MCP22301
USB PD Sink Board
User's Guide

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ISBN: 979-8-3371-0368-6

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MCP22301 USB PD SINK BOARD USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

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

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

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

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP22301 USB PD Sink Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Website
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP22301 USB PD Sink Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Includes a short overview of the MCP22301 device and a general description of the MCP22301 USB PD Sink Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP22301 USB PD Sink Board, a detailed description of the board, and instructions on how to use the GUI.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and layout diagrams for the MCP22301 USB PD Sink Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP22301 USB PD Sink 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...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly 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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP22301 USB PD Sink Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

- **MCP22301 Data Sheet -** ***"Stand-Alone USB Type-C™ Power Delivery 3.1 Controller" (DS20006887)*** – This data sheet provides detailed information regarding the MCP22301 devices.

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

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The Development Systems product group categories are:

- **Compilers** - The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB® C compilers; all MPLAB assemblers (including MPASM assembler); all MPLAB linkers (including MPLINK object linker); and all MPLAB librarians (including MPLIB object librarian).
- **Emulators** - The latest information on Microchip in-circuit emulators.This includes the MPLAB REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** - The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit 3/4 Debug Express.
- **MPLAB IDE** - The latest information on Microchip MPLAB IDE, the Windows Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** - The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are non-production development programmers such as PICSTART Plus and PICkit 2, 3 and 4 programmers.

CUSTOMER SUPPORT

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- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

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

Technical support is available through the website at:
http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (December 2024)

- Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter covers the following topics:

- MCP22301 Device - Overview
- What is the MCP22301 USB PD Sink Board?
- What does the MCP22301 USB PD Sink Board Kit Include?

1.2 MCP22301 DEVICE - OVERVIEW

The MCP22301 is a stand-alone, small form factor USB Type-C™ Power Delivery (PD) Port Controller which integrates a PD solution with SAMD20 (32-bit ARM Cortex-M0+) microcontroller and MCP22350 PD MAC/PHY functionality.

The MCP22301 integrates many of the analog discrete components required for USB Type-C PD applications, including two VCONN FETs with Rp/Rd switching and current/voltage sense circuitry for over-voltage/current detection. This way, the chip provides a low cost, stand-alone, fast time-to-market solution for consumer and industrial applications.

The device can be used for a wide range of USB Power Delivery applications, including but not limited to: Single or Multi-Port source only applications, Bus-Powered Sink applications, Battery-Powered Sink applications, and Dual Role Data/Dual Role Power applications, such as PD-based docking stations or PD-based dongles.

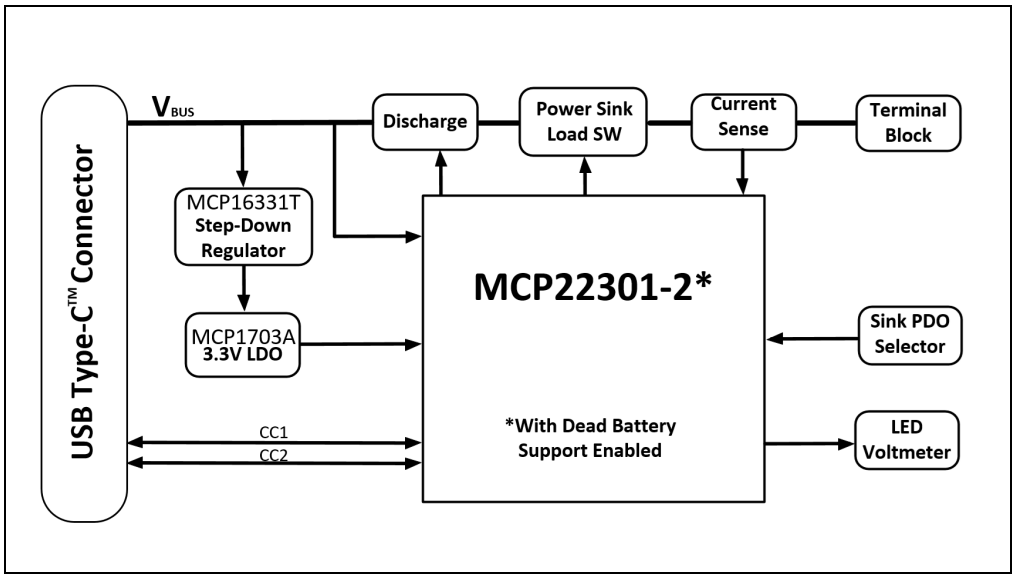


FIGURE 1-1: *MCP22301 USB PD Sink Board Block Diagram.*

1.3 WHAT IS THE MCP22301 USB PD SINK BOARD?

The MCP22301 Basic Sink Application Example Evaluation Kit is a low-cost evaluation platform for Microchip's MCP22301 Standalone Programmable USB Power Delivery (PD) Controller. This RoHS-compliant evaluation platform comes in a small form factor

and adheres to the USB Type-C™ Connector specification and USB PD 3.2 specification.
This board focuses on using the MCP22301 as a "sink" device in USB PD communication, meaning it is designed to receive power rather than supply it.

Powered by Microchip's versatile USB Power Delivery Stack (PDS), this evaluation platform provides a quick and easy way of replacing the standard power connector (barrel plug) in any application with a small form factor, reversible Type-C connector. This bus-powered evaluation platform supports Dead Battery mode.

With the PDS, this platform supports up to eight configurable Power Delivery Objects (PDOs), all of which are selectable through the onboard rotary switch. The platform can also support unique custom PDOs with additional configuration of the PDS, if required.

The available source capabilities and the negotiated voltage and current are displayed on the Graphic User Interface (GUI), using the MCP2221A Breakout Module.

1.4 WHAT DOES THE MCP22301 USB PD SINK BOARD KIT INCLUDE?

The MCP22301 USB PD Sink Board kit includes:

- The MCP22301 USB PD Sink Board (EV71V36A).
- Important Information Sheet.

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP22301 USB PD Sink Board was developed as a compact and low-cost USB Power delivery sink device.

This chapter provides a detailed description of the MCP22301 USB PD Sink Board, as well as instructions on how to use the board.

2.2 FEATURES

The MCP22301 USB PD Sink Board has the following features:

- USB PD VBUS Input voltage range: from 5V up to 48V
- Maximum output current: 5A
- On-board high-performance power MOSFET transistors for load disconnect
- Output overcurrent protection using an MCP6C02 high-side current sense amplifier
- LED for quick status reporting of the USB PD sink
- GUI for detailed status and capabilities reporting, including VBUS voltage, load current, PDO profile via UART communication
- On-board LED VBUS voltage indicator
- Manual PD profile selection switch
- Hardware ready for USB PD Extended Power Range (EPR) sink applications. The existing version of the Microchip Power Delivery Stack (PDS) supports only a Standard Power Range (SPR) of up to 20V, but EPR support may be available in a future release, so only reprogramming is required to enable the EPR capability.

2.3 GETTING STARTED

The MCP22301 USB PD Sink Board is fully assembled and tested to evaluate and demonstrate the MCP22301 device capabilities as a USB-PD sink.

2.3.1 Necessary Instruments and Tools Required for Operation

- USB-PD compatible supply
- USB-C to USB-C cable (optional E-marked with 5A capability)
- Load (optional)
- Digital voltmeter/ammeter (optional)
- Wires for connecting the load to the board output
- USB to serial bridge (recommended MCP2221A Breakout Module) optional
- Computer with GUI (can be downloaded from the board's webpage) installed (optional, not required for operation)

2.4 SETUP PROCEDURE

To test the MCP22301 Extended Power Range Sink Board, the following steps must be completed:

1. Connect a USB Type-C cable to the J1 USB-C Input Connector and to the USB-PD Power Supply.
2. Connect a load to the J4 Output Terminal Block, as shown in Figure 2-1.
3. Connect the MCP2221A Breakout Module to the J5 Connector on the board to enable computer communication between the GUI and the MCP22301 board (optional).
4. Connect the USB cable between the MCP2221A Breakout Module and the computer having the GUI installed (optional).
5. Start the USB-PD Power supply. If the previous steps were successful, some LEDs on the sink board will be lit. When the source capabilities do not meet the sink power requirements, the sink will set the "Capability Mismatch" bit. This, in turn, will assert the MIS_CAP led. After the PD contract is established, the sink circuitry will be enabled, indicated by the EN_SNK led.

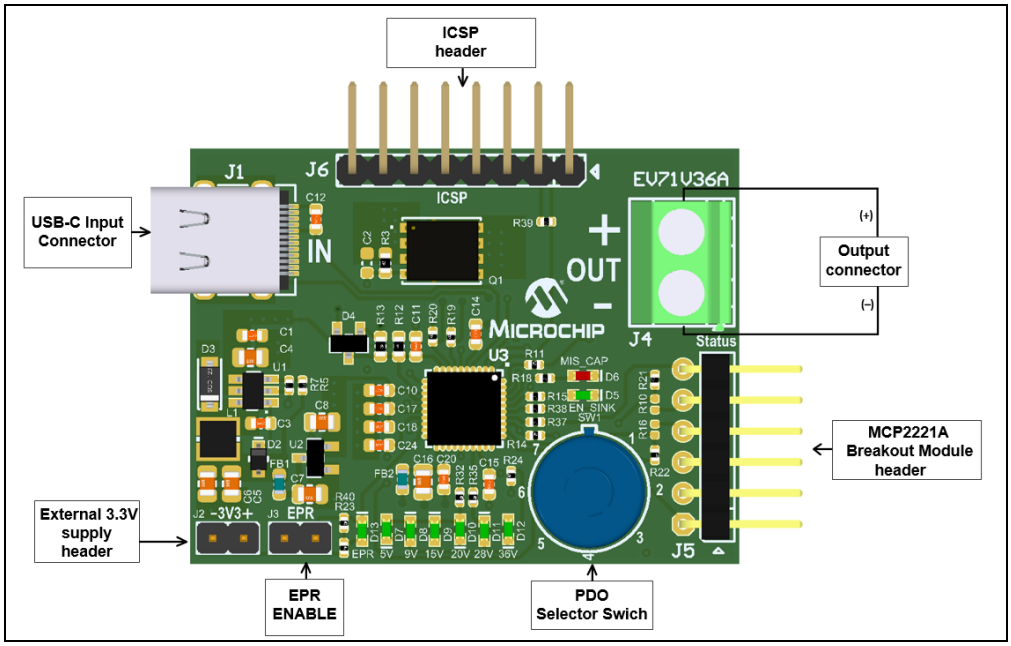


FIGURE 2-1: *MCP22301 USB PD Sink Board PCB (Top View).*

2.4.1 Graphic User Interface (GUI)

1. Start the Sink PD Demo GUI and press the Refresh button for the updated COM ports list.
2. Select from the drop down list the COM port allocated to the USB Serial Device, the MCP2221A board.
3. Press Connect.
4. If the connection was successful, the “Connected” message will appear at the bottom of the window.
5. In the Status Tab, the Port Info shows the PD capabilities.
6. The plots on the right show the updated voltage (top graph), the negotiated current-red and the updated Load current-blue (middle graph) and the updated power (bottom graph).
7. The Negotiated Contract shows the currently selected profile.
8. The Advertised Profiles show the source capabilities and the selected profile highlighted.
9. The profile can be changed using the PDO Selector Switch on the board.
10. The hardware provides a visual indication of the selected voltage in the form of a LED Voltmeter.
11. Available predefined profiles:
    - Position 1: 5V, 3A
    - Position 2: 5V, 3A and 9V, 3A
    - Position 3: 5V, 3A and 15V, 3A
    - Position 4: 5V, 3A and 20V, 5A
    - Position 5: 5V, 3A and 9V, 3A and 15V, 3A and 20V, 5A (Mode A)
    - Position 6: 5V, 3A and 9V, 3A and 15V, 3A and 20V, 5A (Mode B)
    - Position 7: 12V, 3A (nonstandard)
    - Position 8: 5V, 3A

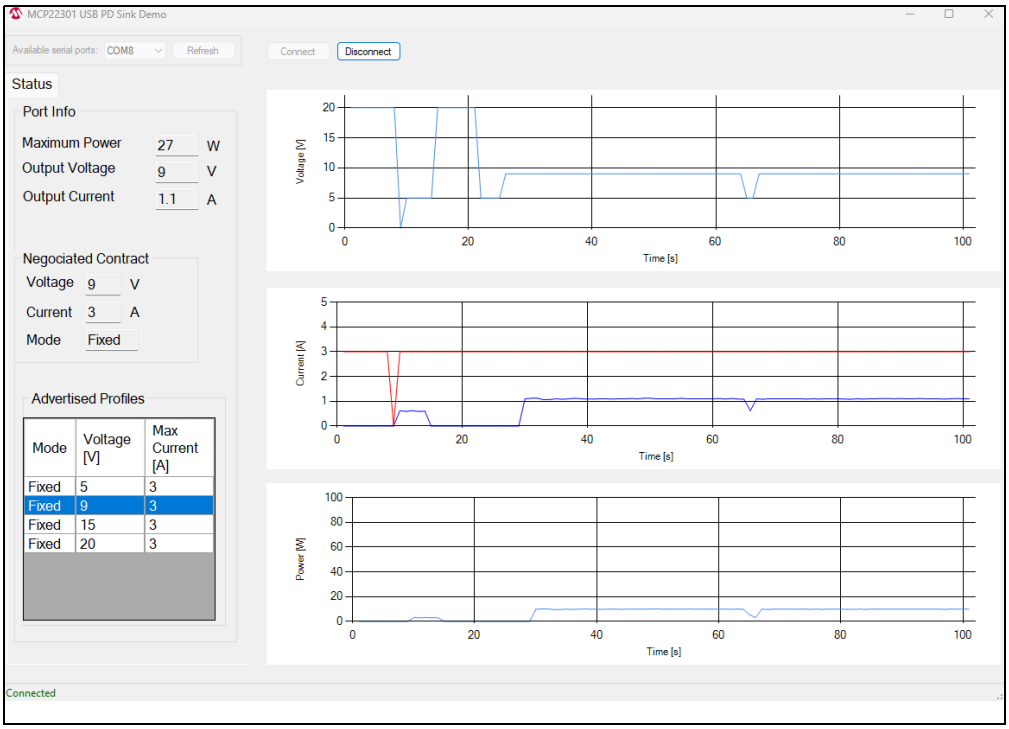


FIGURE 2-2: *Sink PD Demo GUI.*

While positions 5 and 6 look similar, there are some subtle differences, as described below.

In **Mode A** (position 5), the PDS Sink operation does its best to select the highest available wattage PDO at the highest voltage supported by both the Source and the Sink. This mode of operation is useful for a battery-powered type of device that has a buck/boost regulator for charging the battery. With these devices, they will typically prefer to request a voltage level that is close to the battery voltage so that the loss of efficiency due to buck or boost conversion is minimized.

In **Mode B** (position 6), the PDS sink operation does its best to select the highest available wattage PDO at the lowest voltage supported by both the Source and the Sink. This mode of operation is useful for devices that do not have a battery and require a minimum voltage level in order to operate. For example, if the electronics within the system require 14.2V to operate, then there shall be no use case to select any voltage less than 14.2V. Additionally, there may be no point in selecting a 20V PDO if a 15V PDO of the same wattage is available. The 15V PDO will allow the buck conversion down to 14.2V to operate more efficiently than a 20V PDO which requires a 20V (> 14.2V) conversion.

2.5 OPERATING THE MCP22301 USB PD SINK BOARD

Figures 2-6 shows the board typical test setup.

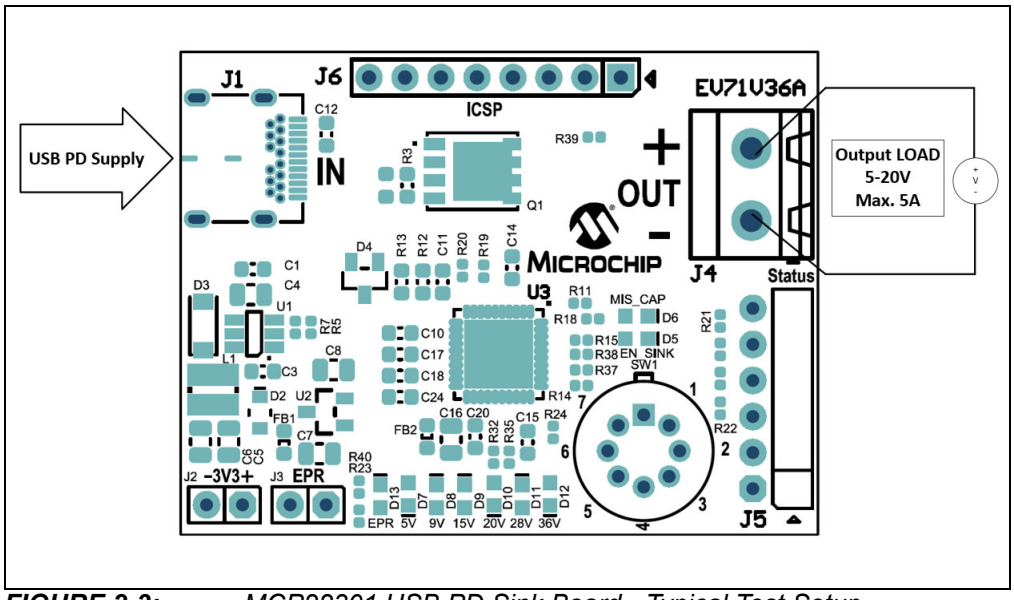


FIGURE 2-3: *MCP22301 USB PD Sink Board - Typical Test Setup.*

Table 2-1 lists all the available connectors and headers on the board.

TABLE 2-1: CONNECTORS DESCRIPTION

Label	Description
J1	USB-C Input
J2	External 3.3V Supply
J3	EPR Enable
J4	Output
J5	PICkit™ Serial/MCP2221
J6	In-circuit Serial Programming

2.6 BOARD PROGRAMMING GUIDE (OPTIONAL)

The boards are pre-programmed with a basic USB-PD Sink application example, that can be found in the "Demo" folder of the Microchip USB Power Delivery Stack (PDS). The PDS firmware is being continuously developed. The supported features may be expanded over time.

The board needs to be reprogrammed to evaluate the latest version of the example from the Microchip USB Power Delivery Stack (PDS) or to use the board as a development tool for a custom solution.

The J6 header can be used to reprogram the board using a standard Microchip PICKit 4/5.

The required equipment includes a Microchip PICKit 4/5, a USB Type C source (any type of Type C source, with or without USB-PD), along with a USB Type-C to USB Type-C cable, if the PICKit 4/5 is not configured to supply programming voltage, and a Windows PC for the MPLAB® IPE software.

Installing MPLAB IPE on the Windows PC:

1. Download the latest version of MPLAB® X IDE for Windows from https://www.microchip.com/en-us/tools-resources/develop/mplab-x-ide
2. Run the installer. Both MPLAB X IDE or MPLAB IPE can be used to program the board. For simplicity, the following information refers exclusively to the MPLAB IPE option with the provided hex file. When asked to select the applications to install, check only the "MPLAB IPE" and "32 bit MCUs" checkboxes.

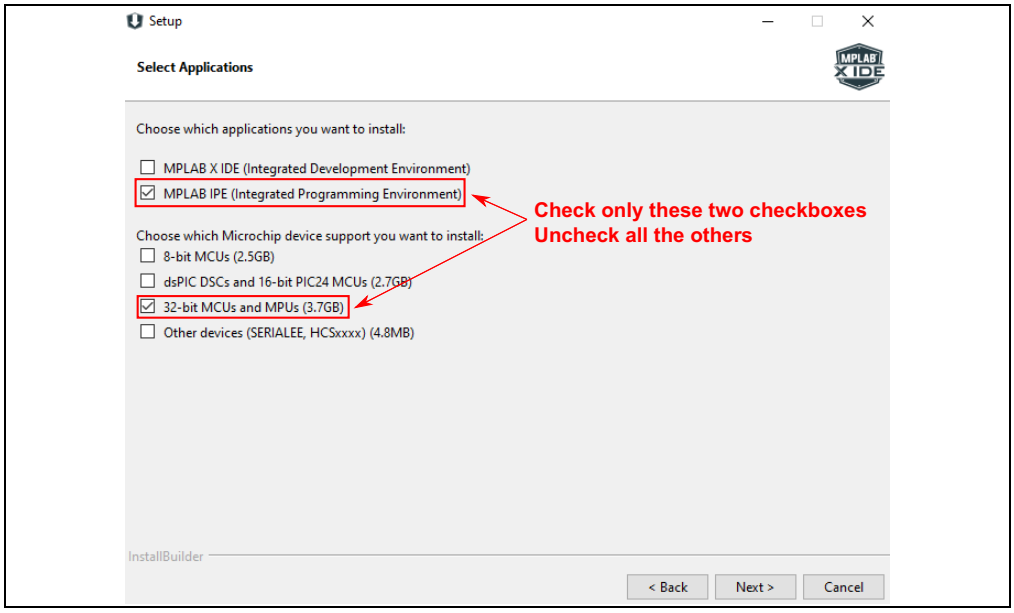


FIGURE 2-4: *MPLAB IPE Install.*

Programming Procedure:

1. Connect the PICKit 4 to the programming header J6 (with the label "ICSP") of the MCP22301 Sink Board, as pictured below.

FIGURE 2-5: *MPLAB PICkit.*

2. Connect the MCP22301 Sink Board to the USB Type C source, using the USB Type-C to USB Type-C cable.
3. Open MPLAB® IPE on the PC.
4. Select Family = "32-bit MCUs (PIC32C/SAM)", Device = "ATSAMD20E16" and then click "Apply."

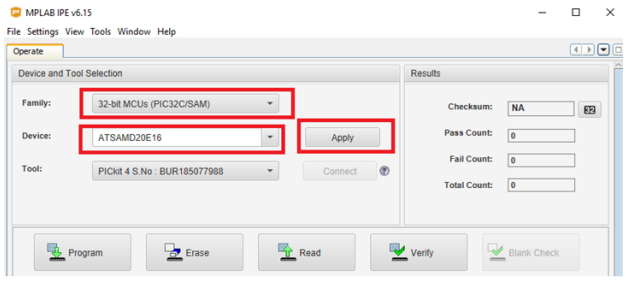


FIGURE 2-6: *Select Family.*

5. In the "Hex file" section, click on "Browse" and select the provided hex file to be programmed on this board (can be downloaded from the board's webpage). Then click on "Program." If the "Programming complete" appears, the programming was successful.

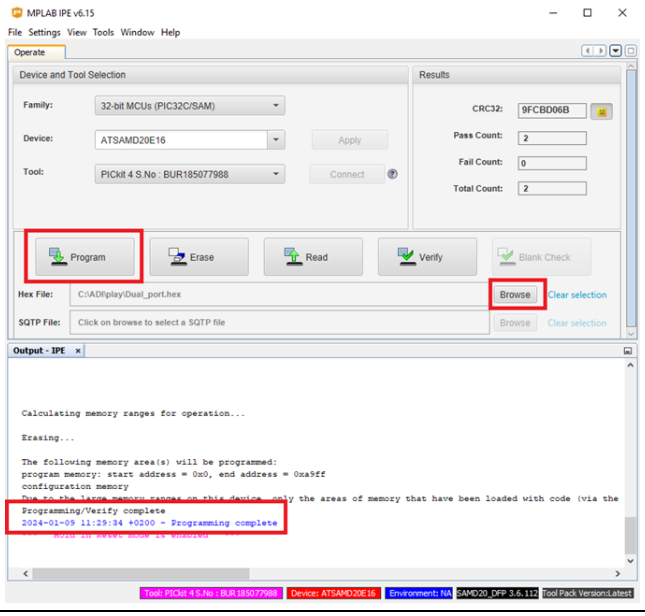


FIGURE 2-7: *Program*

6. Remove the Type-C cable from the MCP22301 Sink Board.
7. Disconnect the PICkit™ 4/5 from the programming header J6 of the MCP22301 Sink Board.

The above programming procedure assumes that the board is powered from the external USB Type-C source. If the USB type-C source is not available, the MCP22301 can be programmed by enabling the "Power target circuit from PICKit 4/5" from the "Power Settings" tab in MPLAB IPE ("Advanced Mode" should be selected first from the "Settings" tab). Only one way of supplying power should be chosen (via USB type-C source or from the PICKit 4/5).

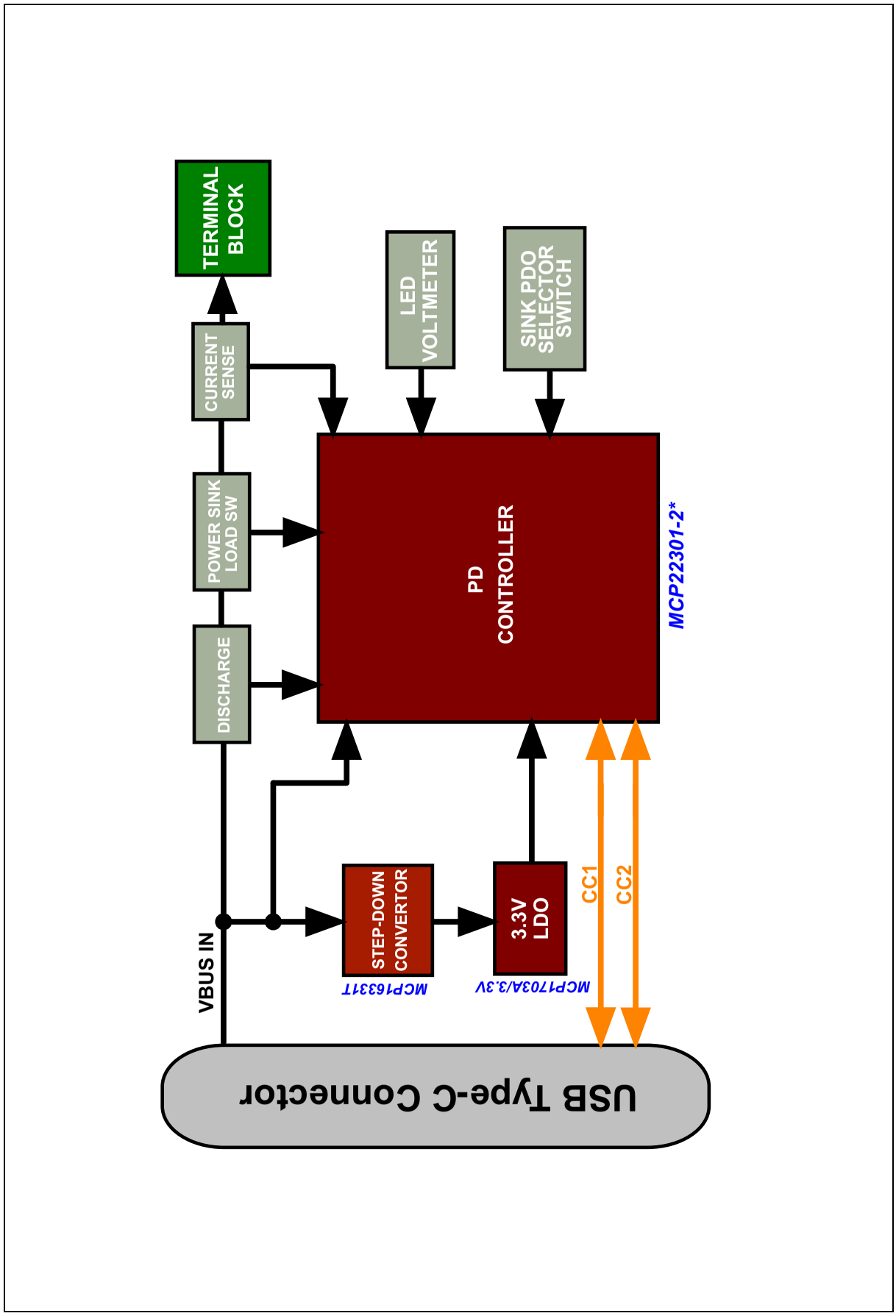
Appendix A. Schematics and Layouts

A.1 INTRODUCTION

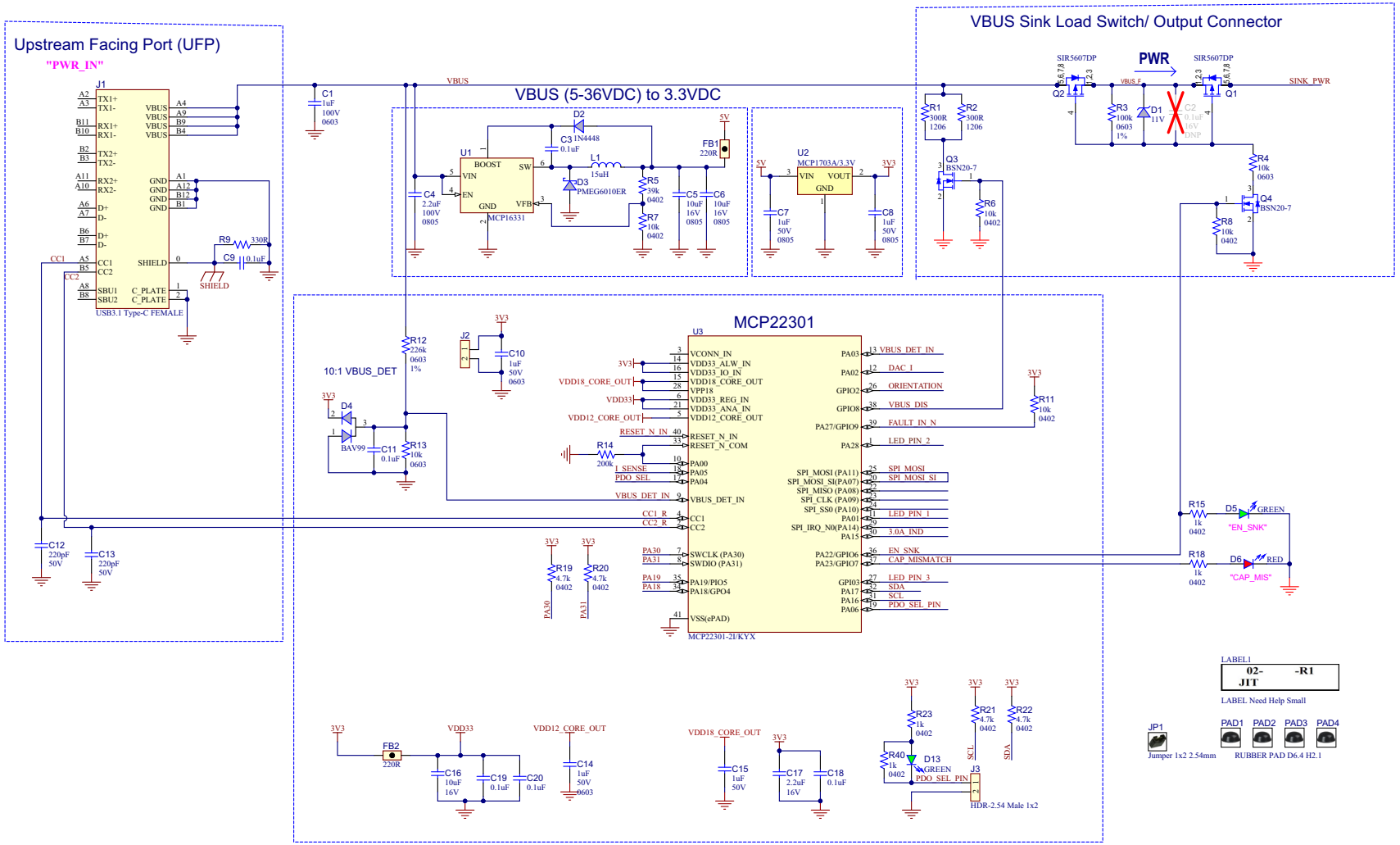
This appendix contains the schematics and layouts of the MCP22301 USB PD Sink Board:

- Board – Block Diagram
- Board – Schematic Page 1
- Board – Schematic Page 2
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Inner Layer 1
- Board – Inner Layer 2
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

A.2 BOARD – BLOCK DIAGRAM

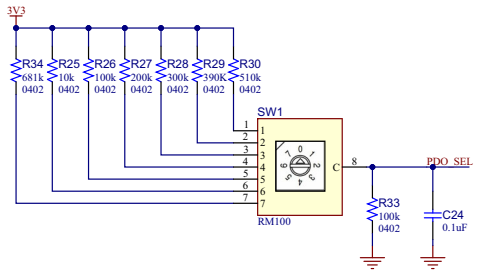


A.3 BOARD – SCHEMATIC PAGE 1



A.4 BOARD – SCHEMATIC PAGE 2

Sink PDO Capability Selector Switch



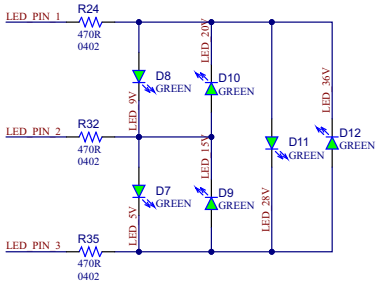
Switch Position	PDO_SEL Voltage
1	5V
2	9V
3	15V
4	20V
5	28V
6	36V
8	9V PPS
9	9V AVS
11	15V AVS
12	28V AVS
13	36V AVS

Use of the PDO Selector Switch depends on PSF application.

A recommended use-case is to use the knob to select on Sink PDO from a pre-configured list of Sink PDO options.

R25	2.99V
R26	1.64V
R27	1.09V
R28	0.82V
R29	0.67V
R30	0.53V
R34	0.42V

VBUS LED Voltmeter



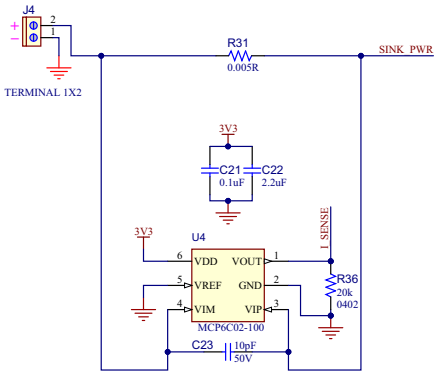
The LED Voltmeter provides a visual indication of the approximate voltage at the PD connector.

Current Sense Amplifier

A discrete current sense amplifier is not required for PSF applications.

This is an optional component which may be used to sense current draw and use that information in an application specific way (i.e.: shutdown in an overcurrent condition)

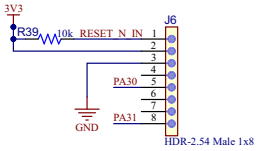
"PWR_OUT"



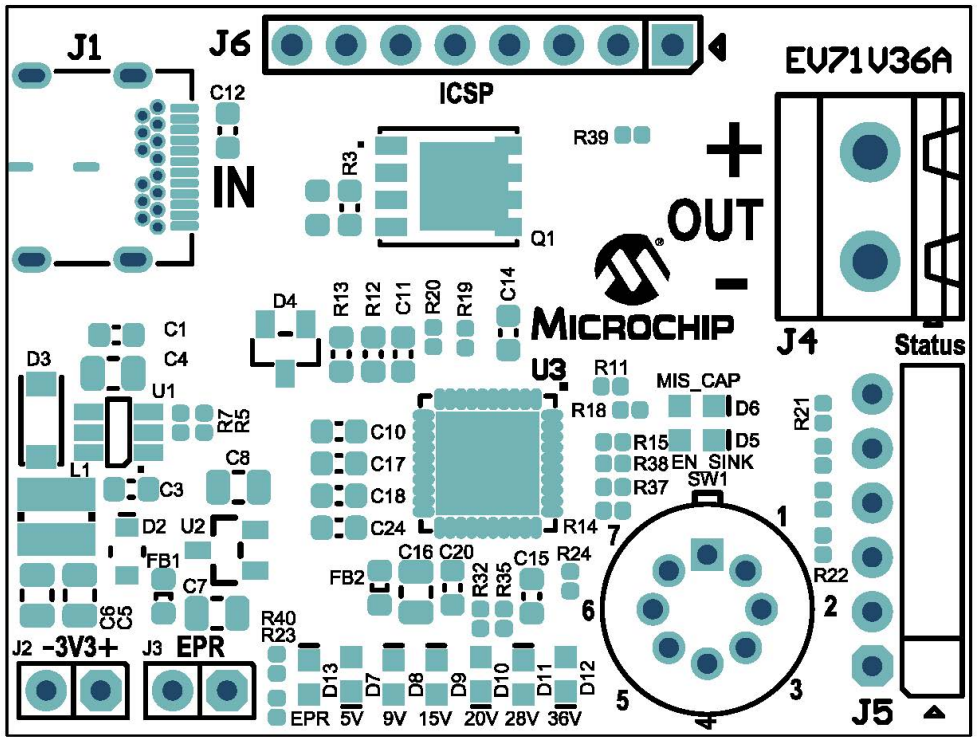
Scale: 5A = 2.5V
Gain = 100

Debug/Status

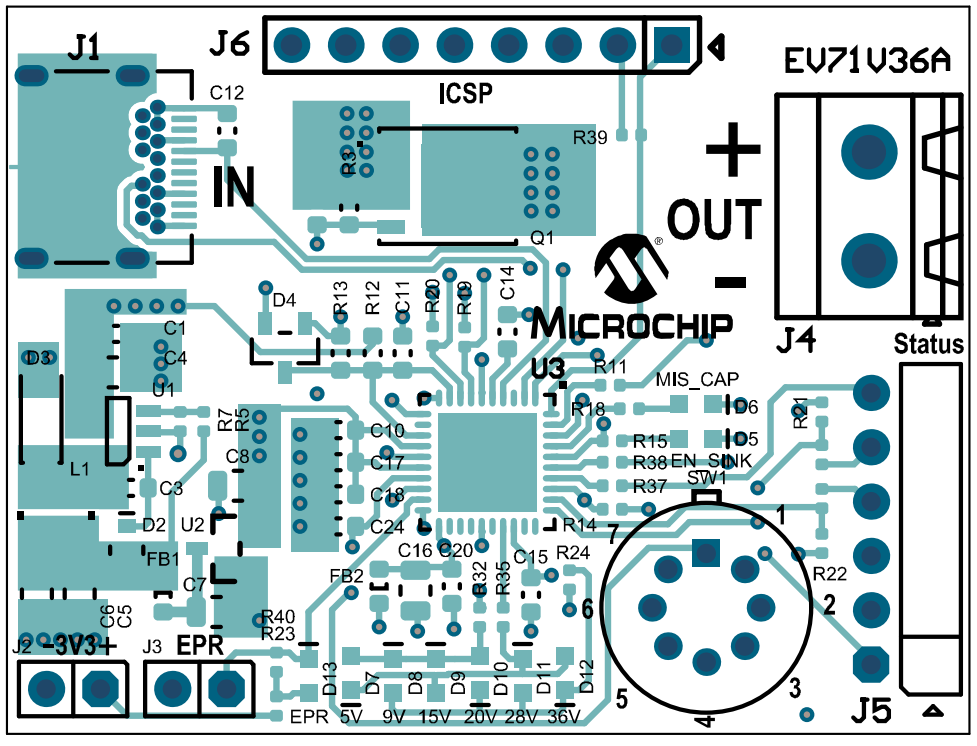
ICSP



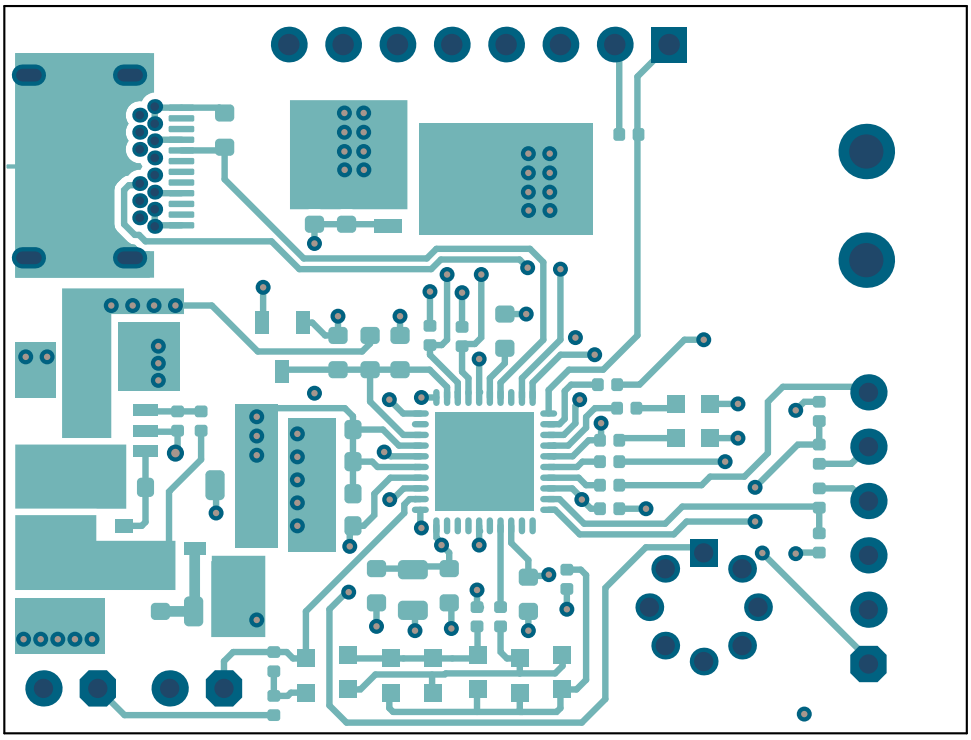
A.5 BOARD – TOP SILK



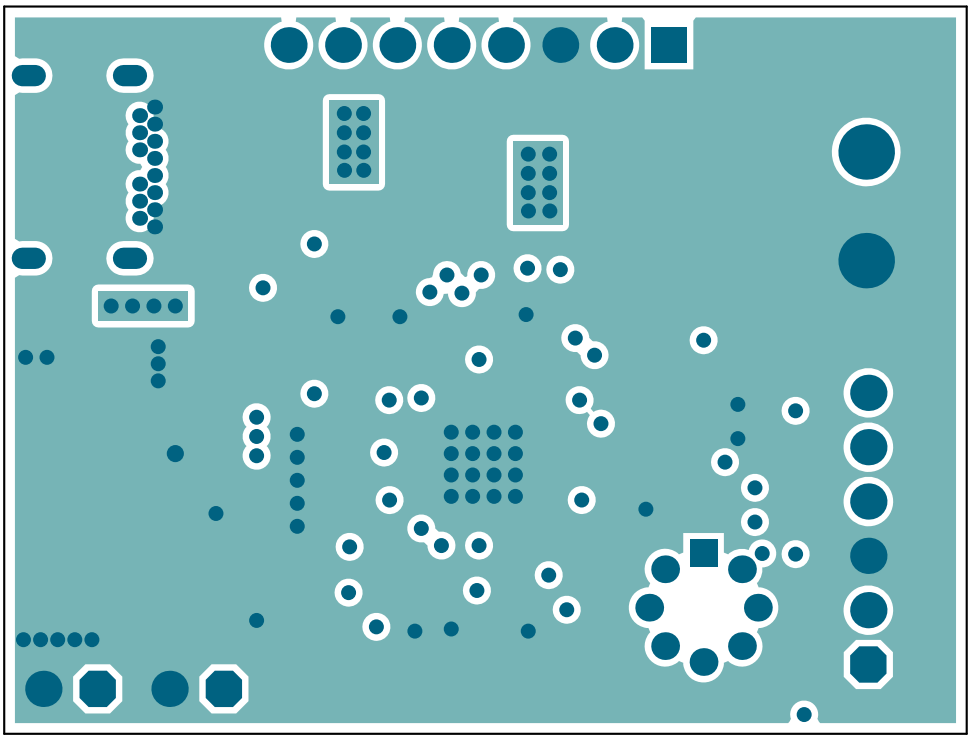
A.6 BOARD – TOP COPPER AND SILK



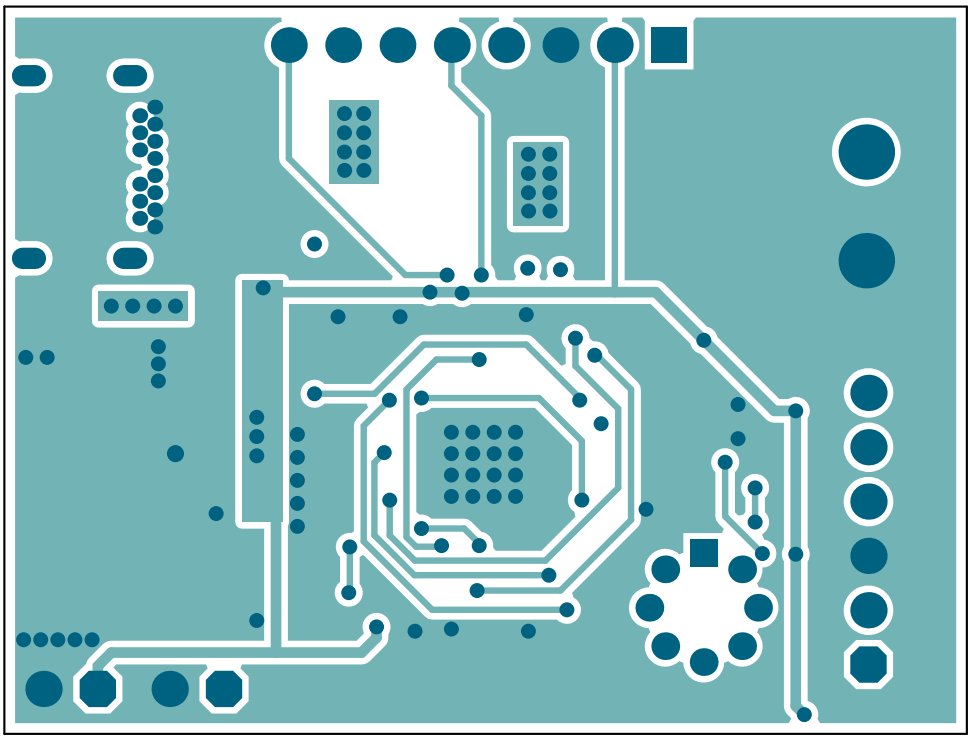
A.7 BOARD – TOP COPPER



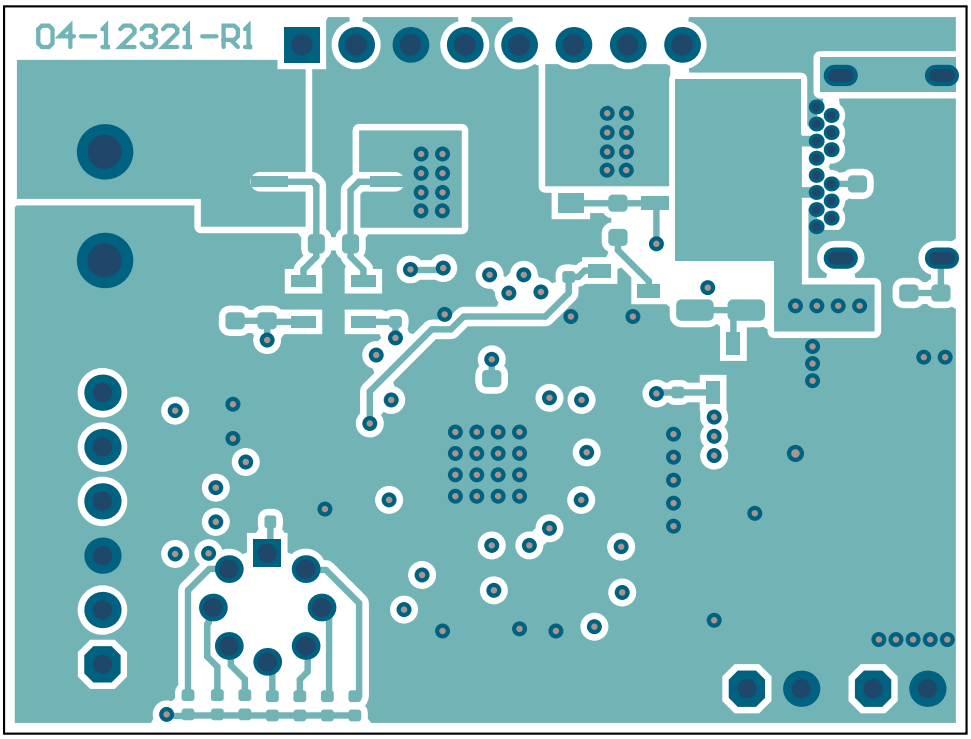
A.8 BOARD – INNER LAYER 1



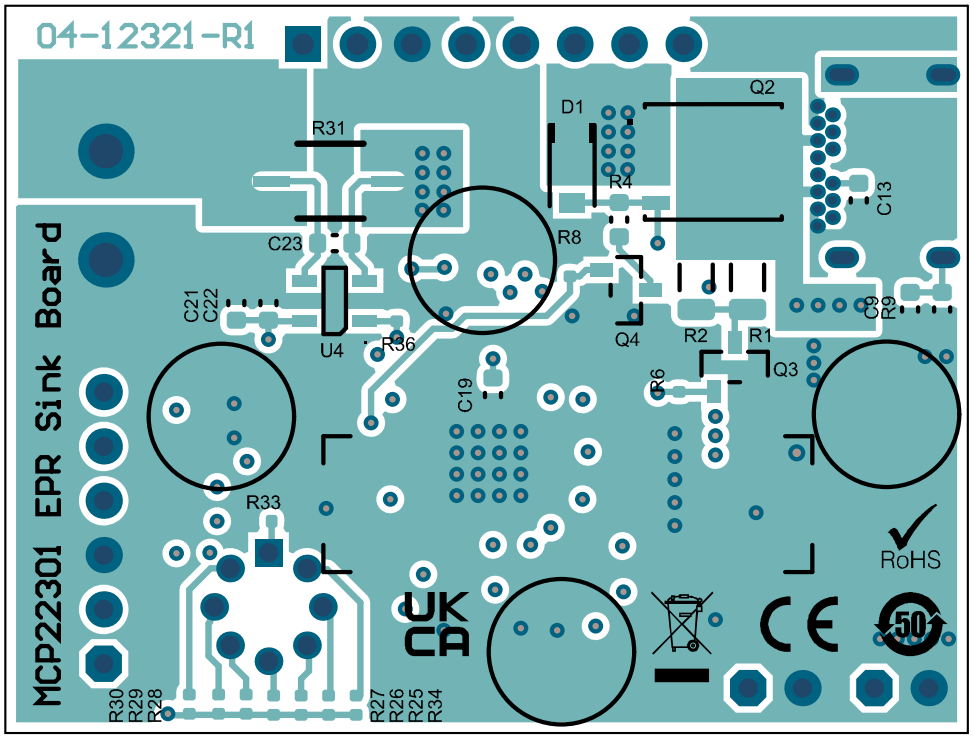
A.9 BOARD – INNER LAYER 2



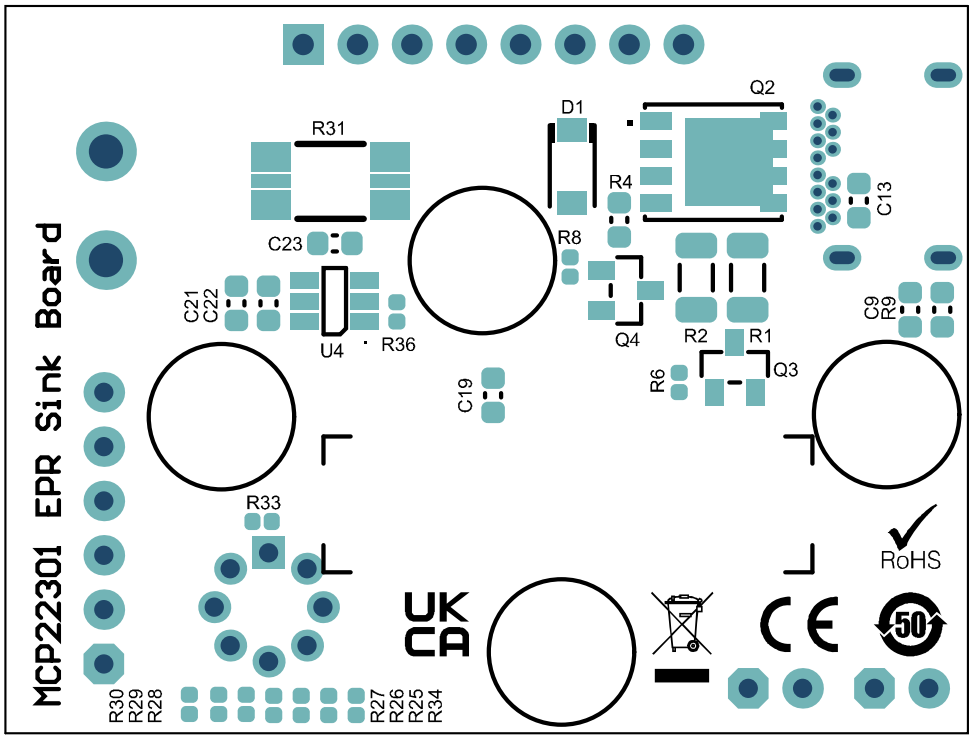
A.10 BOARD – BOTTOM COPPER



A.11 BOARD – BOTTOM COPPER AND SILK



A.12 BOARD – BOTTOM SILK



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor, Ceramic, 1 µF, 100V, 20%, X7T, SMD, 0603	Murata Electronics®	GRM188D72A105ME01J
1	C3	Capacitor, Ceramic, 100 nF, 50V, 10%, X7R, SMD, 0603, AEC-Q200	AVX Corporation	06035C104K4T2A
1	C4	Capacitor, Ceramic, 2.2 µF, 100V, 10%, X7R, SMD, 0805	TDK Corporation	C2012X7R2A225K125AC
3	C5, C6, C16	Capacitor, Ceramic, 10 µF, 16V, 20%, X5R, SMD, 0805	TDK Corporation	C2012X5R1C106M085AC
2	C7, C8	Capacitor, Ceramic, 1 µF, 50V, 10%, X7R, SMD, 0805	Samsung Electro-Mechanics	CL21B105KBFNNNE
7	C9, C11, C18, C19, C20, C21, C24	Capacitor, Ceramic, 0.1 µF, 16V, 10%, X7R, SMD, 0603	Taiyo Yuden Co., Ltd.	EMK107B7104KA-T
3	C10, C14, C15	Capacitor, Ceramic, 1 µF, 50V, 10%, X5R, SMD, 0603	Taiyo Yuden Co., Ltd.	UMK107BJ105KA-T
2	C12, C13	Capacitor, Ceramic, 220 pF, 50V, 5%, NP0, SMD, 0603	KEMET	C0603C221J5GACTU
2	C17, C22	Capacitor, Ceramic, 2.2 µF, 16V, 80%, Y5V, SMD, 0603	Yageo Corporation	CC0603ZRY5V7BB225
1	C23	Capacitor, Ceramic, 10 pF, 50V, 5%, NP0, SMD, 0603	KEMET	C0603C100J5GACTU
1	D1	Diode, Zener, 11V, 500 mW, SMD, SOD-123, AEC-Q101	Diodes Incorporated®	MMSZ5241BQ-7-F
1	D2	Diode, Rectifier, 855 mV, 500 mA, 75V, SOD-323	Diodes Incorporated	1N4448WS-7-F
1	D3	Diode, Schottky, 530 mV, 1A, 60V, SMD, SOD-123	NXPSemiconductors	PMEG6010ER,115
1	D4	Diode, RECTARR, 1V, 215 mA, 70V, SOT-23-3	Comchip Technology	BAV99-G
8	D5, D7, D8, D9, D10, D11, D12, D13	Diode, LED, Green, 2.1V, 30 mA, 6mcd, Clear, SMD, 0603	Lite-On®, Inc.	LTST-C190GKT
1	D6	Diode, LED, Red, 1.8V, 20 mA, 7.1 mcd, Diffuse, SMD, 0603	OSRAM Opto Semi-conductors GmbH.	LS L29K-G1J2-1-Z
2	FB1, FB2	Ferrite, 500 mA, 220R, SMD, 0603	Murata Electronics®	BLM18AG221SN1D
1	J1	Connector, USB3.1, Type-C, Female, TH, R/A	Wurth Elektronik	632723300011
2	J2, J3	Connector, HDR-2.54, Male, 1x2, Gold, 5.84MH, TH, VERT	FCI	68000-202HLF

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-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
1	J4	Connector, Terminal, 5.08 mm, 1X2, Female, 16-30AWG, 13.5A, TH, RA	TE Connectivity	282836-2
1	J5	Connector, HDR-2.54, Male, 1x6, Gold, 5.84MH, TH, R/A	FCI	68016-106HLF
1	J6	Connector, HDR-2.54, Male, 1x8, Gold, 6.00MH, TH, R/A, solder directly	Multicomp Pro	MC34753
1	JP1	Mechanical, HW, Jumper, 2.54 mm, 1x2	Sullins Connector Solutions	SPC02SYAN
1	L1	Inductor, 15 µH, 650 mA, 20%, WE-MAPI Series, SMD, 1212	Wurth Elektronik	74438335150
1	LABEL1	Label, ASSY W/REV Level (Small Modules) Per MTS-0002	Raynen	10010276
4	PAD1, PAD2, PAD3, PAD4	Mechanical, HW, Rubber, Pad, Hemisphere, D6.4, H2.1, Black	Bumper Specialties Inc.	BS25BL07X30RP
2	Q1, Q2	Transistor, FET, P-CH, 60V, 90.9A, 104W PPAK, SO-8	Vishay	SIR5607DP-T1-RE3
2	Q3, Q4	Transistor, FET, N-CH 60V 170mA 370mW SOT-23-3	Diodes Incorporated	BSN20-7, 2N7002-7-F
2	R1, R2	Resistor, Thick Film, 300R 1% 1/4W SMD 1206	ROHM Semiconductor	MCR18EZHF3000
1	R3	Resistor, Thick Film, 100k 1% 1/10W SMD 0603 AEC-Q200	Panasonic Electronic Components	ERJ-3EKF1003V
2	R4, R13	Resistor, Thin Film, 10k 1% 1/16W SMD 0603	TE Connectivity Passive Product	CPF0603F10KC1
1	R5	Resistor, Thick Film, 39k 1% 1/16W SMD 0402 AEC-Q200	D9_Vishay Dale	CRCW040239K0FKED
8	R6, R7, R8, R11, R25, R37, R38, R39	Resistor, Thin Film, 10k 1% 1/10W SMD 0402 AEC-Q200	Vishay/Dale	MCS0402MC1002FE000
1	R9	Resistor, Thick Film, 330R 1% 1/10W SMD 0603	Panasonic	ERJ-3EKF3300V
1	PCB1	Printed Circuit Board		04-12321-R1
1	R12	Resistor, Thick Film,160k 1% 1/10W SMD 0603	Vishay	CRCW0603160KFKEA
2	R14, R27	Resistor, Thick Film, 200k 1% 1/10W SMD 0402 AEC-Q200	Panasonic® - ECG	ERJ-2RKF2003X
4	R15, R18, R23, R40	Resistor, Thick Film, 1k 1% 1/10W SMD 0402	Panasonic - ECG	ERJ-2RKF1001X
4	R19, R20, R21, R22	Resistor, Thick Film, 4.7k 1% 1/10W SMD 0402 AEC-Q200	Panasonic - ECG	ERJ-2RKF4701X
3	R24, R32, R35	Resistor, Thick Film, 470R 1% 1/16W SMD 0402	Walsin Technology Corp.	WR04X4700FTL
2	R26, R33	Resistor, Thick Film, 100k 1% 1/10W SMD 0402 AEC-Q200	Panasonic - ECG	ERJ-2RKF1003X
1	R28	Resistor, Thick Film, 300k 1% 1/10W SMD 0402	Panasonic - ECG	ERJ-2RKF3003X
1	R29	Resistor, Thick Film, 390K 1% 1/16W SMD 0402	Yageo Corporation	RC0402FR-07390KL

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-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
1	R30	Resistor, Thin Film, 510k 1% 1/10W SMD 0402 AEC-Q200	Panasonic - ECG	ERJ-2RKF5103X
1	R31	Resistor, MF, 0.005R 1% WW SMD 2512	Bourns®, Inc.	CRE2512-FZ-R005E-3
1	R34	Resistor, Thick Film, 681k 1% 1/16W SMD 0402 AEC-Q200	Vishay/Dale	CRCW0402681KFKED
1	R36	Resistor, Thick Film, 20k 1% 1/10W SMD 0402 AEC-Q200	Panasonic - ECG	ERJ-2RKF2002X
1	SW1	Switch Rotary 8POS 24V 0.5A TH	C&K Components	RM100002BCB

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 (BOM) – MICROCHIP PARTS

Qty.	Reference	Description	Manufacturer	Part Number
1	U1	Analog Switcher Buck 2 to 24V SOT-23-6	Microchip Technology, Inc.	MCP16331T-E/CH
1	U2	Analog LDO 3.3V SOT-23A-3	Microchip Technology, Inc.	MCP1703AT-3302E/CB
1	U3	Interface USB PD Controller VQFN40	Microchip Technology, Inc.	MCP22301-2I/KYX
1	U4	Analog Current Sense AMP SOT-23-6	Microchip Technology, Inc.	MCP6C02T-100E/CHY

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-3: BILL OF MATERIALS (BOM) – DO NOT POPULATE PARTS

Qty.	Reference	Description	Manufacturer	Part Number
0	C2	Capacitor, Ceramic, 0.1 µF, 16V, 10%, X7R, SMD, 0603	Taiyo Yuden	EMK107B7104KA-T
0	R10, R16	Resistor, Thick Film, 0R <0.01R 1/5W SMD 0402	Vishay	CRCW04020000Z0EDHP

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.