

MCP4XXX Digital Potentiometer Daughter Board User's Guide

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MCP4XXX DIGITAL POTENTIOMETER DAUGHTER BOARD USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

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

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

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP4XXX Digital Potentiometer Daughter Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP4XXX Digital Potentiometer Daughter Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP4XXX Digital Potentiometer Daughter Board.
- **Chapter 2. "Installation and Operation"**– Includes instructions on how to get started with the MCP4XXX Digital Potentiometer Daughter Board.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and layout diagrams for the MCP4XXX Digital Potentiometer Daughter Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP4XXX Digital Potentiometer Daughter Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...

RECOMMENDED READING

Table 1-1 shows the device and associated data sheet literature number. These documents can be downloaded from the Microchip web site at: www.microchip.com.

TABLE 1-1: DEVICES AND DATA SHEET LITERATURE NUMBERS

Device	Literature #		Device	Literature #
MCP4011	DS21978		**MCP41010**	DS11195
MCP4012	DS21978		**MCP41050**	DS11195
MCP4013	DS21978		**MCP41100**	DS11195
MCP4014	DS21978		**MCP42010**	DS11195
MCP4021	DS21945		**MCP42050**	DS11195
MCP4022	DS21945		**MCP42100**	DS11195
MCP4023	DS21945		**—**	—
MCP4024	DS21945		**—**	—

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- Technical Support
- Development Systems Information Line

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

DOCUMENT REVISION HISTORY

Revision A (July 2006)

- Initial Release of this Document.

NOTES:

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP4XXX Digital Potentiometer Daughter Board and covers the following topics:

- What is the MCP4XXX Digital Potentiometer Daughter Board?
- What the MCP4XXX Digital Potentiometer Daughter Board kit includes

1.2 WHAT IS THE MCP4XXX DIGITAL POTENTIOMETER DAUGHTER BOARD?

The MCP4XXX Digital Potentiometer Daughter Board allows the system designer to quickly evaluate the operation of Microchip Technology's MCP42XXX and MCP4021 Digital Potentiometers. The MCP42XXX are dual Digital Potentiometer devices that have the same characteristics as their single Digital Potentiometer devices (MCP41XXX). The MCP4021 devices are non-volatile devices that have similar characteristics as their volatile memory versions (MCP4011). The board supports two MCP42XXX devices to allow the Resistor Networks to be "stacked" and form a programmable windowed Digital Potentiometer and an MCP4021 device, which can be replaced with an MCP4011 device. The board has one MCP42010 device (10 kΩ), which can be the rheostats at the ends, and one MCP42010 device (10 kΩ) which is the potentiometer in the middle and a separate standalone potentiometer.

The board also has an MCP4021-103 (10 kΩ) device for evaluation. The characteristics of this device is similar to the other MCP402X devices. The MCP4021 footprint (SOIC) is the same as the MCP4011 device. The MCP4021 can be removed and replaced with an MCP4011. The MCP4021 can be jumpered into the middle potentiometer configuration to compare the characteristics of the MCP42XXX device to the MCP4011/MCP4021 device.

The board also has a voltage doubler device (TC1240A), which can be used to show the WiperLock™ Technology feature of the MCP4021.

The MCP4XXX Digital Potentiometer Daughter Board has been made configurable, via jumpers. This allows you to determine the configuration that you wish to have the four digital potentiometer of the MCP42XXX devices.

Some of the features include:

- Header to interface to PICDEM™ boards using 28-pin header, including
  - PICDEM™ HPC Explorer Demo Board
  - PICDEM™ FS USB Demo Board
  - PICDEM™ 2 Plus Demo Board (Rev 5 or later)
  - PICDEM™ LCD
- TC1240A Voltage Doubler to generate V_{IHH} voltage for WiperLock Technology evaluation
- Jumpers for configuration of U1-Pot0, U2-Pot0, and U2-Pot1 terminal connections
- Jumpers for MCP4021 Pot (A, W, and B) to replace U1-Pot0 in desired circuit
- Jumpers for routing signals (SI, SO, SCK, and $\overline{CS}$) from either a PICDEM HPC Demo board or a PICDEM FS USB Demo Board
- Pads for easy connection to the Digital Potentiometer signals, including the Resistor Network Terminals and the Serial Interface signals

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1.3 WHAT THE MCP4XXX DIGITAL POTENTIOMETER DAUGHTER BOARD KIT INCLUDES

This MCP4XXX Digital Potentiometer Daughter Board Kit includes:

- MCP4XXX Digital Potentiometer Daughter Board
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - MCP4XXX Digital Potentiometer Daughter Board User's Guide

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

This daughter board allows evaluation of digital potentiometer devices in different circuit configurations. The board supports the MCP42XXX devices and the MCP4011/MCP4021 devices.

This board is intended to be "plugged into" the 28-pin header of the PICDEM™ Demo Boards. The board may also be "jumpered" into a desired application circuit.

2.2 FEATURES

The MCP4XXX Digital Potentiometer Daughter Board has the following features:

- Header to interface to PICDEM™ boards using 28-pin header, including:
  - PICDEM™ HPC Explorer Demo Board
  - PICDEM™ FS USB Demo Board
  - PICDEM™ 2 Plus Demo Board (Rev 5 or later)
  - PICDEM™ LCD
- TC1240A Voltage Doubler to generate V_{IHH} voltage for WiperLock™ Technology evaluation
- Jumpers for configuration of U1-Pot0, U2-Pot0, and U2-Pot1 terminal connections
- Jumpers for MCP4021 Pot (A, W, and B) to replace U1-Pot0 in desired circuit
- Jumpers for routing signals (SI, SO, SCK, and $\overline{CS}$) from either a PICDEM HPC Demo board or a PICDEM FS USB Demo Board
- Pads for easy connection to the Digital Potentiometer signals, including the Resistor Network Terminals and the Serial Interface signals
- Connection terminals may be either through-hole or surface-mount

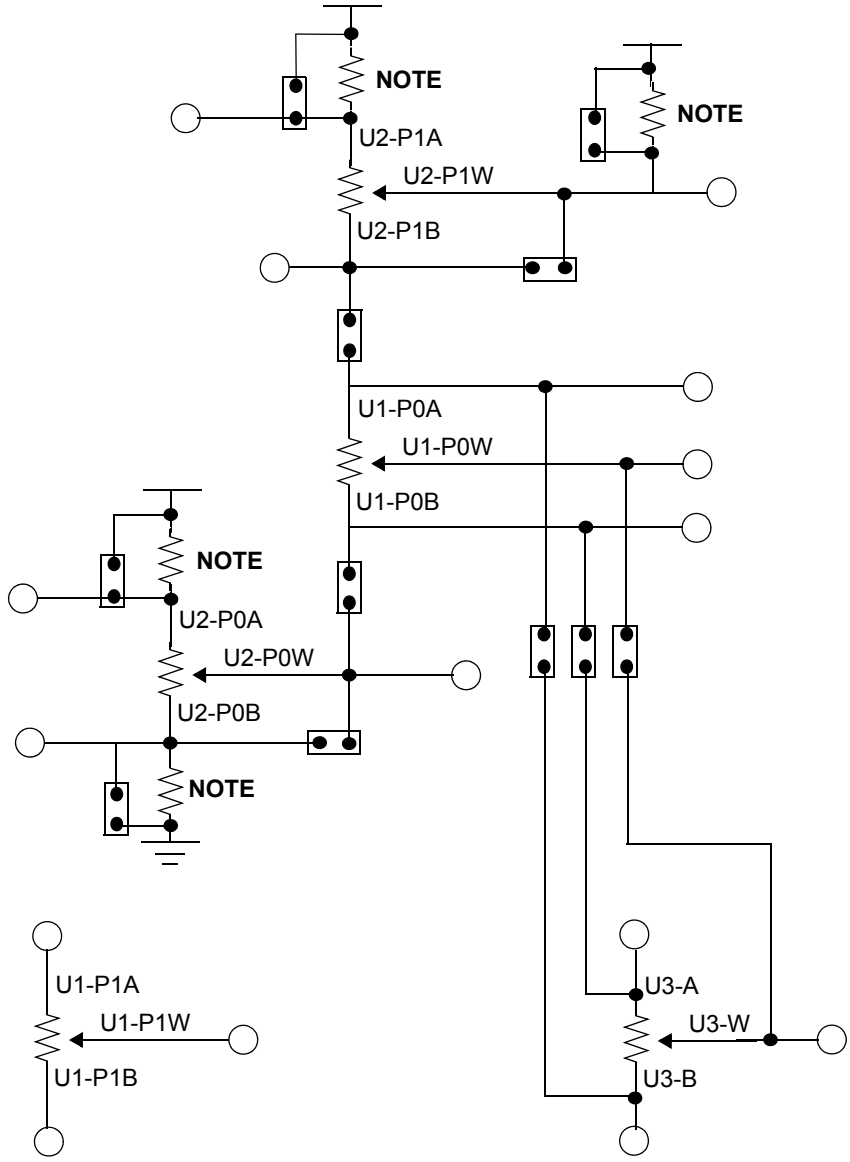
2.3 GETTING STARTED

The MCP4XXX Digital Potentiometer Daughter Board is a board that allows the Digital Potentiometer circuit to be configured in many forms for evaluation of the device. The Resistor Network Circuit is shown in Figure 2-1 and shows the possible configurations that the demo board supports.

The passive components use the surface-mount 805 package layout. Figure 2-2 shows the board circuit.

This demo board supports the following Microchip Digital Potentiometers devices:

- MCP42XXX
- MCP4021
- MCP4011



Note: These footprints are provided so the customer can populate with the desired resistor value or leave unpopulated (open).

FIGURE 2-1: *MCP4XXX Digital Potentiometer Daughter Board Resistor Network Circuit Configuration.*

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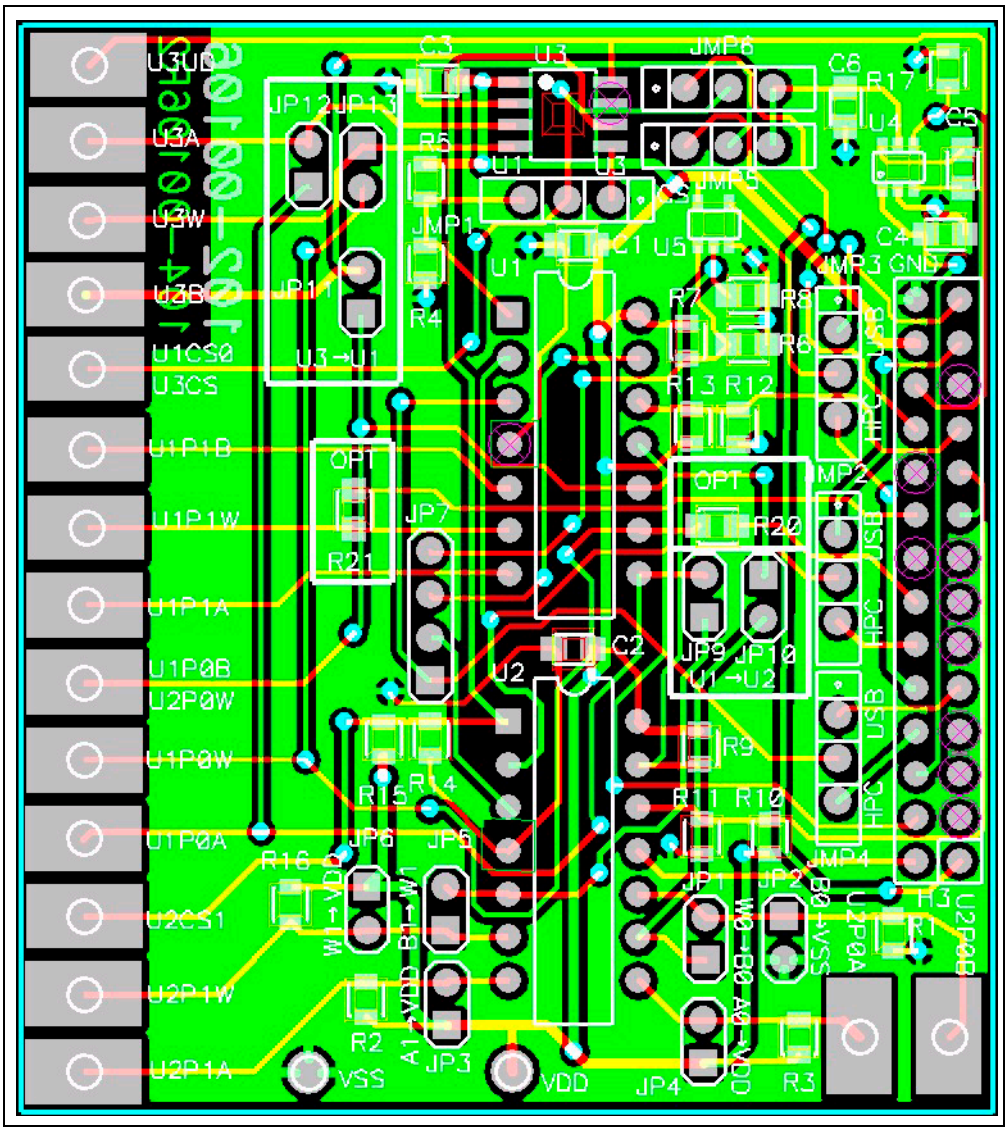


FIGURE 2-2: *MCP4XXX Digital Potentiometer Daughter Board Circuit.*

2.3.1 The Hardware

Figure 2-2 shows the layout of the MCP4XXX Digital Potentiometer Daughter Board. This is a small two-layer board (2.25" x 2.517" (57.2 mm x 63.9 mm)).

There are sixteen connection points/pads that can use either through-hole or surface-mount connector posts and two through hole connections for power/ground. The connections to the SPI signals can be via the center taps of the JMP2 (SCK/SCL), JMP3 (SDO), and JMP4 (SDI/SDA) jumpers.

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2.3.1.1 JUMPERS

Figure 2-3 through Figure 2-6 show the function of the demo board jumpers. Some of the jumpers configure the interface connections, while other configure the resistor network configuration.

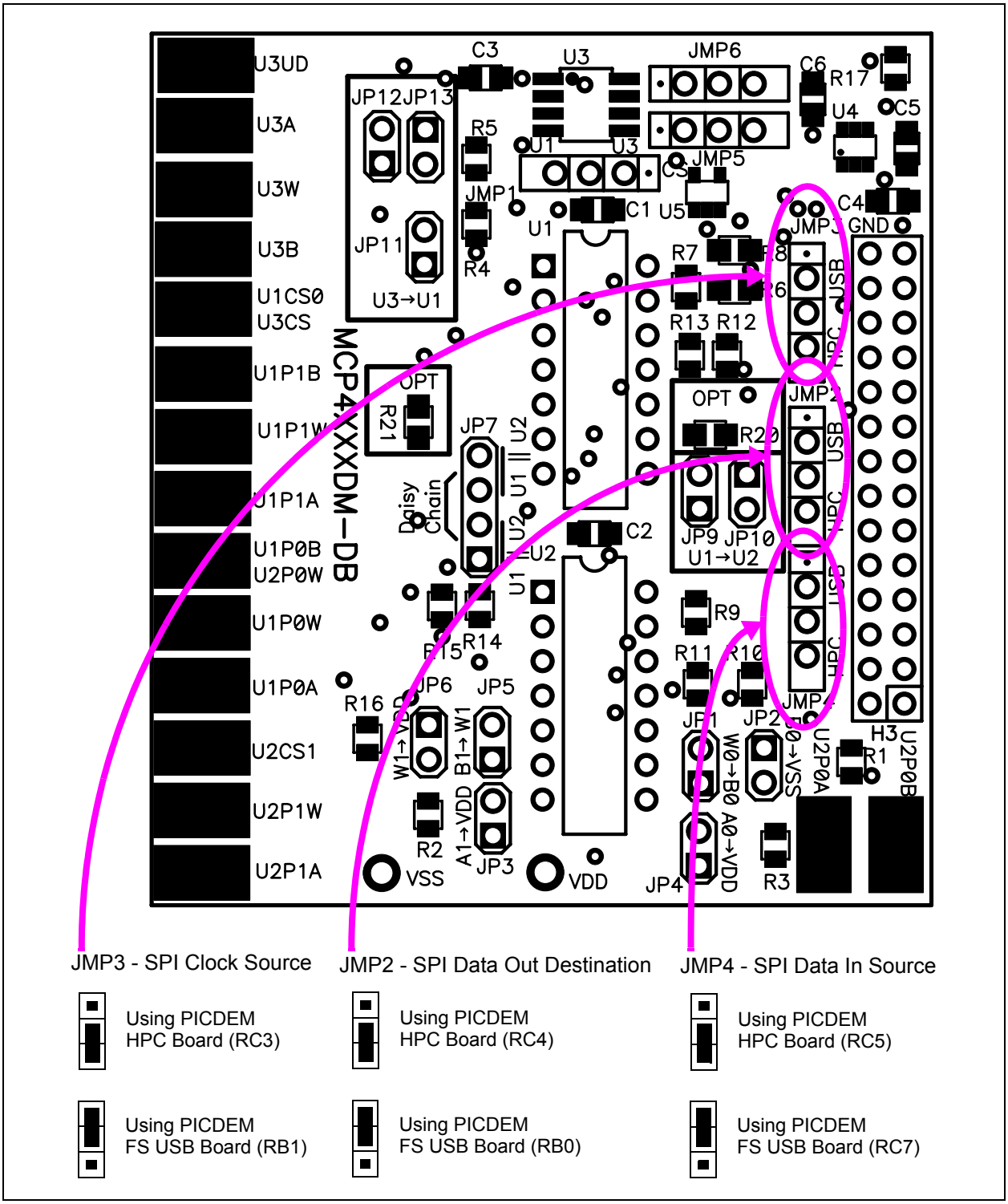


FIGURE 2-3: *Jumper JMP2, JMP3, and JMP4 Configurations.*

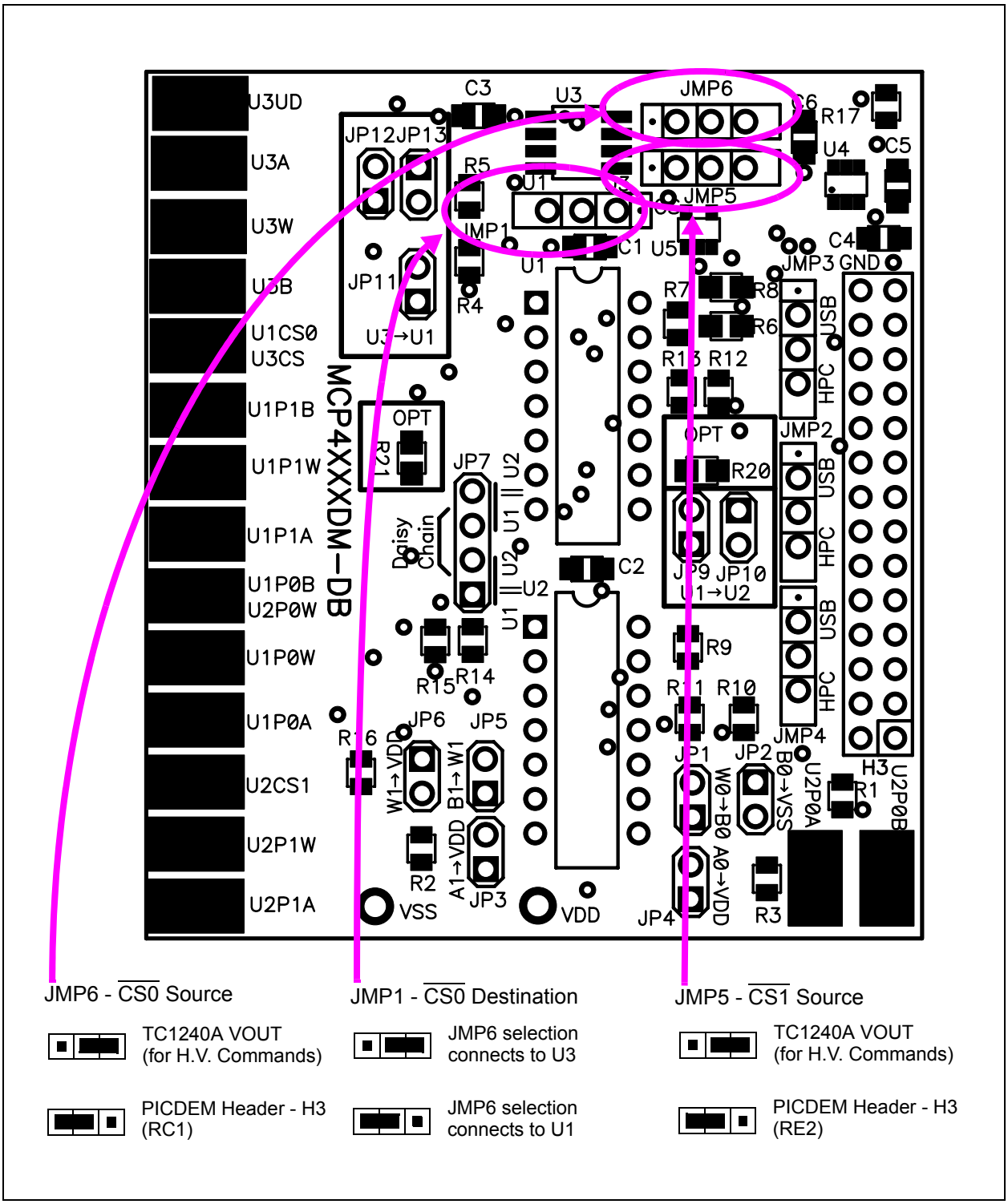


FIGURE 2-4: *Jumper JMP1, JMP5, and JMP6 Configurations.*

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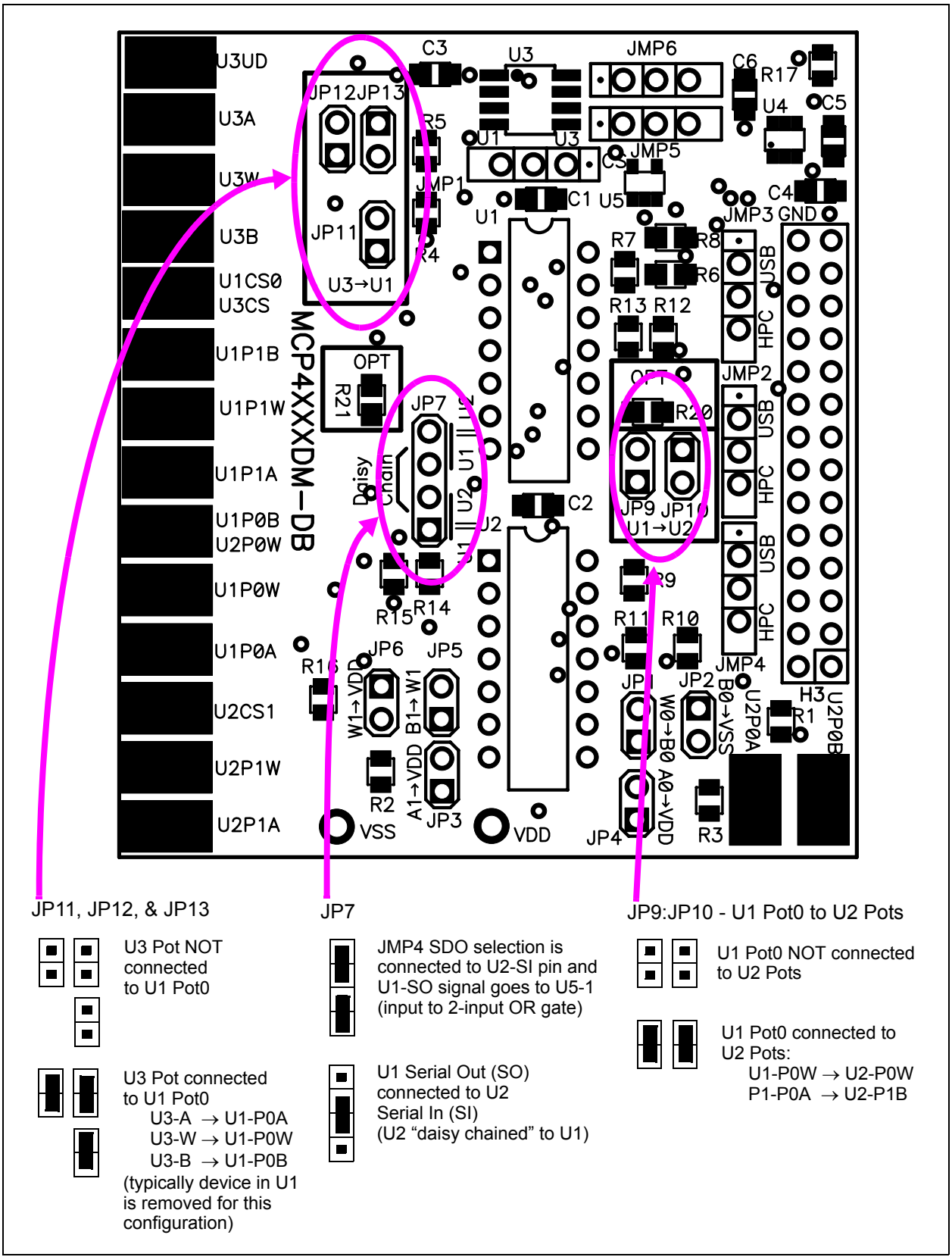
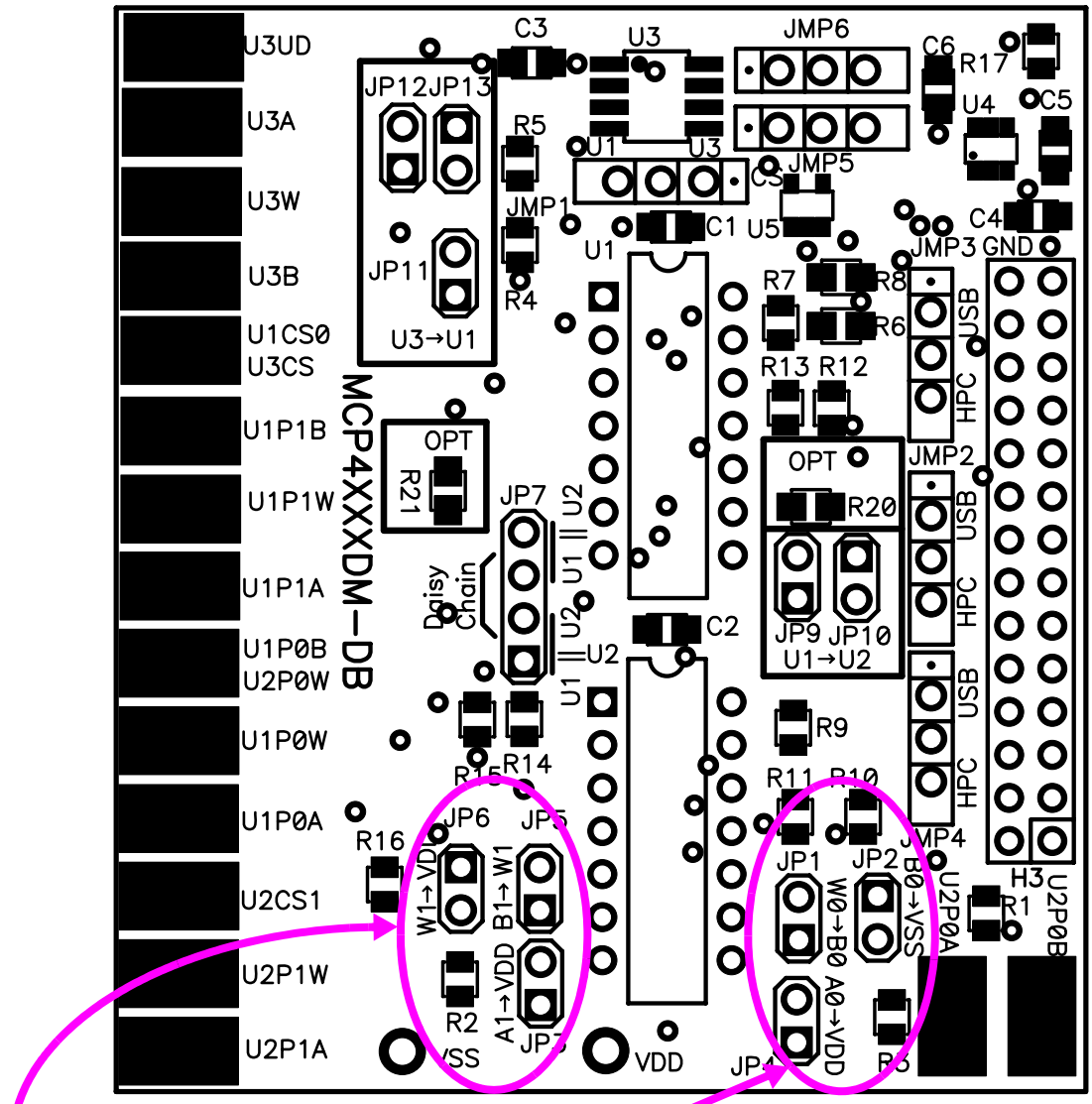


FIGURE 2-5: *Jumper JP7, JP9, JP10, JP11, JP12, and JP13 Configurations.*



JP3, JP5, JP6

JP6 - U2-P1W is floating
(or pulled to VDD via R16)
JP5 - U2-P1B not connected to U2-P1W
JP3 - U2-P1A is floating
(or pulled to VDD via R2)

JP6 - U2-P1W is connected to VDD
JP5 - U2-P1B not connected to U2-P1W
JP3 - U2-P1A is connected to VDD

JP1, JP2, JP4

JP4 - U2-P0A is floating
(or pulled to VDD via R3)
JP2 - U2-P0B is floating
(or pulled to VSS via R1)
JP1 - U2-P0W not connected to U2-P0B

JP4 - U2-P0A is connected to VDD
JP2 - U2-P0B is connected to VSS
JP1 - U2-P0W is connected to U2-P0B

FIGURE 2-6: *Jumper JP1, JP2, JP3, JP4, JP5, and JP6 Configurations.*

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2.3.1.2 PASSIVE COMPONENTS

Table 2-1 shows the optional passive components (resistors) that are by default not populated. Use the schematic to determine which resistors and values are required for your custom configuration.

TABLE 2-1: OPTIONAL PASSIVE COMPONENTS

Device	Comment
R2, R3, R5, R7, R9, R10, R13, R15, R16	Pull-up resistor
R1, R4, R11, R12, R14	Pull-down resistor
R20, R21	In-line resistor. Connected between the U1 wiper outputs and the PICDEM 28-pin header (H3) A/D pins. This is default open due to the PICDEM Demo Boards may have circuitry on these pins which would effect the wiper operation. If these are installed (typically with a 0Ω resistor), ensure that the PICDEM board has been appropriately modified so that the wiper signal is not effected.

2.4 MCP4XXX DIGITAL POTENTIOMETER DAUGHTER BOARD DESCRIPTION

The MCP4XXX Digital Potentiometer Daughter Board PCB is designed to be flexible in the type of device evaluation that can be implemented.

The following sections describe each element of this evaluation board in further detail.

2.4.1 Power and Ground

The MCP4XXX Digital Potentiometer Daughter Board receives its power over the J3 header connector. If the board is to be jumpered into an existing application, then the board can have connection posts installed for the power (V_{DD}) and ground (V_{SS}), which are located below device U2. The layout allows through-hole connection posts.

2.4.2 Connection Pads

The MCP4XXX Digital Potentiometer Daughter Board has pads for all the resistor network signal. These are:

U1-P0A U1-P0W U1-P0B	Socket U1	Potentiometer 0
U1-P01A U1-P1W U1-P1B	Socket U1	Potentiometer 1
U2-P0A U2-P0W U2-P0B	Socket U2	Potentiometer 0
U2-P01A U2-P1W U2-P1B	Socket U2	Potentiometer 1
U3-1A U3-W U3-B	Socket U3	Device only contains single Potentiometer

There are three pads for control signals that are also available:

- U1-CS0/U3-CS
- U2-CS1
- U3-UD

2.4.3 Passive Components (R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15 and R16)

The footprints for these components are present to allow flexibility in the use of fixed resistors for the windowing of the U1-Pot0 (or U3-Pot) to better match your system requirements.

Resistors Used	Jumpers Required	Device Configuration	Comments
R1 & R3	—	U2-Pot0 is windowed	
R2 & R16	—	U2-Pot1 is windowed	
R1 & R2	JP1, JP5, JP9, & JP10	U1-Pot0 is windowed	
R1 & R16	—	U2-Rheo0 Trims R1 U2-Rheo1 Trims R16 U1-Pot0 is windowed	

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2.5 DEMO WITH PICDEM DEMO BOARD

There is one demo for this daughter board. The demo has an assembly versions for the PICDEM HPC Explorer Demo Board and the PICDEM FS USB Demo Board.

The following hardware is required for this demo:

- PC with MPLAB-IDE installed
- ICD 2
- PICDEM HPC Explorer Demo Board (and power supply)
- 4 Channel oscilloscope

> **Note:** An oscilloscope with fewer channels can be used, but this will reduce the information that can be displayed.

Figure 2-7 shows the Resistor Network circuit configuration for the demo. To create this circuit, the Jumper configuration and oscilloscope connection points for the demo are shown in Figure 2-8.

The output waveform is shown in Figure 2-10. For this waveform, the U1-Pot0 is windowed by forcing U2-Pot0 and U2-Pot1 to mid-scale. The Wiper (U1-P0W) is loaded with values to create a Triangle waveform. U1-Pot1 is connected to Power and Ground, and the Wiper (U1-P1W) is loaded with values to create an inverse Triangle waveform.

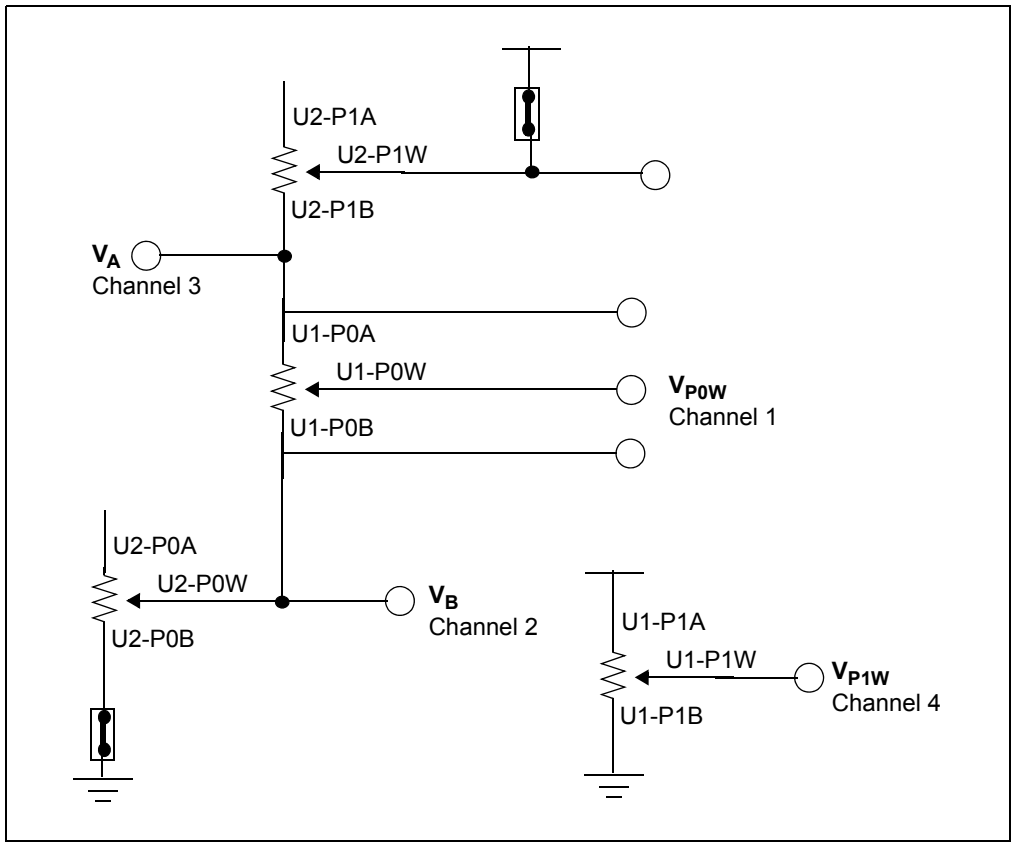


FIGURE 2-7: *Demo Resistor Network Circuit Configuration.*

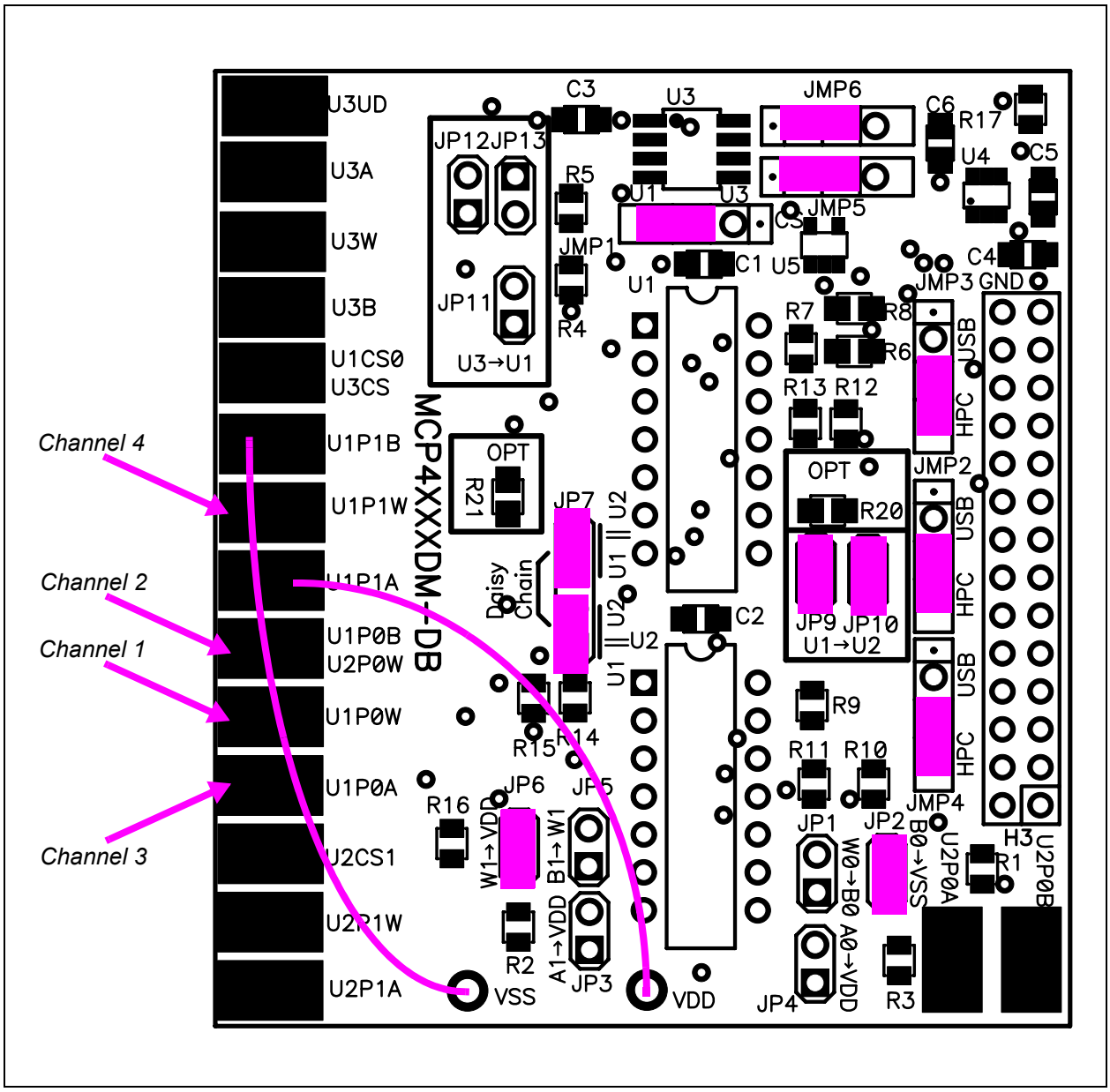


FIGURE 2-8: *Demo Jumper Configuration for use with PICDEM HPC Explorer Demo Board.*

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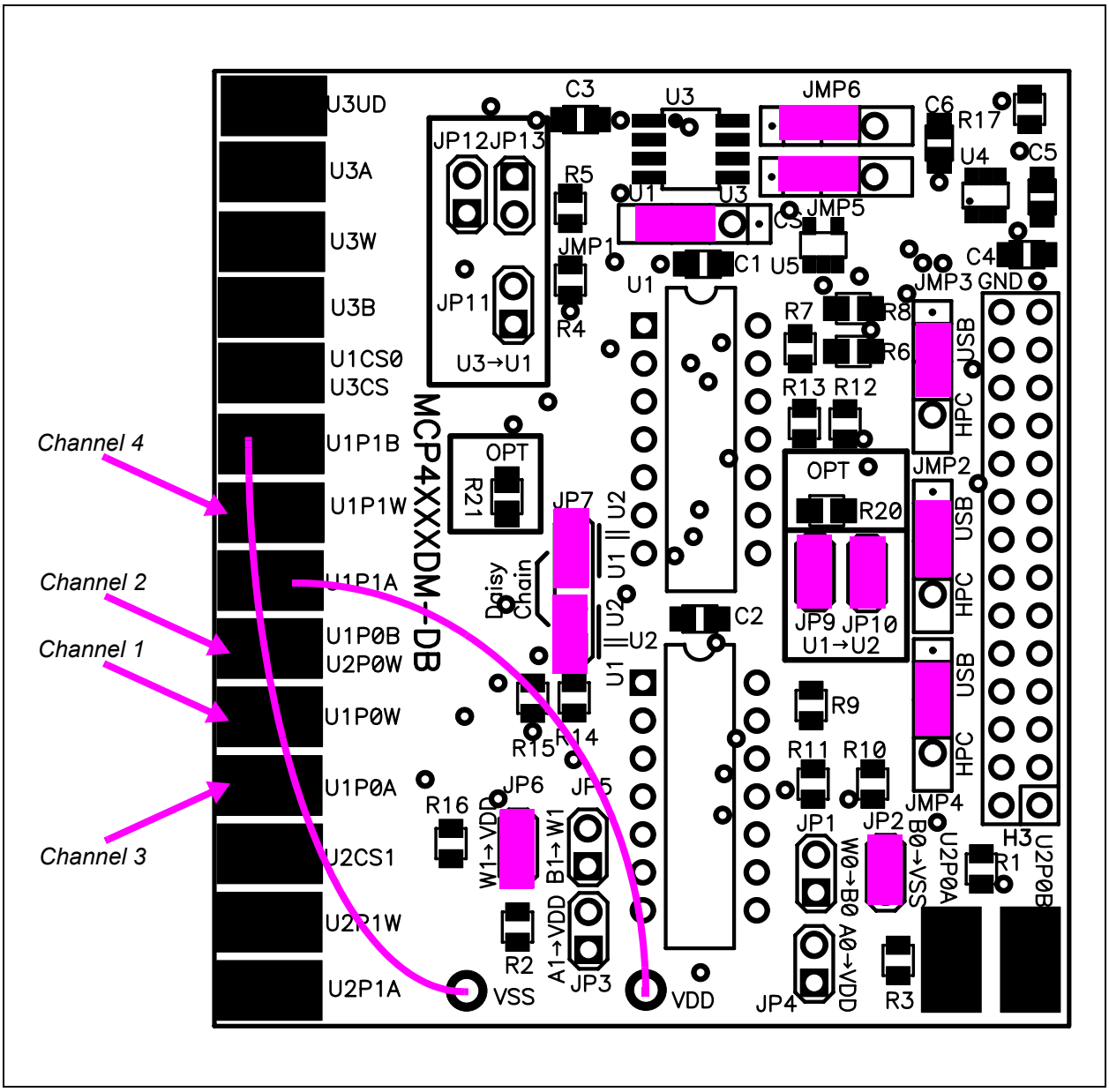


FIGURE 2-9: *Demo Jumper Configuration for use with PICDEM FS USB Demo Board.*

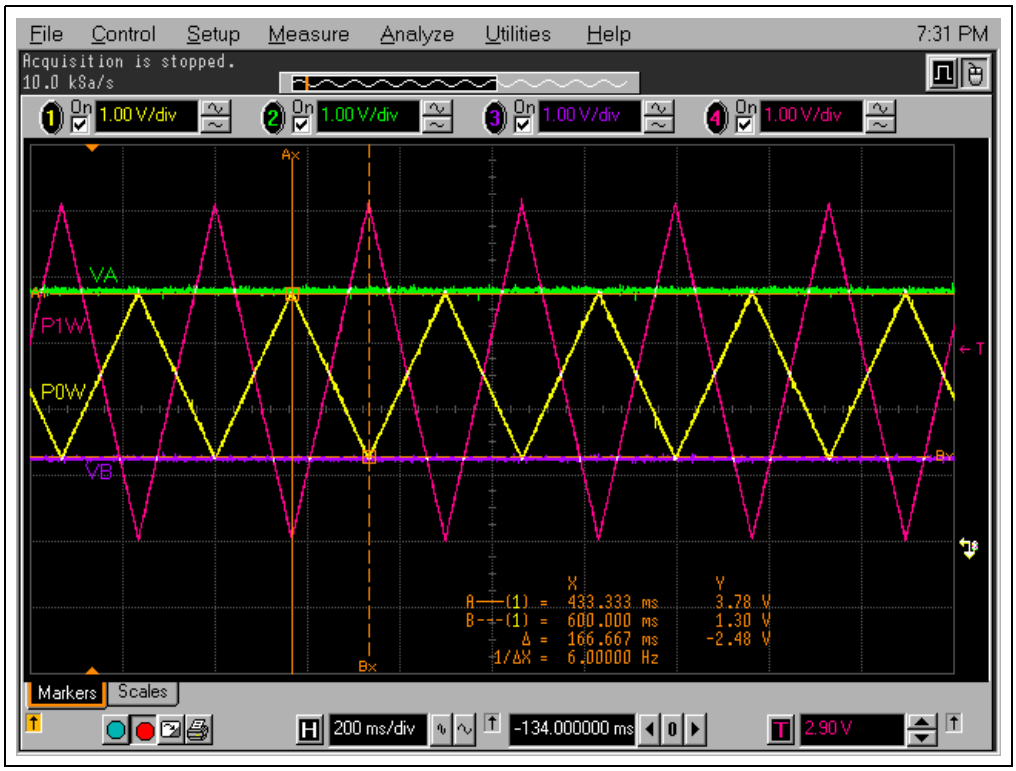


FIGURE 2-10: *Screen Capture of P0W and P1W Output Waveforms.*

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2.5.1 Using the PICDEM HPC Explorer Demo Board

Note: For information on how to use MPLAB-IDE, ICD 2, or any other aspect of the PICmicro Development tool platform, please refer to the appropriate documentation.

Table 2-2 shows the sequence of steps to demonstrate the MCP4XXXDM-DB board (as shipped) with the PICDEM HPC Explorer Demo Board.

TABLE 2-2: DEMO STEPS FOR THE PICDEM HPC EXPLORER DEMO BOARD

Step	Action	Result
1	Connect ICD 2 to the PC and to the PICDEM HPC Explorer Demo Board	—
2	Power up and program the PICDEM HPC Explorer Demo Board with the file “00106 - HPC.hex”	—
3	Disconnect the ICD 2 from the PICDEM HPC Explorer Demo Board	PICDEM HPC Explorer Demo Board program should now be operating
4	Configure the MCP4XXXDM-DB to the jumper settings shown in Figure 2-8.	—
5	Insert the MCP4XXXDM-DB board into the PICDEM HPC Explorer Demo Board J3 header. Ensure proper orientation of Daughter Board to J3 Header. **Note:** You may be required to solder a 28-pin Female header into the J3 header socket.	—
6	Connect U1-P1A to the V_{DD} connection post and U1-P1B to the V_{SS} connection post.	—
7	Turn on oscilloscope and configure as follows: • Channel 1 to 4 @ 1V/Division • Channel 1 to 4 have same ground reference point • Time-base = 200 ms/Division	—
8	Connect the oscilloscope probes as follows: • Channel 1 to the U1-P0W Pad • Channel 2 to the U1-P1A Pad • Channel 3 to the U1-P1B Pad • Channel 4 to the U1-P1W Pad	Output waveform should look similar to Figure 2-10.

2.5.2 Using the PICDEM FS USB Demo Board

Note: For information on how to use MPLAB-IDE, ICD 2, or any other aspect of the PICmicro Development tool platform, please refer to the appropriate documentation.

Table 2-3 shows the sequence of steps to demonstrate the MCP4XXXDM-DB board (as shipped) with the PICDEM FS USB Demo Board.

TABLE 2-3: DEMO STEPS FOR THE PICDEM FS USB DEMO BOARD

Step	Action	Result
1	Connect ICD 2 to the PC and to the PICDEM FS USB Demo Board	—
2	Power up and program the PICDEM FS USB Demo Board with the file "00106 - FS USB.hex"	—
3	Disconnect the ICD 2 from the PICDEM FS USB Demo Board	PICDEM FS USB Demo Board program should now be operating
4	Configure the MCP4XXXDM-DB to the jumper settings shown in Figure 2-9.	—
5	Insert the MCP4XXXDM-DB board into the PICDEM FS USB Demo Board J6 header. Ensure proper orientation of Daughter Board to J6 Header. **Note:** You may be required to solder a 28-pin Female header into the J6 header socket.	—
6	Connect U1-P1A to the V_{DD} connection post and U1-P1B to the V_{SS} connection post.	—
7	Turn on oscilloscope and configure as follows: • Channel 1 to 4 @ 1V/Division • Channel 1 to 4 have same ground reference point • Time-base = 200 ms/Division	—
8	Connect the oscilloscope probes as follows: • Channel 1 to the U1-P0W Pad • Channel 2 to the U1-P1A Pad • Channel 3 to the U1-P1B Pad • Channel 4 to the U1-P1W Pad	Output waveform should look similar to Figure 2-10.

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Appendix A. Schematics and Layouts

A.1 INTRODUCTION

This appendix contains the schematics and layouts for the MCP4XXX Digital Potentiometer Daughter Board. Diagrams included in this appendix:

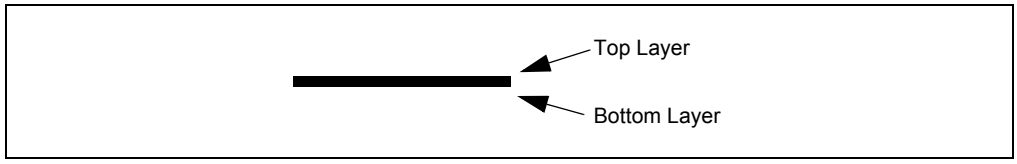
- Board Schematic - Digital Circuitry
- Board - Top Layer

A.2 SCHEMATICS AND PCB LAYOUT

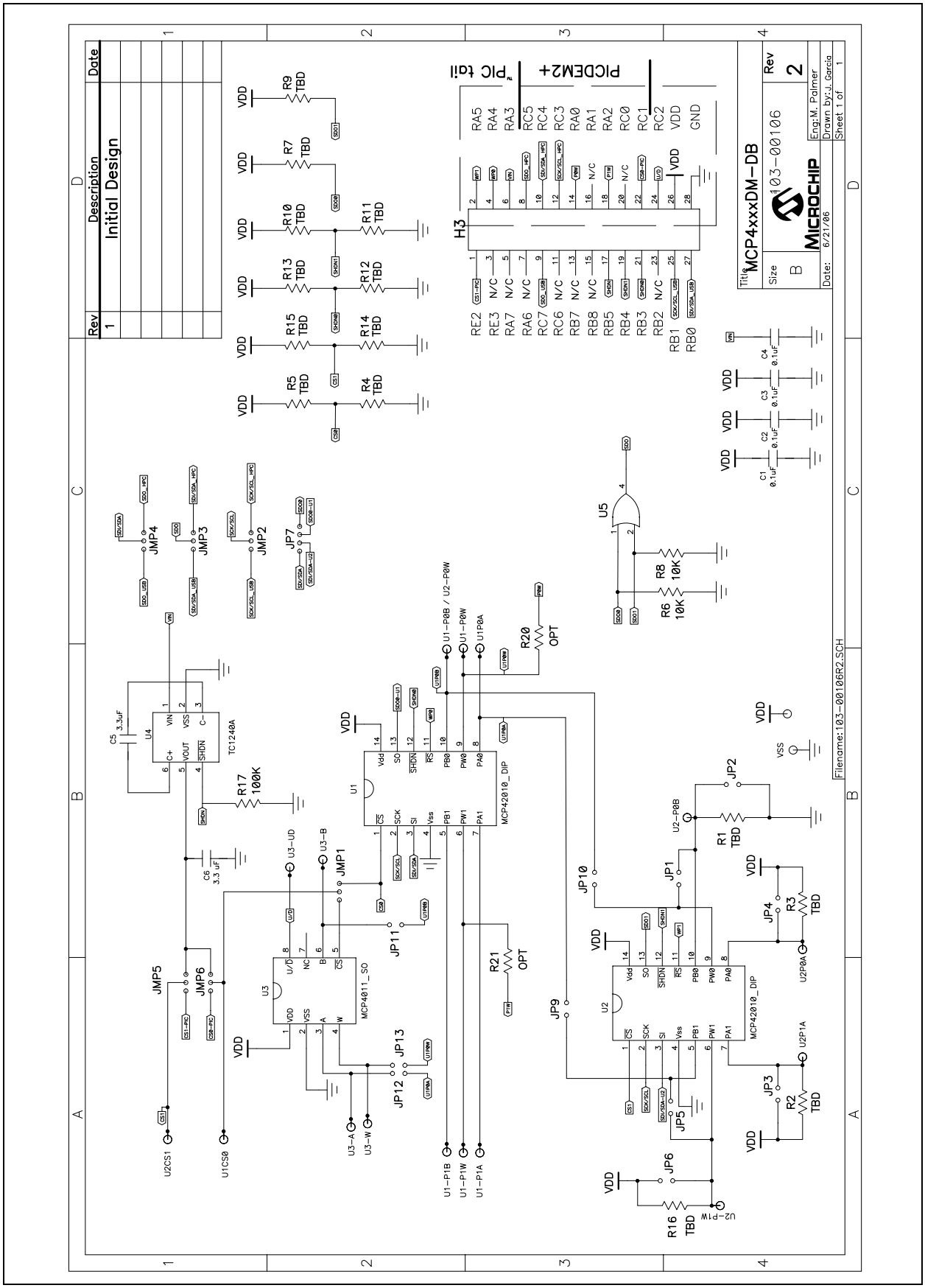
Figure A.3 shows the schematic of the MCP4XXX Digital Potentiometer Daughter Board.

Figure A.4 shows the layout for the top layer of the MCP4XXX Digital Potentiometer Daughter Board. The layer order is shown in Figure A-1.

FIGURE A-1: LAYER ORDER

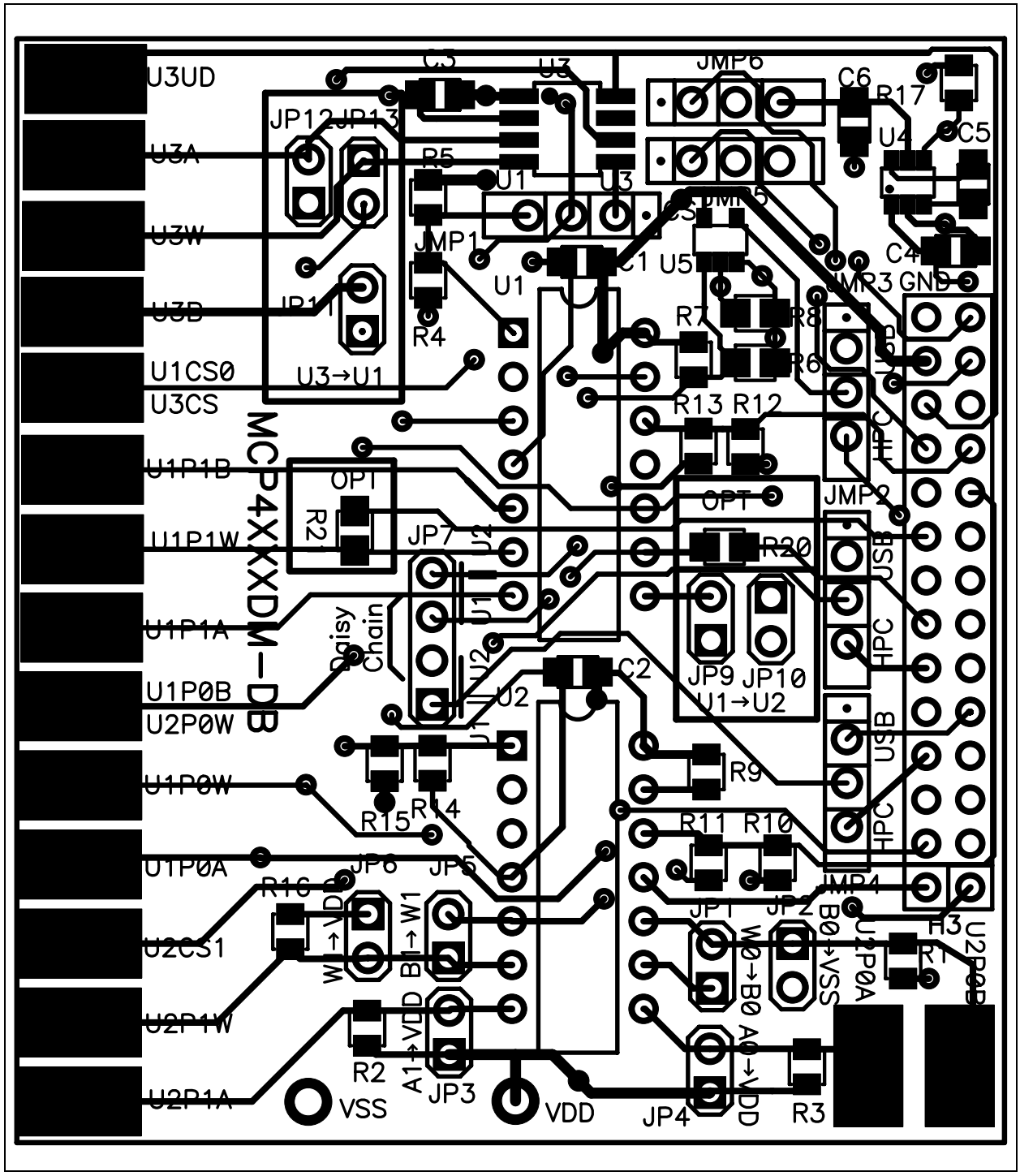


A.3 BOARD SCHEMATIC - DIGITAL CIRCUITRY

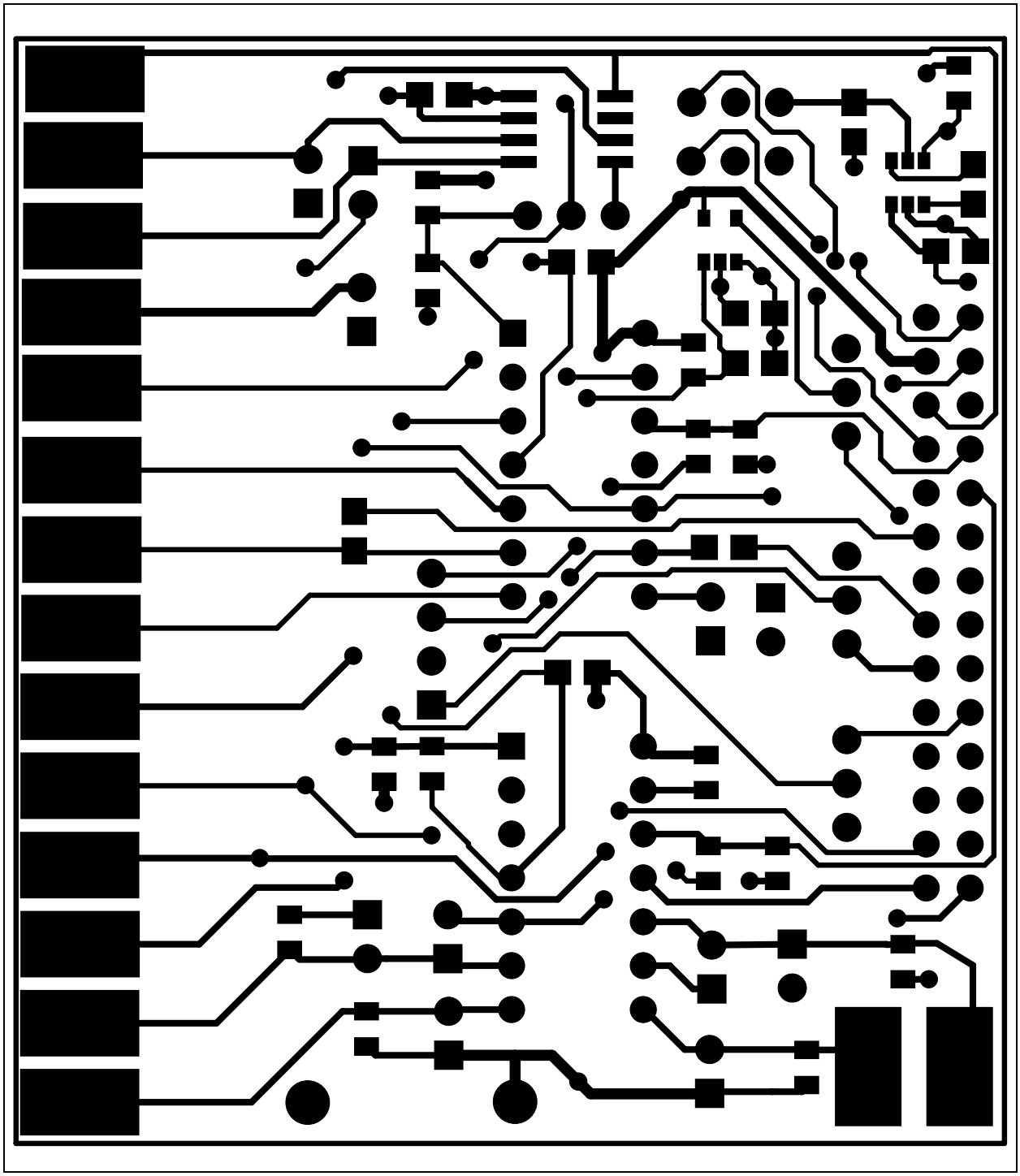


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A.4 TOP LAYER AND SILK SCREEN

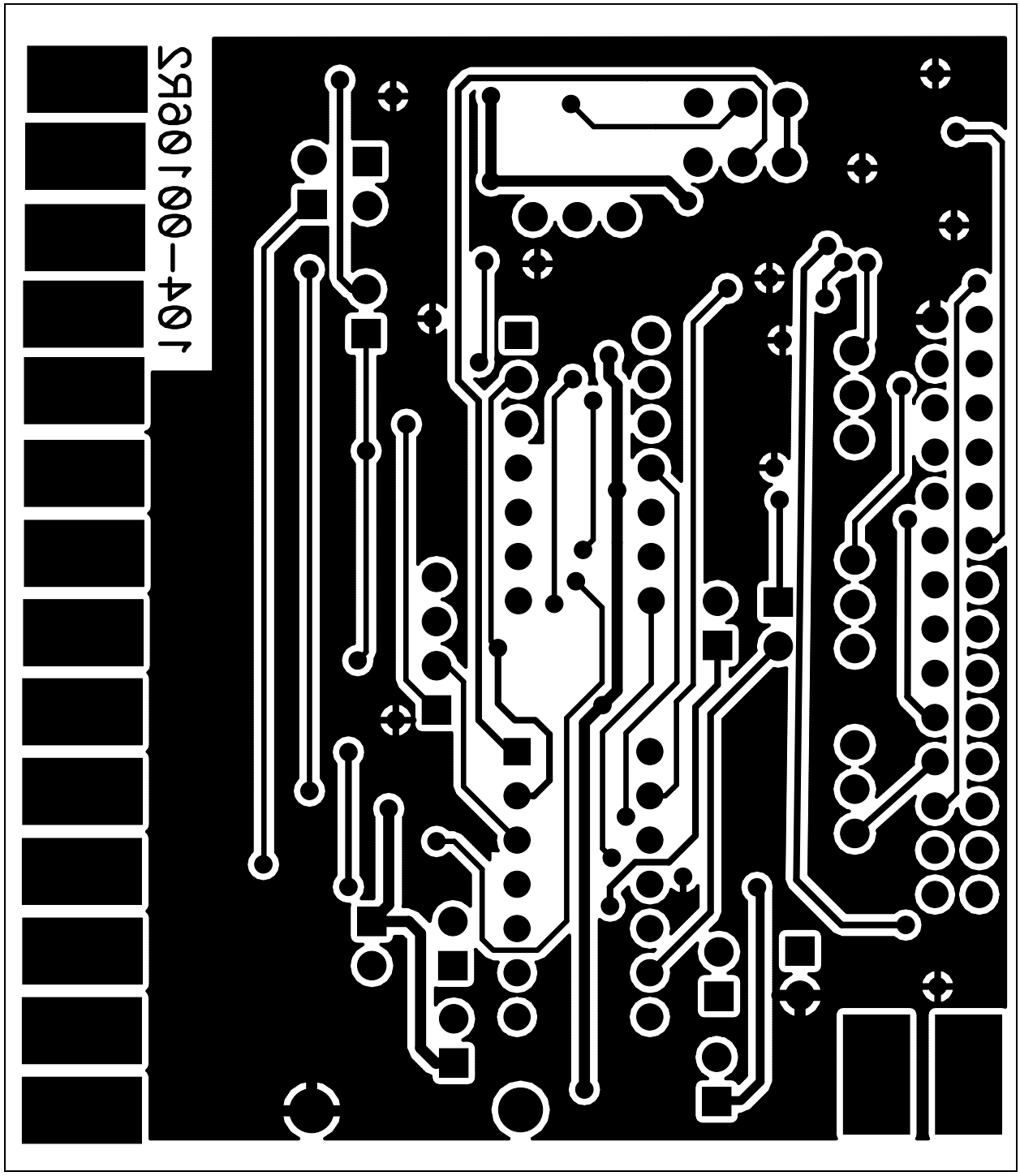


A.5 TOP LAYER

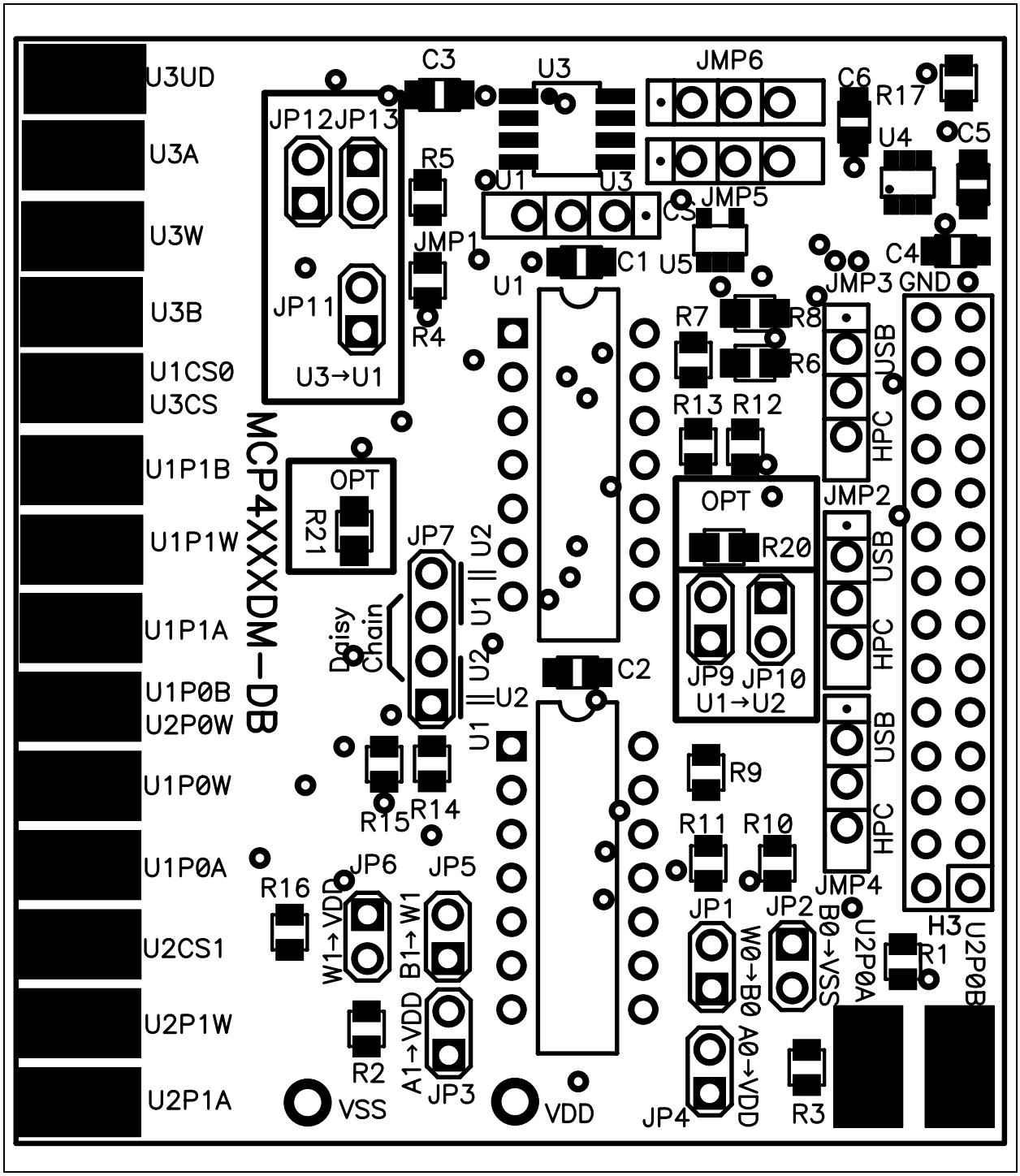


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A.6 BOTTOM LAYER



A.7 TOP COMPONENTS AND SILK SCREEN



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Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS — INSTALLED COMPONENTS

Qty	Reference	Description	Manufacturer	Part Number
4	C1, C2, C3, C4	Device Power Supply Bypass Capacitor Surface-mount (805 package) CAP .1UF 16V CERAMIC X7R 0805	Panasonic® - ECG	ECJ-2VB1C104K
1	C5	TC1240A Charge Double capacitor Surface-mount (805 package) CAP 3.3UF 10V CERAMIC X5R 0805	Panasonic - ECG	ECJ-2FB1A335K
1	C6	TC1240A Output Filer Capacitor Surface-mount (805 package) CAP 3.3UF 10V CERAMIC X5R 0805	Panasonic - ECG	ECJ-2FB1A335K
1	H3	PICDEM Demo Board Interface Header (2x14) Male (Installed on bottom of board) .100" Straight Male Headers Double Row 28 Pin Contact	JAMECO VALUEPRO	2012-254-2X14SG-R
6	JMP1, JMP2, JMP3, JMP4, JMP5, JMP6	1x3 Header (Male) .100" Straight Male Headers 3 Contacts (Gold)	JAMECO VALUEPRO	7000-1X3SG-R
11	JP1, JP2, JP3, JP4, JP5, JP6, JP9, JP10, JP11, JP12, JP13	1x2 Header (Male) .100 MILS Singel Row Straight Male Headers 2 Contacts	JAMECO VALUEPRO	7000-1X2SG-R
1	JP7	1x4 Header (Male) HEADER,.1"ST MALE,1RW,4PIN, .025" PST,.23" GOLDTAIL	JAMECO VALUEPRO	JS-1109-4-R
1	PCB 103-00106	MCP4XXX Demo Daughter Board PCB	Microchip Technology Inc.	103-00106
2	R6, R8	OR gate input pull-down resistor (10kΩ) RES 10.0K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1002V
1	R17	TC1240A SHDN pin pull-down resistor (100kΩ) RES 100K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1003V
2	U1, U2	14-pin Dip Socket SOCKET,IC,14PIN,MACHINE TOOLED LOW PROFILE,SOLDERTAIL	JAMECO VALUEPRO	6100-14-R
2	U1, U2	MCP42010 (DIP footprint)	Microchip Technology Inc.	MCP42010-E/P
1	U3	MCP4021 (SOIC footprint)	Microchip Technology Inc.	MCP4021-103E/SN
1	U4	TC1240A (SOT-23-5 footprint)	Microchip Technology Inc.	TC1240AECHTR
1	U5	Single 2-Input Positive OR gate IC SGL 2IN POS-OR GATE SOT23-5	Texas Instruments	SN74AHT1G32DBVR
12	—	1x2 Shunts Shunt,SHORT BLKS W TAB BLK	JAMECO VALUEPRO	2012JH-R

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-2: BILL OF MATERIALS — COMPONENTS NOT INSTALLED

Qty	Reference	Description	Manufacturer	Part Number
0	R1, R2, R3, R4, R5, R7, R9, R10, R11, R12, R13, R14, R15, R16	Pull-up or Pull-down resistors Surface-mount (805 package)	—	—
0	R20, R21	Wiper (U1-P0W, U1-P1W) Inline resistor (1) Surface-mount (805 package)	—	—

Note 1: This resistor when installed is typically 0W, but depending on the PICDEM Demo Board that it selected, modifications may be required on that PICDEM Demo Board to ensure that the wiper outputs are not adversely affected.An example of this is the removal of the R4 resistor on the PICDEM HPC Explorer Board (Rev 4 PCB) so that the circuitry on the AN1 signal line does not interfere with the operation of the U1-P0W signal.

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Appendix C. Board Testing

The MCP4XXX Digital Potentiometer Daughter Board can be used in multiple configurations. Only a subset of these configurations are tested. The tests were performed with the configuration shown in Figure C-1. The tested nodes are Channel 1 through Channel 4.

Other configurations, Pad connections, and circuit performance are not tested.

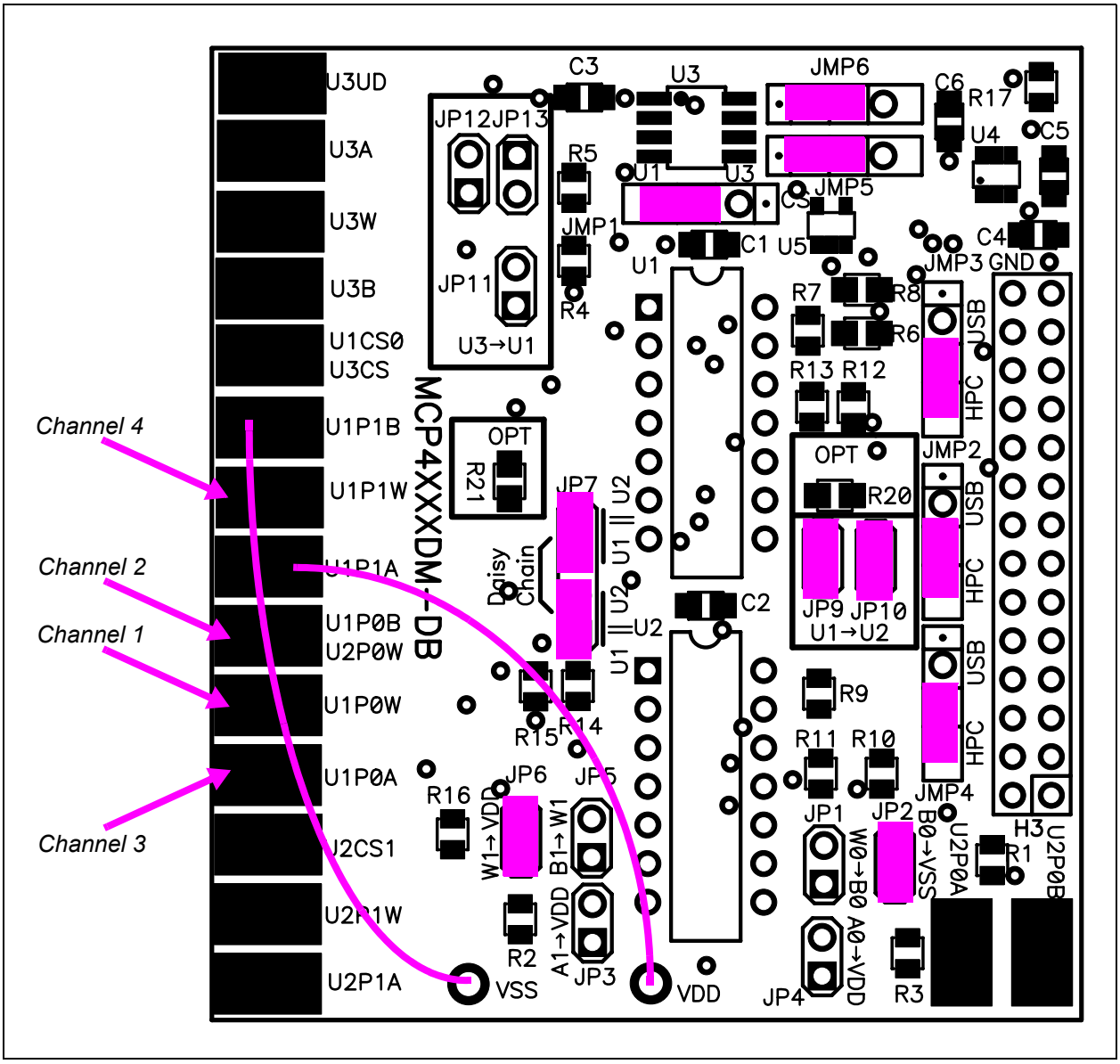


FIGURE C-1: *Tested Jumper Configuration.*

C.1 WHAT IS TESTED

The following portions of the board are tested:

- **MCP42010** (in U1 and U2)
  - U1 MCP42010 Pot 0 and Pot 1 are tested in Potentiometer configuration.
  - U2 MCP42010 Pot 0 and Pot 1 are tested in Rheostat configuration.
- JMP1 (P1 – P2) - $\overline{CS0}$ to U1
- JMP2 (P2 – P3) - PICDEM FS USB Demo Board Configuration
- JMP3 (P2 – P3) - PICDEM FS USB Demo Board Configuration
- JMP4 (P2 – P3) - PICDEM FS USB Demo Board Configuration
- JMP5 (P1 – P2) - $\overline{CS1}$ from H3 RE2 pin
- JMP6 (P1 – P2) - $\overline{CS0}$ from H3 RC1 pin
- JP2, JP6, JP9, and JP10
- H3 Header Signals: VDD, GND, RC5 (SDO), RC3 (SCK/SCL), RC1 (CS0), and RE2 (CS1)
- Pads:U1P1B, U1P1W, U2P1A, U1P0B (U2P0W), U1P0W, and U1P0A

C.2 WHAT IS NOT TESTED

The following portions of the board are NOT tested:

- **MCP4021** (U3)
- **TC1240A** (U4)
- SN74AHT1G32DBVR (U5)
- JP7 in Daisy Chain Configuration
- JMP1 (P1 – P2) - $\overline{CS0}$ to U3
- JMP2 (P1 – P2) - PICDEM FS USB Demo Board Configuration
- JMP3 (P1 – P2) - PICDEM FS USB Demo Board Configuration
- JMP4 (P1 – P2) - PICDEM FS USB Demo Board Configuration
- JMP5 (P2 – P3) - $\overline{CS1}$ from **TC1240A** VOUT pin
- JMP6 (P2 – P3) - $\overline{CS0}$ from **TC1240A** VOUT pin
- JP1, JP3, JP4, JP5, JP11, JP12, and JP13
- H3 Header Signals: RA5 (WP1), RA4 (WP0), RA3 (VIN), RC4 (SDI/SDA), RA0 (P0W), RA2 (P1W), RC2 (U/D), RC7 (SDO), RB5 (SHDN), RB4 (SHDN1), RB3 (SHDN0), RB1 (SCK/SCL), and RB0 (SDI/SDA)
- Pads: U3UD, U3A, U3W, U3B, U1CS0 (U3CS), U2CS1, U2P1W, U2P1A, U2P0A, and U2P0B
- Connections to unpopulated components

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