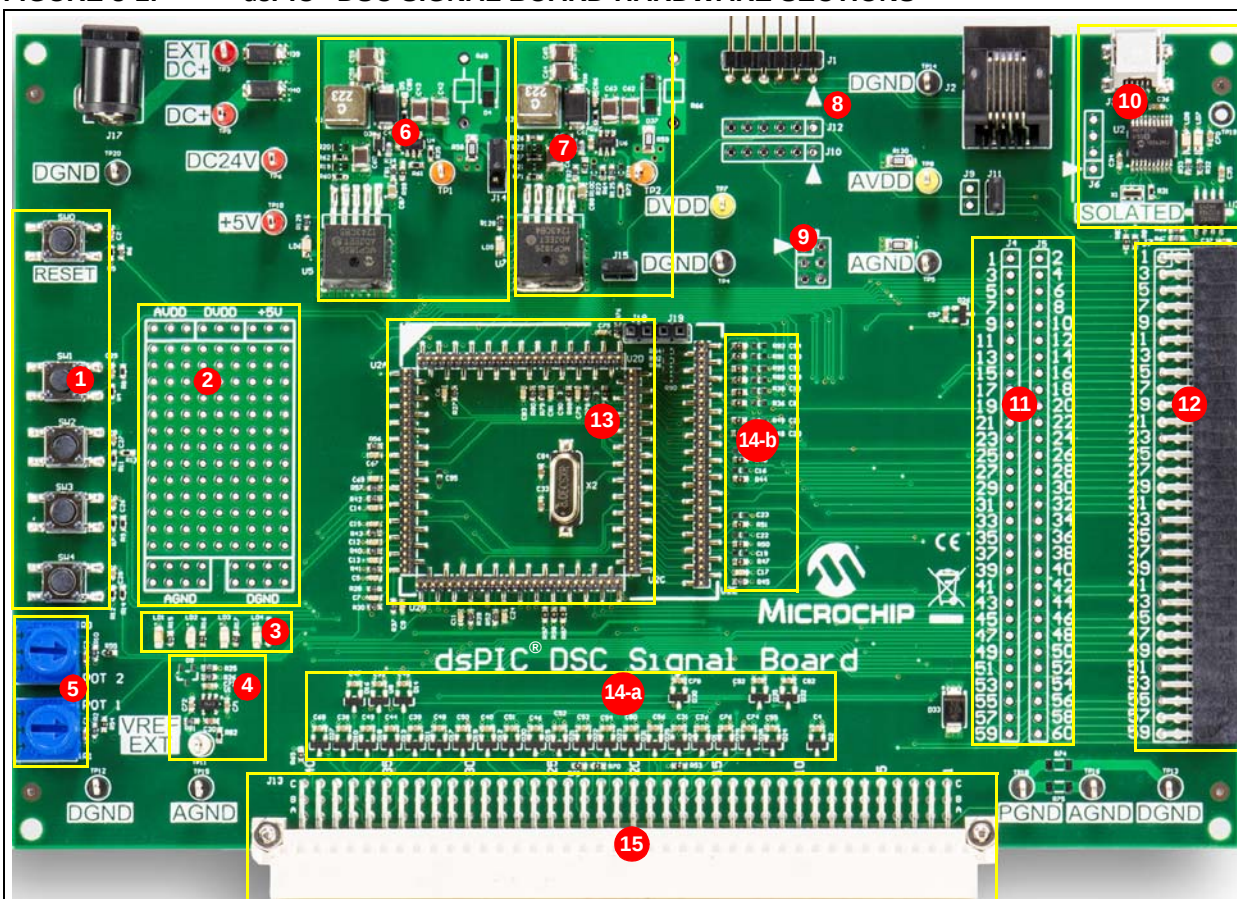
This chapter covers the following topics:

- [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](#).

# dsPIC® DSC Signal Board

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



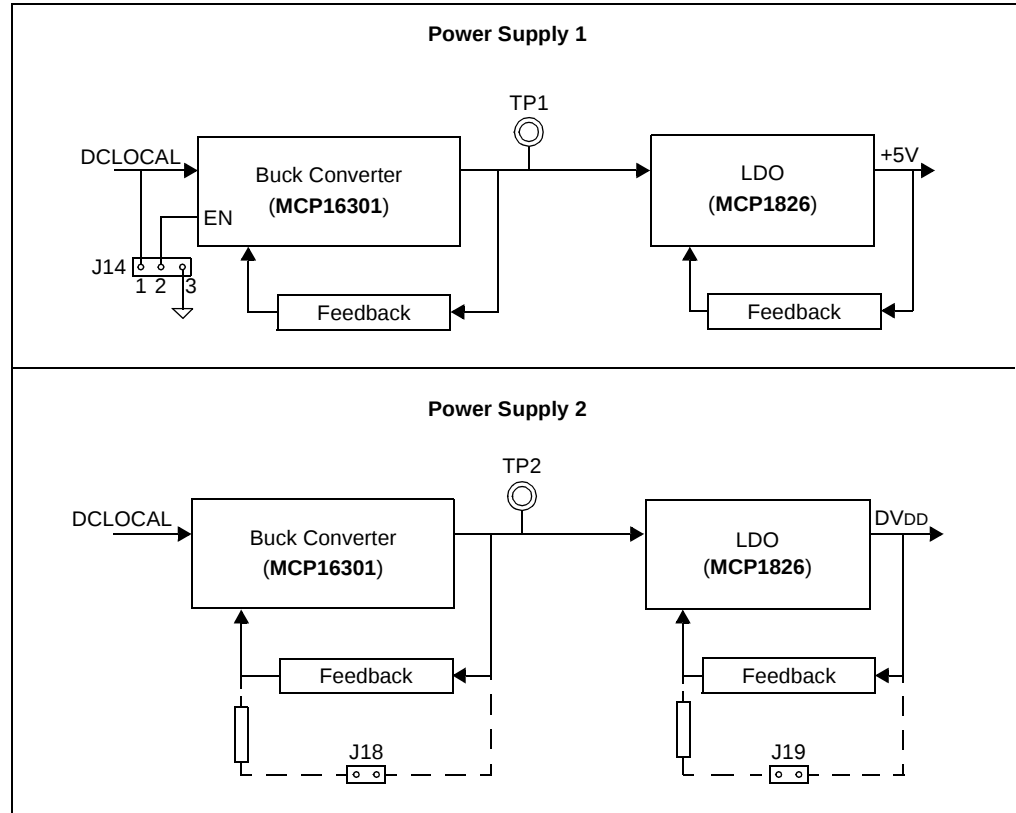
## Legend:

- |                                        |                                                                         |
|----------------------------------------|-------------------------------------------------------------------------|
| 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 (DVDD) 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 1 (see [Note 1](#))

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

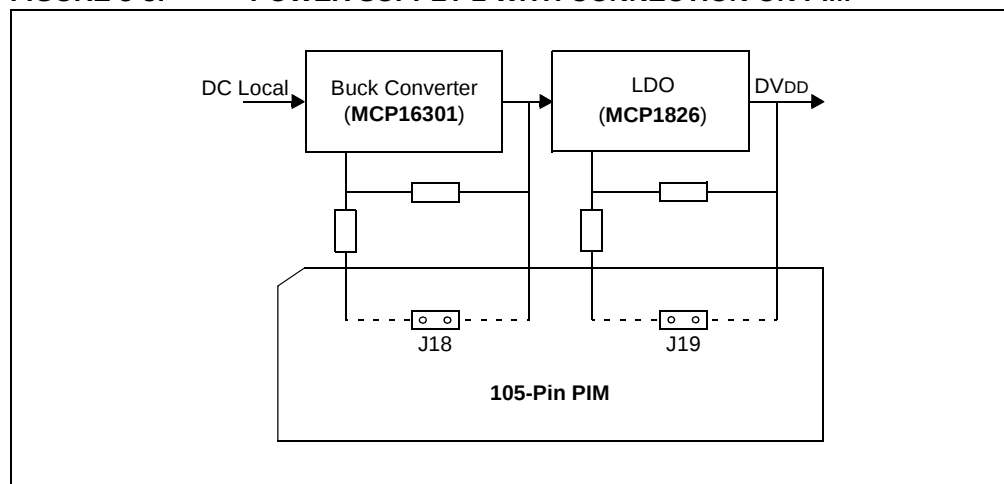
**2:** When the dsPIC DSC Signal Board is used with Microchip's Motor Control 10-24V Driver Board (Dual/Single), the connection of a power supply to the dsPIC DSC Signal Board is optional.

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 1 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**

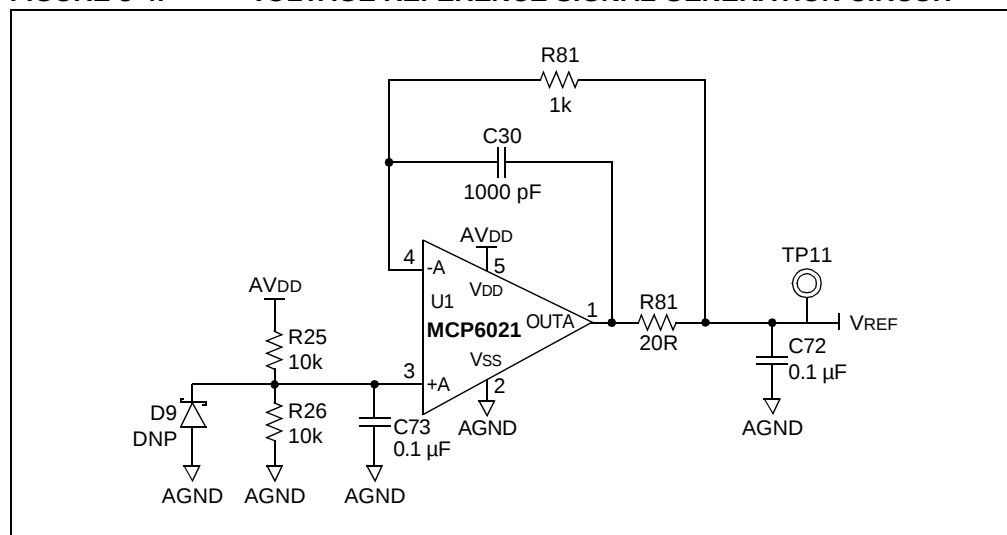


## 3.4 VOLTAGE REFERENCE CIRCUIT

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](#)).

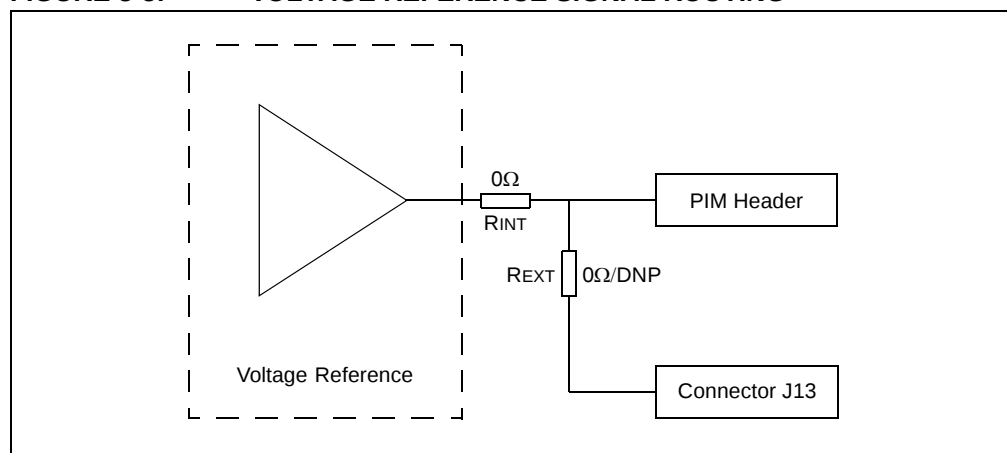
[Figure 3-4](#) shows the circuit used to obtain the voltage reference signal which is half the magnitude of the AVDD. The resistors R25 and R26 form the voltage divider circuit and generate a voltage equal to half of the analog voltage (AVDD). Op Amp U1 MCP6021 is used as the buffer. The resistors R81, 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**

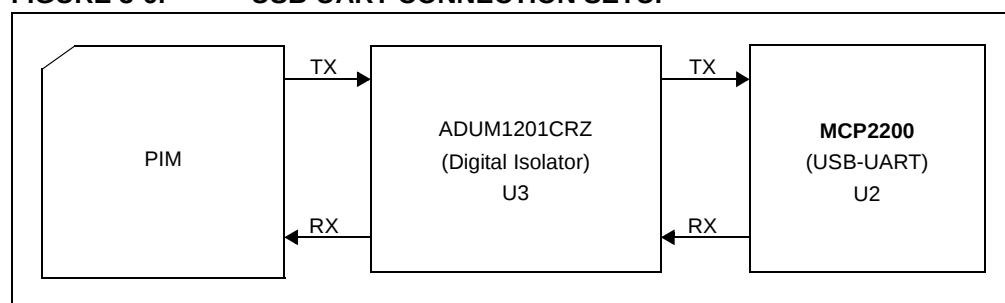


Figure 3-6 shows that the UART signal used for the USB interface is isolated through the ADUM1201CRZ isolator. The MCP2200 is a USB-to-UART serial converter, which enables USB connectivity in applications that have a UART interface. The USB-UART connection setup can support a baud rate of up to 1 Mbps.

## 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)

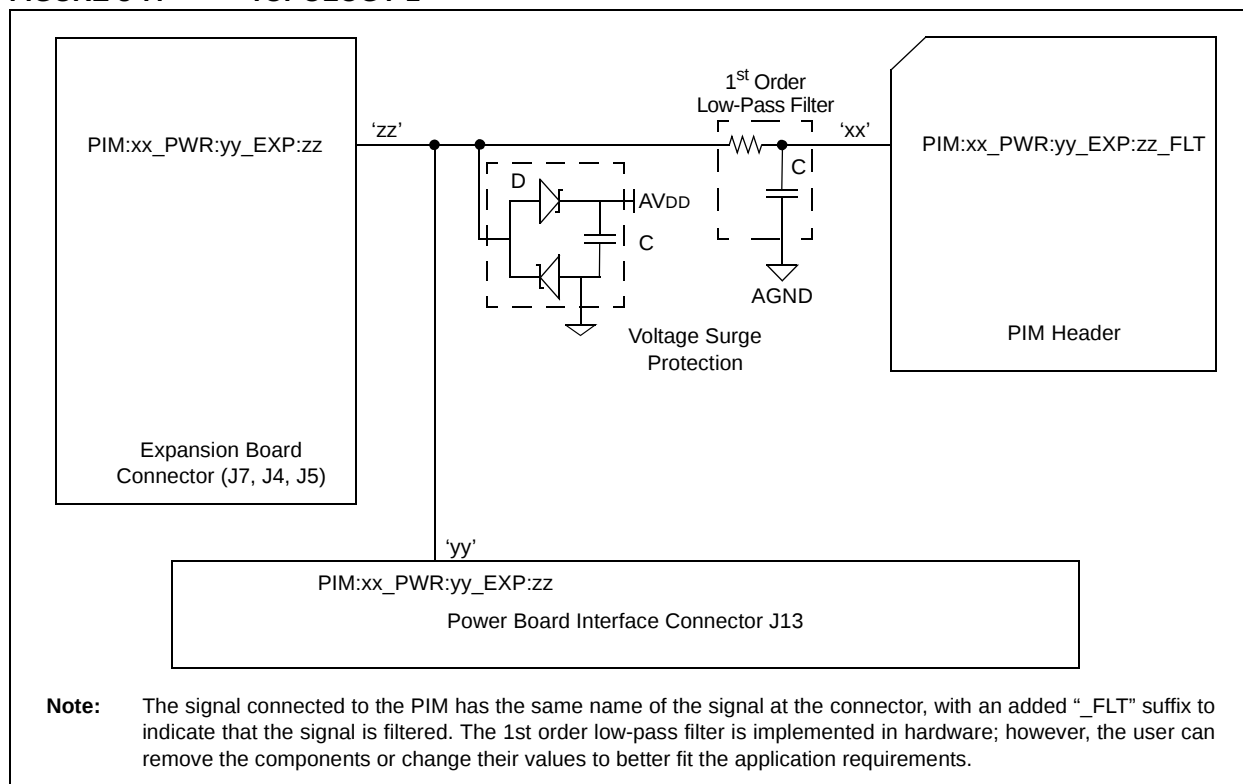
**[\_FLT]**: if present, indicates that the signal between the connector J13 and the PIM is filtered (see [Figure 3-7](#) to [Figure 3-10](#) for different connection topologies).

### 3.6.2 Analog Input Signal Conditioning

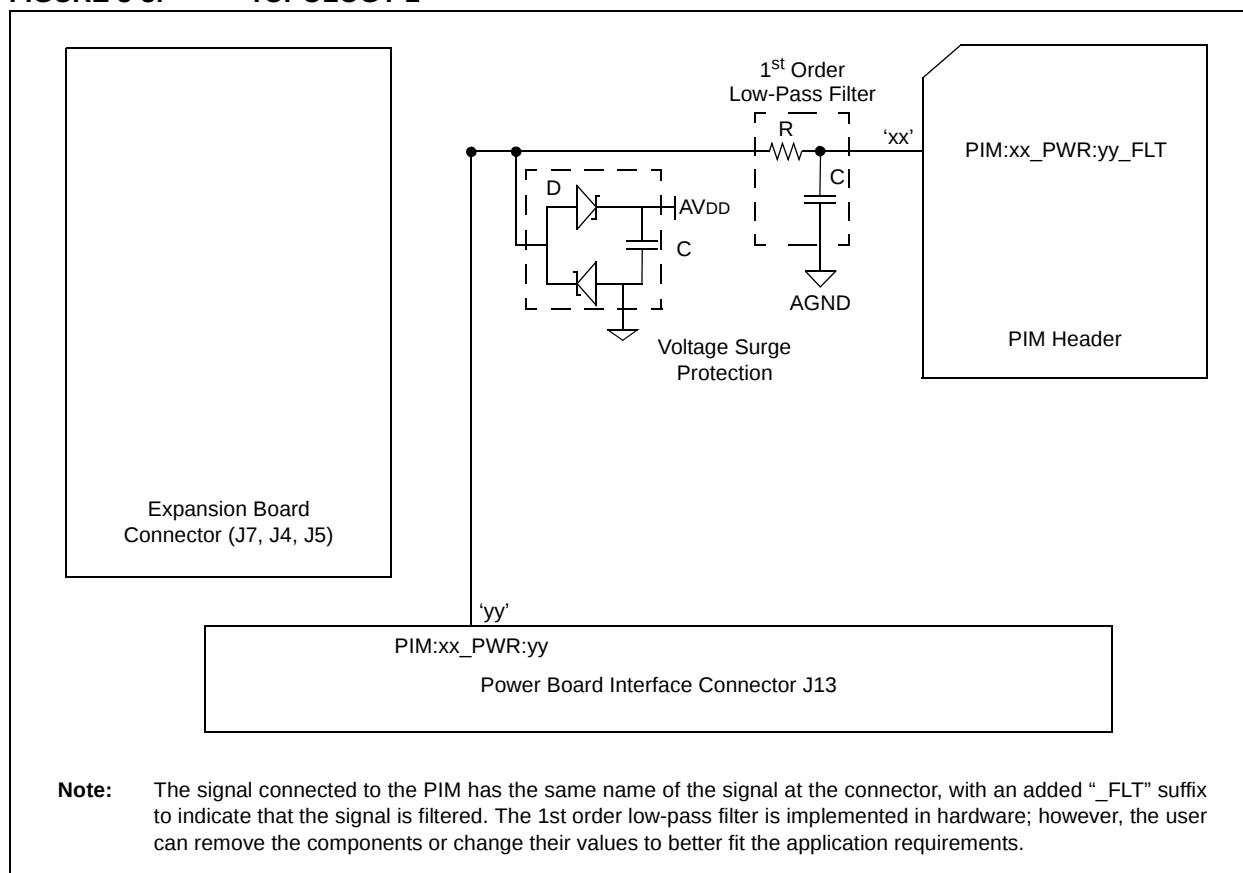
The PIM pins are connected to the power board interface connector J13 and the expansion board connector J7 by the following four possible topologies:

- 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.

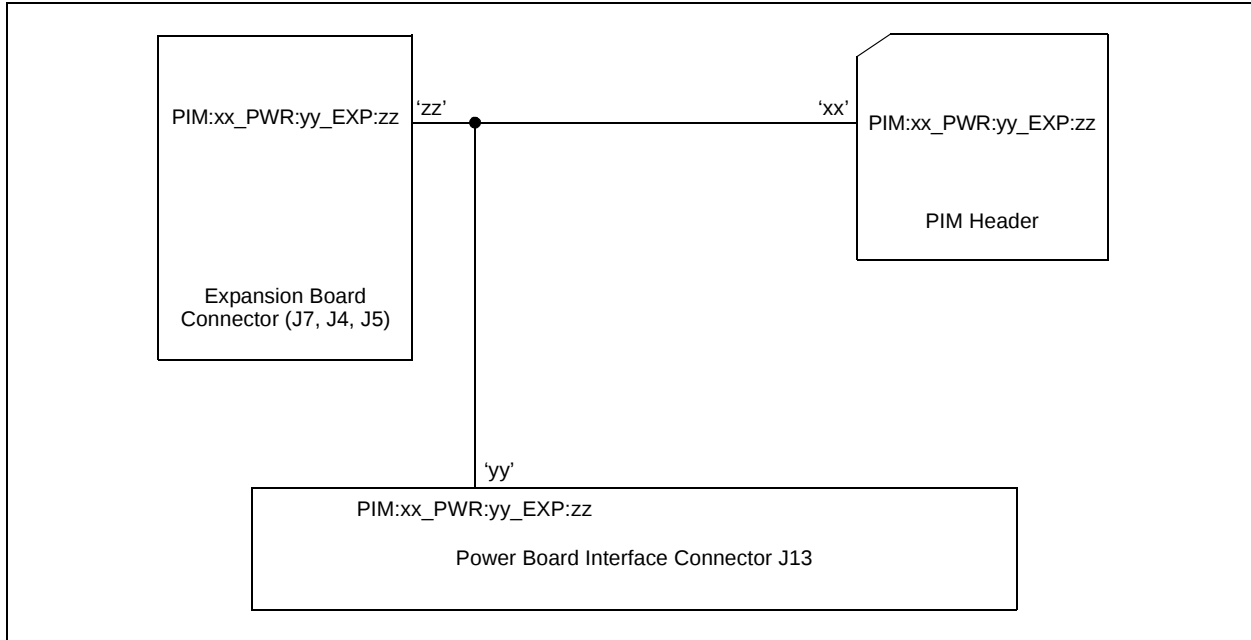
**FIGURE 3-7: TOPOLOGY 1**



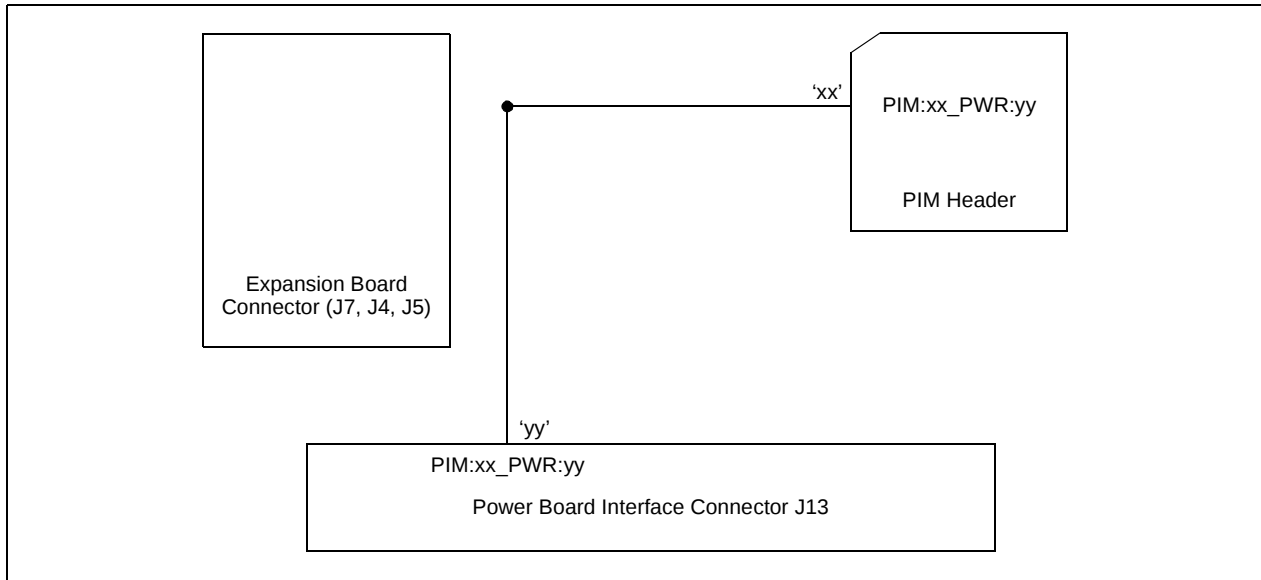
**FIGURE 3-8: TOPOLOGY 2**



**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**

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

Where:

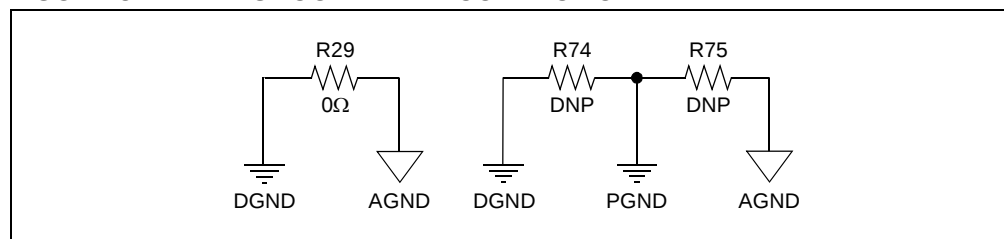
R = 1 kΩ and C = 470 pF

## 3.7 SUPPLY VOLTAGE AND GROUND CONNECTION

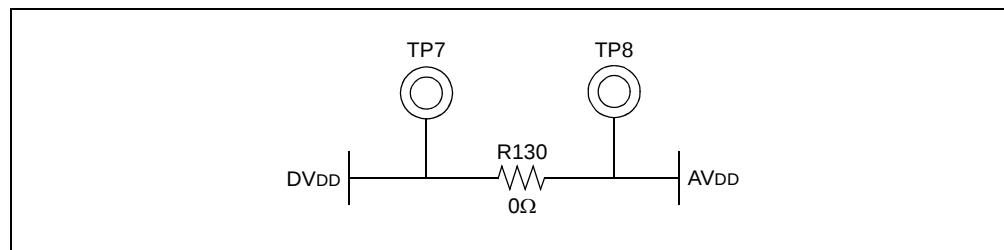
The dsPIC DSC Signal Board has three separate grounds: Digital Ground (DGND), Analog Ground (AGND) and Power Ground (PGND). All three grounds can be connected by populating the resistors R74 and R75 (see [Figure 3-11](#)). DGND and AGND are connected through R29 ( $0\Omega$ ) by default. The Analog Voltage (AVDD) is derived from DVDD through R130 ( $0\Omega$ ), 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 AVDD TO DVDD**



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## **Appendix A. Schematics and Layout**

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### **A.1 INTRODUCTION**

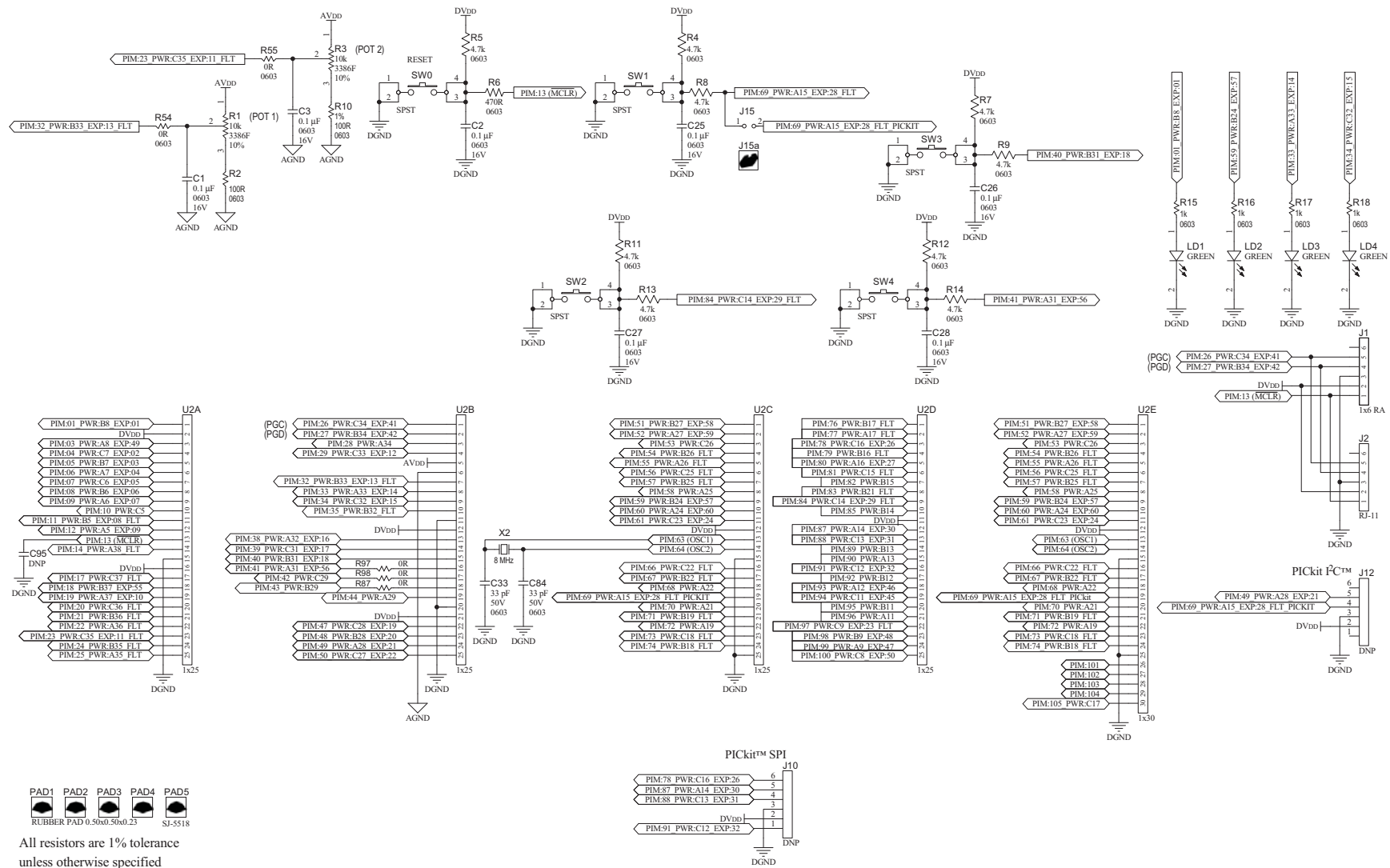
This chapter provides detailed technical information on the dsPIC<sup>®</sup> DSC Signal Board.

### **A.2 BOARD SCHEMATICS AND LAYOUT**

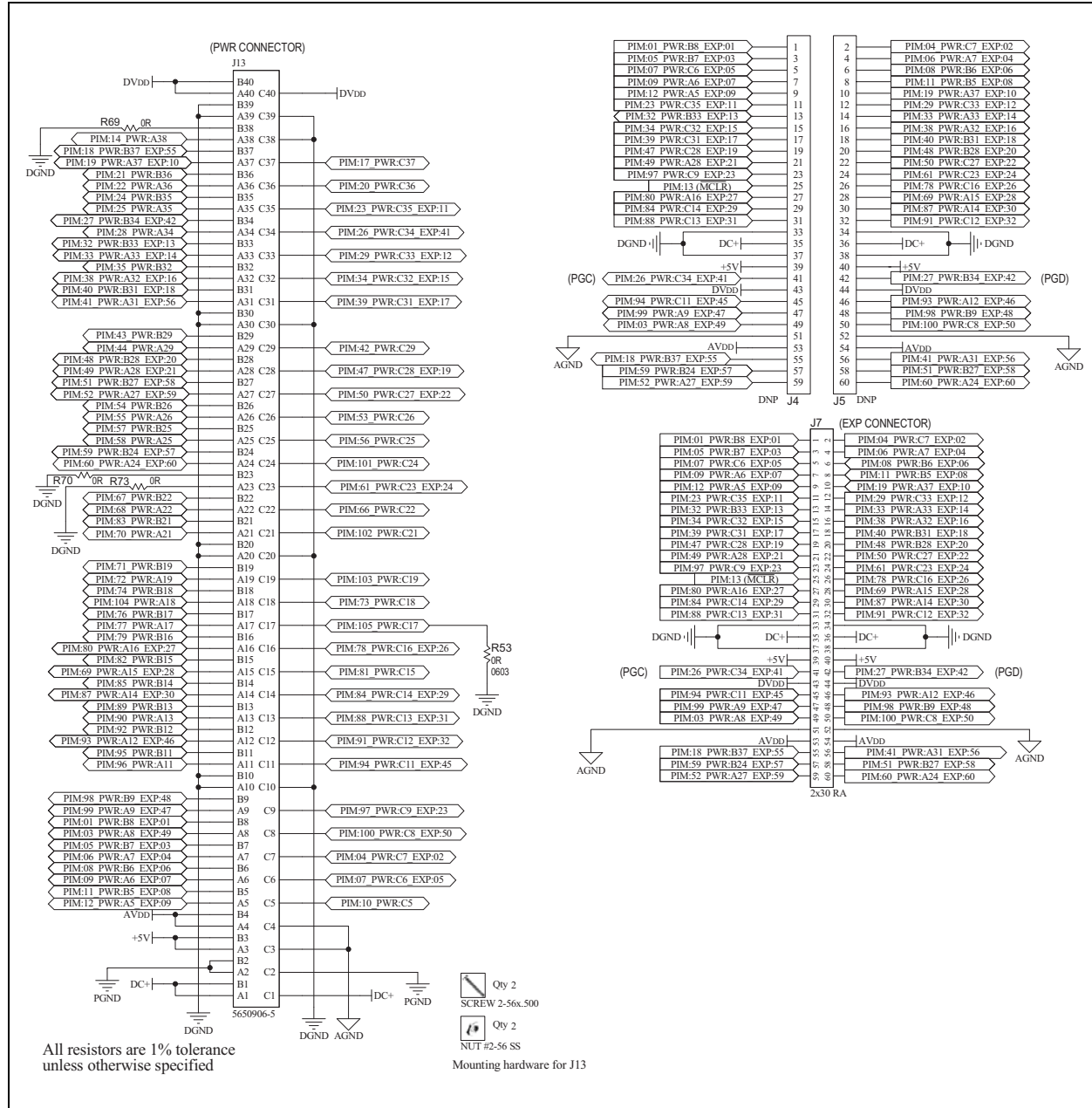
The following are the dsPIC DSC Signal Board schematics and layout:

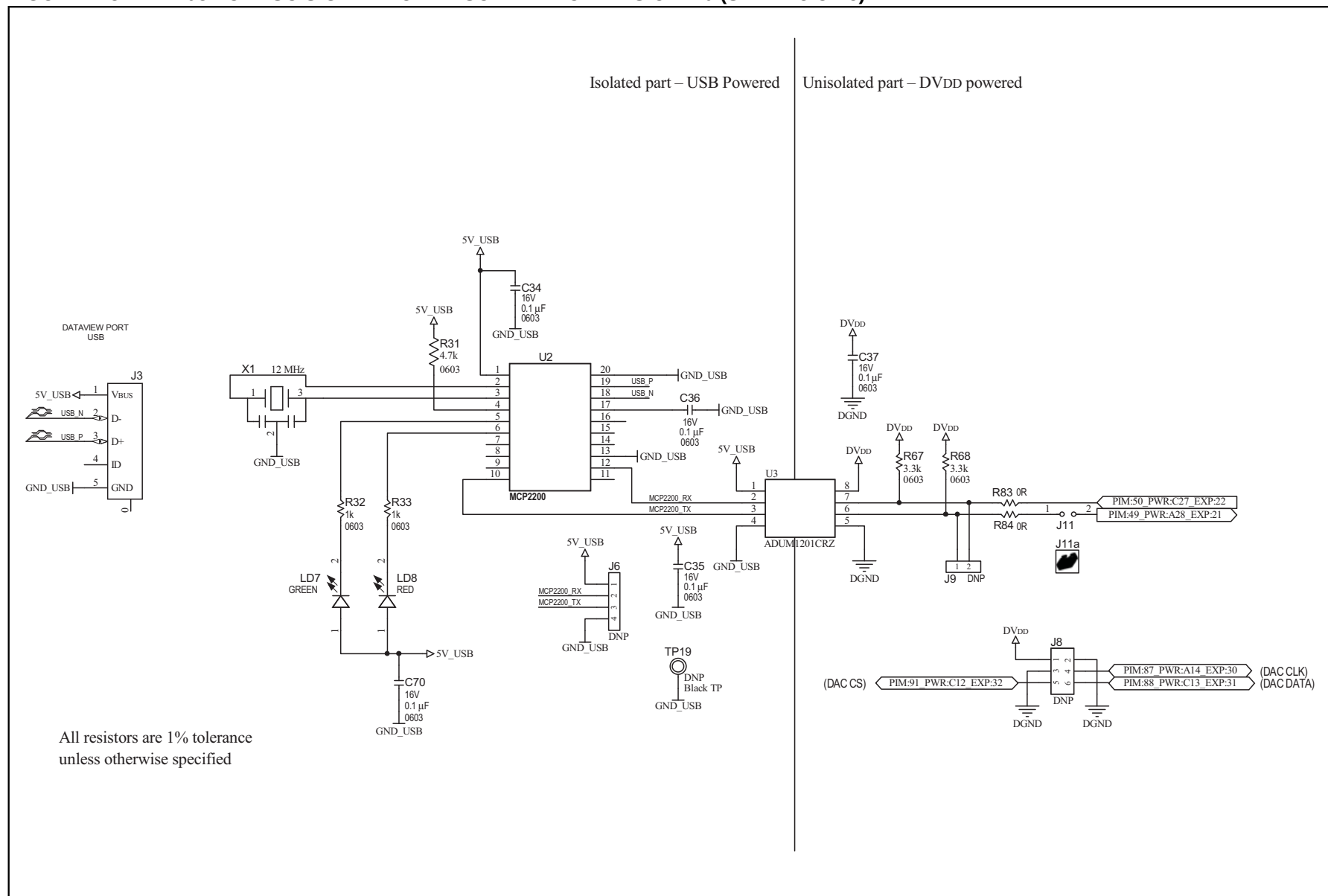
- [Figure A-1](#): dsPIC DSC Signal Board schematics (Sheet 1 of 5)
- [Figure A-2](#): dsPIC DSC Signal Board schematics (Sheet 2 of 5)
- [Figure A-3](#): dsPIC DSC Signal Board schematics (Sheet 3 of 5)
- [Figure A-4](#): dsPIC DSC Signal Board schematics (Sheet 4 of 5)
- [Figure A-5](#): dsPIC DSC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

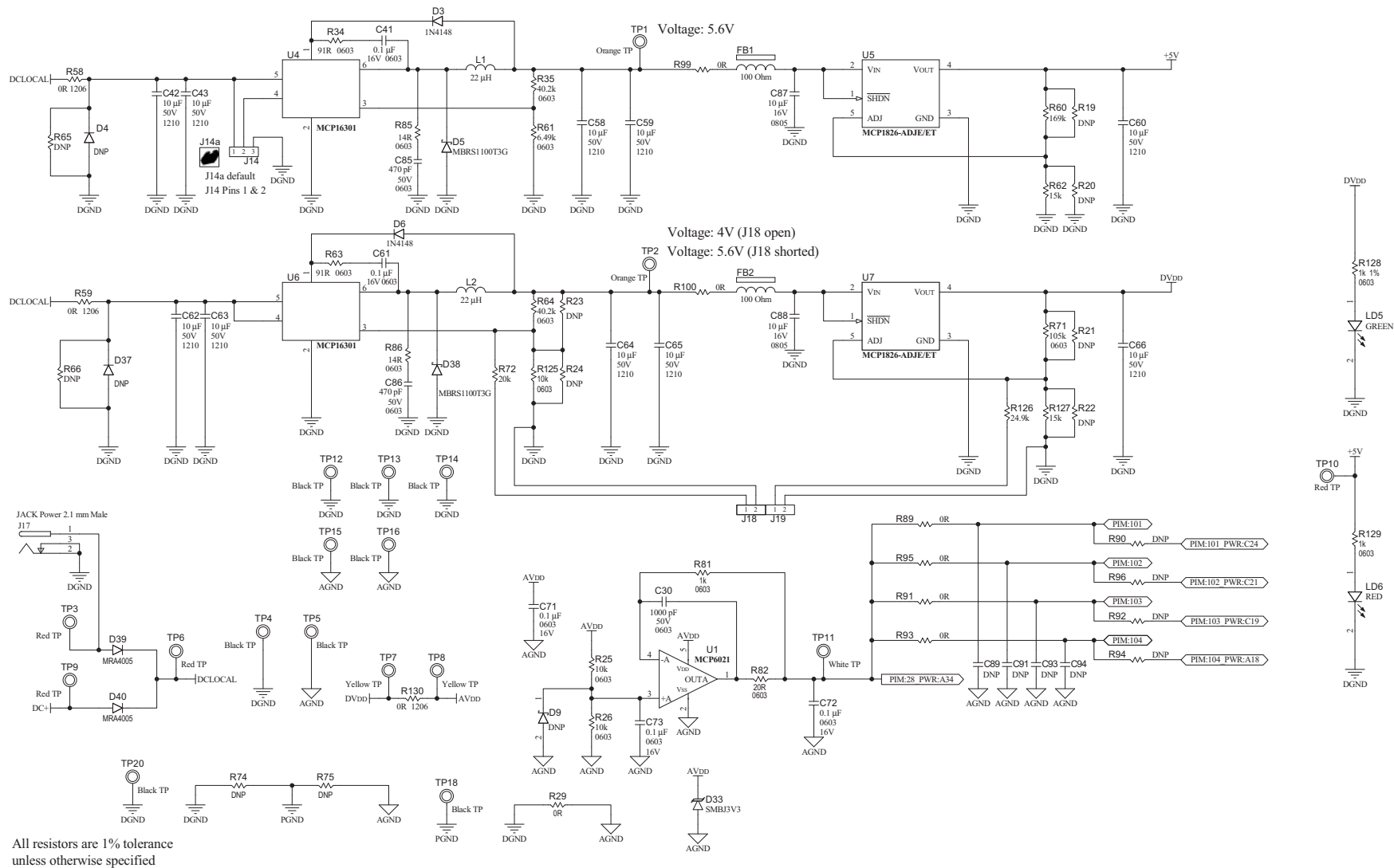
**FIGURE A-1: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 1 OF 5)**

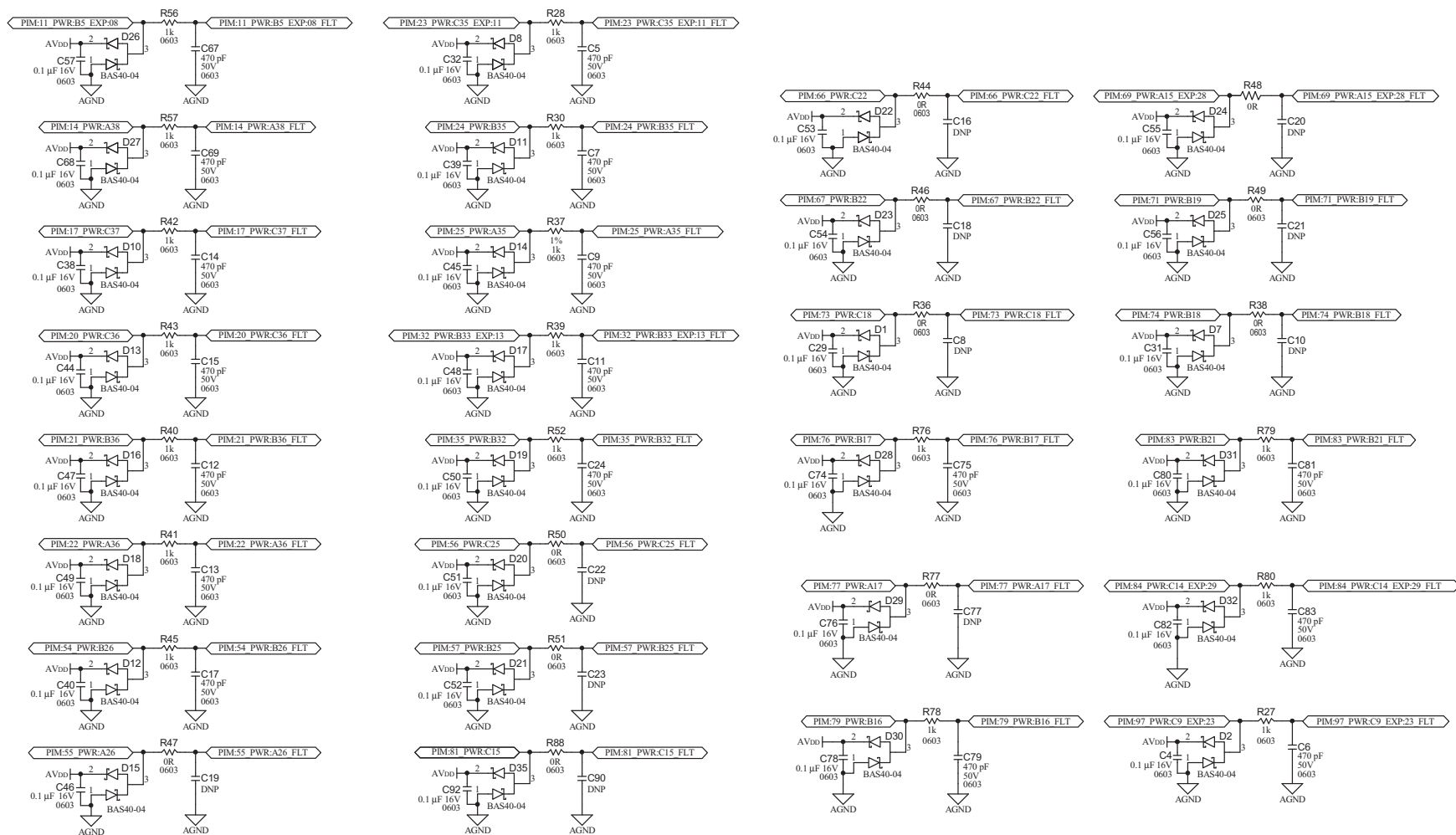


**FIGURE A-2: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 2 OF 5)**



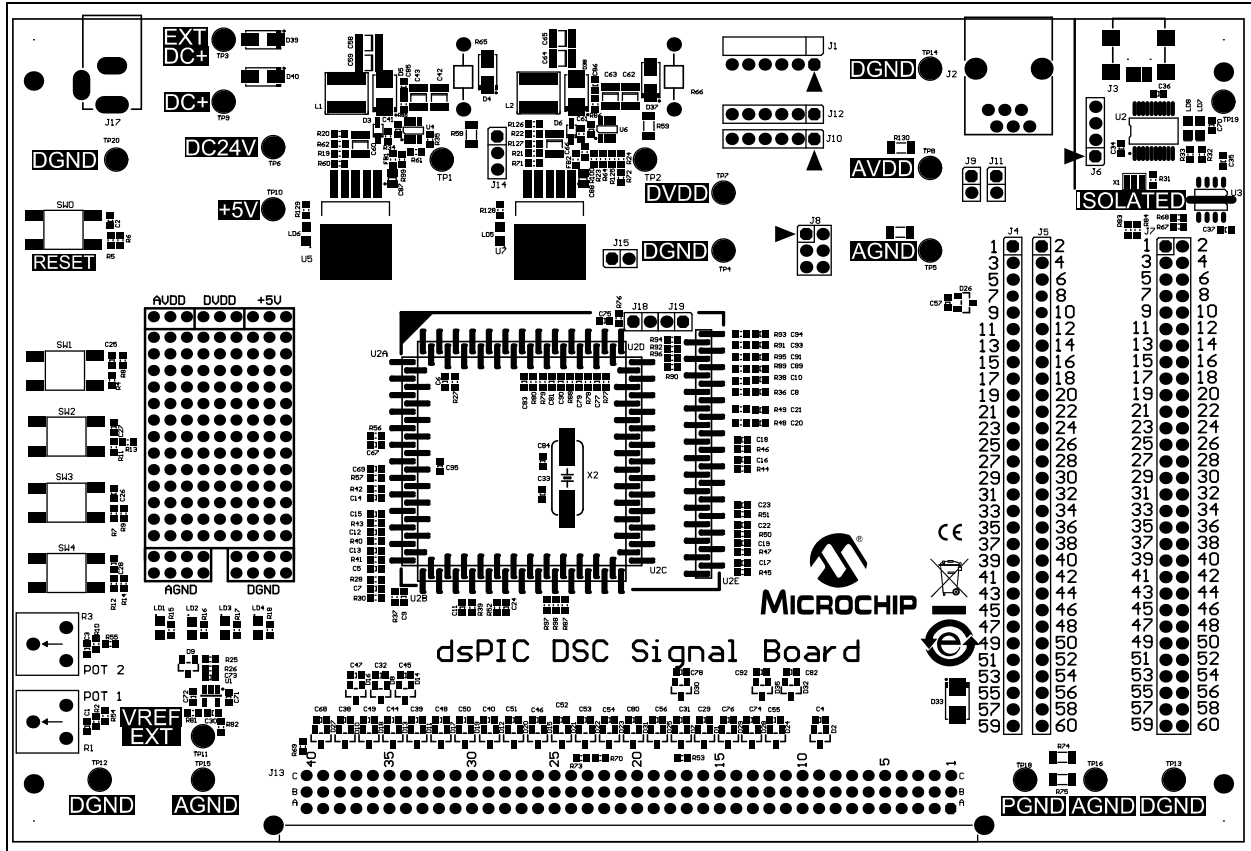
**FIGURE A-3: dsPIC® DSC SIGNAL BOARD SCHEMATIC REVISION 1.0 (SHEET 3 OF 5)**

**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: dsPIC® DSC SIGNAL BOARD LAYOUT



# dsPIC<sup>®</sup> DSC Signal Board

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NOTES:

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## Appendix B. Electrical Specifications

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### B.1 INTRODUCTION

This chapter provides the electrical specifications of the dsPIC<sup>®</sup> DSC Signal Board (see [Table B-1](#)).

**TABLE B-1: ELECTRICAL SPECIFICATIONS**

| Parameter                                  | Operating Range                                                       |
|--------------------------------------------|-----------------------------------------------------------------------|
| Input DC Voltage                           | 10V-24V $\pm 10\%$ (9V-26.4V)                                         |
| Input DC Voltage (Connector J17)           | 24V                                                                   |
| Operating Temperature                      | Ambient +25°C                                                         |
| Output Power Supply 1                      | 5V $\pm 0.5\%$ (4.975V-5.025V)                                        |
| Output Power Supply 2                      | 3.3V $\pm 0.5\%$ (3.316V-3.283V) or<br>5V $\pm 0.5\%$ (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                                                              |

# dsPIC<sup>®</sup> DSC Signal Board

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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  $R_{PIM}$  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:

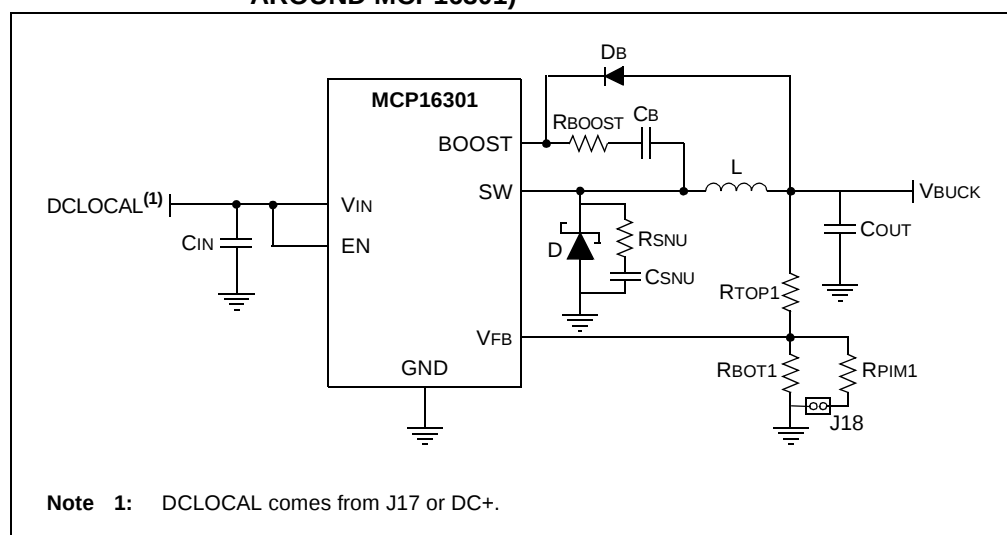
1. [First Stage of Power Supply Circuit Design](#)
2. [Second Stage of Power Supply Circuit Design](#)

#### 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  $K = 0.22V/\mu H$  (see [Note 1](#) in [Table C-1](#)).

**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 <sup>(1)</sup>        | L2 = 22 μH <sup>(1)</sup>             |
| CB         | C41 = 0.1 μF <sup>(1)</sup>      | C61 = 0.1 μF <sup>(1)</sup>           |
| CIN        | C42 = C43 = 10 μF <sup>(1)</sup> | C62 = C63 = 10 μF <sup>(1)</sup>      |
| COUT       | C58 = C59 = 10 μF <sup>(1)</sup> | C64 = C65 = 10 μF <sup>(1)</sup>      |
| VBUCK      | 5.6V                             | +4V (J18 open)<br>+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:**

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

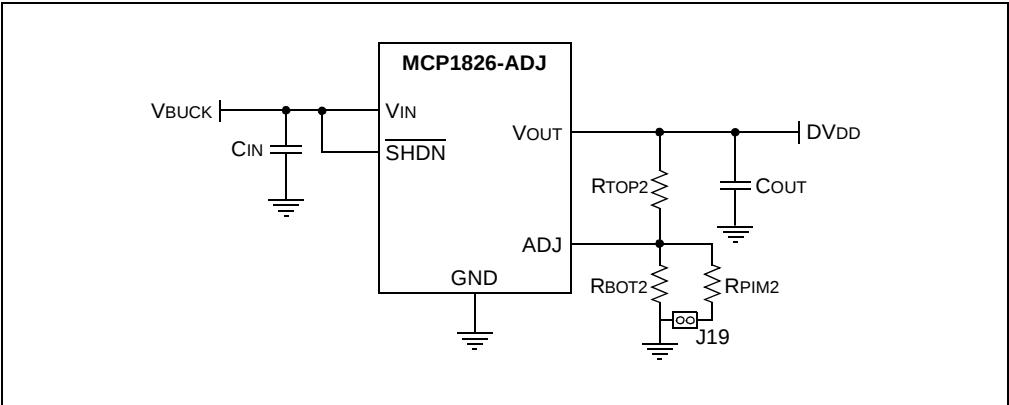
A standard 1N4148 ultra-fast diode for boost diode Db was selected based on recommendations from the “MCP16301/H High-Voltage Input Integrated Switch Step-Down Regulator Data Sheet” (DS20005004). For more information about the snubber circuits, RSNU and CSNU, and series boost resistor, RBOOST, refer 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<sub>BUCK</sub>) = +4V (J18 is open) or +5.6V (J18 is shorted)
- Output Voltage (DV<sub>DD</sub>) = +3.3V when connector, J19, is open
- Output Voltage (DV<sub>DD</sub>) = +5V when connector, J19, is connected

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



If V<sub>ADJ</sub> = 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:**

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

**TABLE C-2: STAGE 2 POWER SUPPLY COMPONENT VALUES**

| Designator | Power Supply 1             | Power Supply 2                        |
|------------|----------------------------|---------------------------------------|
| RTOP2      | R60 = 169 kΩ               | R71 = 105 kΩ                          |
| RBOT2      | R62 = 15 kΩ                | R127 = 15 kΩ                          |
| RPIM2      | —                          | R126 = 24.9 kΩ                        |
| VOUT       | 5 V                        | +3.3V (J19 open)<br>+5V (J19 shorted) |
| CIN        | C87 = 10 μF <sup>(1)</sup> | C88 = 10 μF <sup>(1)</sup>            |
| COUT       | C60 = 10 μF <sup>(1)</sup> | C66 = 10 μF <sup>(1)</sup>            |

**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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