

EVM User's Guide: TPS25751EVM

TPS25751 Evaluation Module



Description

The TPS25751EVM evaluation module (EVM) supports single-port USB Type-C® and Power Delivery (PD) applications. The EVM allows the user to develop various power profiles and debug existing systems for the TPS25751. The intuitive web-based GUI asks the user a few simple questions on the application requirements using clear block diagrams and simple multiple-choice questions. The GUI creates the configuration image for the user's application, reducing much of the complexity associated with competitive USB-PD designs.

Get Started

1. Order the [TPS25751EVM](#), highly integrated USB Type-C and USB PD Controller evaluation module
2. Read the TPS25751EVM user's guide
3. Start development with the [Application Customization Tool](#)
4. Refer to the [data sheet](#), [technical reference manual](#), or [E2E](#) for questions and support

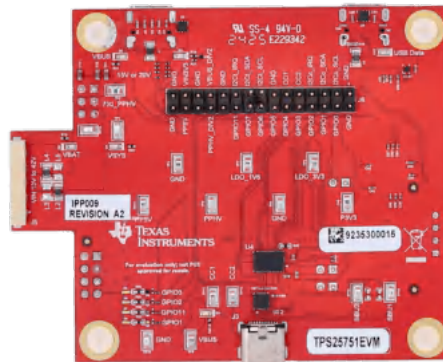
Features

- TPS25751 is certified by USB-IF for PD3.2 specification (TID# 12934)
- Up to 100W (20V/5A) source and sink applications with integrated I2C control for TI battery chargers
 - [BQ25756](#), [BQ25756E](#), [BQ25792](#), [BQ25798](#), [BQ25731](#), and [BQ25713](#)

- 100W (20V/5A) source and 100W (20V/5A) sink with BQ25756(E)EVM for 1S-14(7)S battery applications
- 45W (20V/2.25A) source and 60W (20V/3A) sink with BQ25792/8EVM for 1S-4S battery applications
- 100W (20V/5A) source and 100W (20V/5A) sink with BQ25731EVM for 1S-5S battery applications
- 60W (20V/3A) source and 60W (20V/3A) sink with BQ25713EVM for 1S-4S battery applications
- Easy-to-use GUI with pre-configured firmware to enable features such as:
 - Programmable Power Supply (PPS) for source and sink within 5V–21V range
 - Liquid detection and corrosion mitigation measurable on SBU1 and SBU2
 - Enabling BC1.2 for proprietary and legacy charging
 - Automatic Vendor Info File (VIF) generation for USB Power-Delivery Compliance

Applications

- [Battery pack for cordless power tool, power bank, retail automation and payment](#)
- [Wireless speakers, cordless vacuum cleaner](#)
- [Personal or portable electronics, industrial applications](#)
- [Medical applications, personal care and fitness](#)



TPS25751EVM

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1 Evaluation Module Overview

1.1 Introduction

The TPS25751EVM allows for evaluation of the TPS25751 integrated circuit (IC) as part of a stand-alone testing kit and USB Type-C and Power Delivery (PD) products. The TPS25751 is a highly integrated stand-alone USB Type-C® and Power Delivery (PD) controller optimized for applications supporting USB-C PD power. The TPS25751 integrates managed power paths with robust protection for a complete USB-C PD design. The TPS25751 also integrates control for external battery charger ICs for added ease of use and reduced time to market. This document is the user's guide for the TPS25751 Evaluation Module (TPS25751EVM).

The following is a continuation of the features list:

- Multiple test points and headers for quick and easy debug
 - Exposed VBUS and CCx test points to monitor PD traffic
 - PP5V and PPHV test points to measure voltage transitions

1.2 Kit Contents

- TPS25751EVM
- Ribbon Cable
- EVM Disclaimer Read Me

1.3 Specification

Figure 1-1 shows the block diagram.

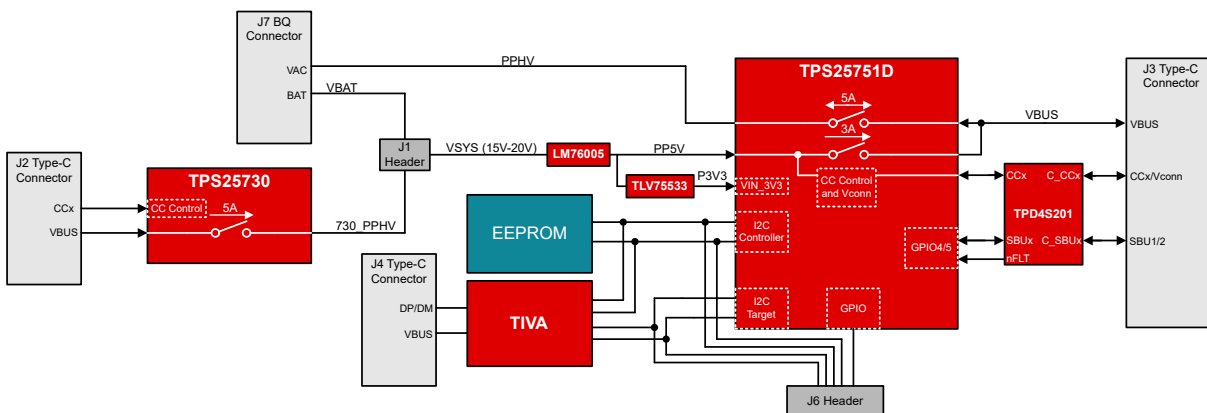


Figure 1-1. TPS25751EVM Block Level Diagram

1.4 Device Information

The TPS25751D is a single-port, USB Type-C PD controller with integrated bidirectional high-voltage power paths for power-only applications. The TPS25751EVM is used to evaluate the functionally equivalent TPS25751S (external high-voltage power path) version of the TPS25751 PD controller. The TPS25751 PD controller is an excellent choice for single port power applications operating in the Standard Power Range (SPR) for Dual Role Power (DRP) applications up to 100W (20V/5A).

The TPS25751EVM includes several devices for complete evaluation of voltage protection, power topology, and an additional TPS25730D PD controller for barrel-jack replacement. For more details on each device on the TPS25751EVM see [Table 1-1](#).

The TPS25751 PD controller is configurable through the Web-based GUI for application specific requirements, architectures, and power roles and data roles. The GUI tool provides additional optional firmware configuration to integrate control for selected Battery Charger Products ([BQ25756](#), [BQ25756E](#), [BQ25792](#), [BQ25798](#), [BQ25731](#), and [BQ25713](#)). For more information on BQ configuration, see [Section 4.3](#).

Table 1-1. Devices on TPS25751EVM

Designator	Device Name	Description
U1	TPS25730	USB Type-C sink-only PD controller, DC barrel jack replacement
U2, U3	TVS2200	22V flat-clamp surge protection device
U4	TPS25751	USB Type-C PD controller
U5	CAT24C256	EEPROM Serial 256-Kb (32-KB) I2C
U6	TPD2E009	Dual ESD protection diode with 5A surge rating
U7	TM4C123GH6PM	TIVA MCU, used in conjunction with GUI to flash the EVM
U8, U11	TLV75533	Low-dropout voltage regulator for 3.3V (P3V3)
U9	TVS0500	5V precision surge protection clamp
U10	LM76005	Synchronous step-down converter for 5V (PP5V)
U12	TPD4S201	USB Type-C Short-to-VBUS and ESD protection for CC and SBU lines. Used for liquid detection.

2 Hardware

2.1 Power Requirements

For standalone PD evaluation, the main power supply for the TPS25751EVM is through the Type-C Sink only port (J2), which accepts 45W Type-C PD Source (15V to 20V). If the Type-C adapter is not capable of minimum 15V, then the TPS25751EVM does not power on properly. Alternatively, the EVM can also be powered on from an external bench supply connected to VSYS test point (TP19), with the bench supply providing 15V-20V range.

Note

VSYS (TP4) has an absolute maximum rating of 48V with recommended maximum of 42V. Applying more than the maximum voltage can cause damage to the EVM.

The TPS25751EVM can also be powered directly through Type-C Connector (J3) to simulate the TPS25751 in a dead battery scenario. When the TPS25751EVM is powered only through port J3, the EVM acts as sink only (unable to source unless VSYS is powered on).

For battery charging application, the selected BQ EVM can be used to power on the TPS25751EVM. The BQ25756EVM comes with a interfacing connector to connect to J7 connector on the TPS25751EVM. If a BQ Battery Charger is connected, the VBUS side of the BQ Battery Charger is connected to the internal high-voltage bidirectional power path (PPHV) of the TPS25751EVM. For more information on setting up and programming TPS25751 for battery charger application refer to [Section 4.3](#).

2.2 Setup

Out of the box, the TPS25751EVM is configured for 15W (5V/3A) source and 100W (20V/5A) sink power. When different configurations are required, use the [Application Customization Tool](#) to create a configuration or load a different configuration template. Refer to [Section 3](#) for detailed instructions on using the Application Customization Tool.

2.3 Header Information

J6 header contains numerous pinout from TPS25751 for testing, evaluation, and debugging purposes. The header pins are clearly labeled on the top layer of the TPS25751EVM for easy access, for details see [Table 2-1](#). Pin 1 is indicated by a white circle, see [Figure 2-1](#) for reference.

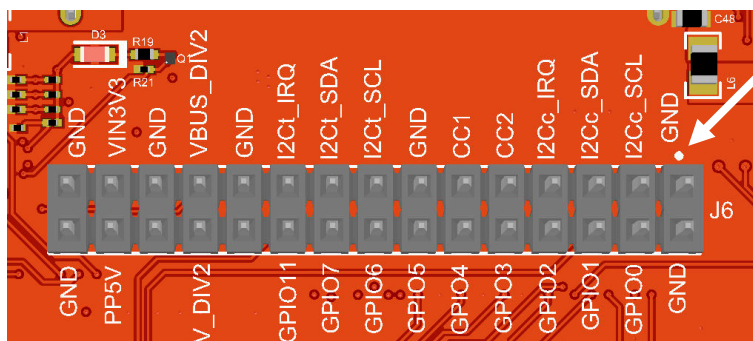


Figure 2-1. J6 Header

Table 2-1. J6 Header Pinout

Pin Number	Pin Label	Description
1	GND	Ground reference for EVM
2	GND	Ground reference for EVM
3	I2Cc_SCL	I2C controller clock line of TPS25751
4	GPIO0	GPIO0 of TPS25751
5	I2Cc_SDA	I2C controller data line of TPS25751
6	GPIO1	GPIO1 of TPS25751
7	I2Cc_IRQ	I2C controller interrupt line of TPS25751. This can also be reconfigured to GPIO12.
8	GPIO2	GPIO2 of TPS25751
9	751_CC2	CC2 pin of J3 Type-C port, used for PD negotiation. This can be VCONN or CC depending on the polarity flip of the USB Type-C cable.
10	GPIO3	GPIO3 of TPS25751
11	751_CC1	CC1 pin of J3 Type-C port, used for PD negotiation. This can be VCONN or CC depending on the polarity flip of the USB Type-C cable.
12	GPIO4	GPIO4 of TPS25751
13	GND	Ground reference for EVM
14	GPIO5	GPIO5 of TPS25751
15	I2Ct_SCL	I2C target clock line of TPS25751
16	GPIO6	GPIO6 of TPS25751
17	I2Ct_SDA	I2C target data line of TPS25751
18	GPIO7	GPIO11 of TPS25751
19	I2Ct_IRQ	I2C target interrupt line of TPS25751. This can also be reconfigured to GPIO10.
20	GPIO11	GPIO11 of TPS25751
21	GND	Ground reference for EVM
22	NC	No connection, do not use
23	VBUS_DIV2	Resistor divider output of VBUS line between TPS25751 and J3 Type-C port. This output pin halves the voltage of VBUS for digital scopes. For example, when VBUS is at 20V, pin 23 is measured at 10V.
24	PPHV_DIV2	Resistor divider output of PPHV pin from TPS25751. This output pin halves the voltage of PPHV for digital scopes. For example when PPHV is at 20V, pin 24 is measured at 10V.
25	GND	Ground reference for EVM
26	NC	No connection, do not use
27	VIN3V3	3.3V supply connected to VIN_3V3 of TPS25751
28	PP5V	5V supply connected to PP5V of TPS25751
29	GND	Ground reference for EVM
30	GND	Ground reference for EVM

Note

Rev A2 added PPHV_DIV2 capability, this is not included on Rev A1 EVM hardware.

2.4 Jumper Information

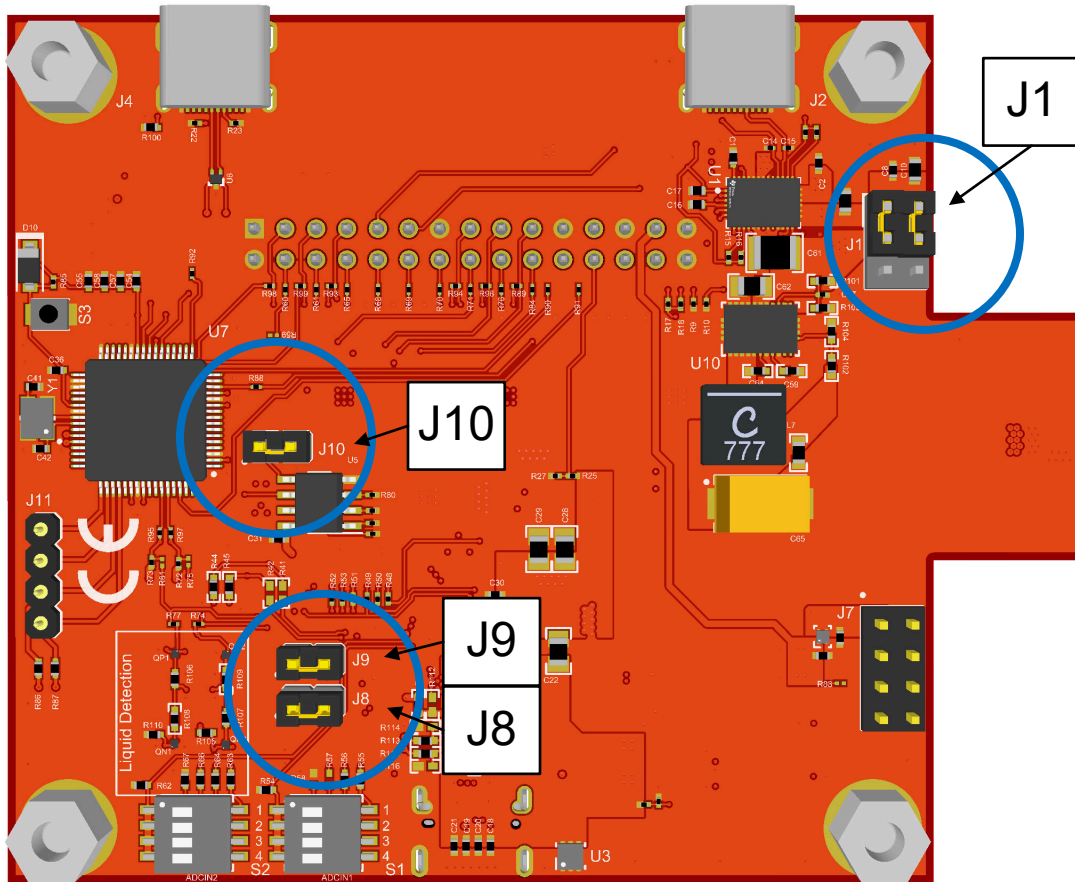


Figure 2-2. Jumper Locations

Table 2-2. Jumper Descriptions

Jumper Designator	Description
J1	Power selector between VBAT and 730_PPHV to board system power (VSYS), see Figure 4-2 .
J8	3.3V input to VIN_3V3 on TPS25751. Remove jumper to disconnect 3.3V power to TPS25751 to simulate dead-battery mode.
J9	3.3V output from LDO_3V3 on TPS25751. Remove jumper to disconnect 3.3V power to the onboard EEPROM. This also disconnects the 3.3V pullup on the I2Cc and I2Ct lines.
J10	I2Cc data line between TPS25751 and EEPROM, remove jumper to disable I2C flash.

Note

Rev A1 and Rev A2 have slight differences in the jumper designator. Make sure to double check the EVM hardware revision when referring to [Table 2-2](#).

2.5 LED Information

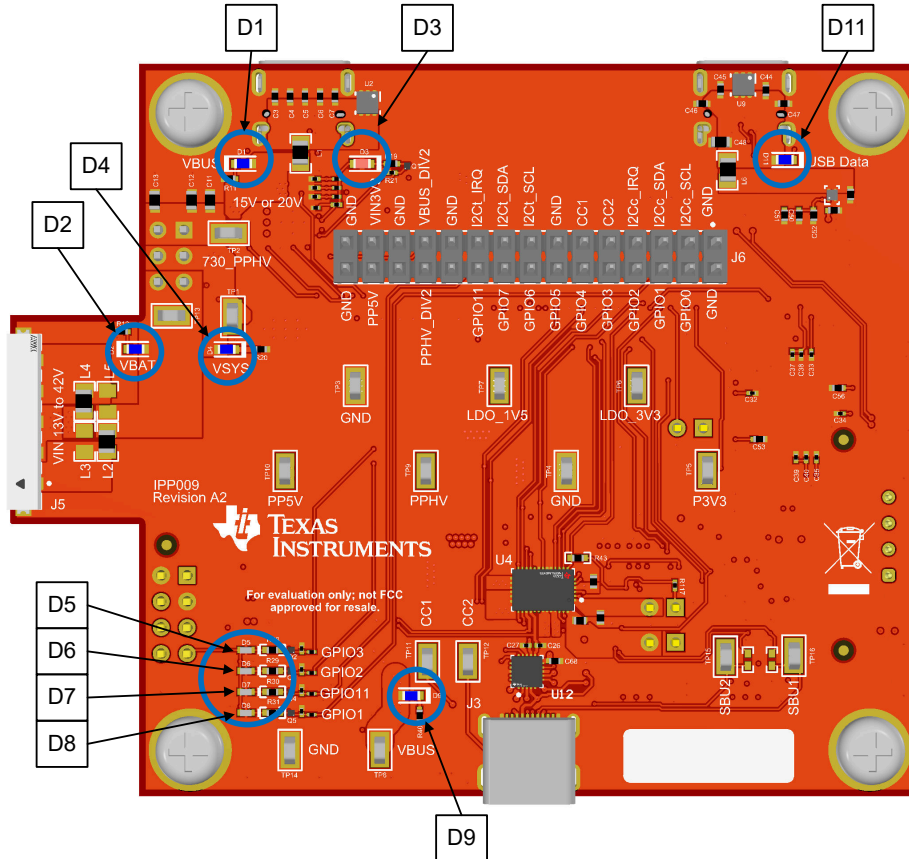


Figure 2-3. LED Locations

Table 2-3. LEDs

Designator	Net Label	Description
D1	730_VBUS	Blue LED that shows when USB Type-C is connected to sink only Type-C port (J2)
D2	VBAT	Blue LED that shows when BQ battery is connected to VBAT
D3	730_Cap_Mismatch	Red LED that shows capability mismatch when an attached source is not providing enough power to the sink only Type-C port (J2)
D4	VSYS	Blue LED that shows when VBAT or 730_PPHV is supplying system power (VSYS)
D5	GPIO3	White LED that shows GPIO3 is high
D6	GPIO2	White LED that shows GPIO2 is high, connected to TPD4S201 FLT signal to indicate OVP fault when LED is low
D7	GPIO11	White LED that shows GPIO11 is high
D8	GPIO 1	White LED that shows GPIO1 is high
D9	751_VBUS	Blue LED that shows when VBUS has a voltage of 5V through 20V
D11	USB_Data	Blue LED that shows when USB Type-C is connected to data Type-C port (J4).

Note

Rev A1 and Rev A2 have slight differences in the LED designator. Make sure to double check the EVM hardware revision when referring to [Table 2-3](#).

2.6 Test Points

Table 2-4. Test Points

Designator	Label	Description
TP1	VSYS	System power of TPS25751EVM, feeds into 5V and 3.3V power rail.
TP2	730_PPHV	TPS25730 high-voltage sinking node in the system, can be connected to VSYS to provided system power through J1.
TP3, TP4	GND	Ground reference for EVM.
TP5	P3V3	3.3V system supply to VIN_3V3 of TPS25751.
TP6	LDO_3V3	3.3V output supply from TPS25751 LDO_3V3 pin, switched from VIN_3V3 or VBUS LDO.
TP7	LDO_1V5	1.5V output of the CORE LDO.
TP8	VBUS	TPS25751 VBUS voltage reference.
TP9	PPHV	TPS25751 high-voltage bidirectional node in the system.
TP10	PP5V	TPS25751 5V system supply to VBUS, supply for CCy pins as VCONN.
TP11	CC1	CC1 pin between J3 Type-C Port and TPD4S201, used for PD negotiation. This can be VCONN or CC depending on the polarity flip of the USB Type-C cable.
TP12	CC2	CC2 pin between J3 Type-C Port and TPD4S201, used for PD negotiation. This can be VCONN or CC depending on the polarity flip of the USB Type-C cable.
TP13	VBAT	Battery voltage reference, can be connected to VSYS to provide system power through J1.
TP14	GND	Ground reference for EVM.
TP15	SBU2	SBU2 pin of J3 Type-C Port, used for liquid detection.
TP16	SBU1	SBU1 pin of J3 Type-C Port, used for liquid detection.

Note

Rev A1 and Rev A2 have slight differences in the Test Point designator. Make sure to double check the EVM hardware revision when referring to [Table 2-4](#).

2.7 Switches and Push-Buttons

Table 2-5. Switches and Push-Buttons

Designator	Label	Description
S1	ADCIN1	Switch used to set the resistor divider for ADCIN1. See the TPS25751 data sheet (SLVSH93) on how to configure the pin-strapping.
S2	ADCIN2	Switch used to set the resistor divider for ADCIN2. See the TPS25751 data sheet (SLVSH93) on how to configure the pin-strapping.
S3	T_RST	Push-button to pull the RST pin (38) of the TIVA device. When pressed, the RST pin goes low.

3 Software

3.1 Software Description

The required software is available at the [TI Gallery](#), and is run from the web browser, provided that Google Chrome™, Firefox®, or Safari® is used. If this is desired, then TI Cloud Agent needs to be installed as a browser extension as well as on the PC. When the application is launched, instructions appear for installing TI Cloud Agent. The software can also be run natively on the PC. If this is desired, then GUI Composer Runtime needs to be installed natively. To install GUI Composer Runtime, click on the downwards-facing arrow inside one of the applications listed in the Gallery, and look towards the bottom set of links that appear. After selecting the native operating system, open the installer and follow the prompts to install the program.

3.1.1 Software Installation

The tool can be launched either through a web browser or as a native application.

3.1.2 Web Browser

1. Navigate to [Developer Gallery](#).
2. Search for the USBCPD Application Customization Tool in the Gallery.
3. Once found, click on the card that has the correct tool.
4. A new tab opens with the application launched. If TI Cloud Agent is not already installed, then instructions appear for installing the required software.

3.1.3 Native Application

1. Navigate to [Developer Gallery](#).
2. Search for the USBCPD Application Customization Tool in the Gallery.
3. Once found, click on the downwards-facing arrow on the bottom left side of the card, and look towards the top set of links that appear. Select the native operating system and open the installer. See figure below for the download button.

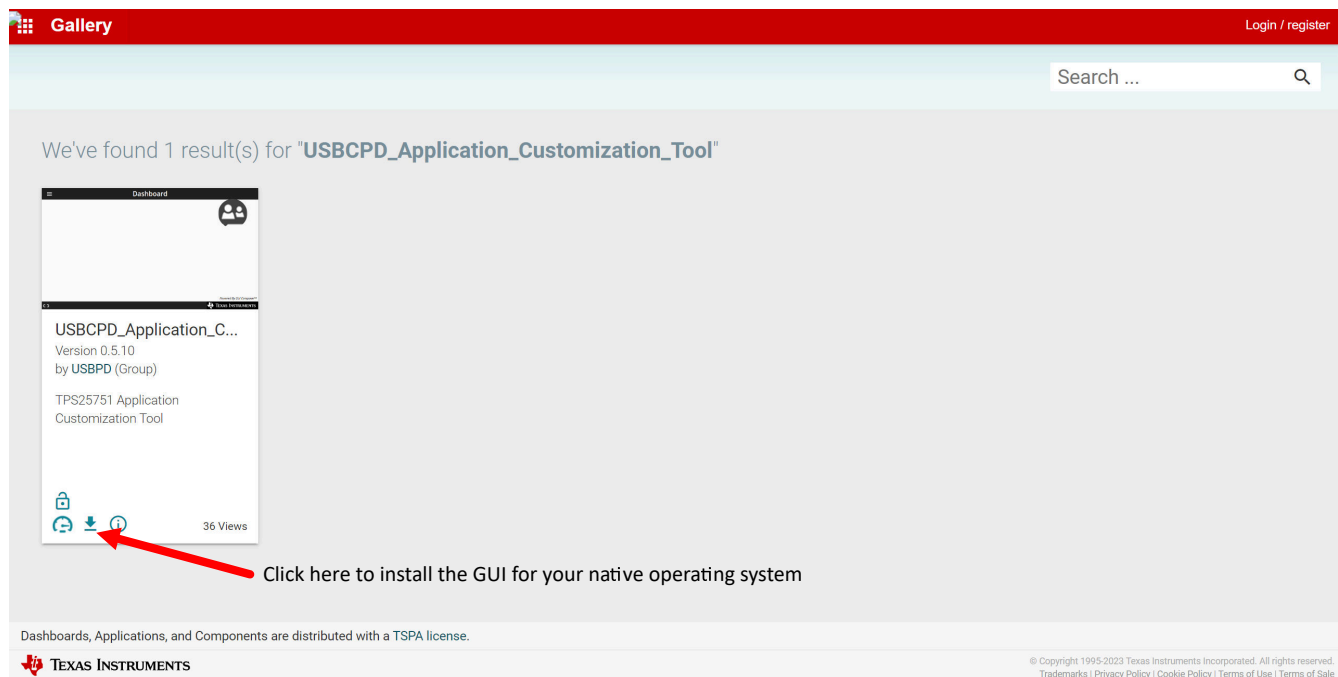


Figure 3-1. Application Customization Tool Download

4. Once the installer is open, follow the directions to install the application.

3.2 Software Development

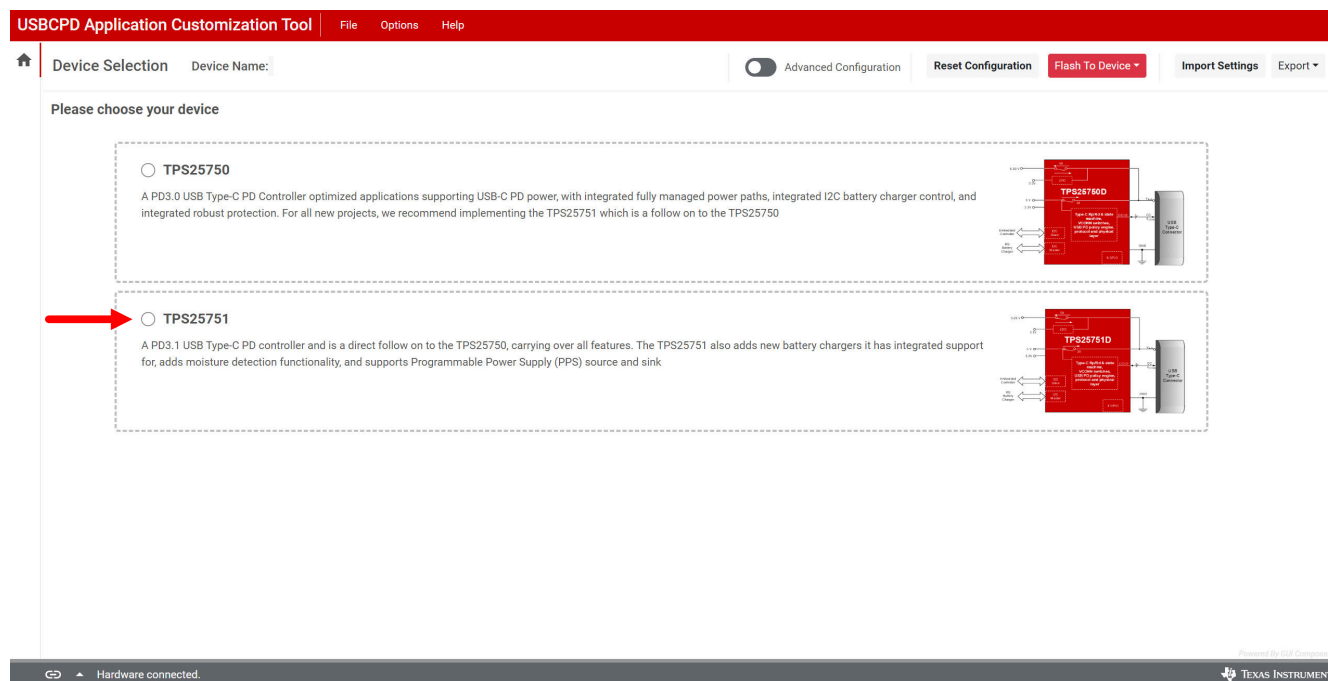
The TPS25751 Application Customization Tool provides users with the following capabilities:

- Generate new configuration settings.
- Load configuration settings to a device
- Save configuration settings in JSON format.
- Export configuration settings in Binary and C format.
- Export Vendor Info File (VIF) based on configuration settings.

3.3 Using the TPS25751 Application Customization Tool

3.3.1 Default View

After launching the Application Customization Tool, a page appears with device selections for TPS25750 and TPS25751. Select TPS25751 to start configuring.



3.3.2 Selecting a Configuration

The first question of the GUI asks to select a configuration the TPS25751 is used for. The ten configurations are separated into three main categories: Power Source (provider) and Power Sink (consumer), Power Sink (consumer) only, and Power Source (consumer) only. When choosing a configuration, check to make sure which variant is selected. Based on the configuration selected, certain questions are disabled. See Figure 3-2 and Table 3-1 for a breakdown of each configuration.

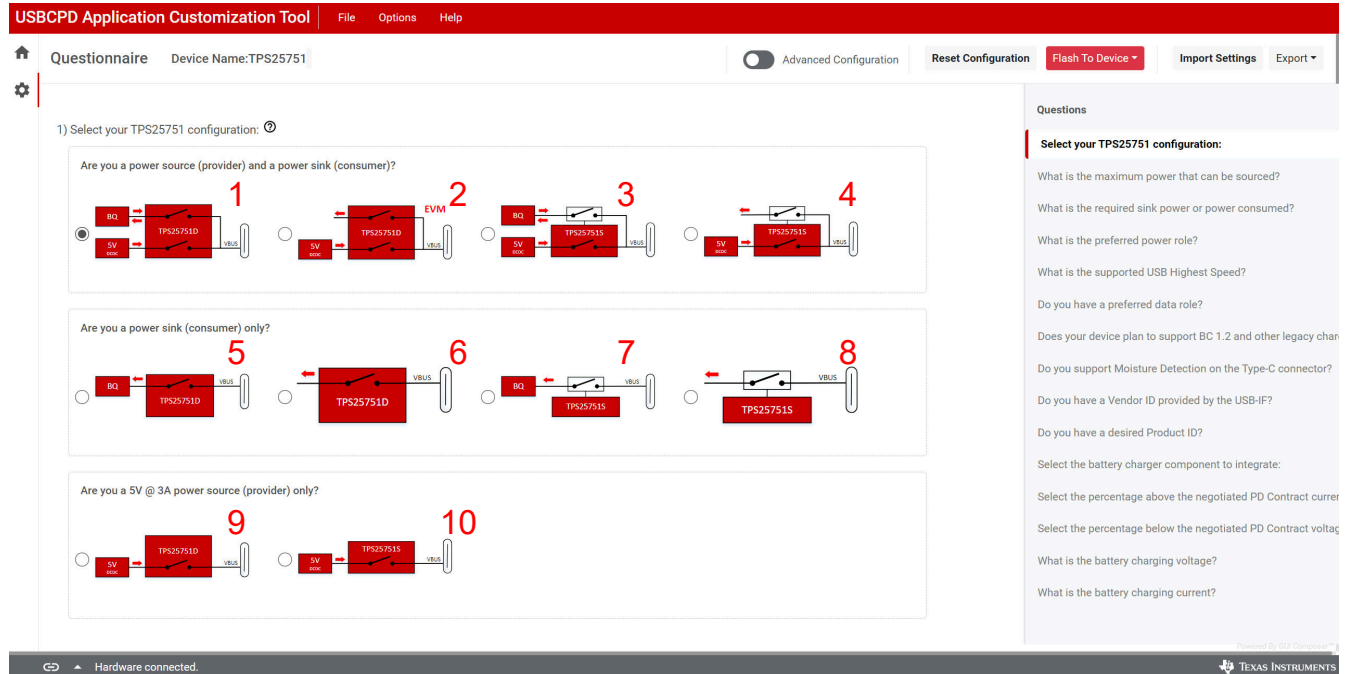


Figure 3-2. Application Customization Tool Configuration

Table 3-1. TPS25751 Configuration

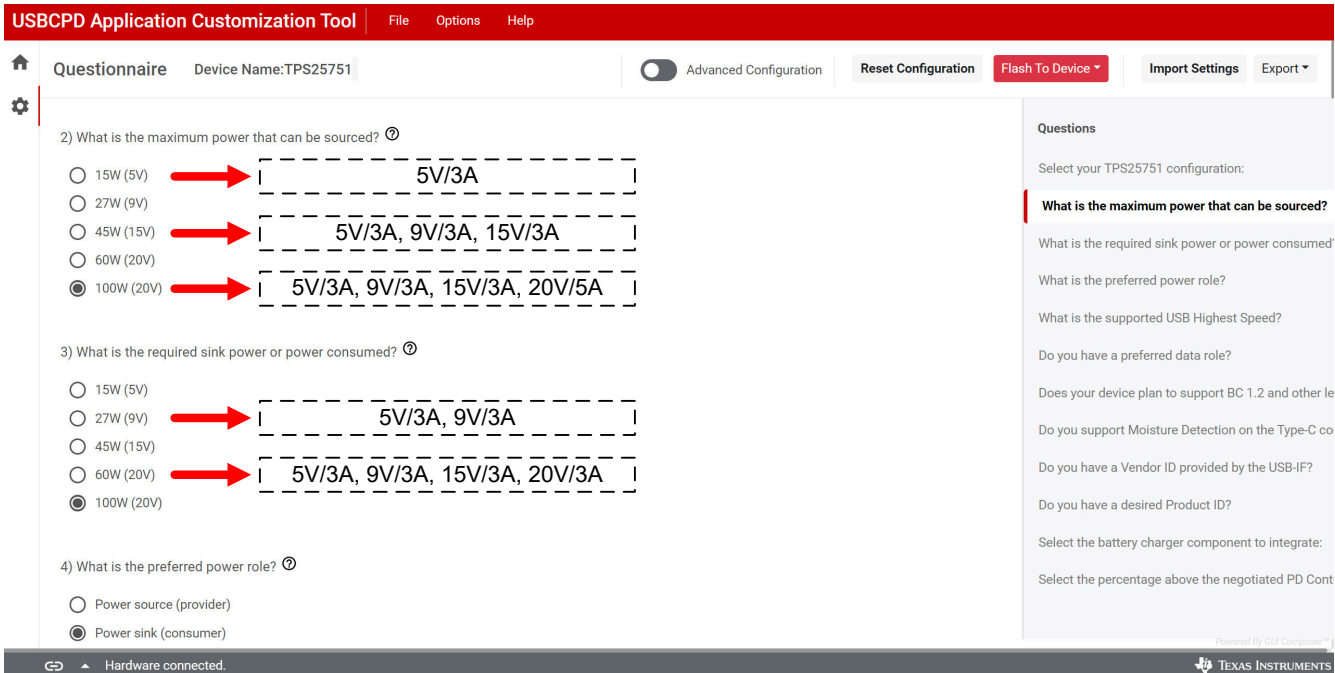
Configuration Index	Device Variation	Power Role	BQ Support	Power Path for Source PDO 1 [9:8]
1	D	Source and Sink (DRP)	Yes	PP3
2	D	Source and Sink (DRP)	No	PP1
3	S	Source and Sink (DRP)	Yes	PP3
4	S	Source and Sink (DRP)	No	PP1
5	D	Sink Only	Yes	N/A
6	D	Sink Only	No	N/A
7	S	Sink Only	Yes	N/A
8	S	Sink Only	No	N/A
9	D	Source Only	No	PP1
10	S	Source Only	No	PP1

3.3.3 Filling Out the Questionnaire

After selecting the TPS25751 configuration, continue to fill out the remaining questions to flash or generate a full configuration. Based on the selection for Question 1, some of the remaining questions can be unavailable for selection.

Questions 2 through 4 asks for the maximum power that is sourced or sunk. If a source-only configuration is selected in Question 1, then Question 3 is not available to select. If a sink-only configuration is selected, then Question 2 is not available to select. Question 4 determines the power role preference of TPS25751, this question is only available if the system is DRP (Dual Role Power).

When selecting the maximum power that can be sourced or sink, this configures the Transmit Source Capabilities (0x32) and Transmit Sink Capabilities (0x33) register of TPS25751 by adding default Source/Sink PDOs. The voltage and current rating applies for both Source and Sink PDOs. See the figure below for the default configuration.



Question 5 asks for the supported USB speed. Based on the selection, this determines what USB speed is enumerated during PD negotiation. If USB data is not required, then select *No USB data is being used*.

Question 6 asks for the preferred data role. Based on the selection, this determines the data role (UFP, DFP, or DRP) TPS25751 is configured for. If there is no preference, then select *No*.

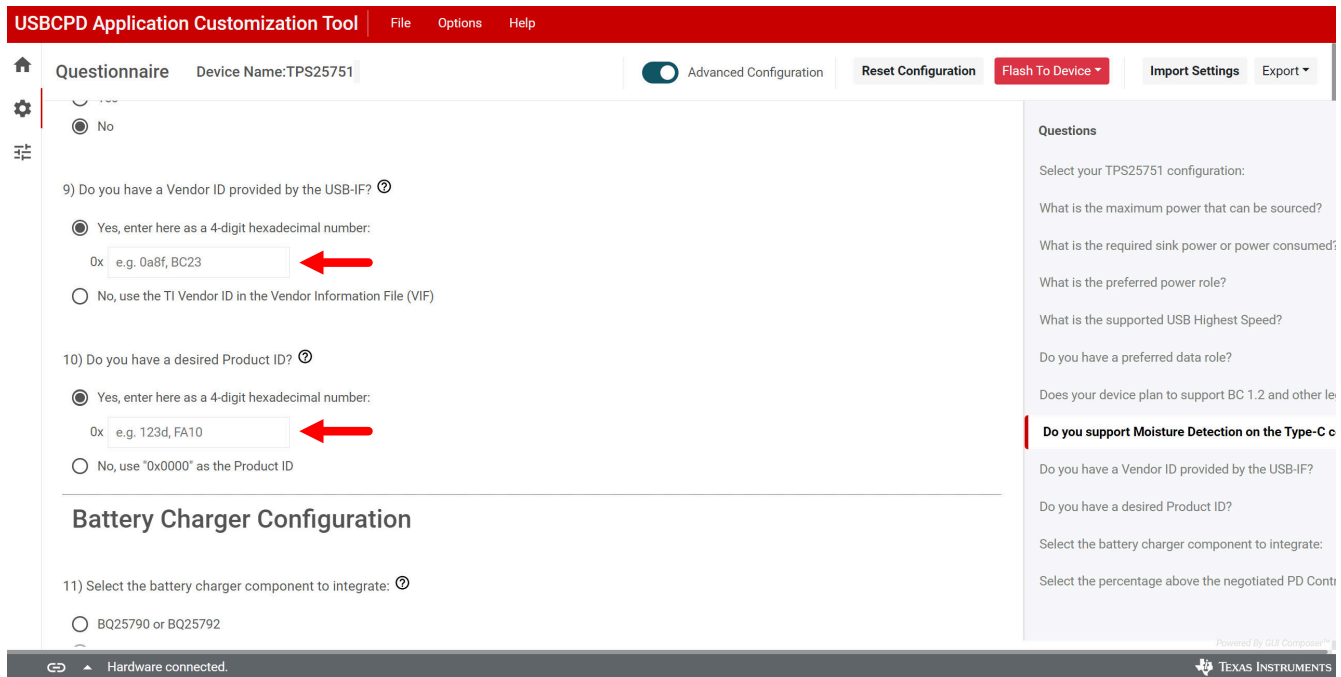
Question 7 asks for BC1.2 and legacy charging support. Based on the selection, TPS25751 can enumerate different BC1.2 charging schemes. Refer to the TPS25751 data sheet for more details.

Question 8 asks for Liquid Detection support. This is a new feature of TPS25751 based on the Type-C specifications for Liquid Detection and Corrosion Mitigation. Refer to [Section 4.4](#) for more details.

Note

TPS25751 is not able to support BC1.2 and Liquid Detection simultaneously since both features utilize the same GPIO pins.

Questions 9 and 10 asks for the Vendor ID and the desired Product ID respectively. The Vendor ID is given by the USB-IF and the Product ID is simply a configuration identifier. Select *Yes* option to enter 4-digit hexadecimal number, otherwise select *No*.



Questions 11 through 18 corresponds to configuring the selected BQ (Battery Charger) device if applicable. These questions are only available for filling in if a BQ configuration is selected in the first question. For all other non-BQ configuration (TPS25751 only), these questions are disabled. Refer to [Section 4.3](#) section for more details on each questionnaire and the applications.

3.3.4 Advanced Configuration Mode

To configure additional fields and registers such as I2C Interrupt Masking, GPIO events, or making custom changes to Source/Sink PDOs, click on the *Advanced Configuration* slider at the top of the tool. After clicking on the slider, a message appears asking for confirmation before enabling *Advanced Configuration*.

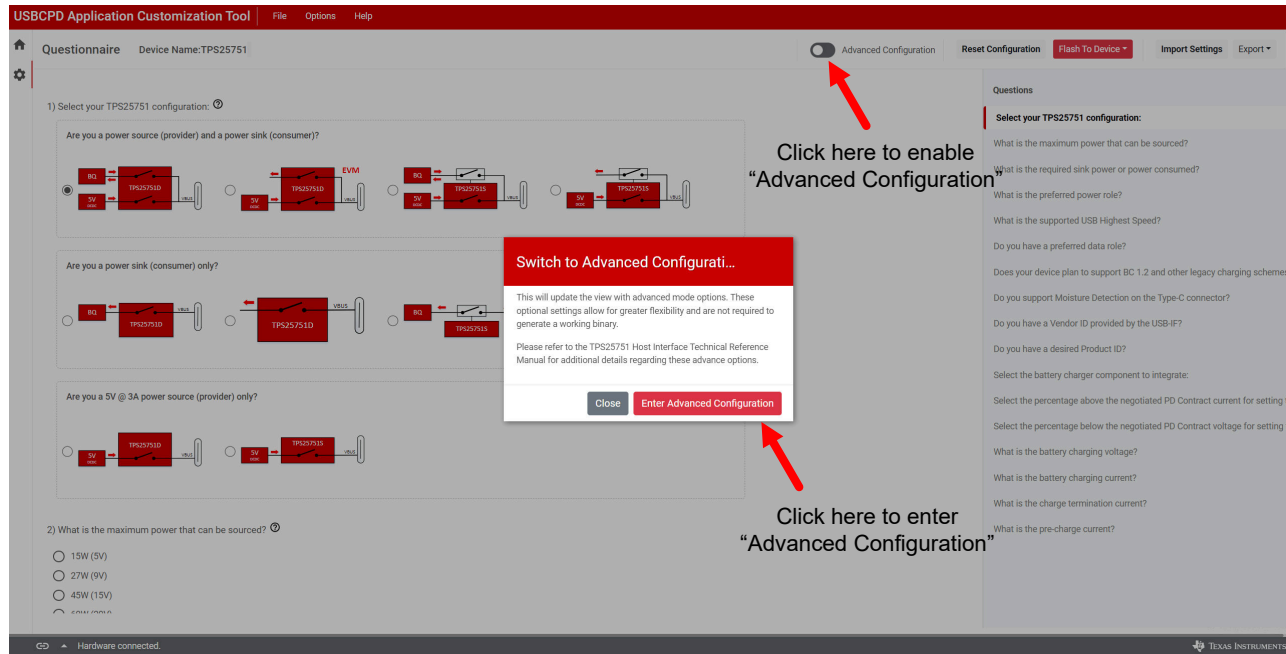


Figure 3-3. Enabling Advanced Configuration

Once Advanced Configuration is enabled, an Advanced Icon appears on the left side underneath the gear icon to go back to the questionnaire. Within Advanced Configuration, users have the ability to configure most available registers on the TPS25751. For details on register fields and the description, refer to the [TPS25751 Technical Reference Manual](#). See the example below of configuring the Source_PDO_4 under Transmit Source Capabilities (0x32).

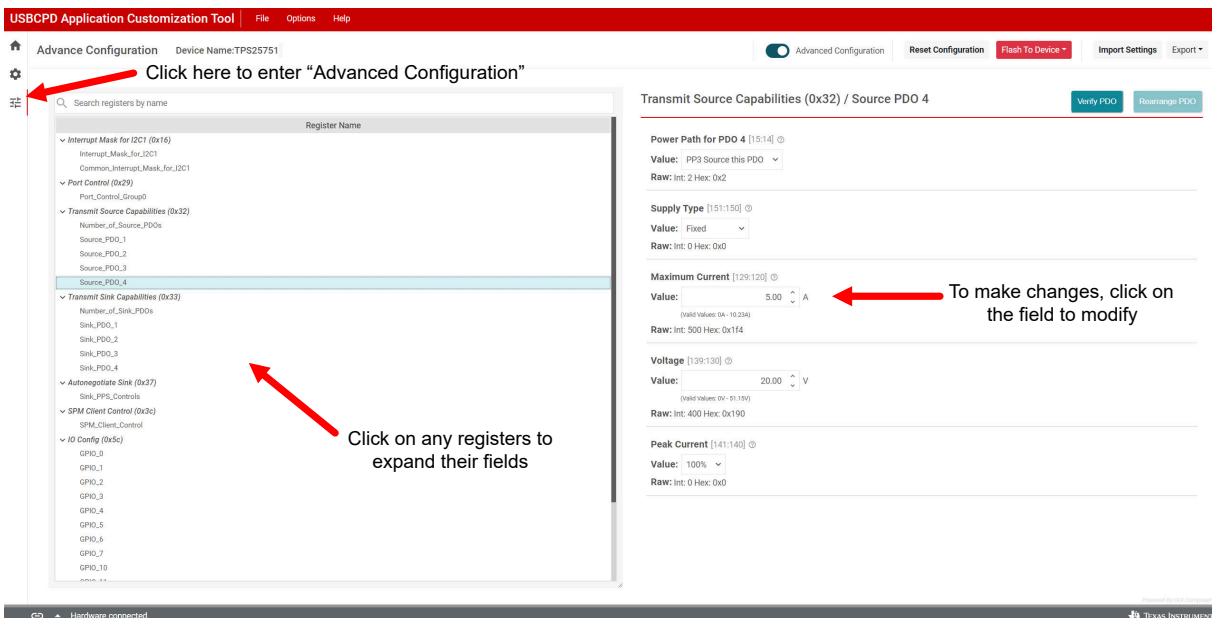


Figure 3-4. Using Advanced Configuration

3.3.5 Flashing Configuration onto EVM

The Application Customization Tool is used to directly load a configuration onto the TPS25751EVM. Connect J4 Type-C connector with a cable (both USB-A to USB-C or USB-C to USB-C® cables work) to a laptop or computer with the Application Customization Tool open. Make sure the TPS25751EVM is properly powered either through J2 Type-C connector to a 15V-20V Type-C adapter or with a bench power supply. See the figure below for reference.

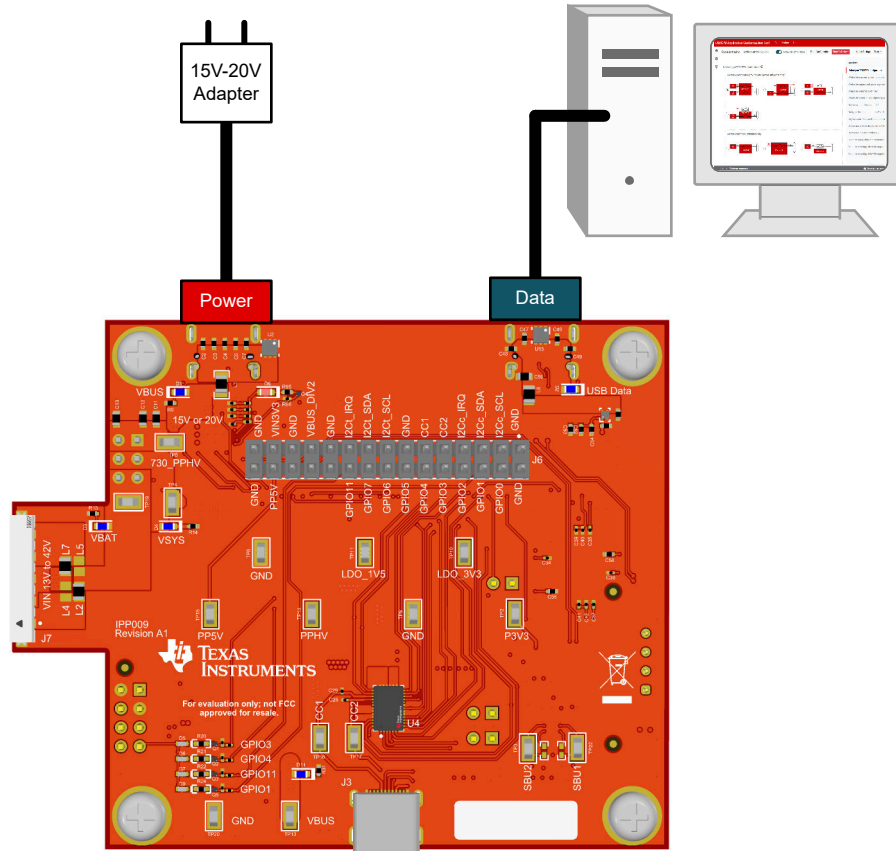


Figure 3-5. TPS25751EVM Connection with PC

Note

When flashing a configuration onto TPS25751EVM, connect the TPS25751EVM with a power source such as a PD adapter or bench power supply. For evaluation battery charging applications with the BQ257xxEVM, connect the BQ EVM after the TPS25751EVM has a proper configuration loaded.

Open the Application Customization Tool and complete the questionnaire, refer to [Section 3.3.3](#) for details on each question. Once the questionnaire is complete and the TPS25751EVM is connected properly, click on Options → Serial Port Configuration to make sure the correct COM port is selected. See the figure below for reference.

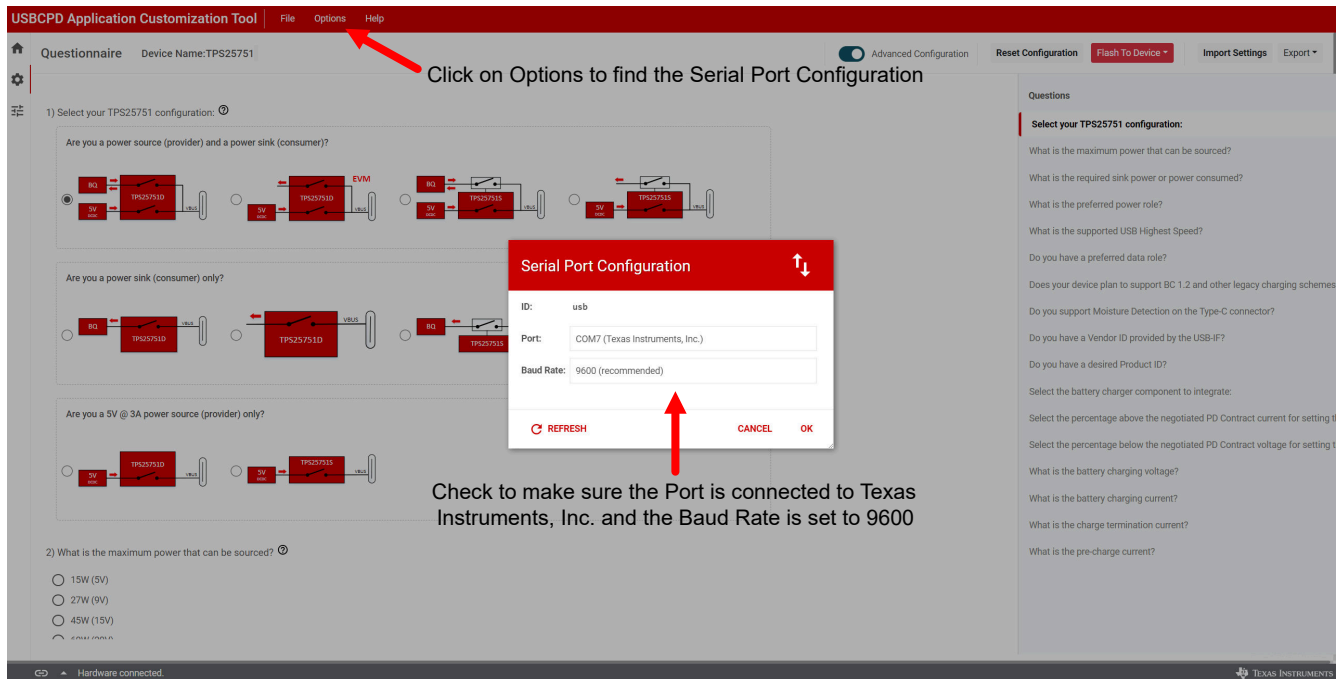
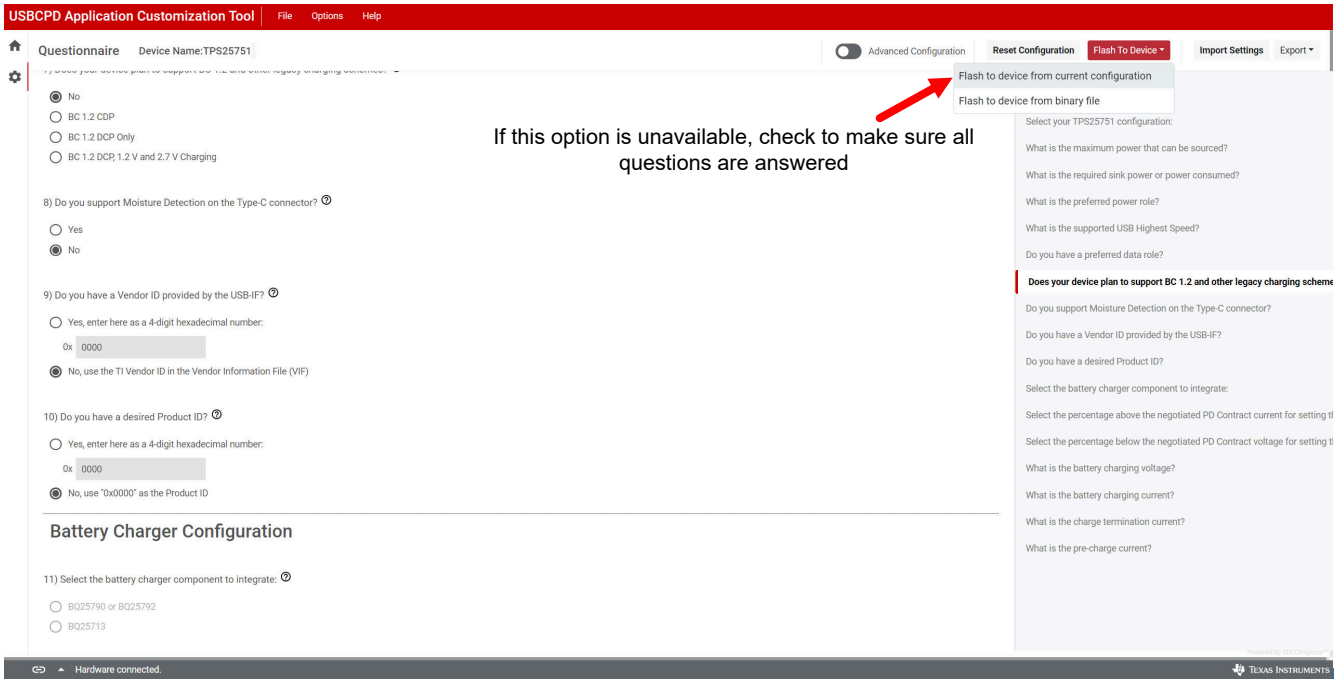


Figure 3-6. Serial Port Configuration Settings

If the TPS25751EVM is unable to connect to the Application Customization Tool, then go through the following debug recommendations:

1. Make sure the cable connecting the computer to the TPS25751EVM supports data.
2. Make sure the power source (whether it's from a Type-C adapter or bench power supply) is supplying 15V-20V. TPS25751EVM cannot power on properly if the power source is less than 15V.
3. Make sure only one tab of the Application Customization Tool is running at any given time. Multiple tools running simultaneously can cause communication issues.

Once the questionnaires are completed and the TPS25751EVM is connected to the Application Customization Tool, click on Flash To Device → Flash to device from current configuration.



If this option is unavailable, check to make sure all questions are answered

Figure 3-7. Flash to Device from Current Configuration

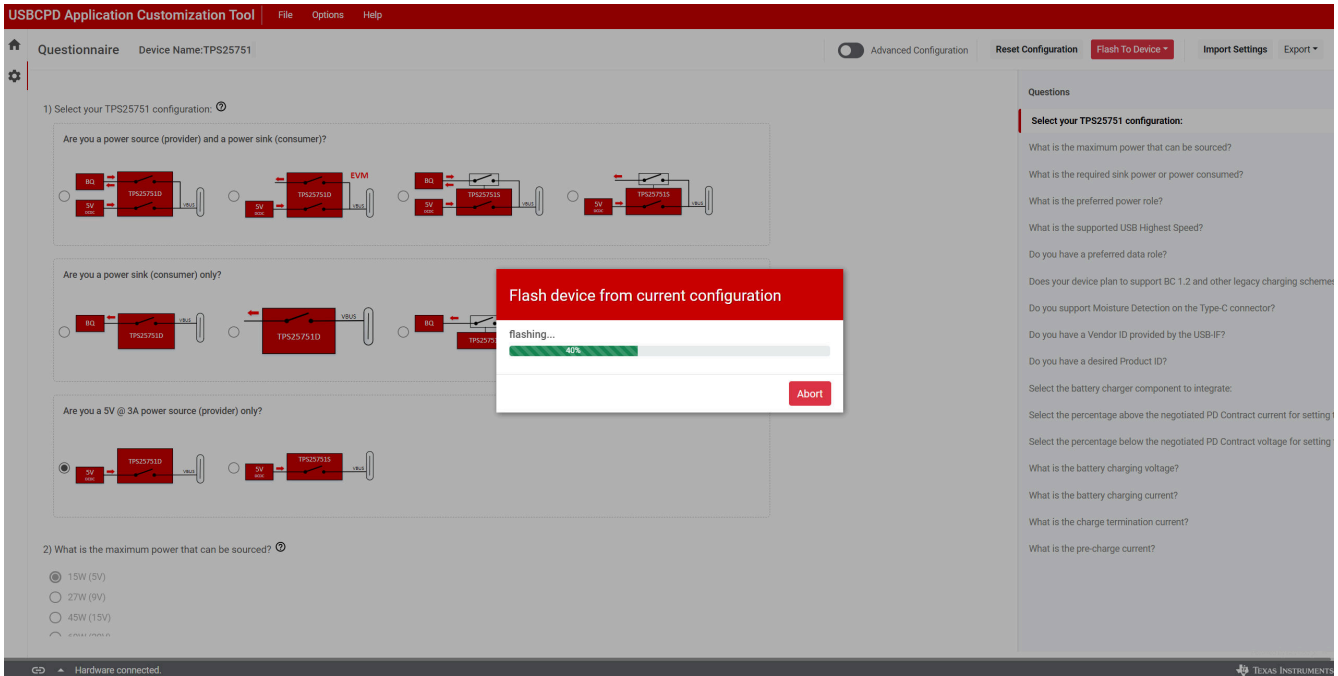


Figure 3-8. Flash to Device from Current Configuration

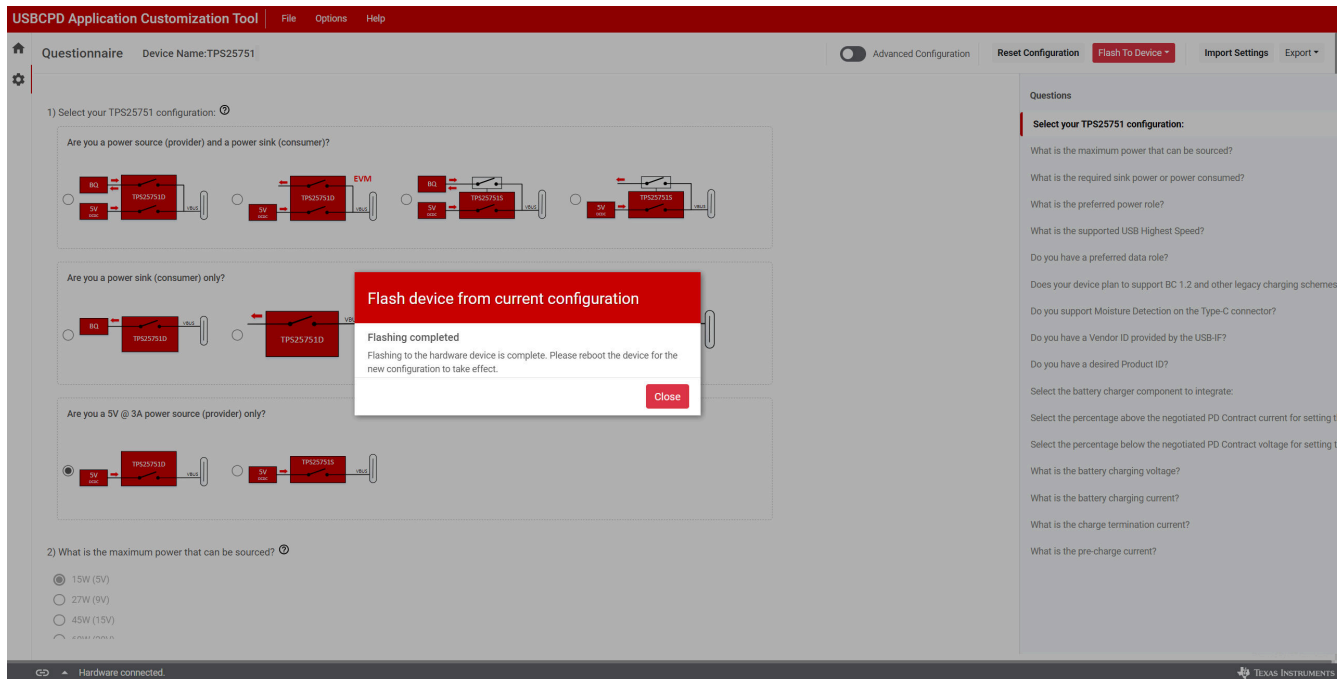


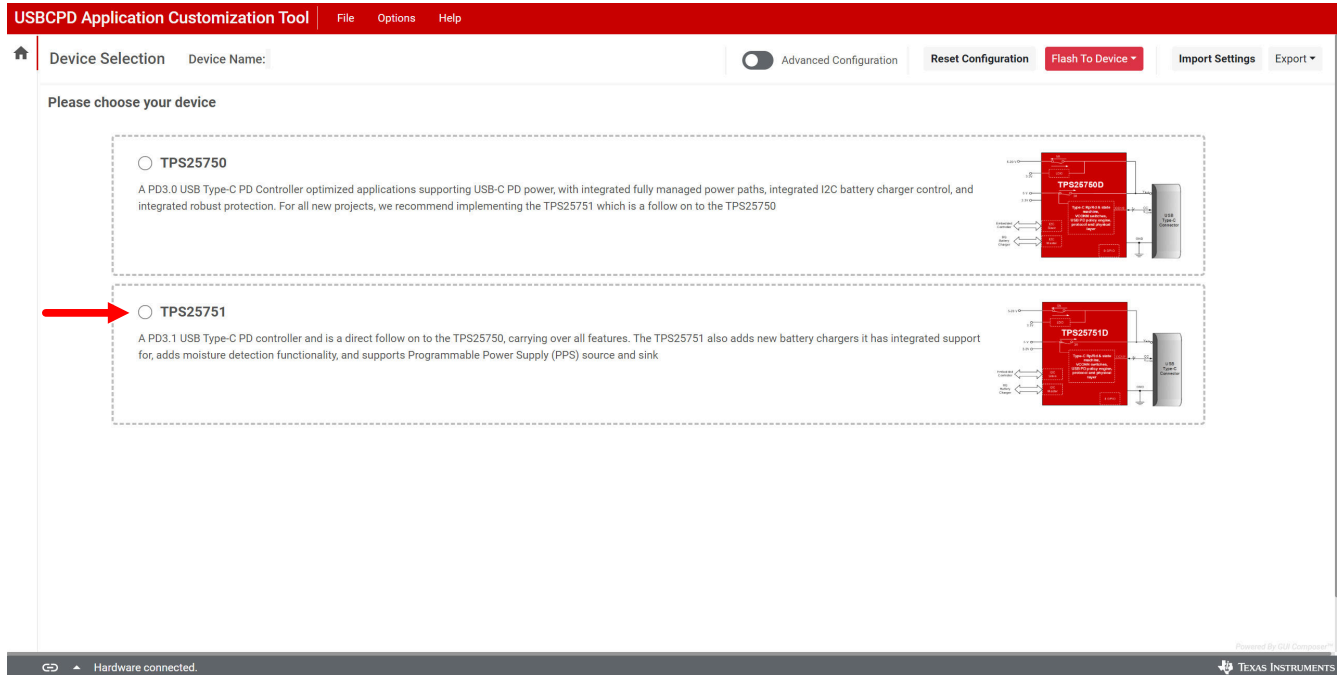
Figure 3-9. Flash to Device from Current Configuration

Note

When the tool is flashing the configuration, DO NOT connect or disconnect any cables on the TPS25751EVM. Connecting or disconnecting any cables can cause errors when flashing.

3.3.6 Additional Settings

The Application Customization Tool includes additional settings for creating new configurations, exporting and importing settings, generating binaries and VIF files. To start, select TPS25751 to start configuring, refer to [Section 3.3.3](#).



3.3.6.1 Generating a New Configuration

To generate a new customization configuration for the TPS25751 device, click the *Reset Configuration* button on the top right side of the tool (this is next to the *Flash To Device* drop-down menu). This button erases the existing configuration and resetting the form back to the default settings. TI recommends to export the existing form first so that the existing configuration is not lost. Refer to [Section 3.3.6.2](#) for details on how to save configurations.

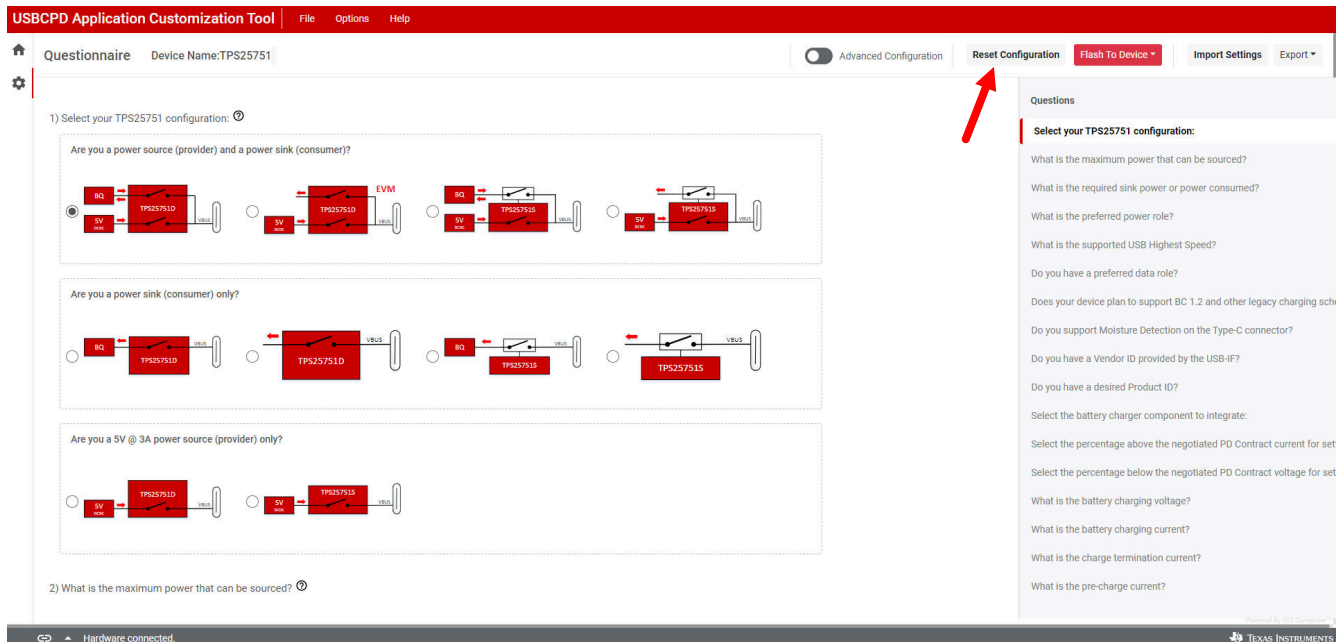


Figure 3-10. Resetting Configuration

3.3.6.2 Exporting and Importing Settings

To save the current tool settings including the current configuration of the device as indicated by the form, click on the *Export* drop-down button on the top-right side of the tool and click on *Export settings*. This opens a window where the user changes the file name of the settings. Enter a file name and click *Export* to export a JSON file.

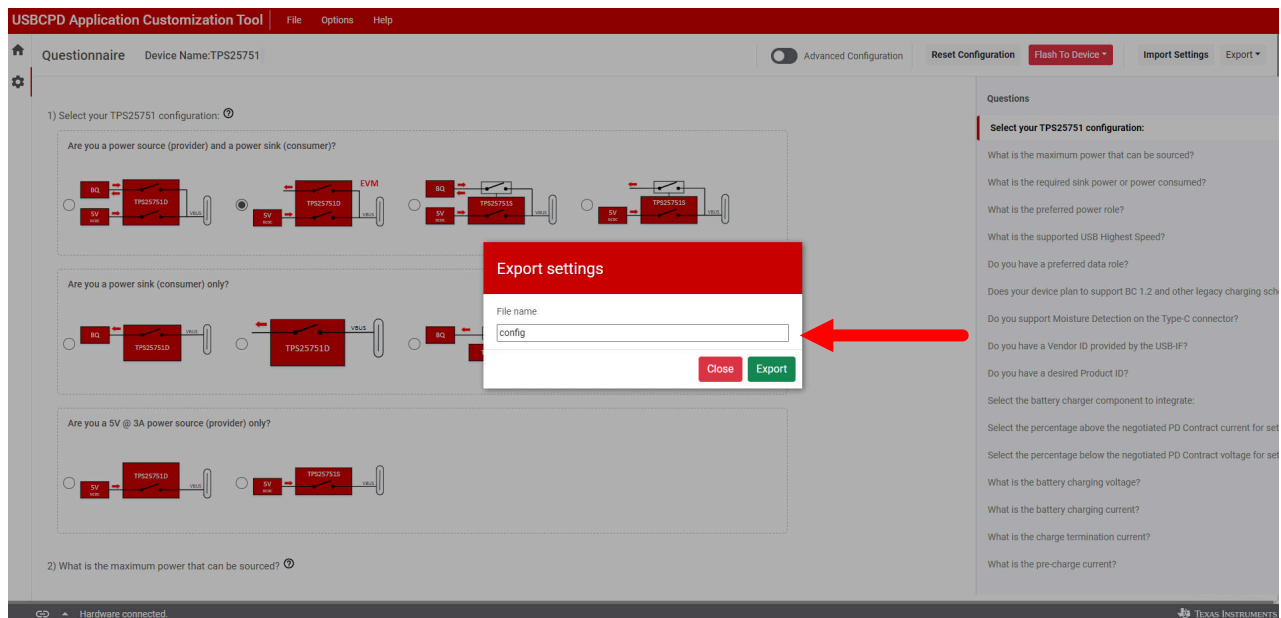
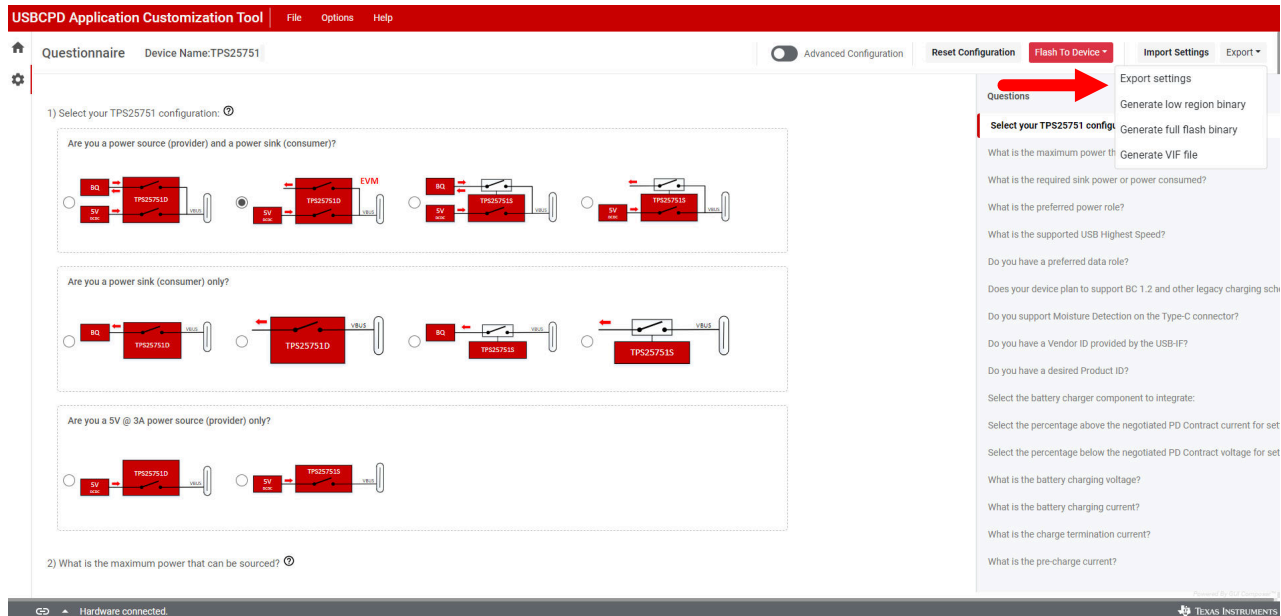


Figure 3-11. Export Settings in Application Customization Tool

To import current tool settings including the current configuration of the device as indicated by the form, click the *Import settings* button on the top-right side of the tool. Select from the directory where the JSON setting file is and click the *Import File* button. The settings are restored in the Application Customization Tool.

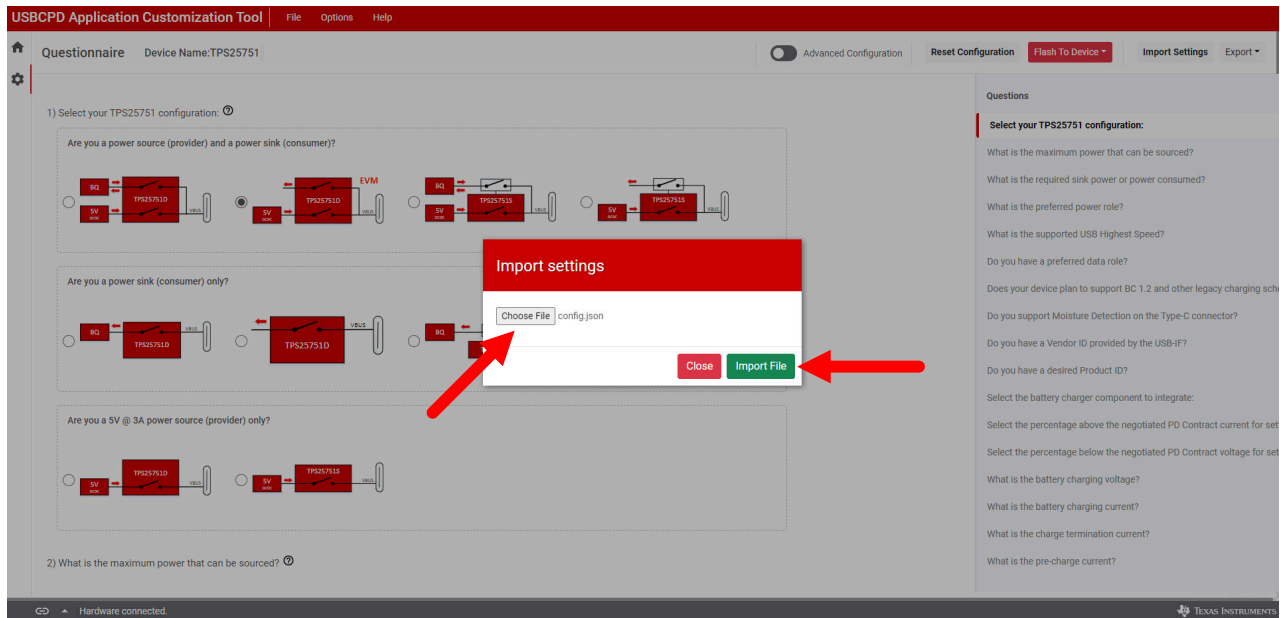
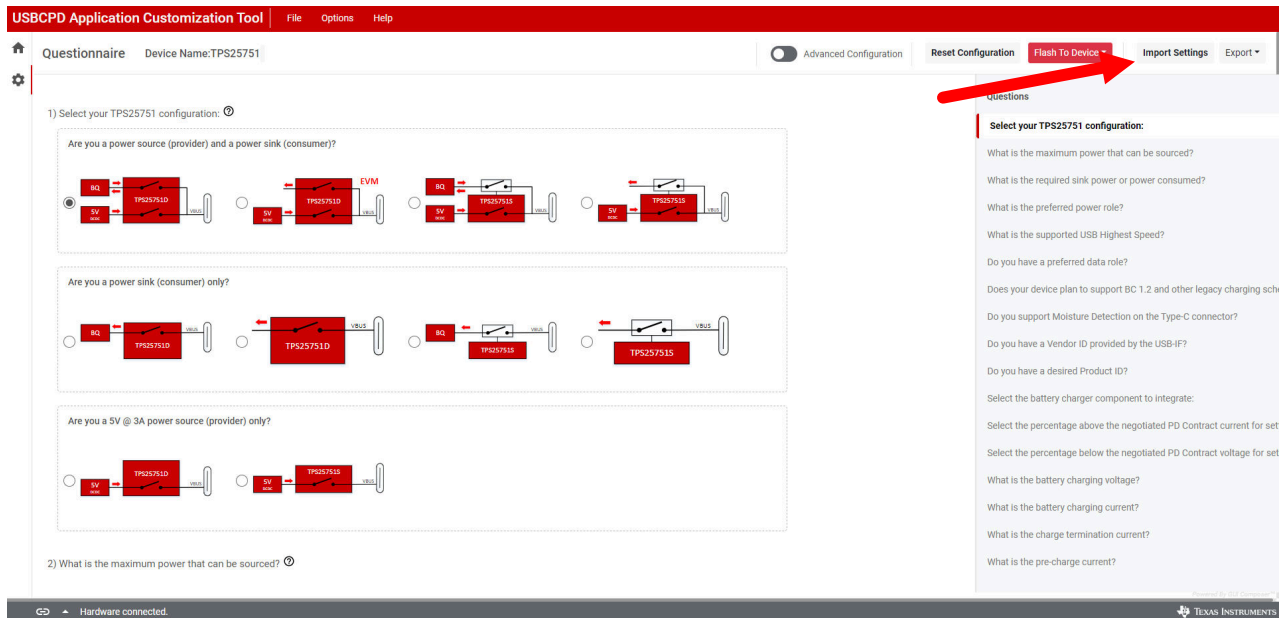


Figure 3-12. Import Settings in Application Customization Tool

3.3.6.3 Generating the Binary

To generate a binary of the current tool settings including the current configuration of the device as indicated by the form, click on the *Export* drop-down button on the top-right side of the tool and click on *Generate low region binary* or *Generate full flash binary*.

Note

Low Region Binary includes the firmware base image and AppConfig, this is used for EC patch loading. Full Flash Binary includes the Low Region and High Region, this is used for EEPROM configuration loading. For more information, refer to the [Technical Reference Manual](#).

Users have the option to generate a .bin or .C file. Select a file format, enter the file name and click the *Download* button to download the binary file.

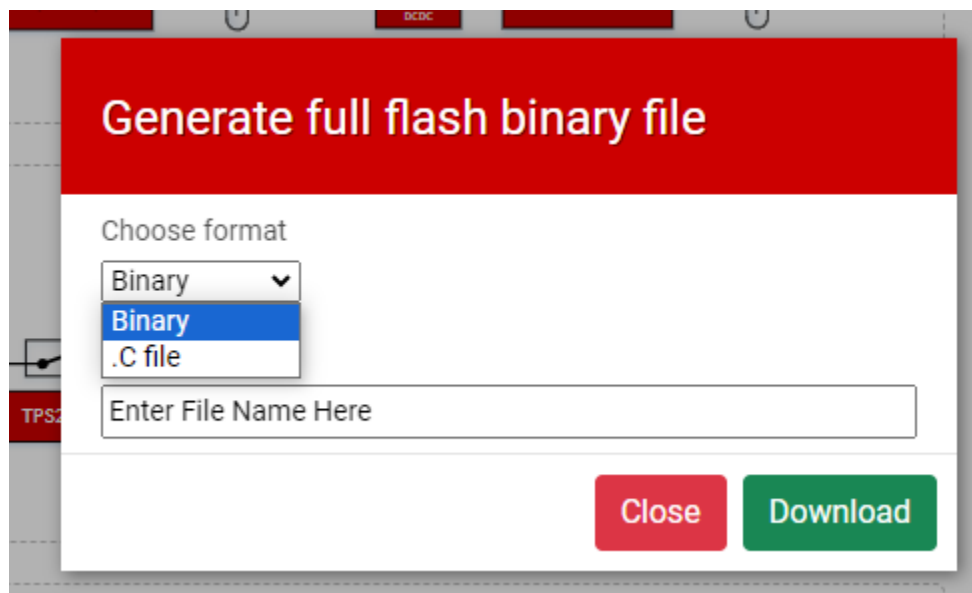
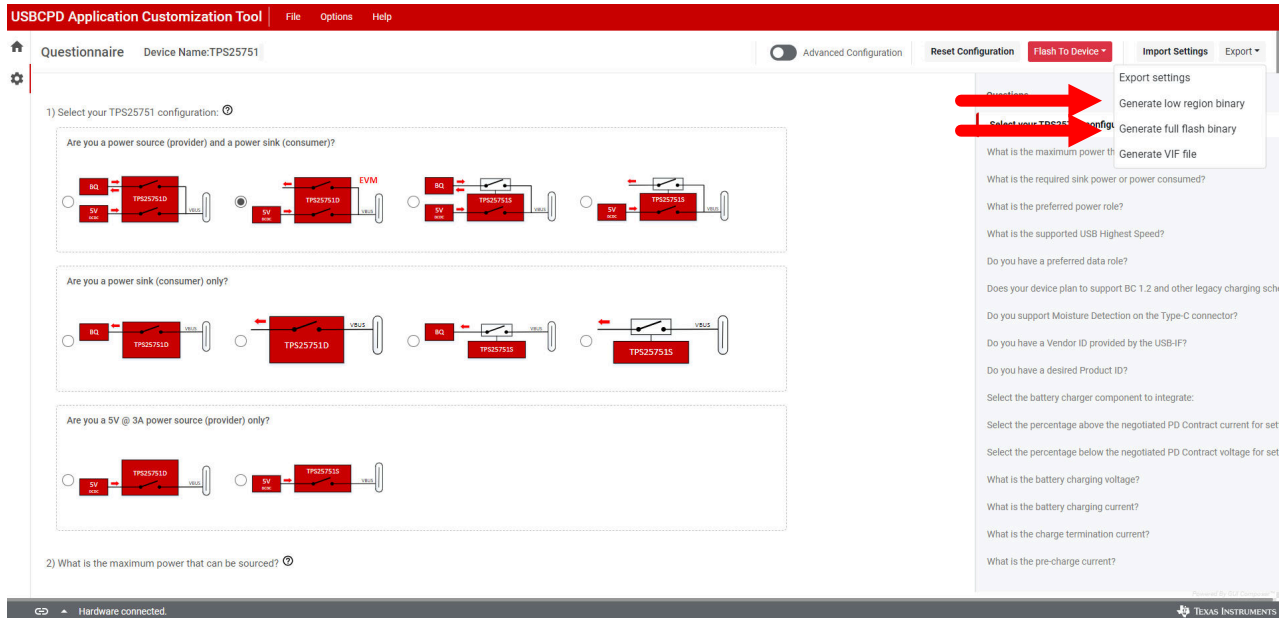


Figure 3-13. Generating Binary Configuration Using the Application Customization Tool

3.3.6.4 Generating the VIF File

To generate a VIF file of the current tool settings including the current configuration of the device as indicated by the form, click on the *Export* drop-down button on the top-right side of the tool and click on *Generate VIF file*. This automatically generates a VIF file to the default save directory on the user's computer. The VIF file is required for Compliance Testing specified by the *USB Power-Delivery Certification* Process. For more information on the VIF generation feature, see the [VIF Generation for USB Type-C® PD Compliance](#) application note. For more information on compliance testing, see the [USB Power Delivery - Compliance Tests](#) application note.

Note

The generated VIF file is to be used as the starting point only, additional changes or modifications are required to match the user's PD configuration and the application design. TI recommends using the VIF Generator Tool from [USB-IF](#) to create or modify VIF files, see [USB Vendor Info File Generator](#).

4 Application Specific Use Case

4.1 Application Specific General Overview

This section explains in more detail how to set up application-specific use cases with the TPS25751EVM for testing Short-to-VBUS overvoltage with TPD4S201, battery-charging applications with BQ257xx devices and configuring Liquid Detection and Corrosion Mitigation.

4.2 TPS4S201 Short-to-V_{bus} Protection

The TPS25751EVM comes with TPD4S201 to protect the TPS25751 PD controller from shorts on the CC and SBU pins. The TPD4S201 is a single-chip USB Type-C port protection device that provides absolute maximum 28V short-to-V_{bus} overvoltage and IEC ESD protection. [Figure 4-1](#) shows where TPD4S201 is located on the EVM.

On the TPS25751EVM, the hardware is set to use GPIO2 on TPS25751D as an active low input. When a short-to-V_{bus} short occurs on the CCx or SBUx pins, TPD4S201 drives the \overline{FLT} pin to indicate a short has occurred and prompts TPS25751 to enter Type-C error recovery. When the \overline{FLT} is driven low, GPIO2 LED D6 toggles low and toggles back high once the short is removed. For more details, see the [TPD4S201 product page](#).

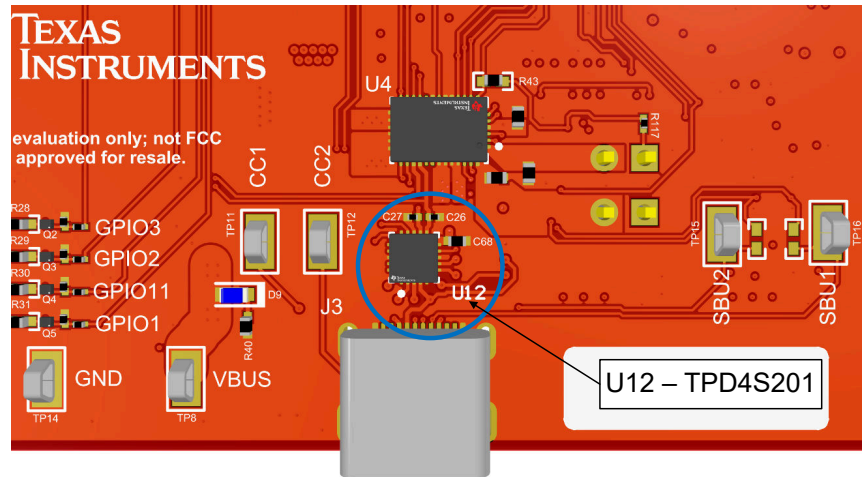


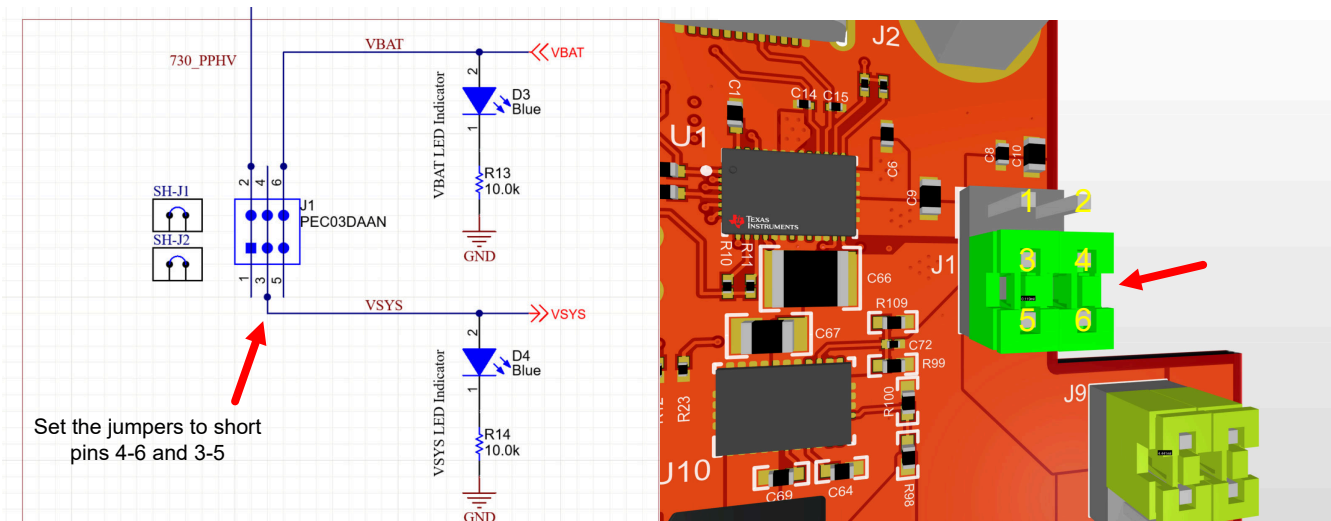
Figure 4-1. TPD4S201 Location

Table 4-1. TPD4S201 Test Points

Test Point on EVM	Description
TP11 - CC1	Connected to C_CC1 (pin 4) of TPD4S201, between TPD4S201 and J3 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP12 - CC2	Connected to C_CC2 (pin 5) of TPD4S201, between TPD4S201 and J3 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP16 - SBU1	Connected to C_SBU1 (pin 1) of TPD4S201, between TPD4S201 and J3 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP15 - SBU2	Connected to C_SBU2 (pin 2) of TPD4S201, between TPD4S201 and J3 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
J6 - GPIO2	Connected from \overline{FLT} (pin 9) of TPD4S201 to GPIO2 of TPS25751D. GPIO2 is set to <i>Fault_Input_Event</i> (33). When TPD4S201 drives this pin low, GPIO2 toggles D6 LED low and TPS25751 enters Type-C error recovery.
J6 - 751_CC1	Connected from CC1 (pin 11) of TPD4S201 to CC1 of TPS25751. This test point is protected from overvoltage and short conditions at the Type-C connector.
J6 - 751_CC2	Connected from CC2 (pin 12) of TPD4S201 to CC2 of TPS25751. This test point is protected from overvoltage and short conditions at the Type-C connector.
J6 - GPIO4	Connected from SBU1 (pin 15) of TPD4S201 to GPIO4 of TPS25751. This test point is protected from overvoltage and short conditions at the Type-C connector.
J6 - GPIO5	Connected from SBU2 (pin 14) of TPD4S201 to GPIO5 of TPS25751. This test point is protected from overvoltage and short conditions at the Type-C connector.

4.3 TPS25751EVM and BQ257xxEVM Setup

The TPS25751EVM can be used in conjunction with the BQ25756(E)EVM, BQ25792EVM or BQ25798EVM, and BQ25713EVM to simulate USB Type-C and battery charger applications. When using the BQ EVM, check to make sure the J1 jumper on the TPS25751EVM is set to select power from VBAT instead of 730_PPHV. See [Figure 4-2](#) for reference.



SELECTOR BATTERY VS TYPE-C

Figure 4-2. J1 Jumper for BQ Setups

When using the TPS25751EVM in conjunction with a BQ257xxEVM, plugging in the Type-C Power Adapter to the J2 port is not a requirement. The BQ257xxEVM can supply power to the TPS25751EVM VSYS through VBAT.

Note

VBAT (TP19) and VSYS (TP4) has an absolute maximum rating of 48V. *Do not* apply more than 48V on VBAT or VSYS.

When using BQ257xxEVM with TPS25751EVM, see the specific BQ257xxEVM for jumper placements to configure battery cells. Incorrect settings of the BQ257xxEVM can result in a non-functioning setup, see the corresponding *Setting up with BQ257xxEVM* sections for further details.

4.3.1 Setting up with BQ25756(E)EVM

The following items are needed to use the TPS25751EVM and BQ25756(E)EVM boards:

1. TPS25751EVM
2. Ribbon cable (included with TPS25751EVM)
3. TPS25751EVM user's guide and application customization tool
4. BQ25756(E)EVM
5. BQ25756EVM [user's guide](#) and [data sheet](#) or BQ25756EEVM [user's guide](#) and [data sheet](#)
6. [BQStudio with EV2400](#) [optional]
7. DC power supply or battery simulator

4.3.1.1 Hardware Setup with BQ25756(E)EVM

To set up the hardware, use the following the instructions:

1. Set the J1 jumper of TPS25751EVM to select VBAT for power, see [Section 4.3](#) for details.
2. Connect the J7 mating connectors of the TPS25751EVM and the BQ25756(E)EVM together.
3. On the bottom side of the TPS25751EVM, attach the ribbon cable to J11 header as [Figure 4-3](#) shows.

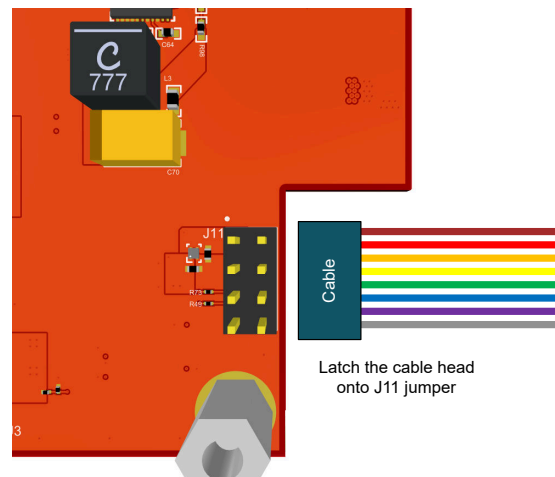


Figure 4-3. Ribbon Cable Connection to J11 Header

4. Connect the other end of the ribbon cable to J8 header of the BQ25756(E)EVM. [Figure 4-4](#) shows the complete setup.

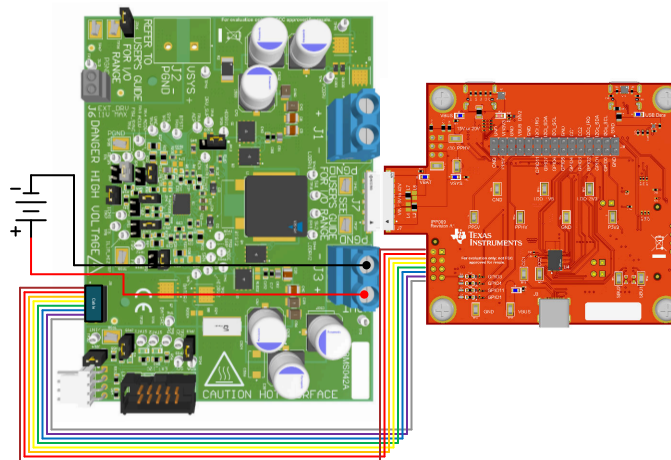


Figure 4-4. TPS25751EVM and BQ25756(E)EVM Hardware Setup

5. See the [BQ25756 evaluation module user's guide](#) or [BQ25756E Evaluation Module user's guide](#) for setting the proper jumpers for battery charging applications. Incorrect jumper settings or insufficient input power can result in a faulty evaluation.

4.3.1.2 Software Setup with BQ25756(E)EVM

Use the following instructions to set up the software configuration.

1. Open the [Application Customization Tool](#) and select one of the TPS25751D + BQ configurations shown in [Figure 4-5](#).

1) Select your TPS25751 configuration: 

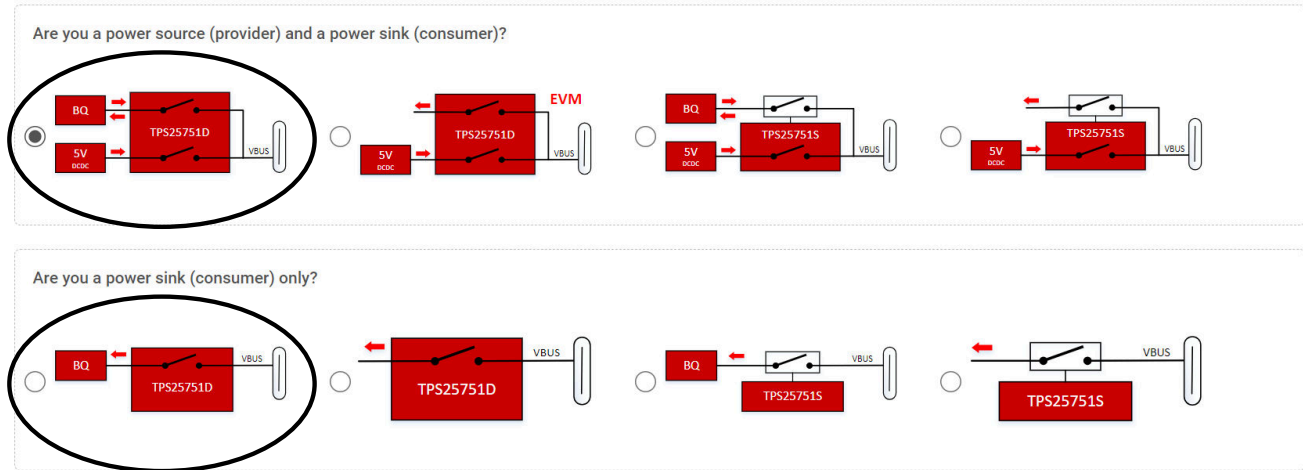


Figure 4-5. TPS25751D + BQ Configurations

2. Fill out the questionnaire from Q2 to Q10, see [Section 3.3.3](#) for more details on each question configuration. All the questions must be filled out to flash or export.
3. Questions 11 through 18 are for Battery Charger (BQ) configurations.
4. For Question 11, select BQ25756(E).
5. For Question 12, select the INDPM configuration for the BQ25756(E).
 - a. For example, if the user selects 5% - *INDPM is set to 5% above the negotiated PD Contract Current* and TPS25751 negotiates a PD contract at 3A, then the INDPM is set to 3.15A.
 - b. This questionnaire configures register 0x06 - IAC_DPM of BQ25756(E).
6. For Question 13, select the VINDPM configuration for the BQ25756(E).
 - a. For example, if the user selects 5% - *VINDPM is set to 5% below the negotiated PD Contract Voltage* and TPS25751 negotiates a PD contract at 5V, the VINDPM is set to 4.75V.
 - b. This questionnaire configures register 0x08 - VAC_DPM of BQ25756(E).
7. For question 14, enter the FB Voltage Regulation Limit in units of Voltage (1.504V through 1.566V, 2mV/bit).
 - This questionnaire configures register 0x00 - VFB_REG of BQ25756(E).
8. For question 15, enter the Charge Current Limit in units of Ampere (0.4A through 20A, 50mA/bit)
 - This questionnaire configures register 0x02 - ICHG_REG of BQ25756(E).
9. For question 16, enter the Charge Termination Current Limit in units of Ampere (0.25A through 10A, 50mA/bit).
 - This questionnaire configures register 0x12 - ITERM of BQ25756(E).
10. For question 17, enter the Precharge Current Limit in units of Ampere (0.25A through 10A, 50mA/bit).
 - This questionnaire configures register 0x10 - IPRECHG of BQ25756(E).
11. See [Section 3.3.6](#) for flashing the configuration or exporting the binary.

4.3.2 Setting up with BQ25792EVM or BQ25798EVM

The following items are needed to use the TPS25751EVM and BQ25792EVM, :

1. TPS25751EVM
2. Test hook clips jumper wires
3. TPS25751EVM User Guide and Application Customization Tool
4. BQ25792EVM or BQ25798EVM
5. BQ25792EVM [user's guide](#) and [data sheet](#) or BQ25798EVM [user's guide](#) and [data sheet](#)
6. [BQStudio with EV2400](#) [optional]
7. DC Power Supply or Battery Simulator

4.3.2.1 Hardware Setup with BQ25792EVM and BQ25798EVM

Use the following instructions to set up the hardware:

1. Set the J1 jumper of TPS25751EVM to select VBAT for power. See [Section 4.3](#) for details.
2. [Figure 4-6](#) shows how to use the test hook clips or jumper wires to connect the two EVMs. See [Table 4-2](#) for details.
3. See the [BQ25792EVM, BQ25798EVM and BQ25798BKUPEVM \(BMS034\) Evaluation Module user's guide](#) for instructions to set the proper jumper for battery charging application. Incorrect jumper settings or insufficient input power can result in a faulty evaluation.

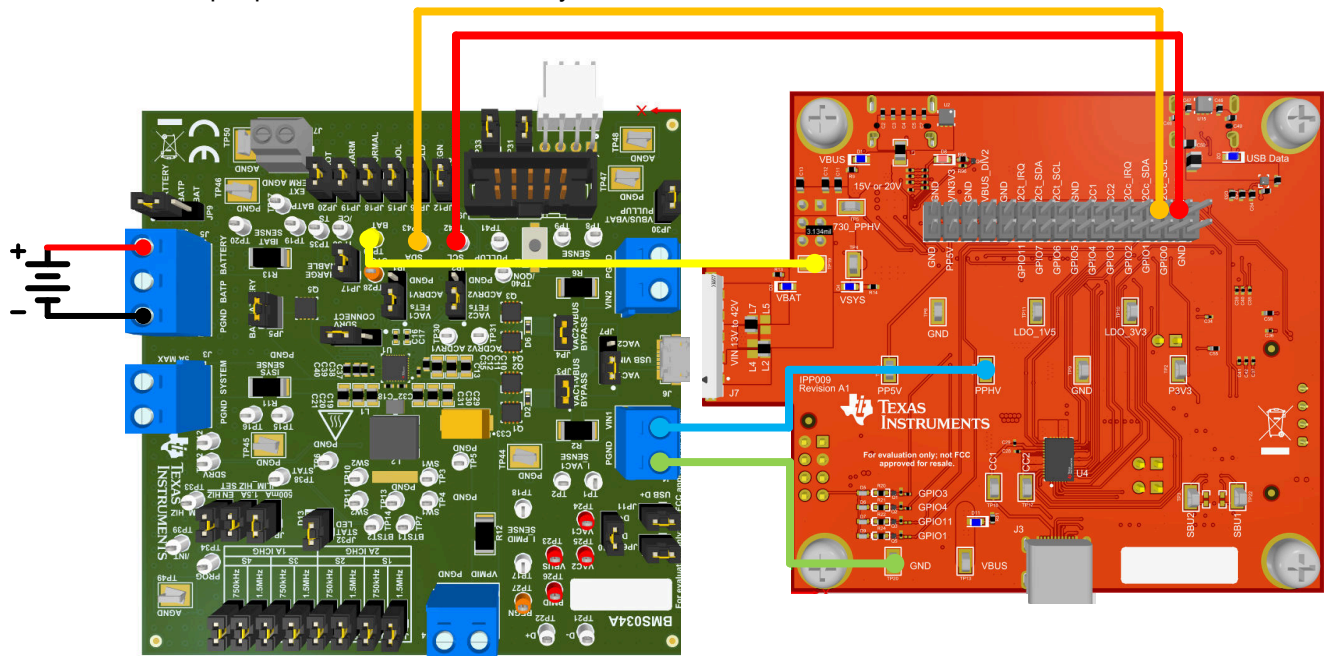


Figure 4-6. TPS25751EVM and BQ25792EVM, BQ25798EVM Hardware Setup

Table 4-2. TPS25751EVM and BQ25792EVM, BQ25798EVM Connections

Color Designator	TPS25751EVM Location	BQ25792EVM, BQ25798EVM Locator
Red	I2Cc_SCL	TP42 - SCL
Orange	I2Cc_SDA	TP43 - SDA
Yellow	TP4 - VBAT	TP29 - BAT
Blue	TP14 - PPHV	J1 - VIN1
Green	GND	PGND

Note

VBAT, PPHV, and GND pins on TPS25751EVM draws significant current, so make sure the cables used to connect the EVMs are able to support high current (maximum 5A).

4.3.2.2 Software Setup with BQ25792EVM and BQ25798EVM

Use the following the instructions to set up the software configuration.

1. Open the [Application Customization Tool](#) and select one of the following TPS25751D + BQ configurations in [Figure 4-7](#):

1) Select your TPS25751 configuration:

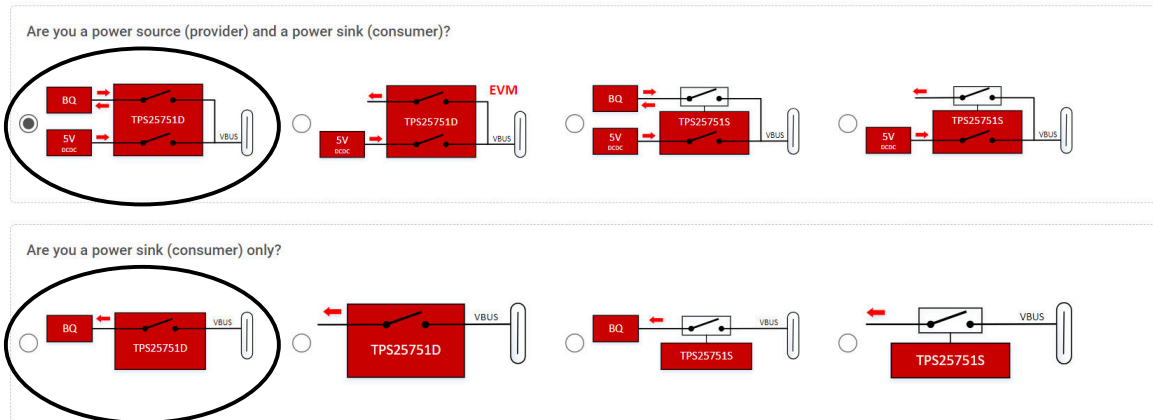


Figure 4-7. TPS25751D + BQ Configurations

2. Fill out the questionnaire from Q2 to Q10, see [Section 3.3.3](#) for more details on each question configuration. All the questions must be filled out to flash or export settings.
3. Questions 11 through 18 are for Battery Charger (BQ) Configurations.
4. For Question 11, select BQ25792/8.
5. For Question 12, select the INDPM configuration for the BQ25792 or BQ25798 EVMs.
 - a. For example, if the user selects 5% - *INDPM is set to 5% above the negotiated PD Contract Current* and TPS25751 negotiates a PD contract at 3A, the INDPM is set to 3.15A.
 - b. This questionnaire configures register 0x06 - IINDPM of BQ25792 or BQ25798.
6. For Question 13, select the VINDPM configuration for the BQ25792 or BQ25798 EVMs.
 - a. For example, if the user selects 5% - *VINDPM is set to 5% below the negotiated PD Contract Voltage* and TPS25751 negotiates a PD contract at 5V, the VINDPM is set to 4.75V.
 - b. This questionnaire configures register 0x05 - VINDPM of BQ25792/8.
7. For question 14, enter the Charge Voltage in units of Voltage (3V through 18.8V, 10mV/bit).
 - This questionnaire configures register 0x01 - VREG of BQ25792/8.
8. For question 15, enter the Charge Current in units of Ampere (0.05A through 5A, 10mA/bit)
 - This questionnaire configures register 0x03 - ICHG of BQ25792/8.
9. For question 16, enter the Charge Termination Current Limit in units of Ampere (0.04A through 1A, 40mA/bit).
 - This questionnaire configures register 0x09 - ITERM of BQ25792/8.
10. For question 17, enter the Precharge Current Limit in units of Ampere (0.04A through 2A, 40mA/bit)
 - This questionnaire configures register 0x08 - IPRECHG of BQ25792/8.
11. See [Section 3.3.6](#) for flashing the configuration or exporting the binary.

4.3.3 Setting up with BQ25731EVM

The following items are needed to use the TPS25751EVM and the BQ25731EVM:

1. TPS25751EVM
2. Test hook clips jumper wires
3. TPS25751EVM User Guide and Application Customization Tool

4. BQ25731EVM
5. [BQ25731EVM user's guide](#) and the [BQ25731 data sheet](#)
6. [BQStudio with EV2400](#) [optional]
7. DC power supply or battery simulator

4.3.3.1 Hardware Setup with BQ25731EVM

Use the following instructions to set up the hardware.

1. Set the J1 jumper of TPS25751EVM to select VBAT for power. See [Section 4.3](#) for details.
2. [Figure 4-8](#) illustrates using the test hook clips or jumper wires to connect the two EVMs. See [Figure 4-9](#) for details.
3. See the [BQ2573X Evaluation Module](#) user's guide for setting the proper jumper for battery charging applications. Incorrect jumper settings or insufficient input power can result in a faulty evaluation.

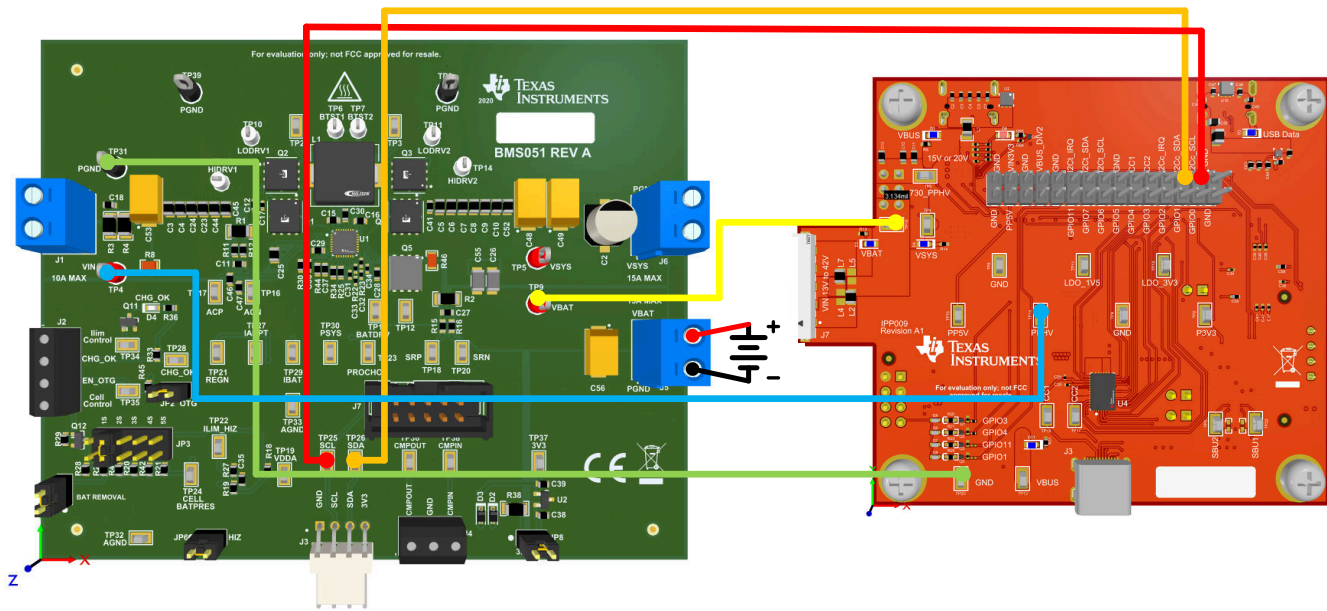


Figure 4-8. TPS25751EVM and BQ25731EVM Hardware Setup

Table 4-3. TPS25751EVM and BQ25731EVM Connections

Color Designator	TPS25751EVM Location	BQ25731EVM Locator
Red	I2Cc_SCL	TP25 - SCL
Orange	I2Cc_SDA	TP26 - SDA
Yellow	TP4 - VBAT	TP9 - VBAT
Blue	TP14 - PPHV	J1 - VIN1 (TP4)
Green	GND	J1 -PGND (TP31)

Note

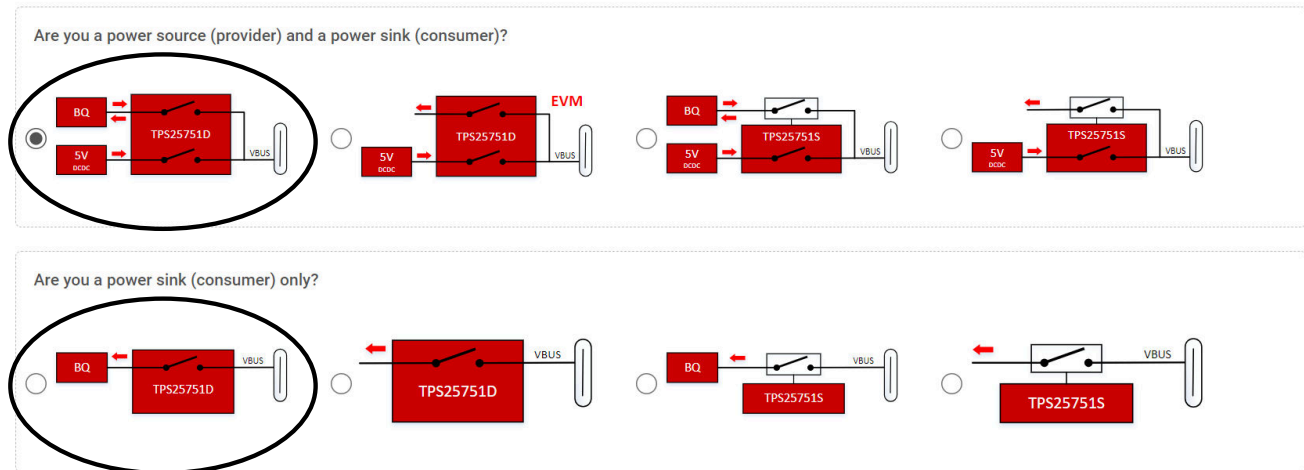
VBAT, PPHV, and GND pins on TPS25751EVM draws significant current, so make sure the cables used to connect the EVMs are able to support high current (maximum 5A).

4.3.3.2 Software Setup with BQ25731EVM

Use the following instructions to set up the software configuration.

1. Open the [Application Customization Tool](#) and select one of the following TPS25751D and BQ configurations:

- 1) Select your TPS25751 configuration: 



2. Fill out the questionnaire from Q2 to Q10, see [Section 3.3.3](#) for more details on each question configuration. All the questions must be filled out to flash or export settings.
3. Questions 11 through 18 are for Battery Charger (BQ) Configurations.
4. For Question 11, select BQ25731.
5. For Question 12, select the INDPM configuration for the BQ25731.
 - a. For example, if the user selects *5% - INDPM is set to 5% above the negotiated PD Contract Current* and TPS25751 negotiates a PD contract at 3A, then the INDPM is set to 3.15A.
 - b. This questionnaire configures register 0x0F - IINDPM of BQ25731.
6. For Question 13, select the VINDPM configuration for the BQ25731.
 - a. For example, if the user selects *5% - VINDPM is set to 5% below the negotiated PD Contract Voltage* and TPS25751 negotiates a PD contract at 5V, then the VINDPM is set to 4.75V.
 - b. This questionnaire configures register 0x0A - VINDPM of BQ25731.
7. For question 14, enter the charge voltage limit in units of Voltage (1.024V through 19.2V, 8mV/bit).
 - This questionnaire configures register 0x04 - VREG of BQ25731.
8. For question 15, enter the charge current limit in units of Ampere (0.064A through 8.128A, 64mA/bit)
 - This questionnaire configures register 0x02 - ICHG of BQ25731.
9. For question 16 and 17, BQ25731 does not have registers to configure the charge termination current and precharge current. These fields are grayed out and do not accept any inputs.
10. See [Section 3.3.6](#) for flashing the configuration or exporting the binary.

4.3.4 Setting up With BQ25713EVM

To use the TPS25751EVM and BQ25713EVM, the following items are needed:

1. TPS25751EVM
2. Test hook clips jumper wires
3. TPS25751EVM User Guide and Application Customization Tool
4. BQ25713EVM
5. BQ25713EVM [user's guide](#) and [data sheet](#)
6. [BQStudio with EV2400](#) [optional]
7. DC Power Supply or Battery Simulator

4.3.4.1 Hardware Setup with BQ25713EVM

To setup the hardware, follow the instructions below.

1. Set the J1 jumper of TPS25751EVM to select VBAT for power. Refer to [Section 4.3](#) for details.
2. Use the test hook clips/jumper wires to connect the two EVMs as shown below. See [Figure 4-9](#) for details.
3. Refer to BQ25713EVM [user's guide](#) for setting the proper jumper for battery charging application. Incorrect jumper settings or insufficient power can result in a faulty evaluation.

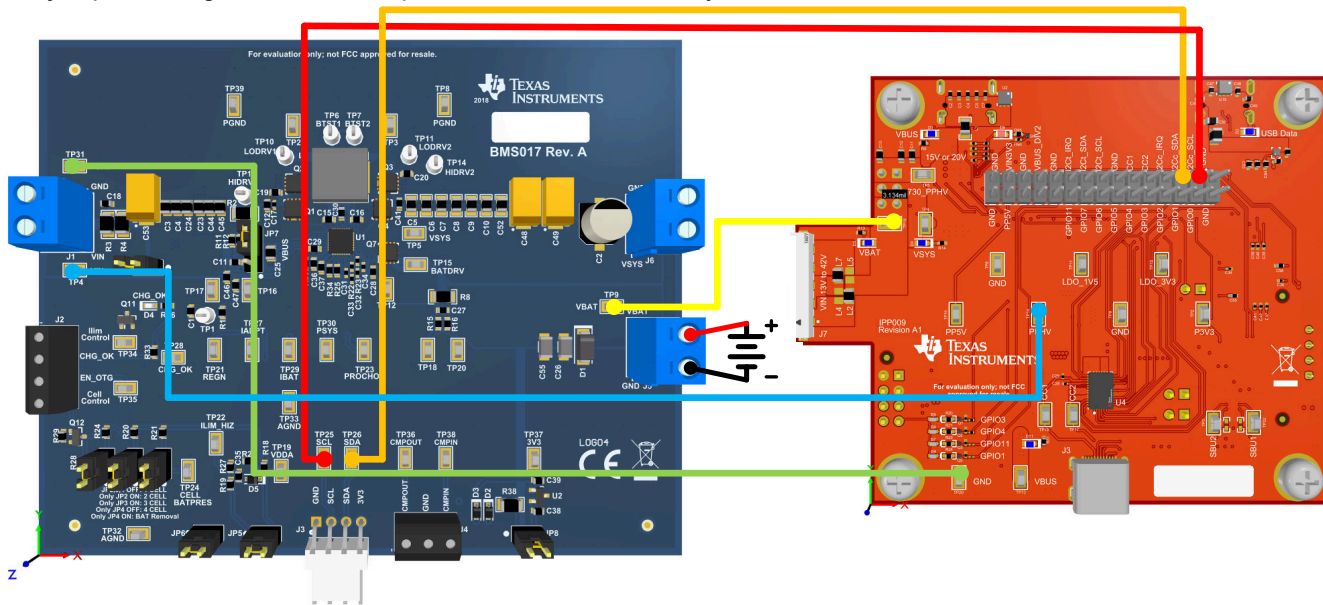


Figure 4-9. TPS25751EVM and BQ25713EVM Hardware Setup

Table 4-4. TPS25751EVM and BQ25713EVM Connections

Color Designator	TPS25751EVM Location	BQ25713EVM Locator
Red	I2Cc_SCL	TP25 - SCL
Orange	I2Cc_SDA	TP26 - SDA
Yellow	TP4 - VBAT	TP9 - BAT
Blue	TP14 - PPHV	J1 - VIN (TP4)
Green	GND	J1 - PGND (TP31)

Note

VBAT, PPHV, and GND pins on TPS25751EVM draws significant current, so make sure the cables used to connect the EVMs are able to support high current (max 5A).

4.3.4.2 Software Setup with BQ25713EVM

Use the following instructions to set up the software configuration:

- Open the [Application Customization Tool](#) and select one of the following TPS25751D + BQ configurations shown in [Figure 4-10](#).

1) Select your TPS25751 configuration: 

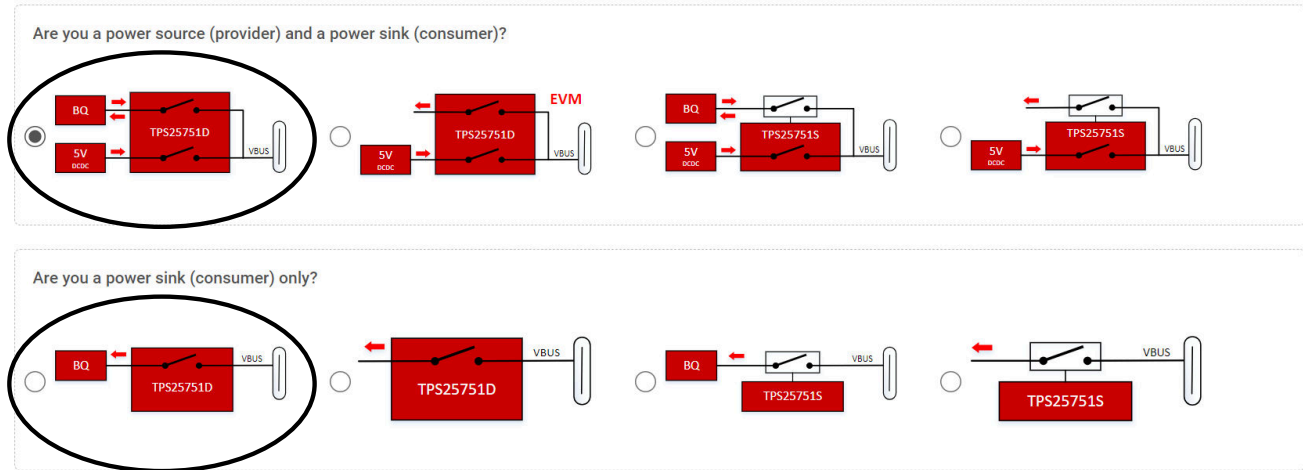


Figure 4-10. TPS25751D + BQ Configurations

- Fill out the questionnaire from Q2 to Q10, see [Section 3.3.3](#) for more details on each question configuration. All the questions must be filled out to flash or export settings.
- Questions 11 through 18 are for Battery Charger (BQ) Configurations.
- For Question 11, select BQ25713.
- For Question 12, select the INDPM configuration for the BQ25713.
 - For example, if the user selects 5% - *INDPM is set to 5% above the negotiated PD Contract Current* and TPS25751 negotiates a PD contract at 3A, the INDPM is set to 3.15A.
 - This questionnaire configures register 0x0F - IIN_HOST of BQ25713.
- For Question 13, select the VINDPM configuration for the BQ25713.
 - For example, if the user selects 5% - *VINDPM is set to 5% below the negotiated PD Contract Voltage* and TPS25751 negotiates a PD contract at 5V, the VINDPM is set to 4.75V.
 - This questionnaire configures register 0x0B/0x0A - input voltage of BQ25713.
- For question 14, enter the Charge Voltage in units of Voltage (1.024V through 19.2V, 8mV/bit).
 - This questionnaire configures register 0x05/0x04 - Max Charge Voltage of BQ25713.
- For question 15, enter the Charge Current in units of Ampere (0.05A through 5A, 10mA/bit).
 - This questionnaire configures register 0x03/0x02 - Charge Current of BQ25713.
- For question 16 and 17, BQ25713 does not have registers to configure the Charge Termination Current and Precharge Current. These fields are grayed out and do not accept any inputs.
- See [Section 3.3.6](#) for flashing the configuration or exporting the binary.

4.4 Liquid Detection and Corrosion Mitigation Overview

TPS25751EVM supports Liquid Detection and Corrosion Mitigation to protect the system from unexpected shorts (liquid, moisture, and debris) on the USB Type-C port. In the Liquid Detection state, TPS25751 monitors the SBU lines for unexpected shorts to ground or high voltage (5V and above). TPS25751 supports Corrosion Mitigation by automatically disabling the Type-C port when a short is detected. When a short is no longer detected across the SBU pins, TPS25751 enters back into normal operation. See the hardware implementation in [Figure 4-11](#), for hardware requirements and see also the [TPS25751 USB Type-C® and USB PD Controller with Integrated Power Switches Optimized for Power Applications](#) data sheet.

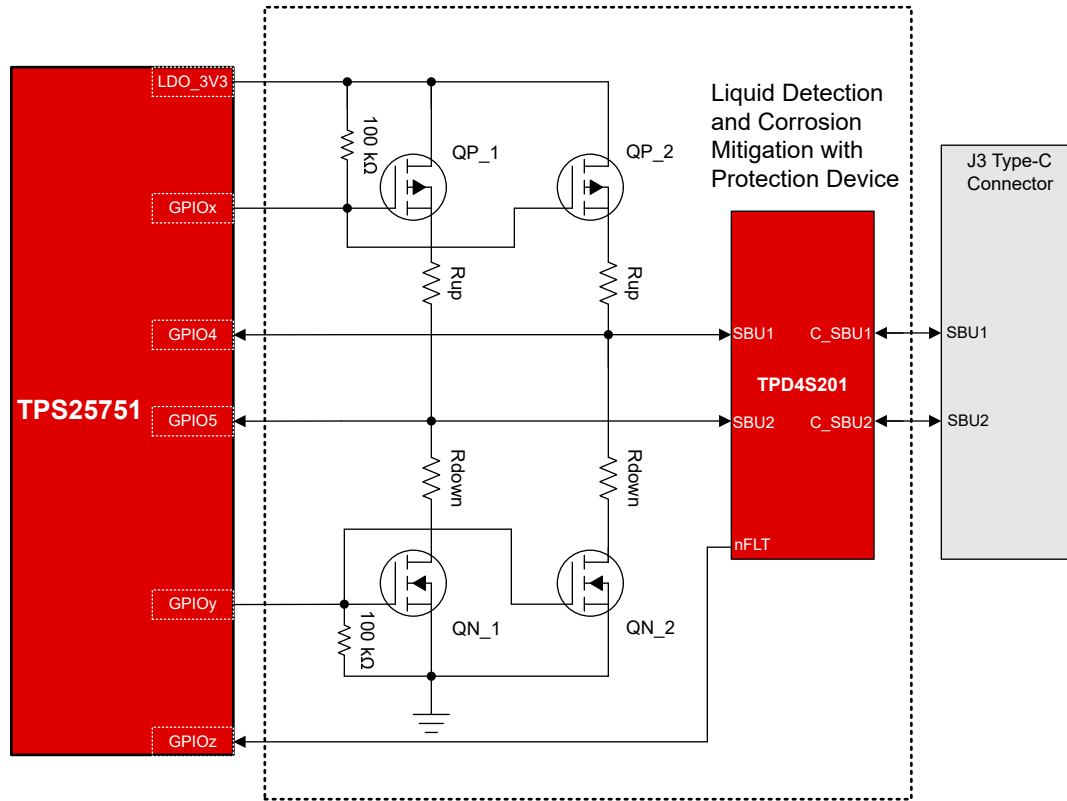


Figure 4-11. Liquid Detection and Corrosion Mitigation Setup

Note

Liquid Detection and Corrosion Mitigation and BC1.2 cannot be configured in the same system. Both applications utilize GPIO4 and GPIO5 of TPS25751 for different functions.

4.4.1 Liquid Detection and Corrosion Mitigation Hardware Setup

Out of the box, the hardware on TPS25751EVM is set up for Liquid Detection and Corrosion Mitigation. R44 and R45 are populated to connect J3 Type-C SBU pins to TPS25751 GPIO4 and GPIO5 for liquid detection, R41 and R42 are not populated. TPD4S201 (U12) is in between TPS25751 and J3 Type-C port for protection in case of a short to VBUS. See also [Figure 4-12](#) and [Figure 4-13](#) for location details.

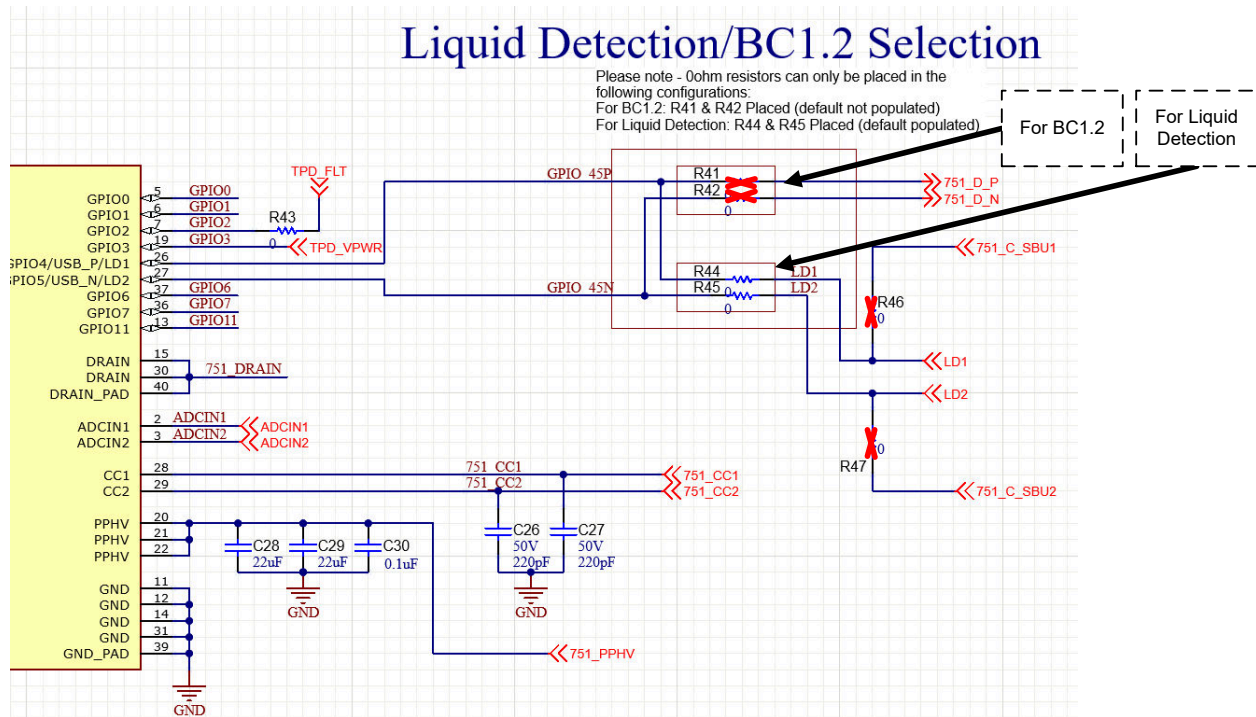


Figure 4-12. Liquid Detection Resistor Selection

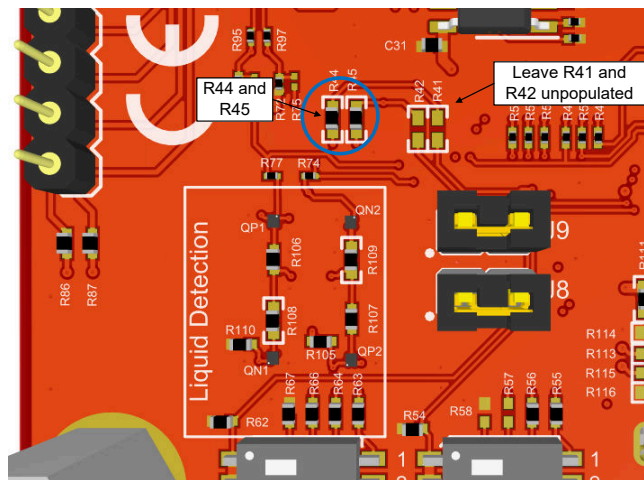


Figure 4-13. Liquid Detection Resistor Location

Note

Liquid Detection and Corrosion Mitigation and BC1.2 cannot be configured in the same system, so make sure R32, R33 and R34, R36 are not both populated at the same time.

Note

The resistor designator for Liquid Detection and BC1.2 are different between Rev A1 and Rev A2 hardware. Make sure to double check the EVM hardware revision when referring to [Section 4.4.1](#),

On the TPS25751EVM the hardware is set to use specific GPIOs for MOSFET control and Liquid Detection feature. For user applications, some GPIOs can be configured differently while some are required for all designs, see [Table 4-5](#) for details on specific test point and the configurability for custom designs. See also [Section 4.4.2](#).

Table 4-5. Liquid Detection Test Points

Test Point on EVM	Description	Configurability
GPIO4	SBU1 measurement line between TPS25751 (LD1) and TPD4S201 (SBU1). This test point is protected from overvoltage and short conditions at the USB-C port.	Not configurable for custom designs
GPIO5	SBU2 measurement line between TPS25751 (LD2) and TPD4S201 (SBU2). This test point is protected from overvoltage and short conditions at the USB-C port.	Not configurable for custom designs
SBU1	SBU1 measurement line between TPD4S201 (C_SBU1) and the USB-C port (SBU1 pin). This test point is subjected to overvoltage and short conditions at the USB-C port.	Not configurable for custom designs
SBU2	SBU2 measurement line between TPD4S201 (C_SBU2) and the USB-C port (SBU2 pin). This test point is subjected to overvoltage and short conditions at the USB-C port.	Not configurable for custom designs
GPIO6	Connected to the gate pin of NFETs (QN1 and QN2) to enable pulldown. When enabled, PD is detecting short to VBUS/CC.	Configurable for custom designs
GPIO7	Connected to the gate pin of P-Channel Field Effect Transistors (PFETs) (QP1 and QP2) to enable pullup. When enabled, PD is detecting short to GND.	Configurable for custom designs
GPIO1	Connected to D9 LED to indicate if liquid is detected at J3 Type-C port.	Configurable for custom designs
GPIO2	Act as an input pin for TPS25751 and connected to the $\overline{\text{FLT}}$ (pin 9) of TPD4S201. When OVP condition occurs at TPD4S201, TPS25751 enters Type-C error recovery, sets CCx pins to Hi-Z state and removes VBUS.	Configurable for custom designs

4.4.2 Liquid Detection and Corrosion Mitigation Software Setup

Use the following instructions to set up Liquid Detection and Corrosion Mitigation software:

1. Open the [Application Customization Tool](#) and fill out the questionnaire, see [Section 3.3.3](#) for more details on each question configuration.
2. For Question 8, select Yes. Selecting Yes enables key registers and fields hidden in Advanced Configuration, [Table 4-6](#) shows the default Liquid Detection configuration:

Table 4-6. Liquid Detection and Corrosion Mitigation Default Configuration

Register	Field	Description
Interrupt Mask for I2C1 (0x16)	Liquid Detection [60]	Enable interrupt event for "Liquid Detection [60]"
IO Config (0x5c)	GPIO_1	Set to "LIQUID_DETECTED (157)". When liquid is detected at J3 Type-C port, GPIO1 toggles D8 LED high until liquid is no longer present
IO Config (0x5c)	GPIO_2	Set to "Fault_Input_Event (33)". When TPD4S201 drives this pin low, GPIO2 toggles D6 LED low and TPS25751 enters Type-C Error Recovery.
IO Config (0x5c)	GPIO_4	Set to "Pin multiplexed to ADC" for detecting liquid on SBU1
IO Config (0x5c)	GPIO_5	Set to "Pin multiplexed to ADC" for detecting liquid on SBU2
IO Config (0x5c)	GPIO_6	Set to "LIQUID_PMOS_CONTROL (155)". GPIO6 is used to toggle the PFET to enable pullup to detect short to VBUS/CC
IO Config (0x5c)	GPIO_7	Set to "LIQUID_NMOS_CONTROL (156)". GPIO7 is used to toggle the NFET to enable pullup to detect short to GND
Liquid Detection Config (0x98)	Enable Corrosion Mitigation [81]	Enable feature to automatically disable Type-C port if liquid is detected
Liquid Detection Config (0x98)	Enable Liquid Detection [82]	Enable feature to detect liquid at Type-C port

3. See [Section 3.3.4](#) to make additional configuration changed by enabling Advanced Configuration.
4. See [TPS25751 data sheet](#) and [TPS25751 Technical Reference Manual](#) for in-depth details of each registers and the fields.

5 Hardware Design Files

5.1 Schematics

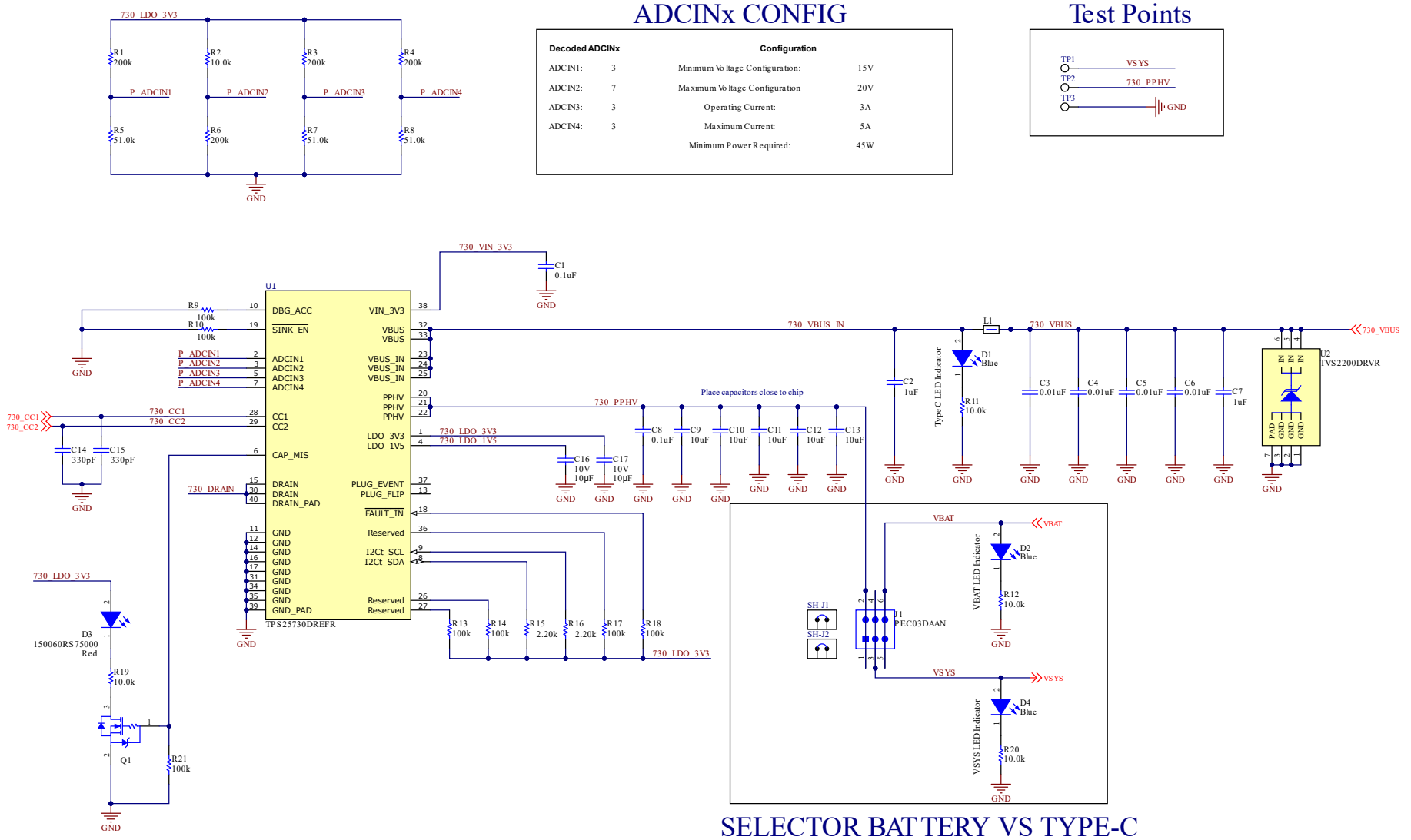


Figure 5-1. TPS25730 Power Input Schematic

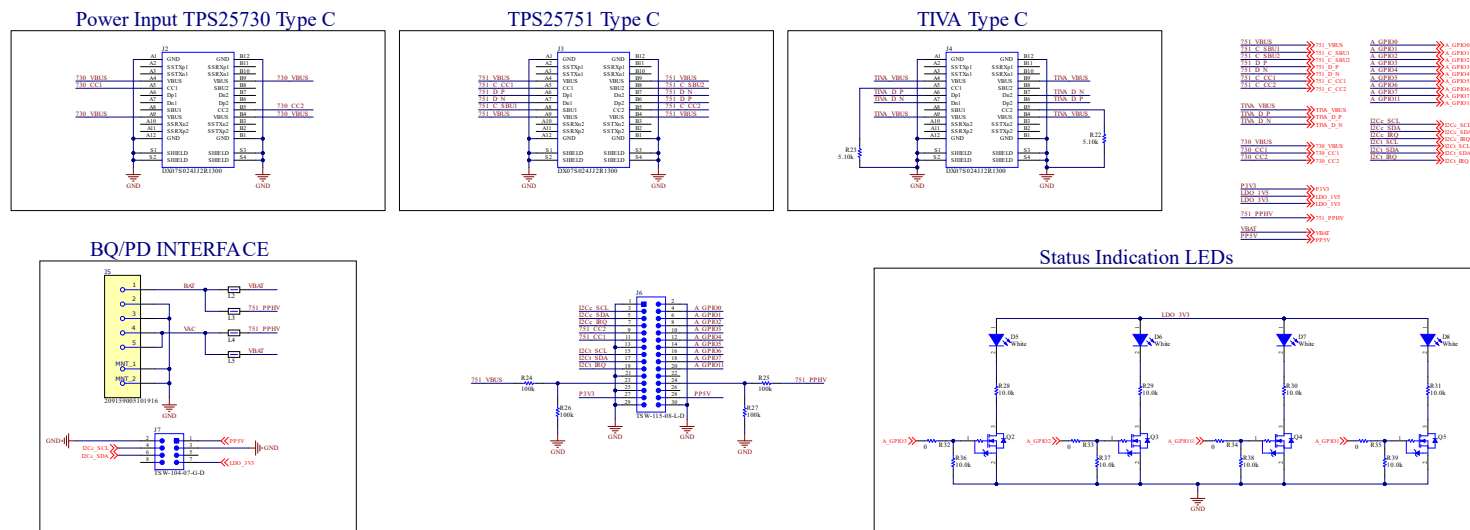


Figure 5-2. USB Type-C® Connectors Schematic

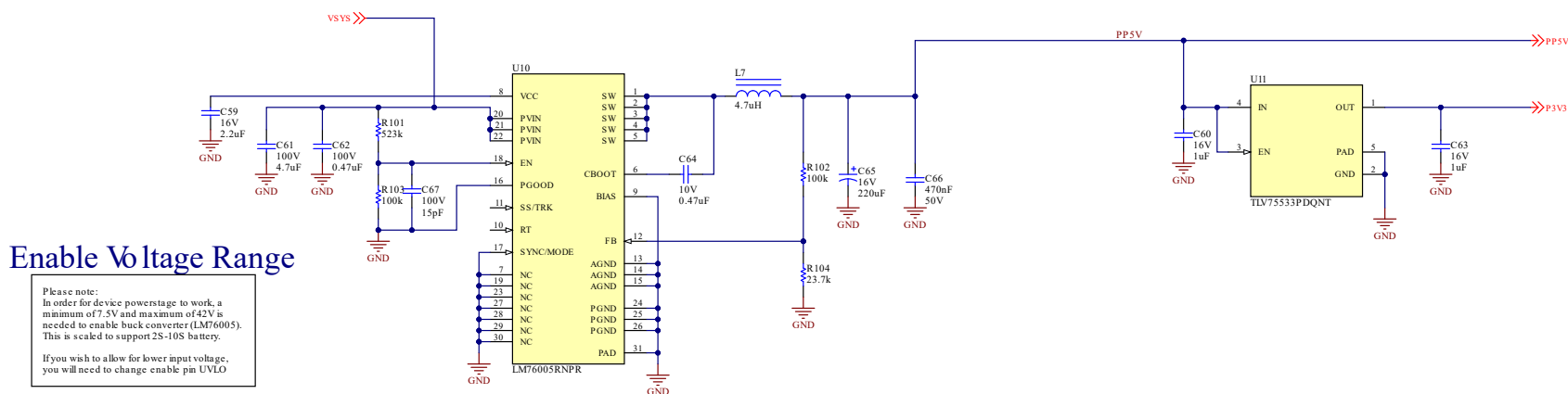


Figure 5-3. Power Stage Schematic

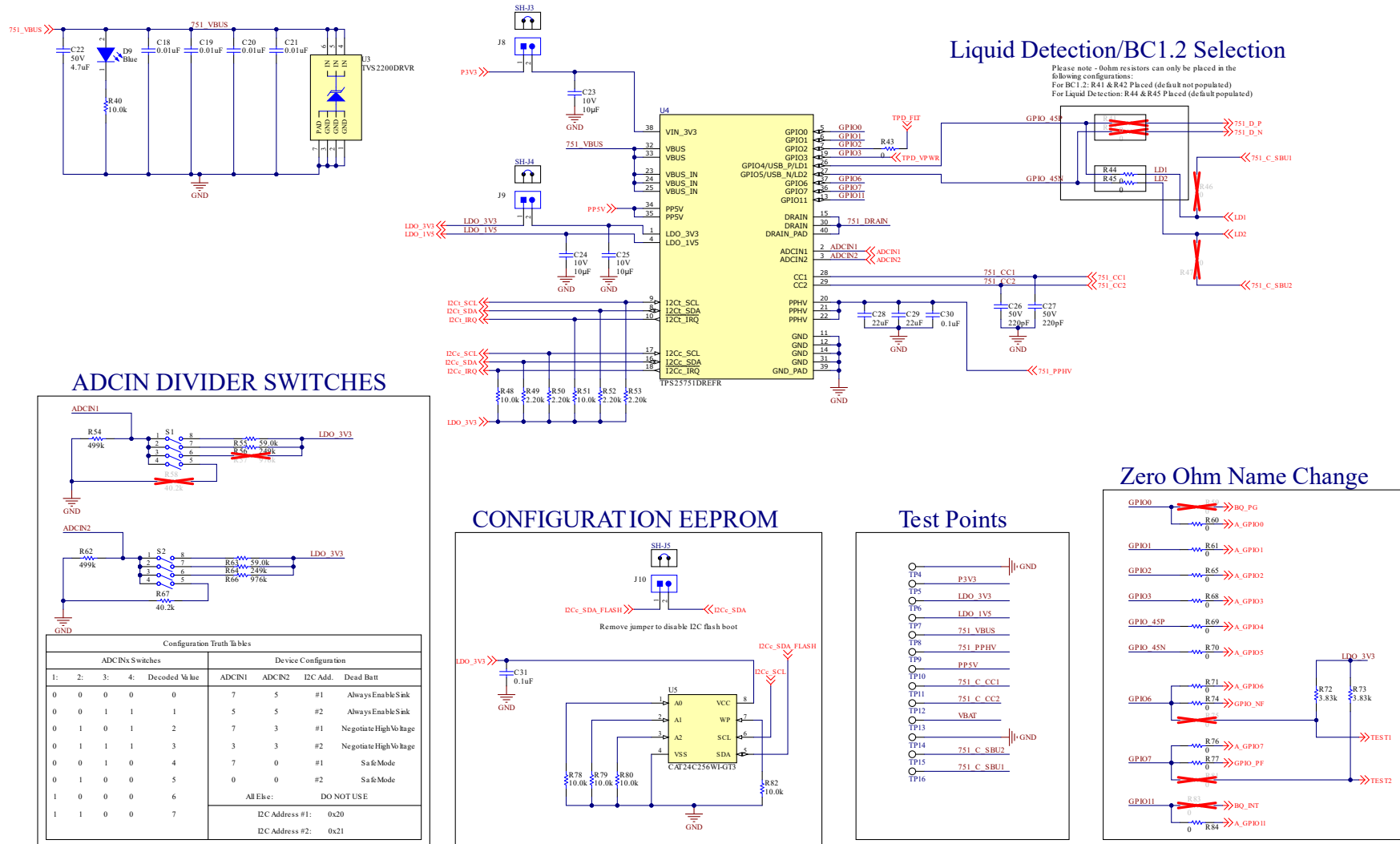
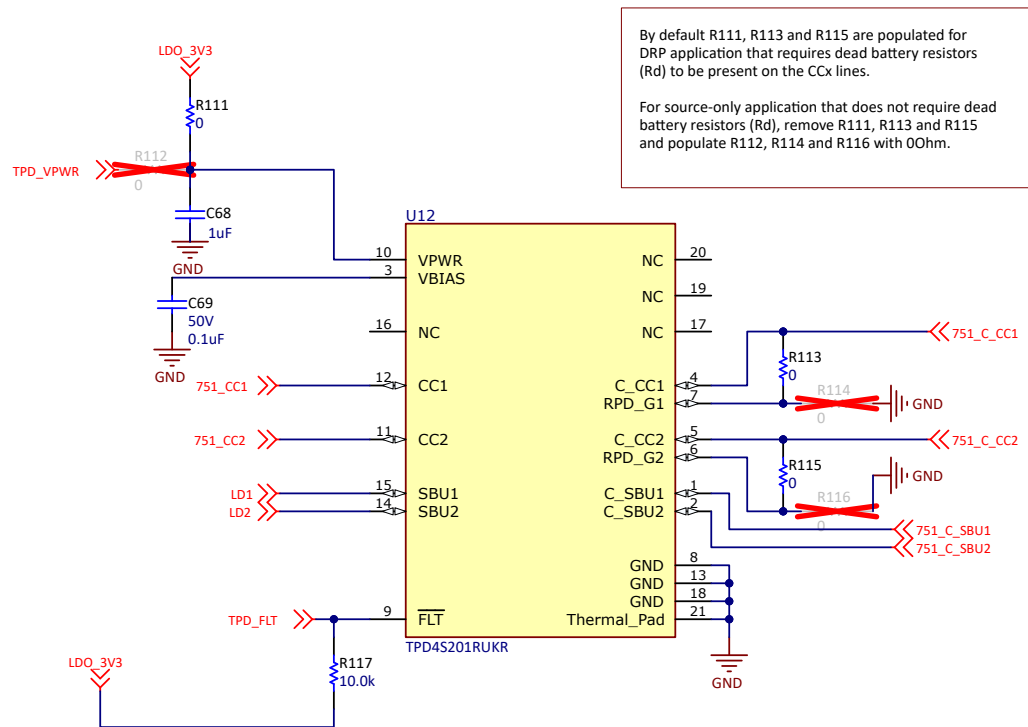


Figure 5-4. TPS25751 Schematic

RESISTOR CONFIGURATION



By default R111, R113 and R115 are populated for DRP application that requires dead battery resistors (Rd) to be present on the CCx lines.

For source-only application that does not require dead battery resistors (Rd), remove R111, R113 and R115 and populate R112, R114 and R116 with 00hm.

Figure 5-5. TPD4S201 Schematic

Liquid Detection

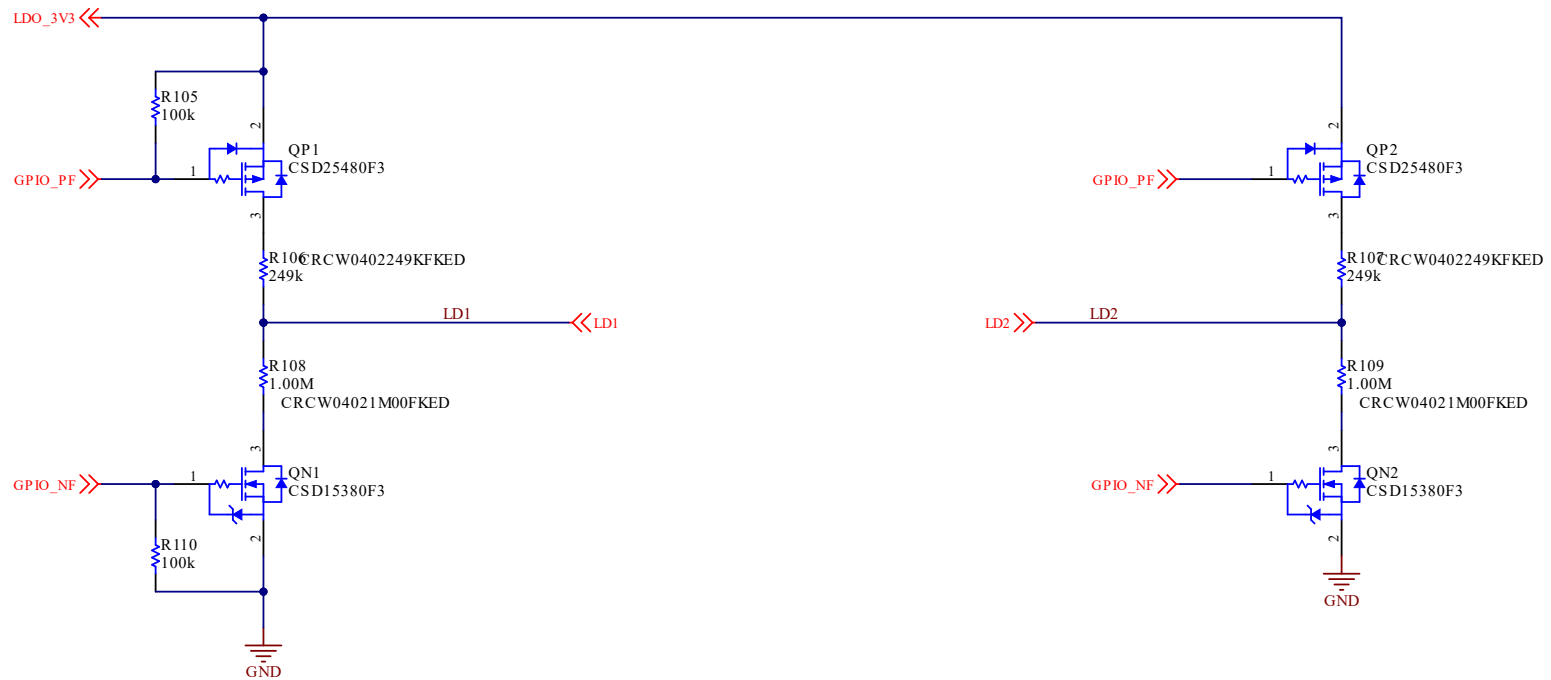


Figure 5-6. Liquid Detection Schematic

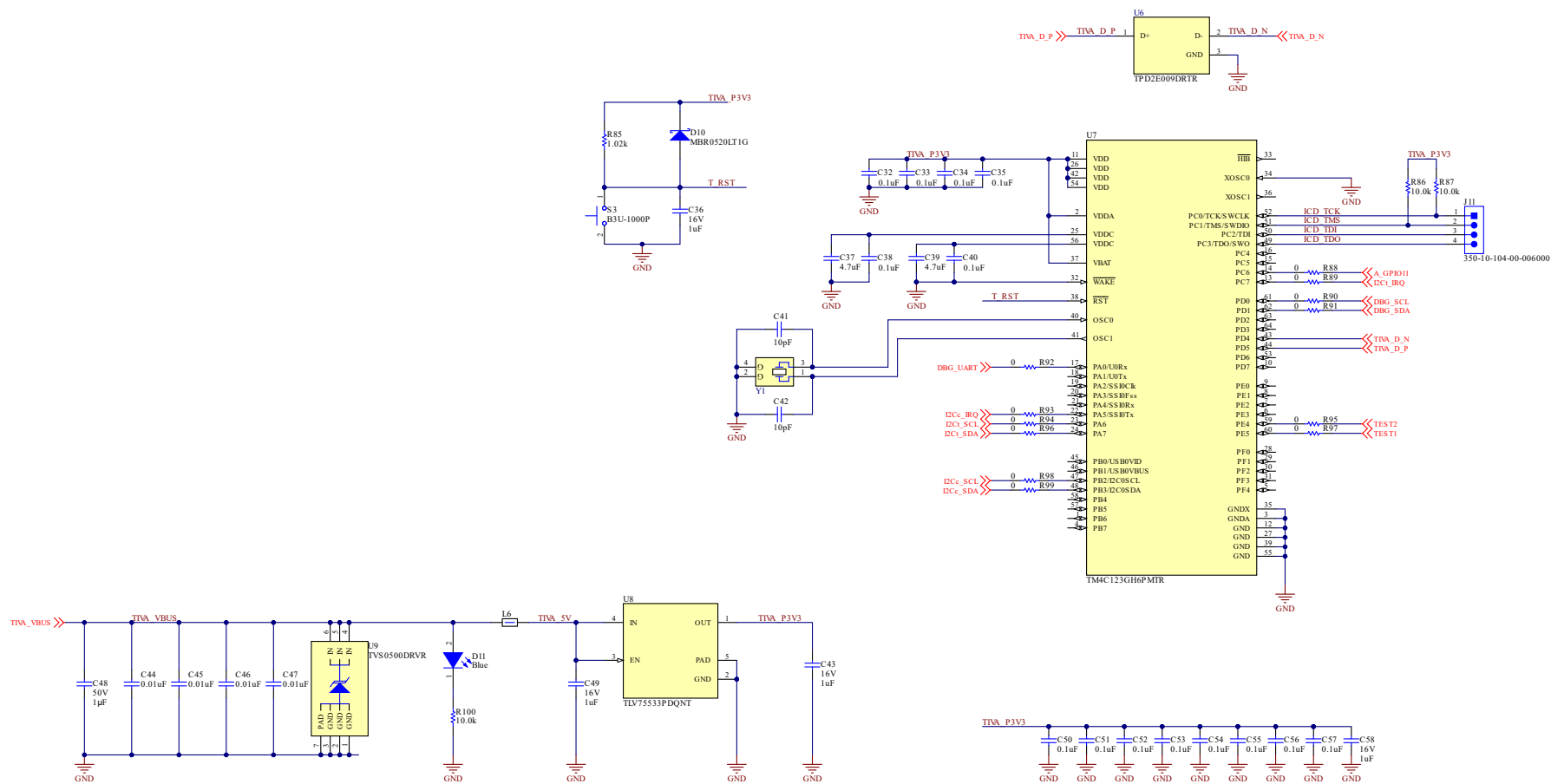


Figure 5-7. TIVA Schematic

5.2 PCB Layouts

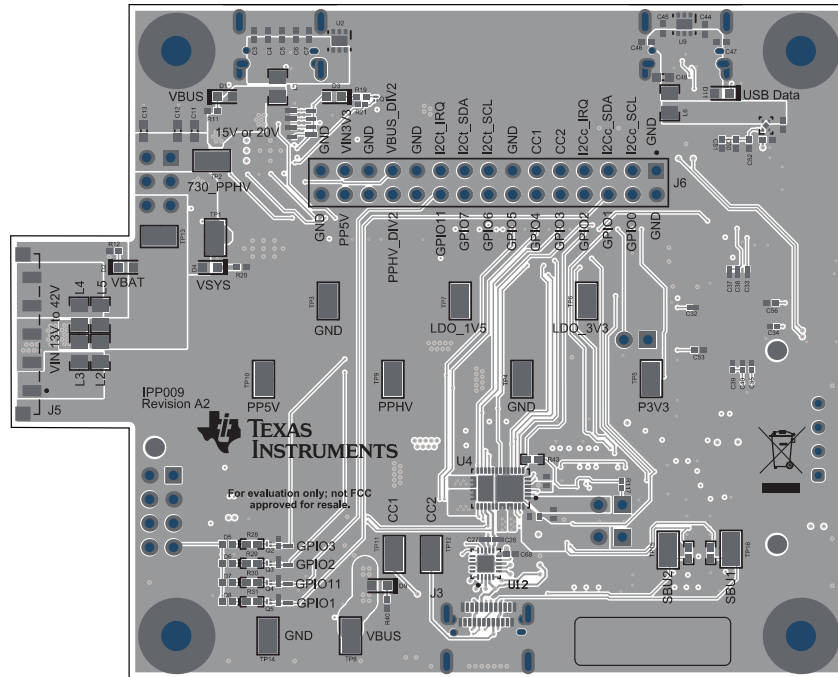


Figure 5-8. TPS25751EVM Top Layer Composite View

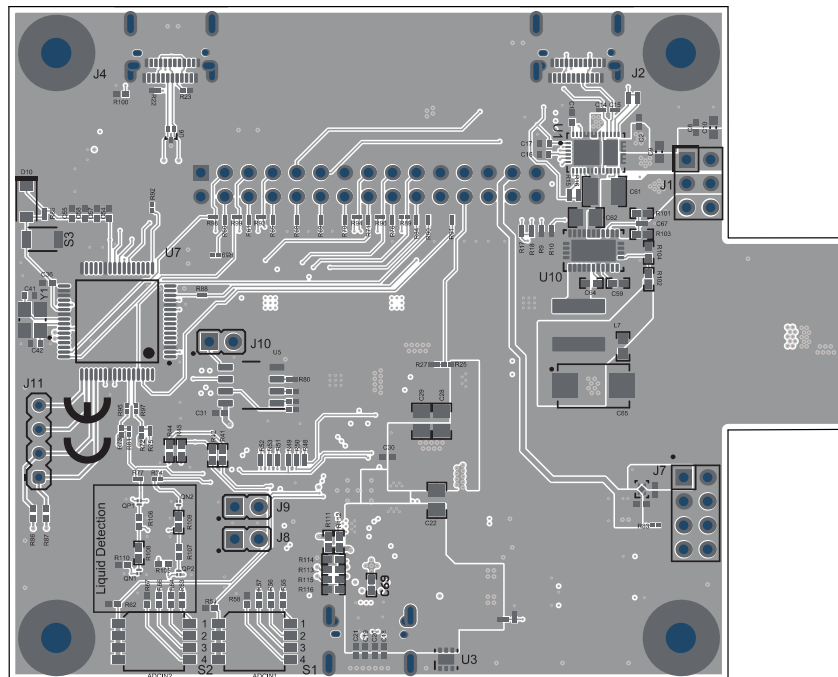


Figure 5-9. TPS25751EVM Bottom Layer Composite View

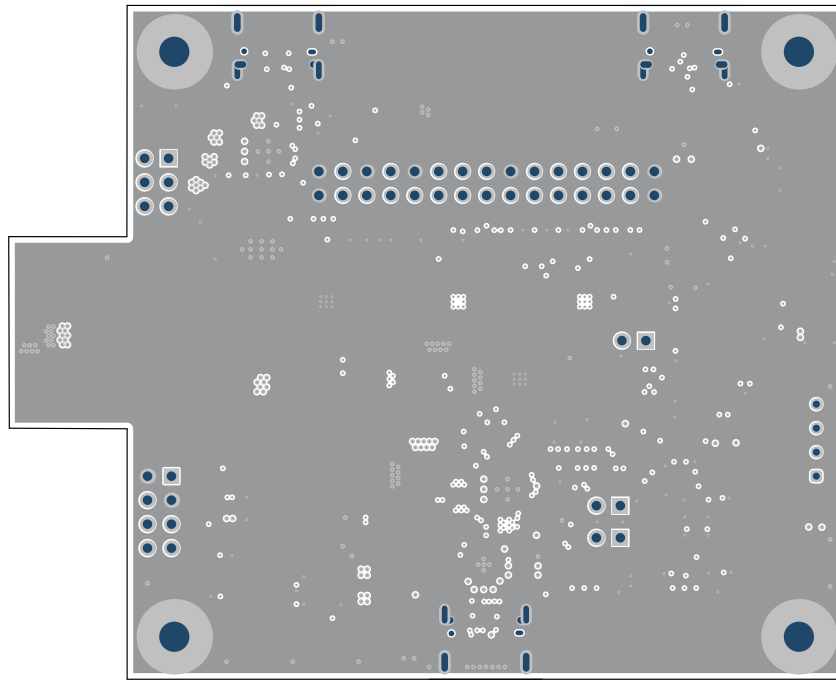


Figure 5-10. TPS25751EVM Ground Layer

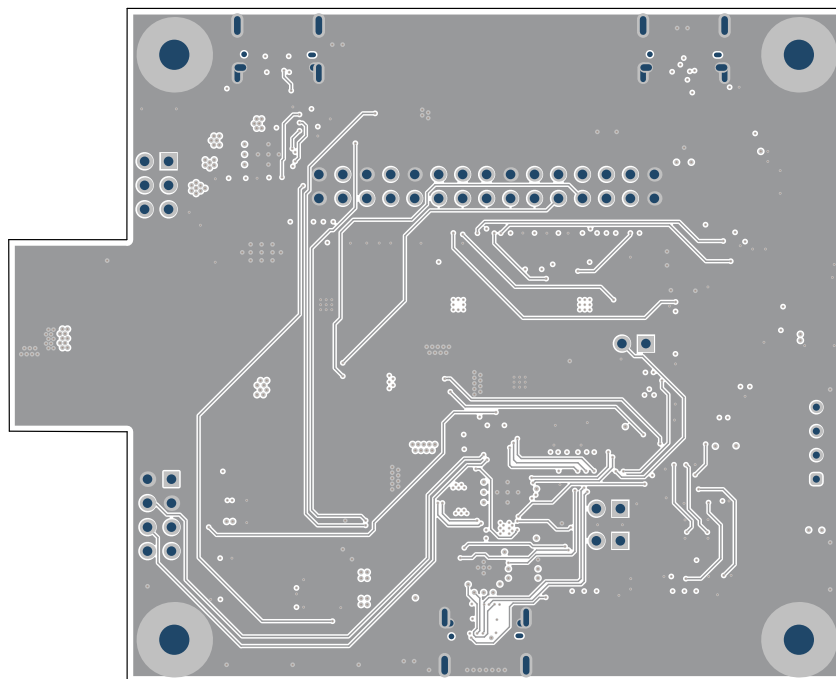


Figure 5-11. TPS25751EVM Signal Layer

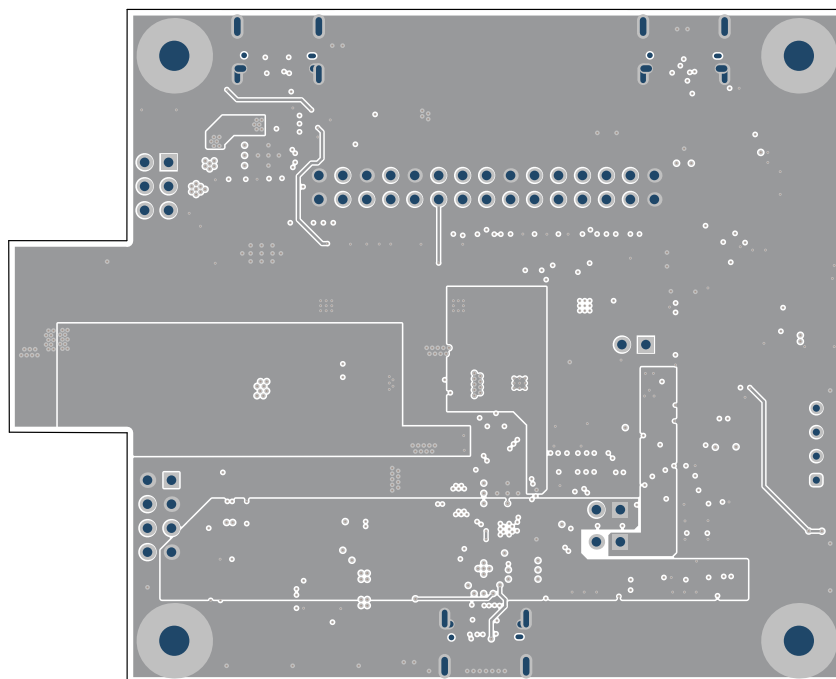


Figure 5-12. TPS25751EVM Power 1 Layer

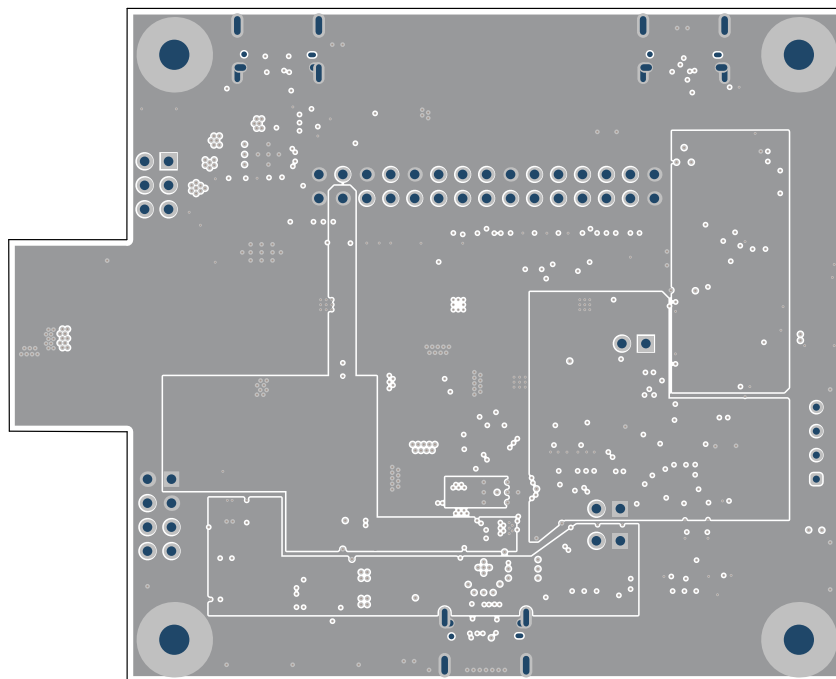


Figure 5-13. TPS25751EVM Power 2 Layer

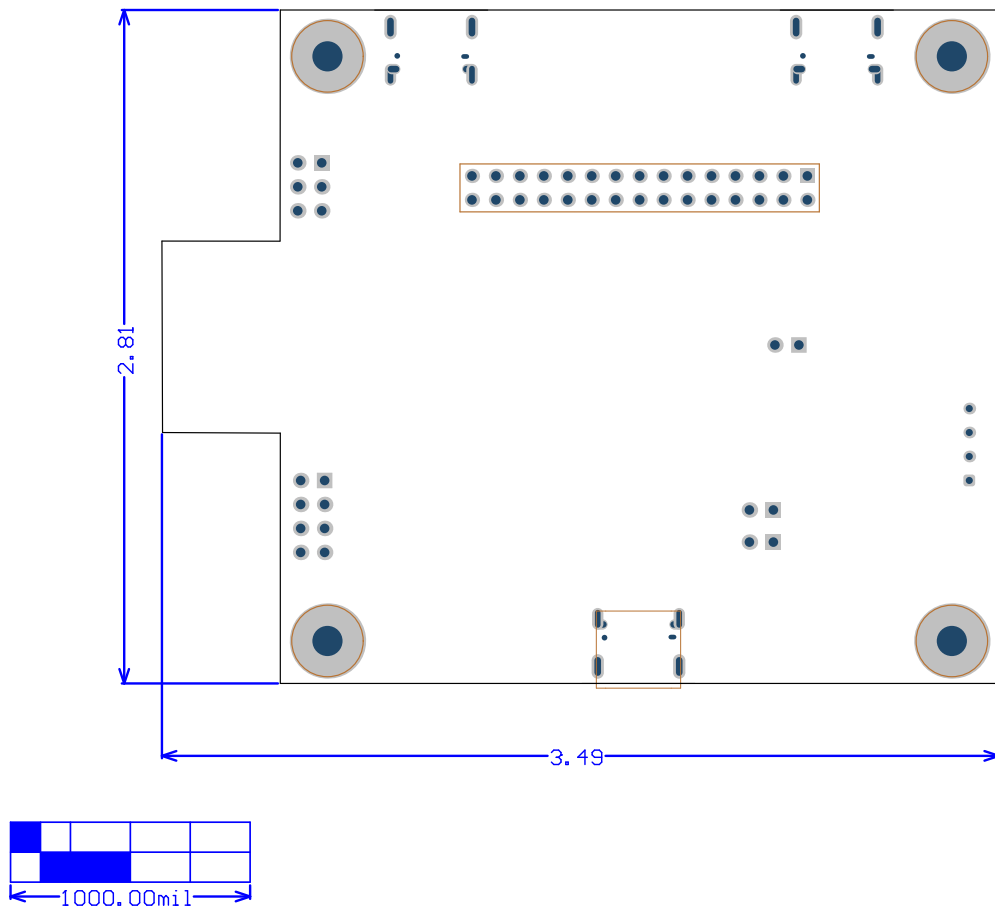


Figure 5-14. TPS25751EVM Board Dimensions

5.3 Bill of Materials (BOM)

The table below lists the bill of materials for TPS25751EVM.

Table 5-1. TPS25751EVM Bill of Materials

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
!PCB1	1		Printed Circuit Board		IPP009	Any
C1, C8, C30, C31	4	0.1uF	CAP, CERM, 0.1uF, 35V, +/- 10%, X5R, 0402	0402	GMK105BJ104KV-F	Taiyo Yuden
C2, C7, C68	3	1uF	CAP, CERM, 1uF, 35V, +/- 10%, X5R, 0402	0402	GRM155R6YA105KE11D	MuRata
C3, C4, C5, C6, C18, C19, C20, C21, C44, C45, C46, C47	12	0.01uF	CAP, CERM, 0.01 uF, 50V, +/- 5%, X7R, 0402	0402	C0402C103J5RACTU	Kemet
C9, C10, C11, C12, C13	5	10uF	CAP, CERM, 10uF, 35V, +/- 20%, X5R, 0603	0603	GRM188R6YA106MA73D	Murata
C14, C15	2	330pF	CAP, CERM, 330pF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H331K030BA	TDK
C16, C17, C23, C24, C25	5	10uF	CAP, CERM, 10uF, 10V, +/- 20%, X5R, 0402	0402	CC0402MRX5R6BB106	Yageo
C22	1	4.7uF	CAP, CERM, 4.7uF, 50V, +/- 10%, X5R, 0805	0805	C2012X5R1H475K125AB	TDK
C26, C27	2	220pF	CAP, CERM, 220pF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H221K030BA	TDK
C28, C29	2	22uF	CAP, CERM, 22uF, 35V, +/- 20%, X5R, 0805	0805	C2012X5R1V226M125AC	TDK
C32, C33, C34, C35, C38, C40	6	0.1uF	CAP, CERM, 0.1uF, 10V, +/- 10%, X5R, 0201	0201	CL03A104KP3NNNC	Samsung Electro-Mechanics
C36, C43, C49, C58, C60, C63	6	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X6S, 0402	0402	C1005X6S1C105K050BC	TDK
C37, C39	2	4.7uF	CAP, CERM, 4.7uF, 6.3V, +/- 20%, X5R, 0201	0201	GRM035R60J475ME15D	MuRata
C41, C42	2	10pF	CAP, CERM, 10pF, 16V, +/- 10%, C0G, 0402	0402	C0402C100K4GACTU	Kemet
C48	1	1uF	CAP, CERM, 1uF, 50V, +/- 20%, X5R, AEC-Q200 Grade 3, 0603	0603	CGA3E3X5R1H105M080AB	TDK
C50, C51, C52, C53, C54, C55, C56, C57	8	0.1uF	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K050BB	TDK
C59	1	2.2uF	CAP, CERM, 2.2uF, 16V, +/- 10%, X6S, 0402	0402	C1005X6S1C225K050BC	TDK
C61	1	4.7uF	CAP, CERM, 4.7uF, 100V, +/- 10%, X7S, 1210	1210	C3225X7S2A475K200AE	TDK

Table 5-1. TPS25751EVM Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
C62	1	0.47uF	CAP, CERM, 0.47 uF, 100V, +/- 10%, X7S, 0805	0805	C2012X7S2A474K125AB	TDK
C64	1	0.47uF	CAP, CERM, 0.47 uF, 10V, +/- 10%, X5R, 0402	0402	GRM155R61A474KE15D	MuRata
C65	1	220uF	CAP, TA, 220uF, 16V, +/- 20%, 0.1ohm, SMD	7343-43	TPSE227M016R0100	AVX
C66	1	0.47uF	CAP, CERM, 0.47 uF, 50V, +/- 10%, X7R, 0603	0603	C1608X7R1H474K080AC	TDK
C67	1	15pF	CAP, CERM, 15pF, 100V,+/- 5%, C0G/NP0, 0201	0201	GRM0335C2A150JA01D	MuRata
C69	1	0.1uF	CAP, CERM, 0.1uF, 50V, +/- 10%, X5R, 0402	0402	C1005X5R1H104K050BB	TDK
D1, D2, D4, D9, D11	5	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D3	1	Red	LED, Red, SMD	LED_0603	150060RS75000	Würth Elektronik
D5, D6, D7, D8	4	White	LED, White, SMD	0402, White	LW QH8G-Q2S2-3K5L-1	OSRAM
D10	1	20V	Diode, Schottky, 20V, 0.5A, SOD-123	SOD-123	MBR0520LT1G	ON Semiconductor
H1, H2, H3, H4	4		Machine Screw, Round, #4-40x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1	1		Header, 100mil, 3x2, Tin, TH	3x2 Header	PEC03DAAN	Sullins Connector Solutions
J2, J3, J4	3		Receptacle, USB 3.1 Type C, R/A, Gold, SMT	Receptacle, USB 3.1 Type C, R/A, SMT	DX07S024JJ2R1300	JAE Electronics
J5	1		SSL Connector 5 Position Socket Board to Board or Cable 0.118" (3.00mm) Solder	CONN_SSL_SOCKET5	209159005101916	KYOCERA AVX
J6	1		Header, 100mil, 15x2, Gold, TH	TH, 30-Leads, Body 1500x200mil, Pitch 100mil	TSW-115-08L-D	Samtec
J7	1		Header, 100mil, 4x2, Gold, TH	4x2 Header	TSW-104-07G-D	Samtec
J8, J9, J10	3		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J11	1		Header, 2.54mm, 4x1, Gold, TH	Header, 2.54mm, 4x1, TH	350-10-104-00-006000	Mill-Max
L1, L2, L4, L6	4	22ohm	Ferrite Bead, 22 ohm @ 100MHz, 6A, 0805	0805	742792021	Würth Elektronik
L7	1	4.7uH	Inductor, Shielded, Composite, 4.7uH, 10.5A, 0.0144ohm, AEC-Q200 Grade 1, SMD	IND_6.4x6.1x6.6	XAL6060-472MEB	Coilcraft

Table 5-1. TPS25751EVM Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650x 0.200 inch	THT-14-423-10	Brady
Q1, Q2, Q3, Q4, Q5, QN1, QN2	7	20V	MOSFET, N-CH, 20V, 0.5A, YJM0003A (PICOSTAR-3)	YJM0003A	CSD15380F3	Texas Instruments
QP1, QP2	2	-20V	MOSFET, P-CH, -20 V, -1.7A, YJM0003A (PICOSTAR-3)	YJM0003A	CSD25480F3	Texas Instruments
R1, R3, R4, R6	4	200k	RES, 200k, 1%, 0.05W, 0201	0201	CRCW0201200KFKED	Vishay-Dale
R2, R36, R37, R38, R39	5	10.0k	RES, 10.0k, 1%, 0.05W, 0201	0201	RC0201FR-0710KL	Yageo America
R5, R7, R8	3	51.0k	RES, 51.0k, 1%, 0.05W, 0201	0201	RC0201FR-0751KL	Yageo America
R9, R10, R13, R14, R17, R18, R21, R24, R25, R26, R27	11	100k	RES, 100k, 1%, 0.05W, 0201	0201	RC0201FR-07100KL	Yageo America
R11, R12, R19, R20, R40, R86, R87, R100	8	10.0k	RES, 10.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R15, R16, R49, R50, R52, R53	6	2.20k	RES, 2.20k, 1%, 0.05W, 0201	0201	CRCW02012K20FKED	Vishay-Dale
R22, R23	2	5.10k	RES, 5.10k, 1%, 0.05W, 0201	0201	RC0201FR-075K1L	Yageo America
R28, R29, R30, R31	4	10.0k	RES, 10.0k, 1%, 0.063W, 0402	0402	RC0402FR-0710KL	Yageo America
R32, R33, R34, R35, R60, R61, R65, R68, R69, R70, R71, R74, R76, R77, R84, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99	27	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010000Z0ED	Vishay-Dale
R43, R44, R45, R111, R113, R115	6	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R48, R51, R78, R79, R80, R82, R117	7	10.0k	RES, 10.0k, 1%, 0.05W, 0201	0201	CRCW020110K0FKED	Vishay-Dale
R54, R62	2	499k	RES, 499k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402499KFKED	Vishay-Dale

Table 5-1. TPS25751EVM Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
R55, R63	2	59.0k	RES, 59.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040259K0FKED	Vishay-Dale
R56, R64, R106, R107	4	249k	RES, 249k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402249KFKED	Vishay-Dale
R66	1	976k	RES, 976k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402976KFKED	Vishay-Dale
R67	1	40.2k	RES, 40.2k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040240K2FKED	Vishay-Dale
R72, R73	2	3.83k	RES, 3.83k, 1%, 0.05W, 0201	0201	CRCW02013K83FKED	Vishay-Dale
R85	1	1.02k	RES, 1.02k, 1%, 0.05W, 0201	0201	RC0201FR-071K02L	Yageo America
R101	1	523k	RES, 523k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402523KFKED	Vishay-Dale
R102, R103	2	100k	RES, 100k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100KFKED	Vishay-Dale
R104	1	23.7k	RES, 23.7k, 1%, 0.1W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF2372X	Panasonic
R105, R110	2	100k	RES, 100k, 1%, 0.063W, 0402	0402	RC1005F104CS	Samsung Electro-Mechanics
R108, R109	2	1.00Meg	RES, 1.00M, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04021M00FKED	Vishay-Dale
S1, S2	2		DIP Switch, SPST 4Pos, Slide, SMT	6.2x2.0x6.2mm	TDA04H0SB1	C&K Components
S3	1		SWITCH TACTILE SPST-NO 0.05A 12V	3x1.6x2.5mm	B3U-1000P	Omron Electronic Components
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5	5	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16	16		Test Point, Miniature, SMT	Testpoint_Keystone_Minature	5015	Keystone Electronics
U1	1		Sink-only USB Type-C® and USB Power Delivery (PD) controller with no firmware development required 38-WQFN -40 to 125	WQFN38	TPS25730DREFR	Texas Instruments
U2, U3	2		22V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	Texas Instruments

Table 5-1. TPS25751EVM Bill of Materials (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
U4	1		USB Type-C and USB PD Controller with Integrated Power Switches Optimized for Power Applications	WQFN38	TPS25751DREFR	Texas Instruments
U5	1		256kb I2C CMOS Serial EEPROM, SOIC-8	SOIC-8	CAT24C256WI-GT3	ON Semiconductor
U6	1		ESD Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85 degC, 3-pin SOT (DRT), Green (RoHS & no Sb/Br)	DRT0003A	TPD2E009DRTR	Texas Instruments
U7	1		Tiva C Series Microcontroller, 256KB Flash, 32KB SRAM, 12 Bit, 12 Channels, -40 to 105 degC, 64-Pin LQFP (PM), Green (RoHS & no Sb/Br), Tape and Reel	PM0064A	TM4C123GH6PMTR	Texas Instruments
U8, U11	2		500mA, Low IQ, Small Size, Low Dropout Regulator, DQN0004A (X2SON-4)	DQN0004A	TLV75533PDQNT	Texas Instruments
U9	1		5V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS0500DRVR	Texas Instruments
U10	1		3.5V to 60V 5A Synchronous Step-Down Voltage Regulator, RNP0030A (WQFN-30)	RNP0030A	LM76005RNPR	Texas Instruments
U12	1		USB Type-C@ 28V SPR Port Protector: Short-to-VBUS Overvoltage and IEC ESD Protection	WQFN20	TPD4S201RUKR	Texas Instruments
Y1	1		Crystal, 16MHz, 8pF, SMD	3.2x0.75x2.5mm	NX3225GA-16.000M-STD-CRG-1	NDK

6 Additional Information

6.1 Trademarks

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6.2 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits can be more susceptible to damage because very small parametric changes can cause the device not to meet the published specifications.

6.3 Terminology

[TI Glossary](#) lists and explains generic terms, acronyms, and definitions.

[A Primer on USB Type-C® and USB Power Delivery Applications and Requirements](#) lists and explains USB Type-C and USB Power Delivery terms, acronyms and definitions.

6.4 Device Support

6.4.1 Third-Party Products Disclaimer

TI's publication of information regarding third-party products or services does not constitute an endorsement regarding the ability of such products or services or a warranty, representation or endorsement of such products or services, either alone or in combination with any TI product or service.

6.4.2 Supplemental Content

For the device to function in accordance with the relevant specifications, the user needs to download the latest version of the firmware for the device (see section on receiving notification of documentation and firmware updates). If the latest version of the firmware is not downloaded and incorporated into the device, then the device is provided “as is” and TI makes no warranty or representation whatsoever in respect of such device, and disclaims any and all warranties and representations with respect to such device. Further, if the latest version of the firmware is not downloaded and incorporated into the device, TI is not be liable for and specifically disclaims any damages, including direct damages, however caused, whether arising under contract, tort, negligence, or other theory of liability relating to the device, even if TI is advised of the possibility of such damages.

6.5 Documentation Support

6.5.1 Documentation Support

- [USB Power Delivery Specification](#)
- [USB-PD Specifications](#)
- [USB Type-C Cable and Connector Specifications](#)
- [USB Document Library](#)
- [USB Power Delivery - Compliance Reports](#)

6.6 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

6.7 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask questions to get the quick design help you need. Linked content is provided "AS IS" by the respective contributors. The content does not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (March 2024) to Revision B (October 2025)	Page
• Updated USB-IF PD specification version from 3.1 to 3.2, and added BQ25731 and VIF generation feature....	1
• Updated EVM image to RevA2.....	1
• Added TPD4S201 in block diagram.....	4
• Added BQ25731, replaced TPD2S300 U5 with TPD4S201 U12, replaced U5 with CAT24C256.....	5
• Updated J6 header and pinout descriptions including PPHV_DIV2.....	6
• Updated jumper designator based on Rev A2.....	8
• Updated LED designator net label and description based on RevA2.....	9
• Updated Test Points designator label based on RevA2.....	10
• Added VIF generation capabilities.....	12
• Added column for PP3 config.....	13
• Added link for VIF Application Note.....	25
• Added new section for testing TPD4S201.....	26
• Added new section for testing TPD4S201.....	26
• Added BQ25756E version.....	27
• Deleted dead battery auto clear configurations for BQ25756(E).....	29
• Deleted dead battery auto clear configurations for BQ25792 and BQ25798.....	31
• Added Section 4.3.3 section	31
• Added Section 4.3.3.1 section.....	32
• Added Section 4.3.3.2 section.....	33
• Deleted dead battery auto clear configurations.....	35
• Updated block diagram with TPD4S201.....	36
• Updated resistor designator for BC1.2 (R32/33 to R41/42) and Liquid Detection (R34/36 to R44/45), replaced TPD2S300 with TPD4S201.....	36
• Added GPIO_2 in the Default Configuration table.....	38
• Updated schematic based on Rev A2.....	39
• Updated PCB design based on RevA2.....	45
• Updated <i>Bill of Materials</i> table based on RevA2.....	49

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User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

-
- 4 *EVM Use Restrictions and Warnings:*
 - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
 - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
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 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
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