

1 Evaluation Module Overview

1.1 Introduction

The TPS25751AEVM is an evaluation module designed to facilitate comprehensive assessment of the TPS25751A in both standalone configurations and USB Type-C and power delivery (PD) applications. The TPS25751A features integrated managed power paths with robust protection for complete USB-C PD designs. Additionally, the device integrates I2C communication control for external battery charger integrated circuits (ICs), adding ease of use and accelerating time to market. This user's guide provides detailed information for evaluating and implementing the TPS25751A evaluation module.

The following is a continuation of the features list:

- Support integration with the following BQ EVMs
 - [BQ25756](#), [BQ25756E](#), BQ25792, [BQ25798](#), [BQ25731](#), [BQ25713](#), and [BQ25690](#)
 - 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
 - 60W (20V:3A) source and 100W (20V:3A) sink with BQ25690EVM for 1S-7S battery applications
- Multiple test points and headers for quick and easy debugging
 - Exposed VBUS and CCx test points to monitor PD traffic
 - PP_5V and PP_HV test points to measure voltage transitions
- Pre-configured firmware to support features such as:
 - Programmable power supply (PPS) for source and sink within 5V to 21V range
 - Liquid detection and corrosion mitigation measurable on either SBU1 and SBU2, CC1 and CC2, or Dp and Dm
 - Enabling BC1.2 for proprietary and legacy charging
 - Current sensing analog-to-digital converter (ADC) reading using a GPIO on VBUS
 - Automatic vendor information file (VIF) generation for USB power-delivery compliance

1.2 Kit Contents

- TPS25751AEVM
- Ribbon cable
- XT30M cable
- XT30F cable
- EVM Disclaimer Read Me

1.3 Specification

[Figure 1-1](#) shows the block diagram.

1.4 Device Information

The TPS25751AS is a single-port, USB Type-C PD controller with an external bidirectional high-voltage power path for power-only applications. The TPS25751AEVM is used to evaluate the functionally equivalent TPS25751AD (internal high-voltage power path) version of the TPS25751A PD controller. The TPS25751A 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 TPS25751AEVM includes several devices for complete evaluation of voltage protection, power topology, current sensing, and an additional TPS25730S PD controller for barrel-jack replacement.

The TPS25751A 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.

Table 1-1. Devices on TPS25751AEVM

Designator	Device Name	Description
U1	TPS25751A	USB Type-C SPR Dual Role Power PD controller
U2	TPD4S201	CC1/2 and SBU1/2 20V port protection with short to VBUS protection and ESD protection
U3	TVS2200	22V flat-clamp surge protection device
U4	CAT24C256	EEPROM Serial 256-Kb (32-KB) I2C
U5	TPS25730	USB Type-C sink-only PD controller, DC barrel jack replacement
U6	TVS2200	22V flat-clamp surge protection device, USB-C sink only protection
U7	TPD4S201	Sink only PD controller CC1/2 short to VBUS and ESD protection
U8	LM76005	Synchronous step-down converter for 5V (PP_5V)
U9	TLV757P	Low-dropout voltage regulator for 3.3V (P3V3)
U10	INA296A3	VBUS current sensor for ADC reading and OCP
U11	SC0914-13	Raspberry Pi Pico MCU, used in conjunction with GUI to flash the EVM
U12	TVS0500DRVR	5V flat-clamp to protect PICO port
U13	TPD2EUSB30	Dual ESD protection diode with 5A surge rating
U14	W25Q16JVSNIQ-TR	SPI 16Mbit Flash for PICO
U15	TPD2S300	30V short to VBUS Protection, DP/DM protection
Q1	CSD87501L	30V N channel MOSFET, External Power Path

2 Hardware

2.1 Power Requirements

For standalone PD evaluation, the main power supply for the TPS25751AEVM is through the Type-C sink-only port (J8), which accepts a 45W Type-C PD source (15V to 20V). If the Type-C adapter is not capable of minimum 15V, then the TPS25751AEVM does not power on properly. Alternatively, the EVM can also be powered on from an external bench supply connected to VSYS test point (TP3), with the bench supply providing a voltage with a 15V to 20V range. Note VSYS (TP3) has an absolute maximum rating of 48V with a recommended maximum of 42V. Applying more than the maximum voltage can cause damage to the EVM.

The TPS25751AEVM can also be powered directly through Type-C Connector (J14) to simulate the TPS25751A in a dead battery scenario. When the TPS25751AEVM is powered only through port J14, the EVM acts as sink-only to the connected port partner (unable to source unless VSYS is powered on). For battery charging applications, the selected BQ EVM can be used to power on the TPS25751AEVM. The BQ25792 and BQ257928EVM come with an interfacing connector to connect to J12 connectors on the TPS25751AEVM. 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 (PP_HV) of the TPS25751AEVM. For more information on setting up and programming TPS25751A for battery charger applications, refer to [Section 4.3](#).

2.2 Setup

Out of the box, the TPS25751AEVM is configured for a 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 the USB CPD Application Customization Tool User's Guide for detailed instructions on using the application customization tool.

2.3 Header Information

H1 and H2 headers contain numerous pinouts from TPS25751A for testing, evaluation, and debugging purposes. The header pins are labeled on the top layer of the TPS25751AEVM for easy access. For details see [Figure 2-1](#) and [Figure 2-2](#).

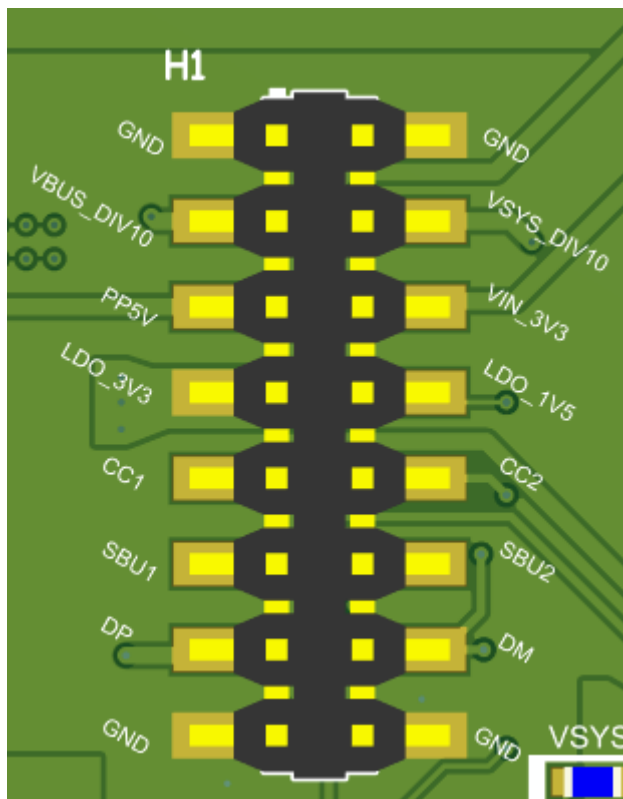


Figure 2-1. H1 Header

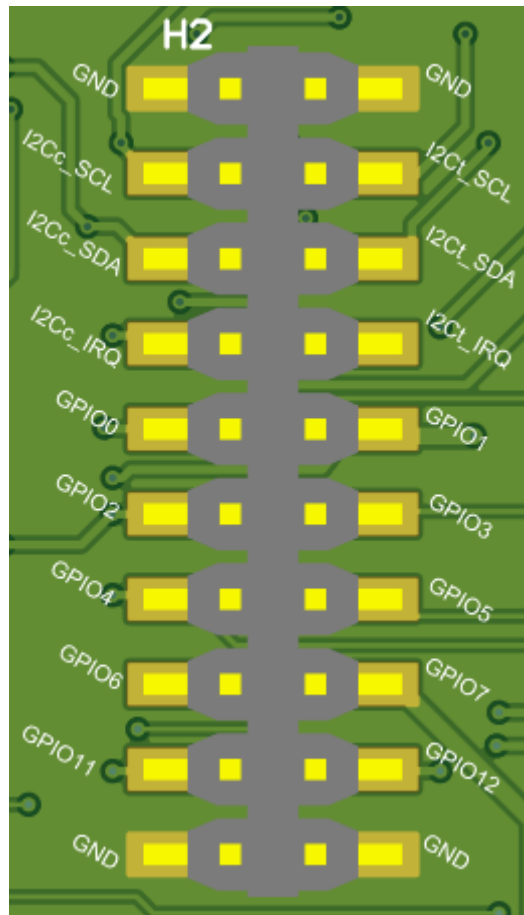


Figure 2-2. H2 Header

Table 2-1. Headers Description

Pin Number	H1 Pin Label	H1 Pin Description
1	GND	Ground reference for EVM
2	GND	Ground reference for EVM
3	VBUS_D10	VBUS voltage reference divided down by 10 (for example, 5V = 500mV)
4	VSYS_D10	VSYS voltage reference divided down by 10 (for example, 5V = 500mV)
5	PP_5V	PD Controller 5V system supplies through internal PP_5V to VBUS
6	VIN_3V3	3.3V system supply to PD Controller VIN_3V3 pin
7	LDO_3V3	3.3V output supply from PD Controller LDO_3V3 pin
8	LDO_1V5	1.5V output supply from PD controller LDO_1V5 pin
9	CC1	System side of CC1 of PD controller, located between Husker and the PD controller
10	CC2	System side of CC2 of PD controller, located between Husker and the PD controller
11	SBU1	System side of SBU1 of PD controller, located between Husker and the PD controller
12	SBU2	System side of SBU1 of PD controller, located between Husker and the PD controller
13	GND	Ground reference for EVM
14	NC	No connect
15	NC	No connect

Table 2-1. Headers Description (continued)

Pin Number	H1 Pin Label	H1 Pin Description
16	NC	No connect

2.4 Jumper Information

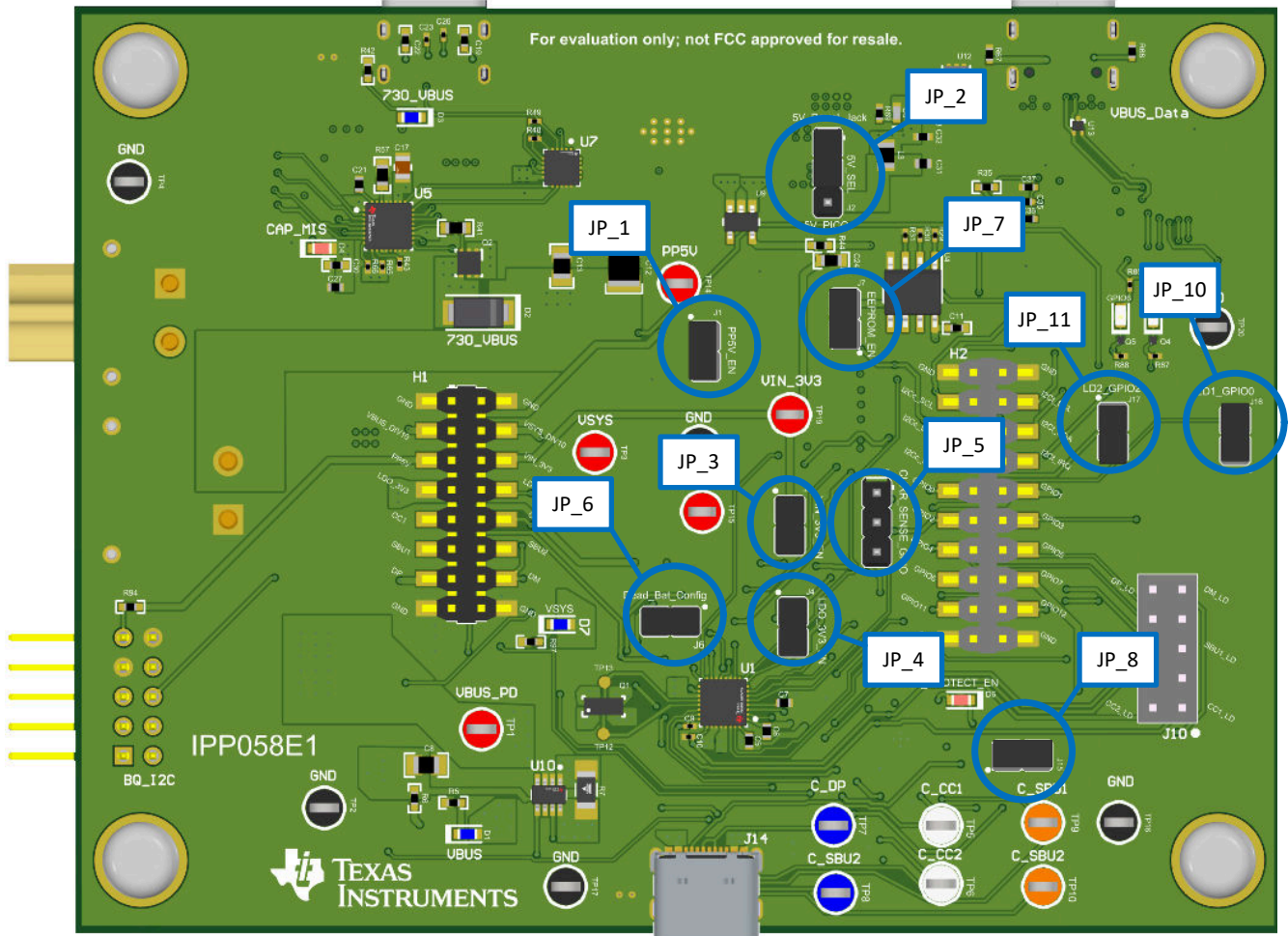


Figure 2-3. Jumper Locations

Table 2-2. Jumper Descriptions

Jumper Net Name	Jumper Designator	Pin Description
PP_5V_EN	JP_1	5V input to PD controller PP_5V. Remove jumper to disconnect 5V power to PP_5V.
PP_5V_Sel	JP_2	Select PP_5V 5V source, either from on-board 5V Buck (powered from Power Type C) or from the PICO port (naively 5V from computer USB port).
VIN_3V3	JP_3	3.3V input to PD controller VIN_3V3. Remove jumper to disconnect 3.3V power to PD controller for simulating DB mode.
LDO3V3	JP_4	3.3V output from PD controller LDO_3V3. Remove jumper to disconnect 3.3V rail to EEPROM and 3.3V pull-ups to I2Cc/I2Ct lines (removes all power draw from PD LDO_3V3 pin).
OCP Sel	JP_5	Select if INA (U10) is connected to GPIO0 or GPIO4.

Table 2-2. Jumper Descriptions (continued)

Jumper Net Name	Jumper Designator	Pin Description
DB_CONFIG/I2C_ADDR	JP_6	Configures Dead Battery mode of PD controller. Keep jumper on for SafeMode, remove jumper for AlwaysEnableSink.
EEPROM_EN	JP_7	I2Cc data line between PD controller and EEPROM. Remove jumper to disable I2C config load from EEPROM (PD remains in PTCH).
FLT_Husker	JP_8	FLT output pin from Husker to indicate Short-to-VBUS on its C_CCx/C_SBUx pins. Keep jumper on for connection from Husker FLT to PD Controller GPIO1, remove jumper for no FLT connection from Husker to PD Controller GPIO1.
LD SEL	JP_9	Select which pins to use for Liquid Detection (CCx or SBUx).
LD1_GPIO0	JP_10	LD1 resistor divider is connected to GPIO0 for ADC measurement
LD2_GPIO2	JP_11	LD2 resistor divider is connected to GPIO2 for ADC measurement

2.5 LED Information

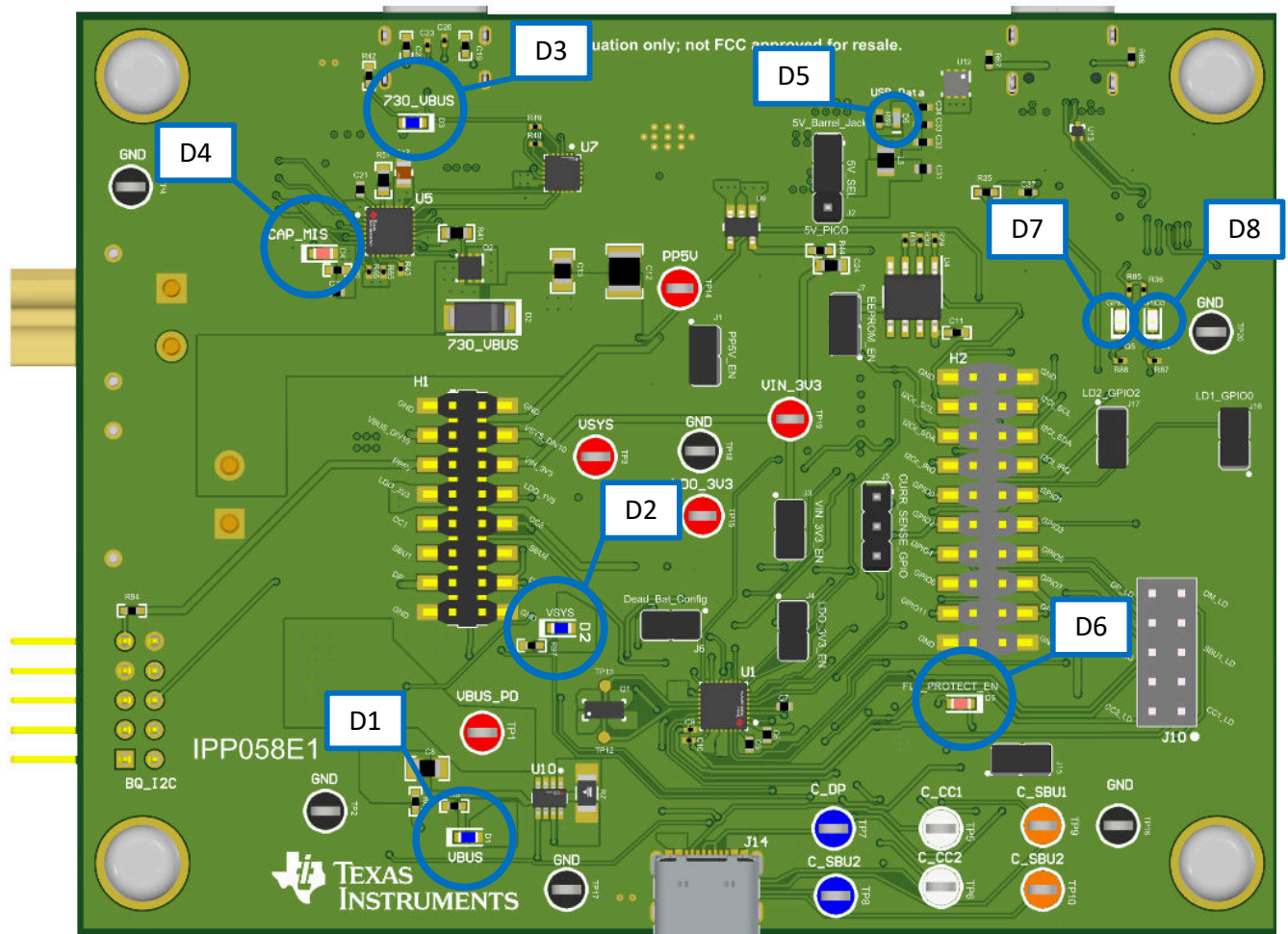


Figure 2-4. LED Locations

Table 2-3. LED Descriptions

Designator	Net Label	Description
D1	VBUS	Blue LED that shows when BQ battery is connected to VBAT
D2	VSYS (PP_HV)	Blue LED that shows when VBAT or 730_PP_HV is supplying system power (VSYS)
D3	730_VBUS	Blue LED that shows when USB Type-C is connected to sink only Type-C port (J8)
D4	730_CAP_MIS	Red LED that shows capability mismatch when an attached source is not providing enough power to the sink only Type-C port (J8)
D5	USB_Data	White LED that shows when USB Type-C is connected to data Type-C port (J9).
D6	FLT_Husker	Red LED that shows when the protection devices assert a FLT event
D7	GPIO6	Yellow LED that shows GPIO6 is high
D8	GPIO3	Yellow LED that shows GPIO3 is high

2.6 Test Points

Table 2-4. Test Point Description

Designator	Net Label	Description
VBUS	TP_1	PD Controller VBUS voltage reference
GND	TP_2	Ground reference for EVM, this GND shall be placed close to VBUS
VSYS	TP_3	PD Controller VSYS voltage reference (updated terminology from previous PP_HV label to match the 'S' variant)
GND	TP_4	Ground reference for EVM< this GND shall be placed close to VSYS
C_CC1	TP_5	Connector side of CC1 of PD controller, located between Husker and the USB-C/PD Port
C_CC2	TP_6	Connector side of CC2 of PD controller, located between Husker and the USB-C/PD Port
C_DP	TP_7	Connector side of DP of PD controller, located between Husker and the USB-C/PD Port
C_DM	TP_8	Connector side of DM of PD controller, located between Husker and the USB-C/PD Port
C_SBU1	TP_9	Connector side of SBU1 of PD controller, located between Husker and the USB-C/PD Port
C_SBU2	TP_10	Connector side of SBU2 of PD controller, located between Husker and the USB-C/PD Port
GATE_VBUS	TP_12	Connected to N-ch MOSFET that has source tied to VBUS
GATE_VSYS	TP_13	Connected to N-ch MOSFET that has source tied to VSYS
PP_5V	TP_14	TPS25751A 5V system supply to VBUS, supply for CCy pins as VCONN
LDO_3V3	TP_15	3.3V output supply from TPS25751A LDO_3V3 pin, switched from VIN_3V3 or VBUS LDO.
GND	TP_16	Ground reference for EVM, this GND shall be placed close to VBUS
GND	TP_17	Ground reference for EVM, this GND shall be placed close to VBUS
GND	TP_18	Ground reference for EVM, this GND shall be placed close to VBUS
VIN_3V3	TP_19	PD Controller VIN_3V3 voltage
GND	TP_20	Ground reference for EVM, this GND shall be placed close to VBUS

2.7 Switches and Push Buttons

Table 2-5. Switches and Push-Buttons Description

Designator	Label	Description
S1	TP_20	Push-button to pull the RST the Pi PICO 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. For detailed information on how to install, launch, and utilize the GUI with the TPS25751AEVM see the GUI User's Guide. This also includes instructions on flashing the TPS25751AEVM.

The application customization tool is used to directly load a configuration onto the TPS25751AEVM. Connect J9 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 TPS25751AEVM is properly powered either through J8 Type-C connector to a 15V to 20V Type-C adapter or with a bench power supply. See [Figure 3-1](#) for reference.

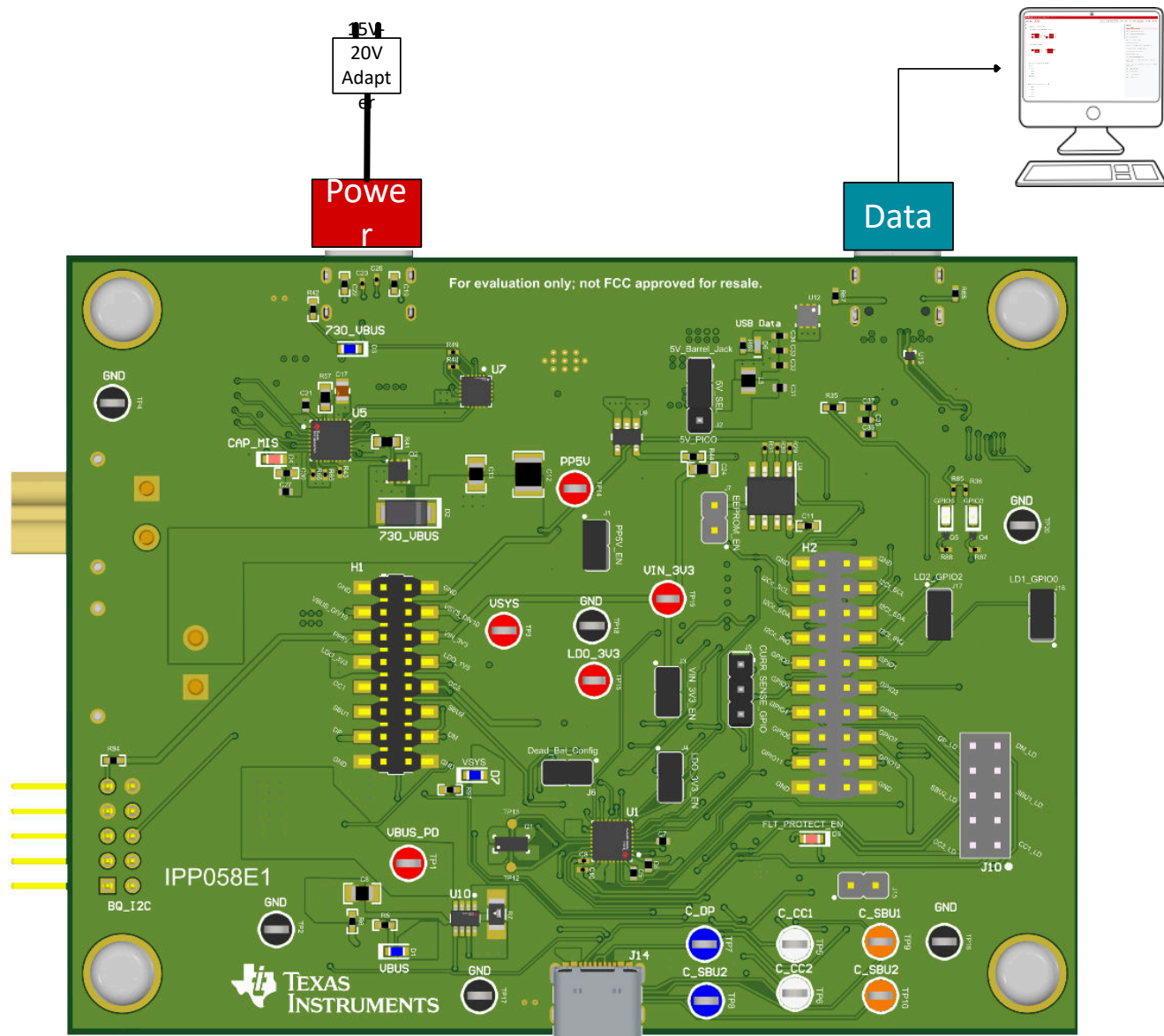


Figure 3-1. TPS25751AEVM Connection with PC

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 TPS25751AEVM for testing short-to-VBUS overvoltage with TPD4S201, battery-charging applications with BQ257xx devices, and configuring liquid detection and corrosion mitigation.

4.2 TPD4S201 Short-to-Vbus Protection

The TPS25751AEVM comes with TPD4S201 to protect the TPS25751A 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 four channels short-to-Vbus overvoltage and IEC ESD protection. TPD2S300 protects the TPS25751A PD controller from shorts to the DP and DM pins. The TPD2S300 is a single-chip USB Type-C port protection device that provides absolute maximum 28V two channels short-to-Vbus overvoltage and IEC ESD protection.

On the TPS25751AEVM, the hardware is set to use GPIO1 on TPS25751AS as an active low input. When a short-to-Vbus short occurs on the CCx, SBUx, or DP or DM pins, the FLT pin is driven low by a protection device to indicate a short has occurred and prompts TPS25751A to enter Type-C error recovery. When the FLT is driven low, GPIO1 LED D6 toggles low and toggles back high once the short is removed. For more details, see the [TPD4S201](#) and [TPD2S300](#) product pages.

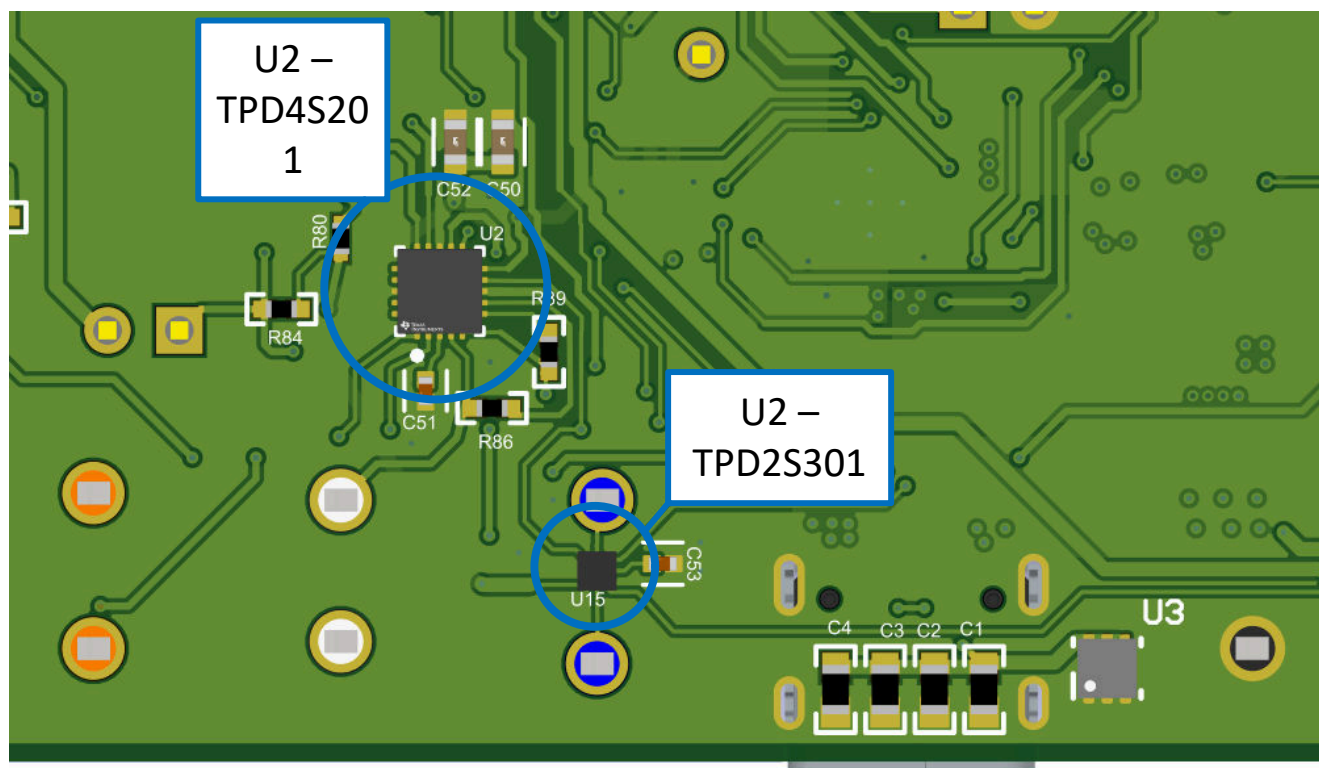


Figure 4-1. TPD4S201 and TPD2S300 EVM Location

Table 4-1. TPD4S201 Test Points

Test Point on EVM	Description
TP5 - C_CC1	Connected to C_CC1 (pin 4) of TPD4S201, between TPD4S201 and J14 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP6 - C_CC2	Connected to C_CC2 (pin 5) of TPD4S201, between TPD4S201 and J14 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP9 - C_SBU1	Connected to C_SBU1 (pin 1) of TPD4S201, between TPD4S201 and J14 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.
TP10 - C_SBU2	Connected to C_SBU2 (pin 2) of TPD4S201, between TPD4S201 and J14 Type-C connector. This test point is subjected to overvoltage and short conditions at the Type-C connector.

Table 4-1. TPD4S201 Test Points (continued)

Test Point on EVM	Description
JP_15 - GPIO1	Connected from FLT (pin 9) of TPD4S201 to GPIO1 of TPS25751A. Set GPIO1 to <i>Fault_Input_Event (33)</i> with in the GUI. When TPD4S201 drives this pin low, GPIO1 toggles D6 LED low and TPS25751A enters Type-C error recovery.
H1 Pin9- CC1	Connected from CC1 (pin 11) of TPD4S201 to CC1 of TPS25751A. This test point is protected from overvoltage and short conditions at the Type-C connector.
H1 Pin10-CC2	Connected from CC2 (pin 12) of TPD4S201 to CC2 of TPS25751A. This test point is protected from overvoltage and short conditions at the Type-C connector.
H1 Pin11-SBU1	Connected from SBU1 (pin 15) of TPD4S201 to SBU1 of TPS25751A. This test point is protected from overvoltage and short conditions at the Type-C connector.
H1 Pin12-SBU2	Connected from SBU2 (pin 14) of TPD4S201 to SBU2 of TPS25751A. This test point is protected from overvoltage and short conditions at the Type-C connector.

4.3 TPS25751AEVM and BQ257xxEVM Setup

The TPS25751AEVM can be used in conjunction with the BQ25756(E)EVM, BQ25792EVM or BQ25798EVM, BQ25731EVM, BQ25713EVM, and BQ25690EVM to simulate USB Type-C and battery charger applications.

When using the TPS25751AEVM in conjunction with a BQ257xxEVM, plugging in the Type-C power adapter to the J8 port is not a requirement. The BQ257xxEVM can supply power to the TPS25751AEVM VSYS through VBAT.

Note

VSYS (TP_3) has an absolute maximum rating of 48V. Do not apply more than 48V on VSYS. When using BQ257xxEVM with TPS25751AEVM, see the specific BQ257xxEVM for jumper placements to configure battery cells. Incorrect settings of the BQ257xxEVM can result in a non-functioning setup. See [Section 4.3.2](#) for further details.

For GUI application configuration details, see the USB-C PD Application Customization Tool User's Guide.

4.3.1 Hardware Setup with BQ25756(E)EVM

To use the TPS25751AEVM and BQ25756EVM, the following items are needed:

1. TPS25751AEVM
2. Ribbon cable (included with TPS25751AEVM)
3. BQ25756 interposer board (included with TPS25751AEVM)
4. Application customization tool
5. BQ25756EVM
6. BQ25756EVM [user's guide](#) and [datasheet](#)
7. [BQStudio with EV2400](#) (optional)
8. DC power supply or battery simulator

To setup the hardware, follow the instructions below:

1. Connect the J11 and J13 mating connectors of the TPS25751AEVM to the reciprocal connectors on the provided BQ25756 interposer board. The silk-screen *BQ25756* on the BQ25756 interposer board must be oriented on the same plane as the top of the TPS26750EVM. See [TPS25751AEVM and BQ25756\(E\)EVM Hardware Setup](#).
2. Unscrew the screws on headers J1 and J3 of the BQ25756EVM enough for the BQ25756 interposer board prongs to fit into the aforementioned headers.
3. Insert the other side of the BQ25756 interposer board to headers J1 and J3 on the BQ25756EVM. Verify the prongs are inserted all the way into the headers.

Note

Repeated insertion and removal of TPS25751AEVM mating connectors from the BQ25756 interposer board (depending upon how the boards are grasped and pulled) can cause the prongs on the side of the interposer board connected to the BQ25756EVM to come out of the J1 and J3 headers enough to cause an insufficient electrical connection between the BQ25756EVM and the TPS25751AEVM. *Please recheck interposer board connections when detaching and re-attaching BQ25756EVM from the TPS25751AEVM.*

4. Tighten the screws on headers J1 and J3 of the BQ25756EVM.
5. Attach the ribbon cable to header J12 on the TPS25751AEVM as shown in [Figure 4-2](#).
6. Connect the other end of the ribbon cable to J8 header of the BQ25756(E)EVM.
7. To power the board using a simulated battery, connect the simulated battery to header J3 in the orientation shown on the silkscreen (+ and - symbols next to J3).
8. For setting the proper jumper for battery charging application, refer to [BQ25756 Evaluation Module User's Guide](#). Incorrect jumper settings or insufficient input power can result in a faulty evaluation.

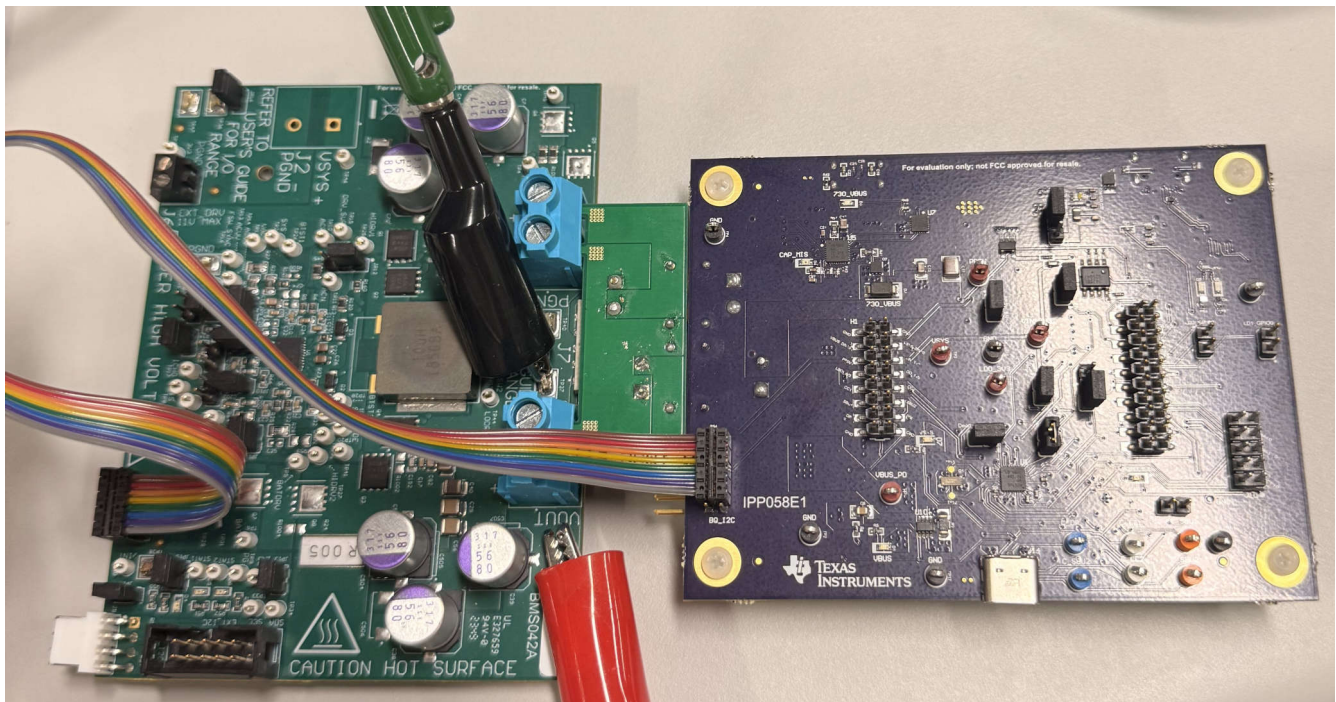


Figure 4-2. TPS25751AEVM and BQ25756(E)EVM Hardware Setup

4.3.2 Setting up with BQ25792EVM or BQ25798EVM

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

1. TPS25751AEVM
2. Test hook clips jumper wires
3. TPS25751AEVM user's guide and application customization tool
4. BQ25792EVM or BQ25798EVM
5. BQ25792EVM [user's guide](#) and datasheet or BQ25798EVM [user's guide](#) and [datasheet](#)
6. [BQStudio with EV2400](#) (optional)
7. DC power supply or battery simulator

Use the following instructions to set up the hardware:

1. [Figure 4-3](#) shows how to use the test hook clips or jumper wires to connect the two EVMs. See [Table 4-2](#) for details.

- See the [BQ25792EVM](#), [BQ25798EVM](#), and [BQ25798BKUPEVM \(BMS034\) Evaluation Module user's guide](#) for instructions on how to set the proper jumper for battery charging applications. Incorrect jumper settings or insufficient input power can result in a faulty evaluation.

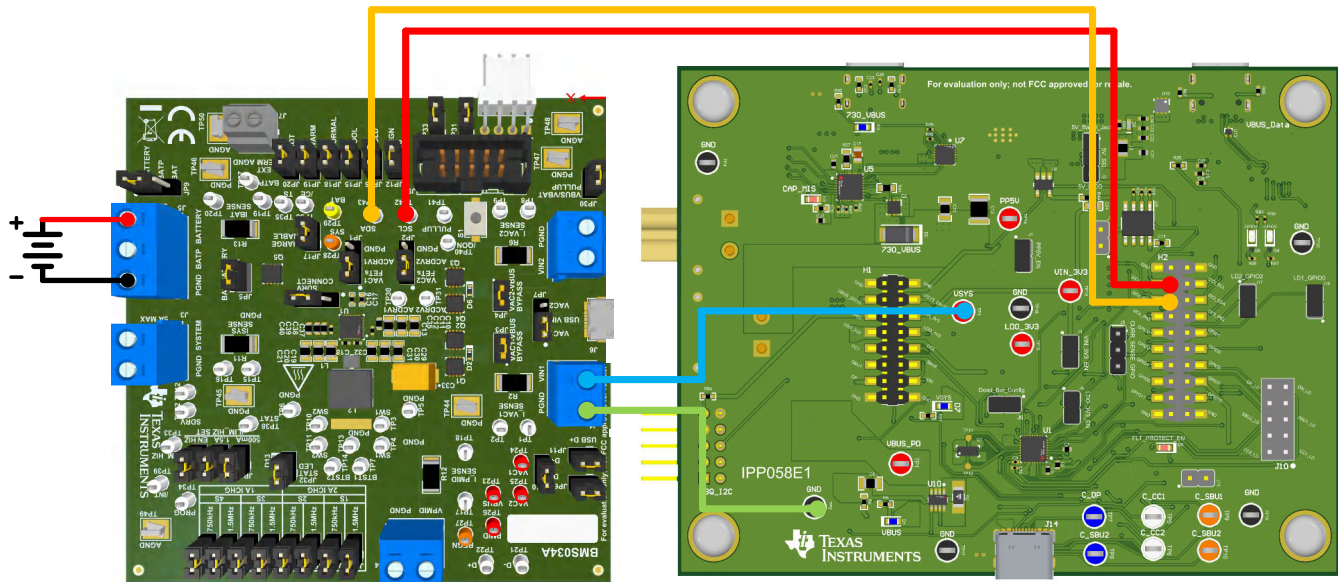


Figure 4-3. TPS25751AEVM and BQ25792EVM, BQ25798EVM Hardware Setup

Table 4-2. TPS25751AEVM and BQ25792EVM, BQ25798EVM Connections

Color Designator	TPS25751EVM Location	BQ25792EVM, BQ25798EVM Locator
Red	I2Cc_SCL	TP42 - SCL
Orange	I2Cc_SDA	TP43 - SDA
Blue	TP14 - VSYS	J1 - VIN1
Green	GND	PGND

Note

VSYS and GND pins on TPS25751AEVM draw significant current, so verify the cables used to connect the EVMs are able to support high current (maximum 5A).

4.3.3 Liquid Detection and Corrosion Mitigation Overview

TPS25751AEVM 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, TPS25751A monitors the SBU, CC, or DP/DM lines for unexpected shorts to ground or high voltage (5V and above). The configuration of the pins used for liquid detection is chosen by the user. TPS25751A supports corrosion mitigation by automatically disabling the Type-C port when a short is detected. When a short is no longer detected across the monitor pins, TPS25751A enters back into normal operation. For GUI application configuration details, see USB-C PD Application Customization Tool User's Guide.

4.3.3.1 Liquid Detection and Corrosion Mitigation Hardware Setup

TPD4S201 (U2) is in between TPS25751A and J14 Type-C port for protection in case of a short to VBUS. J10 requires jumper connections from the selected monitor pins to LD_1, and LD_2. JP_10 and JP_11 are connected to GPIO0 and GPIO2 via header pins. See [Figure 4-4](#) below for the jumper header pin connections required to implement liquid detection.

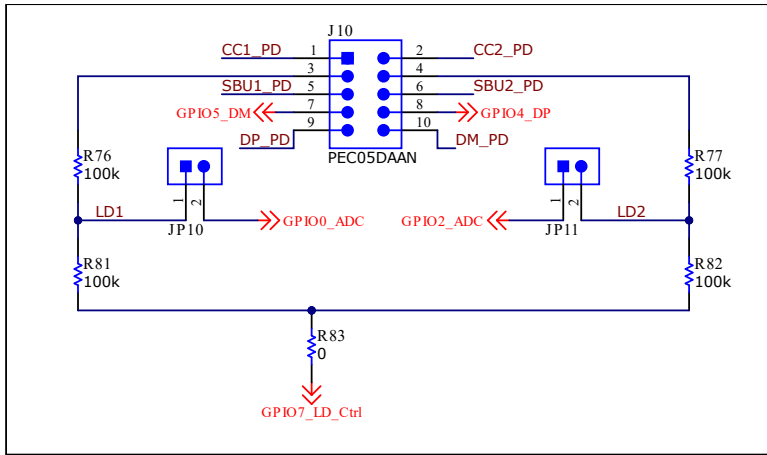


Figure 4-4. Liquid Detection Jumper Selection

The example selection using the CC1/2 lines for the monitor pins in Figure 4-5 shows CC1 (Pin1) and CC2 (Pin 2) connecting to LD_1 (Pin 3) and LD_2 (Pin 4). See Table 4-3 for all monitor pin connections to LD_1 and LD_2. Note that jumper wires are needed to utilize the Dp/Dm pins for liquid detection.

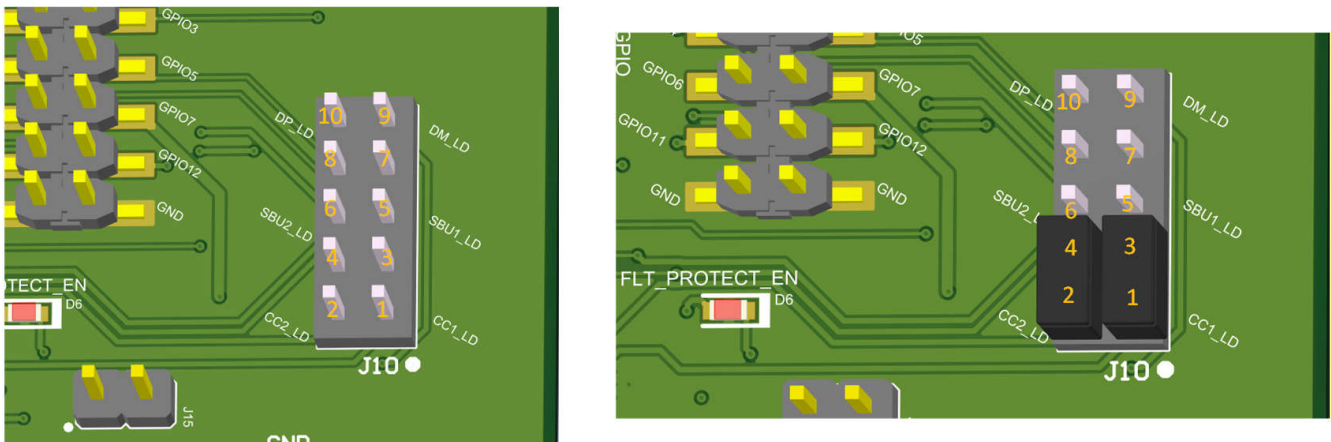


Figure 4-5. J10 Header for Liquid Detection Monitor Pin Selection

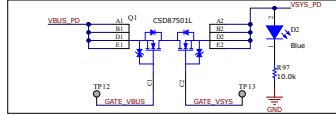
Table 4-3. J10 Jumper for Liquid Detection Monitor Pin Connections

Monitor Pin for LD	Pin 3 (LD_1) connects to	Pin 4 (LD_2) connects to
CC1 and CC2	Pin 1	Pin 2
SBU1 and SBU2	Pin 5	Pin 6
Dp and Dm	Pin 9	Pin 10

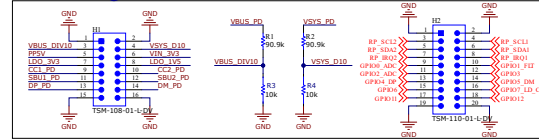
5 Hardware Design Files

5.1 Schematics

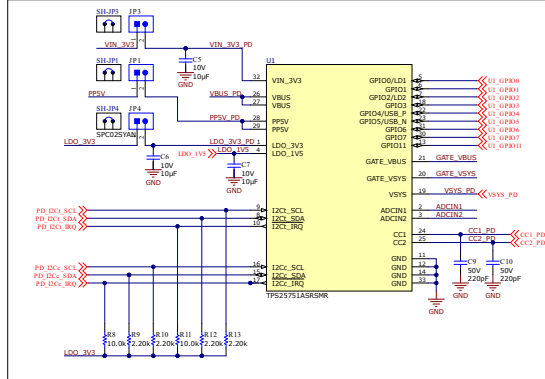
External Power Path



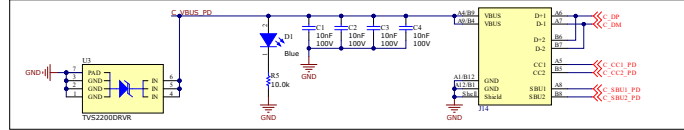
Header Digital



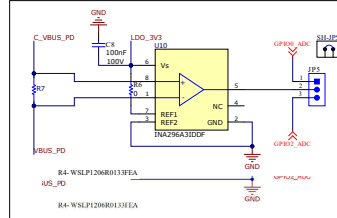
TPS25751A PD Controller



DUT Port



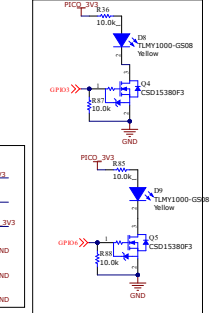
VBUS Current Sense



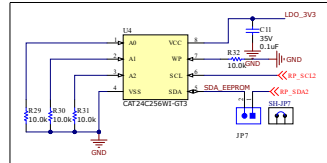
Disable I2Ct



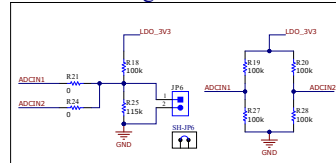
GPIO 3 & 6 Diodes



EEPROM



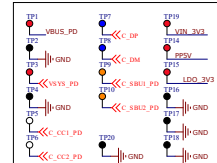
ADCIN Config for DRP



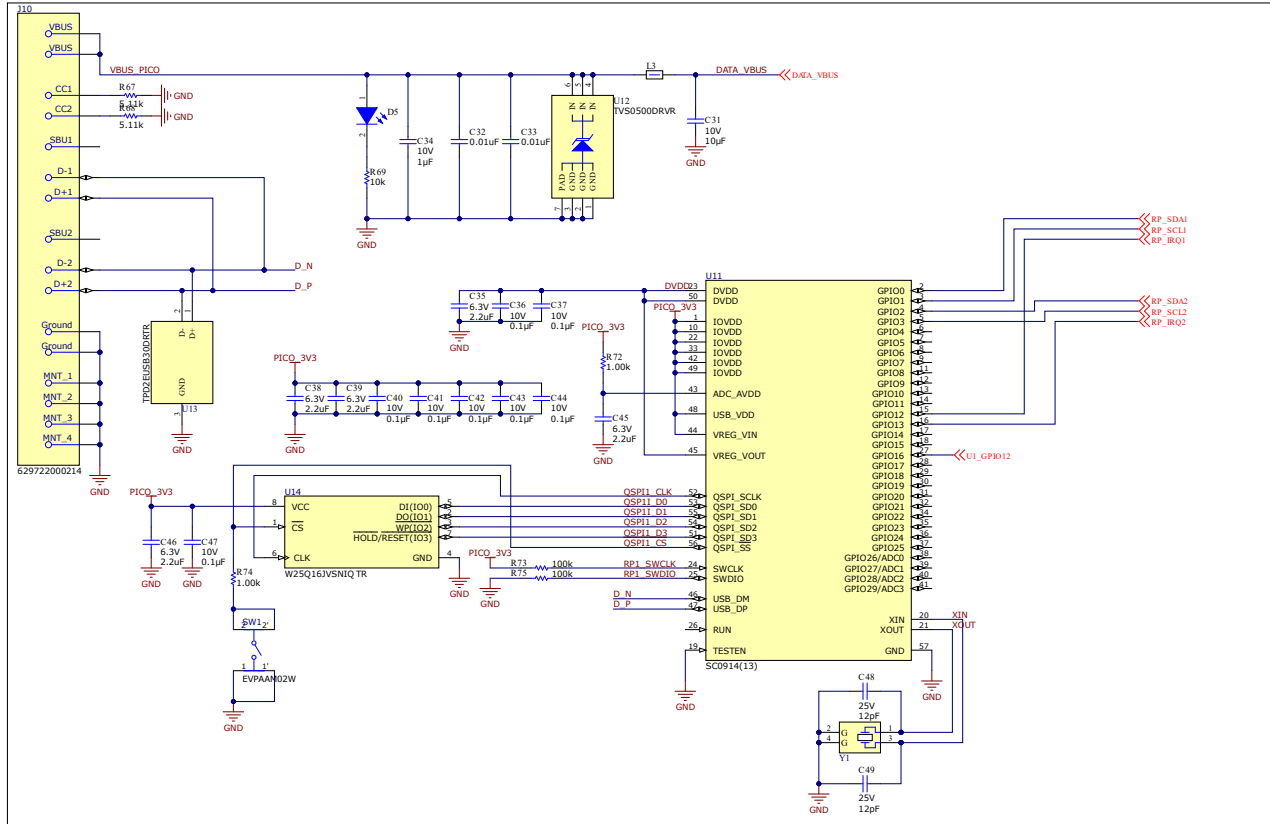
GPIO Functions



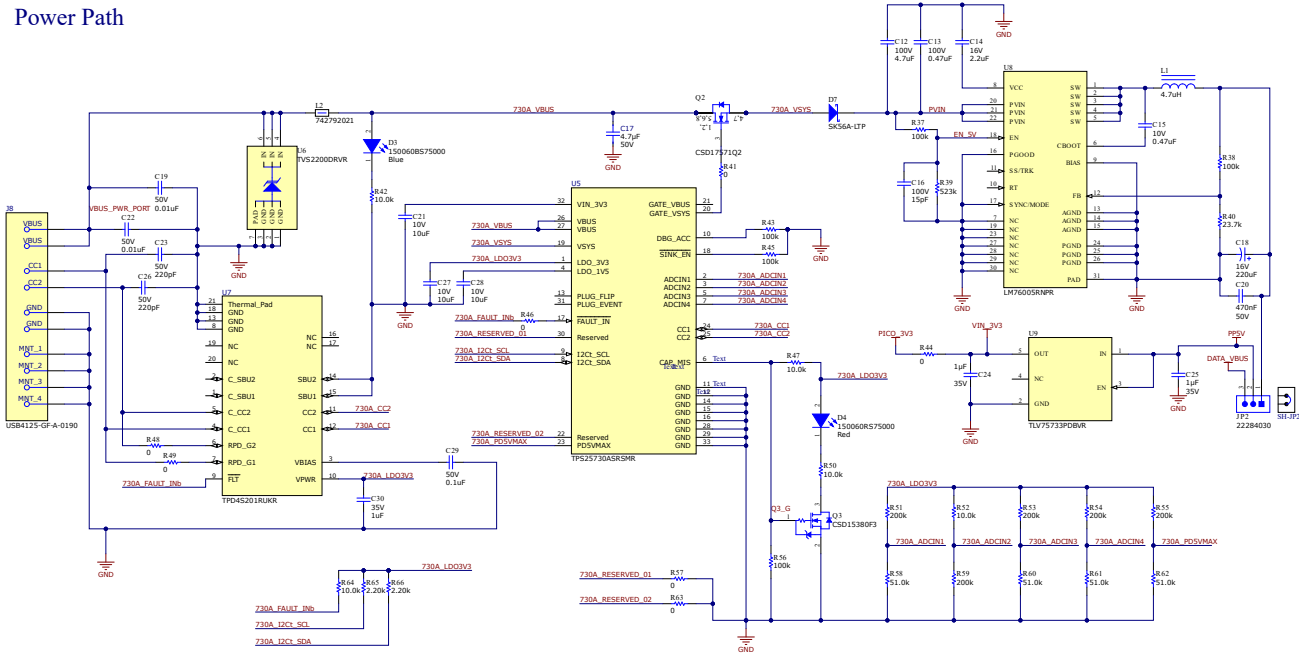
Test Points



Raspberry Pi Pico



Power Path



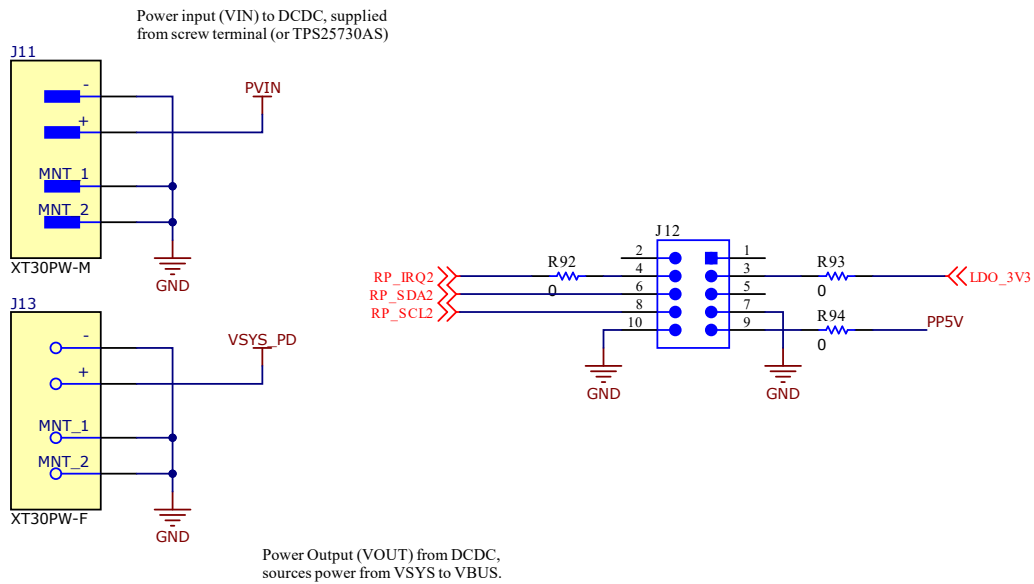
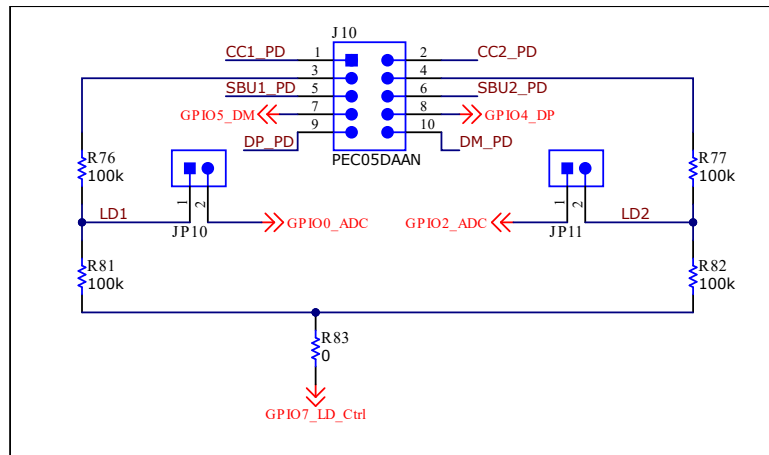


Figure 5-1. TPS25751AEVM Schematic

5.2 PCB Layouts

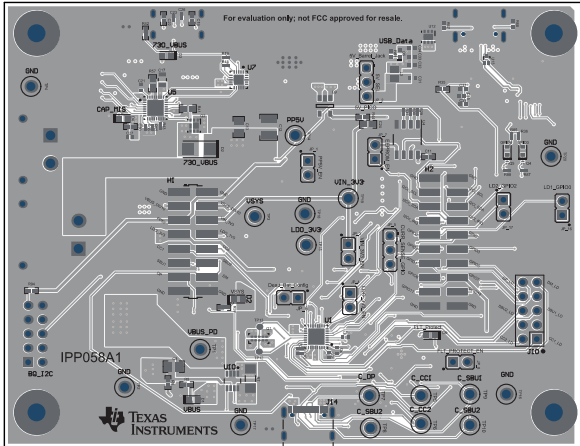


Figure 5-2. TPS25751AEVM Top Layer Composite

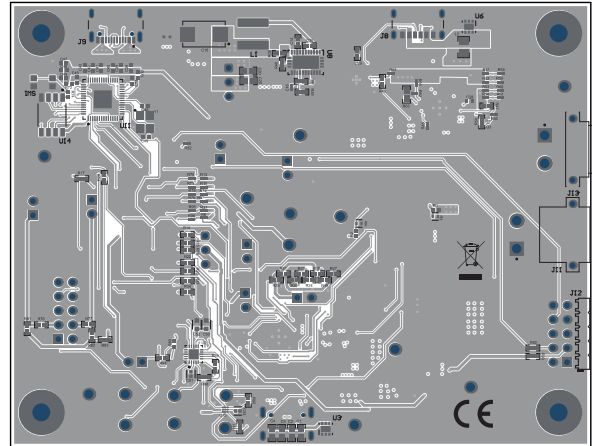


Figure 5-3. TPS25751AEVM Bottom Layer Composite

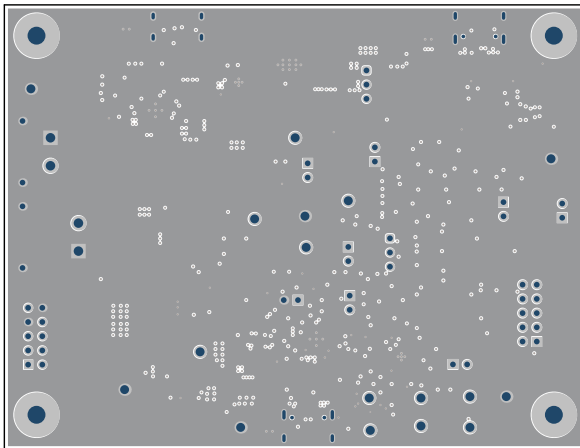


Figure 5-4. TPS25751AEVM Ground Layer

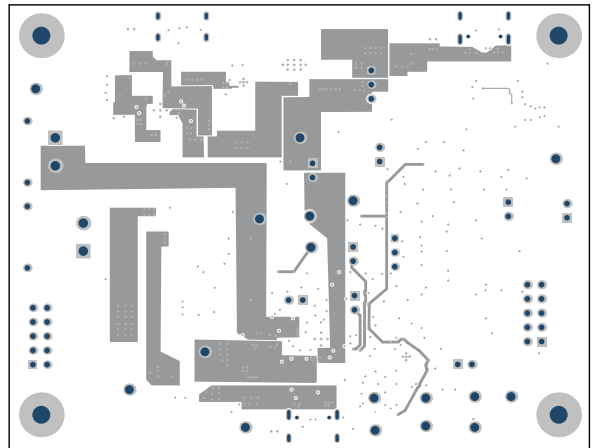


Figure 5-5. TPS25751AEVM Power Layer

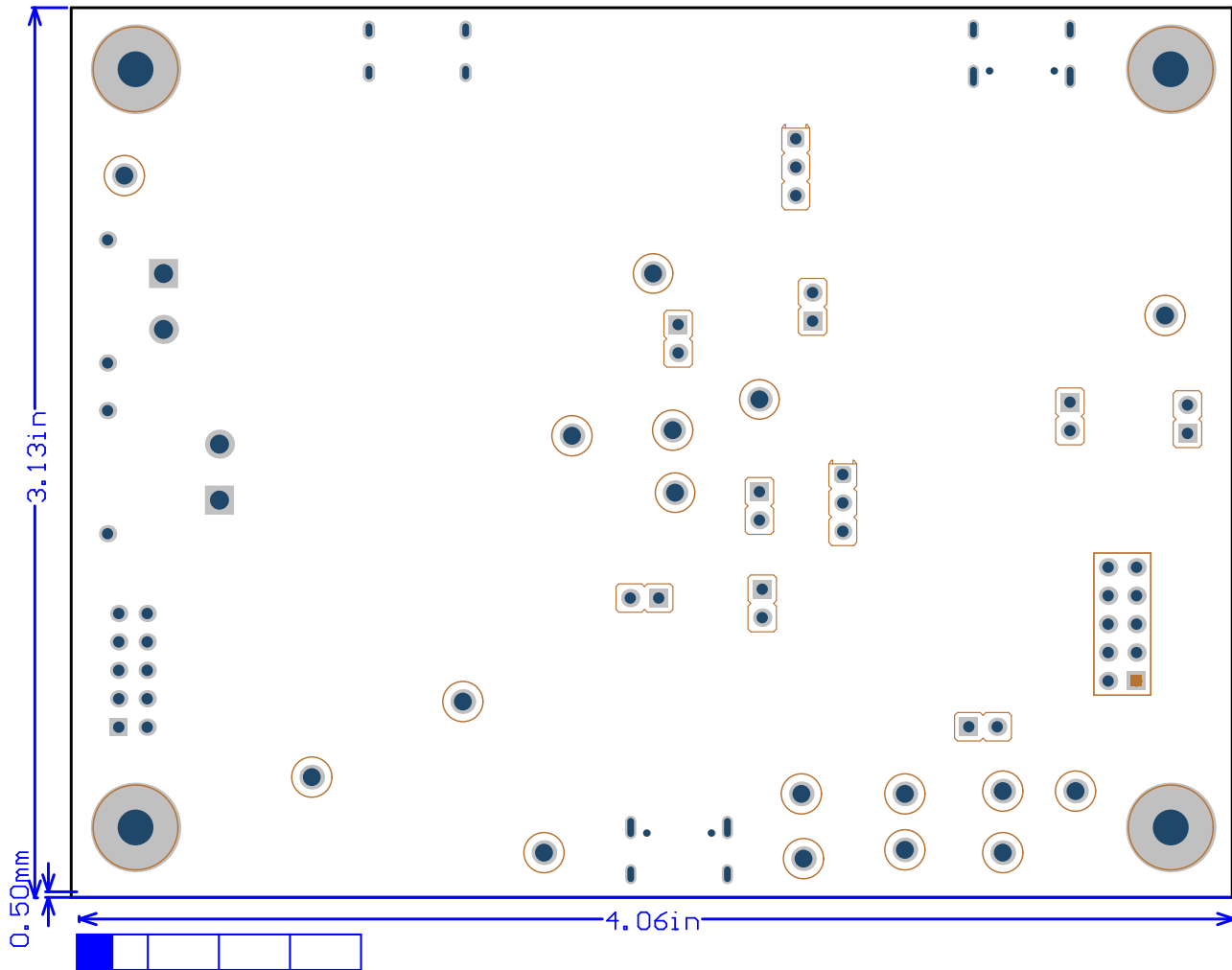


Figure 5-6. TPS25751AEVM Board Dimensions

5.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		IPP058	Any
C1, C2, C3, C4	4	0.01uF	CAP, CERM, 0.01uF, 100V, ±10%, X7R, 0603	0603	C0603X103K1RA CTU	Kemet
C5, C6, C7	3	10uF	CAP, CERM, 10µF, 10V, ±20%, X5R, 0402	0402	CC0402MRX5R6 BB106	Yageo
C8	1	0.1uF	CAP, CERM, 0.1uF, 100V, ±10%, X7R, 0805	0805	C0805C104K1RA CTU	Kemet
C9, C10, C23, C26	4	220pF	CAP, CERM, 220 pF, 50V, ±10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H22 1K030BA	TDK
C11	1	0.1uF	CAP, CERM, 0.1uF, 35V, ±10%, X5R, 0402	0402	GMK105BJ104KV -F	Taiyo Yuden

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C12	1	4.7uF	CAP, CERM, 4.7uF, 100V, ±10%, X7S, 1210	1210	C3225X7S2A475 K200AE	TDK
C13	1	0.47uF	CAP, CERM, 0.47uF, 100V, ±10%, X7S, 0805	0805	C2012X7S2A474 K125AB	TDK
C14	1	2.2uF	CAP, CERM, 2.2uF, 16V, ±10%, X6S, 0402	0402	C1005X6S1C225 K050BC	TDK
C15	1	0.47uF	CAP, CERM, 0.47uF, 10V, ±10%, X5R, 0402	0402	GRM155R61A474 KE15D	MuRata
C16	1	15pF	CAP, CERM, 15pF, 100V, ±5%, C0G/NP0, 0201	0201	GRM0335C2A150 JA01D	MuRata
C17	1	4.7µF	Chip Multilayer Ceramic Capacitors for General Purpose, 0805, 4.7uF, X7R, 15%, 10%, 50V	0805	GRM21BZ71H475 KE15L	MuRata
C18	1	220uF	CAP, TA, 220uF, 16V, ±20%, 0.1Ω, SMD	7343-43	TPSE227M016R0 100	AVX
C19, C22, C32, C33	4	0.01uF	CAP, CERM, 0.01uF, 50V, ±5%, X7R, 0402	0402	C0402C103J5RA CTU	Kemet
C20	1	0.47uF	CAP, CERM, 0.47uF, 50V, ±10%, X7R, 0603	0603	C1608X7R1H474 K080AC	TDK
C21, C27, C28	3	10uF	CAP, CERM, 10uF, 10V, ±20%, X5R, 0402	0402	CL05A106MP5NU NC	Samsung Electro- Mechanics
C24, C25	2	1uF	CAP, CERM, 1uF, 35V, ±10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1V10 5K080AC	TDK
C29	1	0.1uF	CAP, CERM, 0.1uF, 50V, ±10%, X5R, 0402	0402	C1005X5R1H104 K050BB	TDK
C30	1	1uF	CAP, CERM, 1uF, 35V, ±10%, X5R, 0402	0402	GRM155R6YA105 KE11D	MuRata
C31	1	10uF	CAP, CERM, 10µF, 10V, ±20%, X5R, 0402	0402	0402ZD106MAT2 A	AVX
C34	1	1uF	CAP, CERM, 1µF, 10V, ±20%, X5R, 0402	0402	CC0402MRX5R6 BB105	Yageo America
C35, C38, C39, C45, C46	5	2.2uF	CAP, CERM, 2.2uF, 6.3V, ±20%, X5R, 0402	0402	JMK105BJ225MV- F	Taiyo Yuden
C36, C37, C40, C41, C42, C43, C44, C47	8	0.1uF	CAP, CERM, 0.1µF, 10V, ±10%, X7R, AEC-Q200 Grade 1, 0402	0402	C0402C104K8RA CAUTO	Kemet
C48, C49	2	12pF	CAP, CERM, 12pF, 25V, ±5%, C0G/NP0, 0402	0402	GRM1555C1E120 JA01D	MuRata

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C50, C52	2	1 μ F	1 μ F \pm 10% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	0603	8.85012E+11	Würth Elektronik
C51, C53	2	100nF	100nF \pm 10% 50V Ceramic Capacitor X7R 0402 (1005 Metric)	0402	0402B104K500HI	NextGen Components
D1, D2, D3	3	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D4, D6	2	Red	LED, Red, SMD	LED_0603	150060RS75000	Würth Elektronik
D5	1	White	LED, White, SMD	0402, White	LW QH8G-Q2S2-3K5L-1	OSRAM
D7	1	60V	Diode, Schottky, 60V, 5A, SMA	SMA	SK56A-LTP	Micro Commercial Components
D8, D9	2	Yellow	LED, Yellow, SMD	1.6 \times 0.8mm	TLMY1000-GS08	Vishay-Semiconductor
H1	1		Header, 2.54mm, 8x2, Gold, SMT	Header, 2.54mm, 8x2, SMT	TSM-108-01-L-DV	Samtec
H2	1		Header, 2.54mm, 10x2, Gold, SMT	Header, 2.54mm, 10x2, SMT	TSM-110-01-L-DV	Samtec
H3, H4, H5, H6	4		Machine Screw, Round, #4-40 \times 1/4, Nylon, Phillips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H7, H8, H9, H10	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J8	1		24 (6 + 18 Dummy) Position USB-C (USB TYPE-C) USB 2.0 Receptacle Connector	CONN_USB	USB4125-GF-A-0190	GCT
J10			Connector USB 2.0 Type C Horizontal SMT	CONN_USB	6.29722E+11	Würth Elektronik
J11	1		Socket, DC supply, XT30, male, PIN: 2, on PCBs, THT, yellow, 15A, 500V	CONN_PLUG2	XT30PW-M	Amass
J12	1		Header, 2.54mm, 5x2, Gold, R/A, TH	Header, 2.54mm, 5x2, R/A, TH	TSW-105-09-G-D-RA	Samtec
J13	1		Socket, DC supply, XT30, female, PIN: 2, on PCBs, THT, yellow, 15A	CONN_SOCKET_DC2	XT30PW-F	Amass
J14	1		Connector USB 2.0 Type C Horizontal SMT		629722000214	Würth Elektronik
JP1, JP3, JP4, JP6, JP7, JP8, JP10, JP11	8		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
JP2, JP5	2		Header, 2.54mm, 3x1, Tin, TH	Header, 2.54mm, 3x1, Tin, TH	22284030	Molex
JP9	1		Header, 100mil, 5x2, Tin, TH	Header, 5x2, 100mil, Tin	PEC05DAAN	Sullins Connector Solutions

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
L1	1	4.7uH	Inductor, Shielded, Composite, 4.7µH, 10.5A, 0.0144Ω, AEC-Q200 Grade 1, SMD	IND_6.4x6.1x6.6	XAL6060-472MEB	Coilcraft
L2, L3	2	22Ω	Ferrite Bead, 22Ω @ 100MHz, 6A, 0805	0805	742792021	Würth Elektronik
Q1	1	30V	MOSFET, 2-CH, N-CH, 30V, A, YJG0010A (PICOSTAR-10)	YJG0010A	CSD87501L	Texas Instruments
Q2	1	30V	MOSFET, N-CH, 30V, 22A, DQK0006C (WSON-6)	DQK0006C	CSD17571Q2	Texas Instruments
Q3, Q4, Q5	3	20V	MOSFET, N-CH, 20V, 0.5A, YJM0003A (PICOSTAR-3)	YJM0003A	CSD15380F3	Texas Instruments
R1, R2	2	90.9k	RES, 90.9k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040290K9F KED	Vishay-Dale
R3, R4	2	10k	10kΩ ±1% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Thick Film	0402	CRCW040210K0F KEDC	Vishay
R5, R42, R47, R50, R97	5	10.0k	RES, 10.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0F KED	Vishay-Dale
R6, R14, R15, R16, R17, R21, R22, R23, R24, R26, R33, R34, R35, R44, R46, R83, R86, R89, R90, R91, R92, R93, R94	23	0	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z 0ED	Vishay-Dale
R7	1	13.3m	13.3mΩ ±1% 1W Chip Resistor 1206 (3216 Metric) Anti-Sulfur, Automotive AEC-Q200, Current Sense, Moisture Resistant, Pulse Withstanding Metal Element	1206 (3216 metric)	WSLP1206R0133 FEA	Vishay
R8, R11, R29, R30, R31, R32, R36, R85, R87, R88	10	10.0k	RES, 10.0k, 1%, 0.05W, 0201	0201	CRCW020110K0F KED	Vishay-Dale
R9, R10, R12, R13, R65, R66	6	2.20k	RES, 2.20k, 1%, 0.05W, 0201	0201	CRCW02012K20F KED	Vishay-Dale
R18	1	100k	RES, 100k, 1%, 0.1W, 0402	0402	ERJ-2RKF1003X	Panasonic

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R25	1	115k	RES, 115k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402115KF KED	Vishay-Dale
R37, R38	2	100k	RES, 100k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100KF KED	Vishay-Dale
R39	1	523k	RES, 523k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402523KF KED	Vishay-Dale
R40	1	23.7k	RES, 23.7k, 1%, 0.1W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF2372X	Panasonic
R41, R57, R63	3	0	RES, 0, 5%, 0.1W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic
R43, R45, R56	3	100k	RES, 100k, 1%, 0.05W, 0201	0201	RC0201FS-7D100 KL	Yageo America
R48, R49, R70, R71, R78, R79, R95, R96	8	0	RES, 0, 5%, 0.05W, 0201	0201	CRCW02010000Z 0ED	Vishay-Dale
R51, R53, R54, R59	4	200k	RES, 200k, 1%, 0.05W, 0201	0201	CRCW0201200KF KED	Vishay-Dale
R52, R64	2	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0710K L	Yageo America
R58, R60, R61, R62	4	51.0k	RES, 51.0k, 1%, 0.05W, 0201	0201	RC0201FR-0751K L	Yageo America
R67, R68	2	5.11k	RES, 5.11k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04025K11F KED	Vishay-Dale
R69, R80	2	10k	RES, 10k, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0J NED	Vishay-Dale
R72, R74	2	1.00k	RES, 1.00k, 1%, 0.0625W, 0402	0402	RC0402FR-071KL	Yageo America
R73, R75	2	100k	RES, 100k, 1%, 0.0625W, 0402	0402	RC0402FR-07100 KL	Yageo America
R76, R77, R81, R82	4	100k	RES, 100k, 1%, 0.063W, 0402	0402	RC1005F104CS	Samsung Electro-Mechanics
R84	1	10.0k	RES, 10.0k, 1%, .0625W, 0402	0402	RT0402BRD0710 KL	Yageo America
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6, SH-JP7, SH-JP8, SH-JP10, SH-JP11	10	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
SW1	1		SWITCH TACTILE SPST-NO 0.02A 15V	SMT_SW_3MM5_2MM9	EVPAAM02W	Panasonic
TP1, TP3	2		Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone Electronics
TP2, TP4, TP16, TP17, TP18, TP20	6		Test Point, Compact, Black, TH	Black Compact Testpoint	5006	Keystone Electronics

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
TP5, TP6	2		Test Point, Compact, White, TH	White Compact Testpoint	5007	Keystone Electronics
TP7, TP8	2		Test Point, Compact, Blue, TH	Blue Compact Testpoint	5122	Keystone Electronics
TP9, TP10	2		Test Point, Compact, Orange, TH	Orange Compact Testpoint	5008	Keystone Electronics
TP14, TP15, TP19	3		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone Electronics
U1	1		USB Type-C® and USB PD Controller With Integrated Power Switches Optimized for Power Applications	VQFN32	TPS25751ASRSMR	Texas Instruments
U2, U7	2		USB Type-C® 28V SPR Port Protector: Short-to-VBUS Overvoltage and IEC ESD Protection	WQFN20	TPD4S201RUKR	Texas Instruments
U3, U6	2		22-V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	Texas Instruments
U4	1		256kb I2C CMOS Serial EEPROM, SOIC-8	SOIC-8	CAT24C256WI-GT3	ON Semiconductor
U5	1		USB Type-C® and USB PD Controller With Integrated Power Switches Optimized for Power Applications	VQFN32	TPS25730ASRSMR	Texas Instruments
U8	1		3.5V to 60V 5A Synchronous Step-Down Voltage Regulator, RNP0030A (WQFN-30)	RNP0030A	LM76005RNPR	Texas Instruments
U9	1		500-mA, Low IQ, Small Size, Low Dropout Regulator, DBV0005A (SOT-23-5)	DBV0005A	TLV75733PDBVR	Texas Instruments
U10	1		-4V to 110V, Bidirectional, 1MHz, 5V/μs, Ultra-Precise Current Sense Amplifier, SOT23-8	SOT23-8	INA296A3IDDF	Texas Instruments

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
U11	1		ARM® Cortex®-M0+ - Microcontroller IC 32-Bit Dual-Core 133MHz External Program Memory 56-QFN (7x7)	QFN56	SC0914(13)	Raspberry Pi
U12	1		5V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS0500DRVR	Texas Instruments
U13	1		ESD Solution for Super-Speed (6Gbps) USB 3.0 Interface, 2 Channels, -40 to +85°C, 3-pin SOT (DRT), Green (Rohs & No Sb/Br)	DRT0003A	TPD2EUSB30DRTR	Texas Instruments
U14	1		NOR Flash Serial (SPI, Dual SPI, Quad SPI) 3V/3.3V 16M-bit 2M × 8 6ns 8-Pin SOIC N T/R	SOIC8	W25Q16JVSNIQTR	Winbond
U15	1		USB Type-C Short-to-VBus and IEC ESD Protector for CC, YFF0009AJAJ (DSBGA-9)	YFF0009AJAJ	TPD2S300YFFR	Texas Instruments
Y1	1		Crystal, 12MHz, 30ppm, SMD	3.20x0.70x2.50mm	7M-12.000MAHE-T	TXC Corporation
R19, R20, R27, R28	0	100k	RES, 100k, 1%, 0.1W, 0402	0402	ERJ-2RKF1003X	Panasonic
R55	0	200k	RES, 200k, 1%, 0.05W, 0201	0201	CRCW0201200KF KED	Vishay-Dale

6 Additional Information

6.1 Trademarks

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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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・イ

ンスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 <https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

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.

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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.
 - 4.3 *Safety-Related Warnings and Restrictions:*
 - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
 - 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.
 - 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
 5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
 6. *Disclaimers:*
 - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
 - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
 7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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