

EVM User's Guide: TPS25752AEVM

TPS25752A Evaluation Module



Description

The TPS25752AEVM evaluation module (EVM) supports single-port USB Type-C® and power delivery (PD) applications in the source-only capacity. The EVM allows the user to develop various power profiles and debug existing systems for the TPS25752A. The intuitive web-based GUI asks the user a few simple questions on the application requirements using clear block diagrams and simple drop-down selection 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

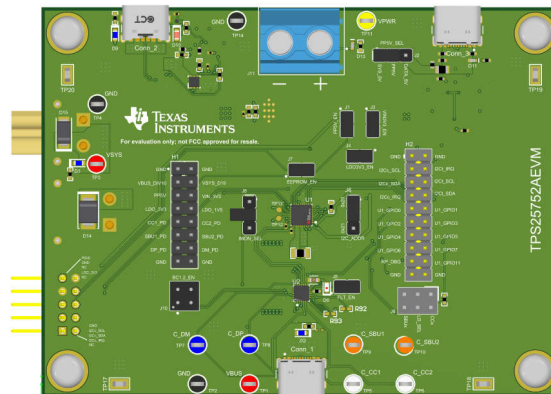
1. Order the TPS25752AEVM, a highly integrated USB Type-C and USB PD controller evaluation module (EVM)
2. Read the TPS25752AEVM user's guide
3. Start development with the application customization tool
4. Refer to the datasheet, technical reference manual, and the E2E™ forums for questions and support

Features

- Up to 100W (20V/5A) source applications
- Easy-to-use GUI with pre-configured firmware to configure voltage ranges, charging protocols, and all aspects of the attached TPS25752A USB-PD controller
- Multiple test points and headers for quick and easy debug signals, such as VBUS, CCx, and ADCINx lines

Applications

- [Battery pack for cordless power tool](#)
- [Power bank](#)
- [Retail automation and payment](#)
- [Wireless speakers](#)
- [Cordless vacuum cleaner](#)
- [Personal or portable electronics](#)
- [Medical and healthcare](#)



TPS25752A

1 Evaluation Module Overview

1.1 Introduction

The TPS25752AEVM evaluation module is a full-featured evaluation module used to evaluate the TPS25752A USB-PD controller. This board contains everything necessary to evaluate USB-PD applications capable of SPR (standard power range) source-only applications using the TPS25752A USB-PD controller. A pre-flashed embedded microcontroller is included on the board, which allows for easy communication and programming of the EEPROM attached to the TPS25752A device, eliminating the need for an external programmer or debugger. A full-fledged GUI is provided to interact with the device and includes functions such as initial configuration, exporting programming and patch artifacts, and reading diagnostic or fault information from the TPS25752A device on-the-fly.

1.2 Kit Contents

- TPS25752AEVM
- EVM disclaimer read me

1.3 Specification

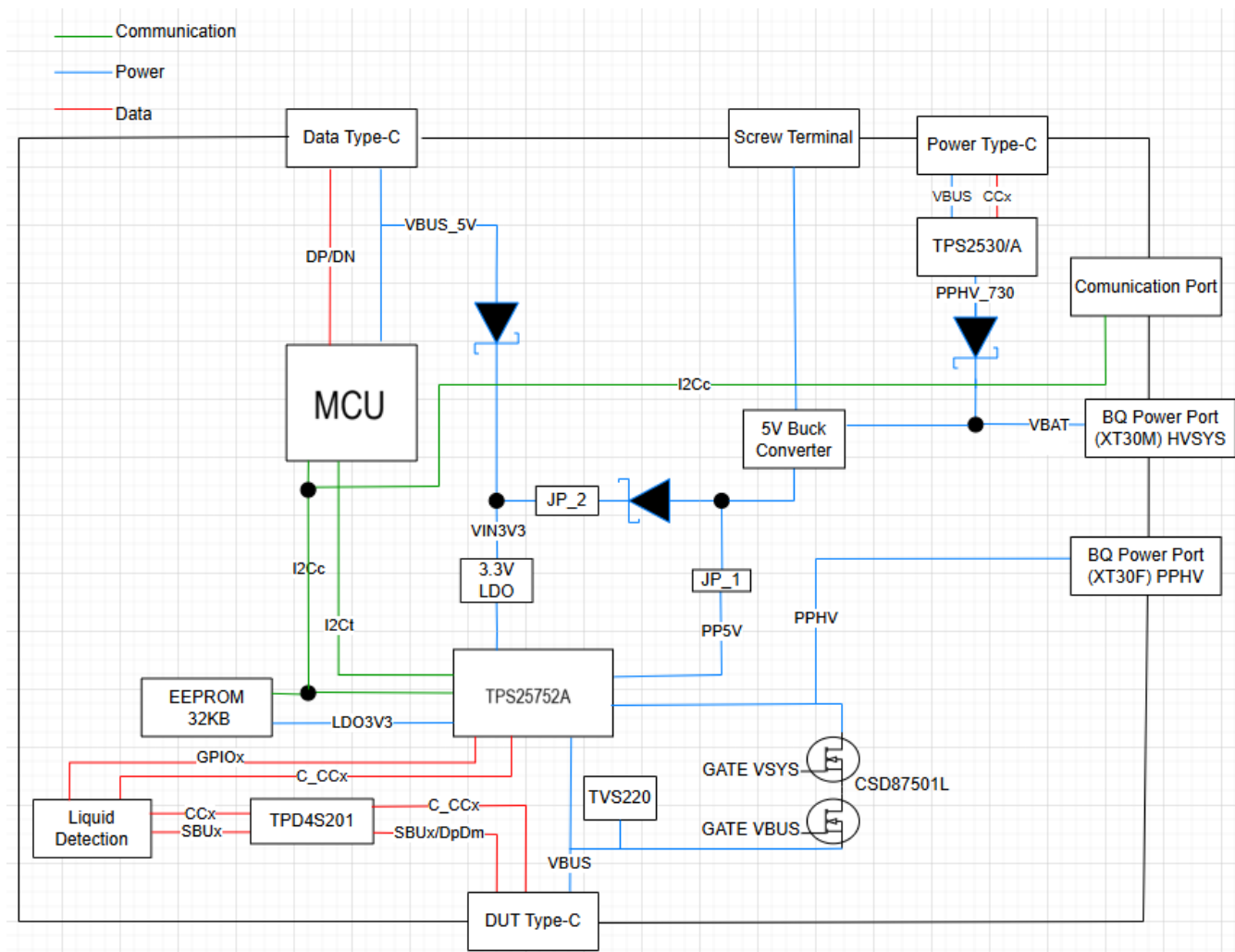


Figure 1-1. TPS25752AEVM Block Diagram

1.4 Device Information

The TPS25752A device is a single-port, USB Type-C® PD controller with an external high-voltage power path for source-only applications. The TPS25752AEVM evaluation module is used to evaluate the functionally equivalent TPS25752AD (internal high-voltage power path) version of the TPS25752A PD controller. The TPS25752A PD controller is an excellent choice for single port power applications operating in the standard power range (SPR) for source-only applications up to 100W (20V/5A).

The TPS25752AEVM evaluation module includes several devices for complete evaluation of voltage protection, power topology, current sensing and an additional TPS25730A PD controller for barrel-jack replacement. For more details on each device on the TPS25752AEVM, see [Table 1-1](#).

Table 1-1. Devices on TPS25752AEVM

Designator	Device Name	Description
U1	TPS25752A	USB Type-C SPR source only PD controller
U2	TPD4S201	20V port protection with short to VBUS protection
U5	TPS25730A	USB Type-C sink-only PD controller, DC barrel jack replacement

2 Hardware

2.1 Power Requirements

For a standalone PD evaluation, the main power supply for the TPS25752AEVM evaluation module is through the Type-C sink-only port (Conn_2), which accepts a 45W Type-C PD source (15V to 20V). If the Type-C adapter is not capable of a minimum of 15V, then the TPS25752AEVM does not power on properly. Alternatively, the EVM can also be powered on from an external bench supply connected to the VSYS test point (TP3), with the bench supply providing a voltage range of 15V-20V.

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.

For the power source, when providing power to the sink connected to the TPS25752A device, an external DC/DC EVM can be connected to the TPS25752AEVM. The TPS55288, TPS55289, and LM251772 DC/DC devices can interface with the TPS25752AEVM. The corresponding DC/DC EVMs are connected directly through J12, J13, and J14 and can be mated seamlessly without requiring a separate ribbon cable connection.

2.2 Setup

Out of the box, the TPS25752AEVM evaluation module is configured for a 15W (5V/3A) source power. When different configurations are required, use the application customization tool to create a configuration or load a different configuration template. Refer to the GUI user's guide for detailed instructions on using the application customization tool.

TPS25752AEVM 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, TPS25752A device monitors the SBU or CC lines for unexpected shorts to ground or high voltage (5V and above). The user selects the configuration of the pins used for liquid detection. The TPS25752A device supports corrosion mitigation by automatically disabling the Type-C port when a short is detected. When a short is no longer detected across the monitored pins, the TPS25752A device enters back into normal operation. To select which pins are monitored for liquid detection, jumpers can be added to header J9 to connect either the SBUx lines from being used or the CCx lines from being used.

2.3 Jumper Information

Table 2-1. Jumper Information

Jumper Net Name	Jumper Designator	Pin Description
PP5V_EN	J1	5V input to the PD controller PP5V. Remove jumper to disconnect 5V power to PP5V.
PP5V_Sel	J2	Select the PP5V 5V source from either: <ul style="list-style-type: none"> The onboard 5V buck (powered from power USB Type-C) The PICO port (natively 5V from computer USB port)
VIN3V3	J3	3.3V input to the PD controller VIN_3V3. Remove jumper to disconnect 3.3V power to PD controller.
LDO3V3	J4	3.3V output from PD controller LDO_3V3. Remove jumper to disconnect the 3.3V rail to EEPROM and the 3.3V pullups to the I2Cc/I2Ct lines (removes all power draw from the PD LDO_3V3 pin).
FLT_EN	J5	Enables a fault output from the protection device going into TPS25752A.
I2C_ADDR	J6	Configures I2C target address between 0x20 and 0x21.

Table 2-1. Jumper Information (continued)

Jumper Net Name	Jumper Designator	Pin Description
EEPROM_EN	J7	I2Cc data line between the PD controller and EEPROM. Remove jumper to disable the I2C configuration load from EEPROM (PD remains in PTCH).
LD SEL	JP9	Select which pins to use for liquid detection (CCx or SBUx).
BC1.2_EN	JP10	Enables BC1.2 functionality for providing power on legacy devices.

2.4 LED Information

Table 2-2. LED Information

Designator	Net Label	Description
D1	N/A	N/A
D2	VBUS	Blue LED that shows when the BQ battery is connected to VBUS.
D3	VSYS	Blue LED that shows when power is applied to VSYS.
D6	FLT	Red LED indicating fault from protection device.
D9	System Power	Blue LED indicating power is provided to Conn_2 (barrel jack replacement power).
D10	Capability Mismatch	Red LED indicating capability mismatch of Conn_2 connection (make sure sufficient power source is connected).
D11	MCU Power	Indicates power is being provided to PICO MCU.
D13	System Power (Header)	LED showing that power has been provided by the J11 system power connector.

2.5 Test Points

Table 2-3. Test Point Information

Designator	Net Label	Description
VBUS	TP1	PD controller VBUS voltage reference.
GND	TP2, TP4, TP14, TP17 to TP20	Ground references for EVM.
VSYS	TP3	PD controller VSYS voltage reference.
C_CC1	TP5	Connector side of CC1 of the PD controller, located between the protection device and the USB-C/PD port.
C_CC2	TP6	Connector side of CC2 of the PD controller, located between the protection device and the USB-C/PD port.
C_DP	TP7	Connector side of DP of the PD controller, located between the protection device and the USB-C/PD port.
C_DM	TP8	Connector side of DM of the PD controller, located between the protection device and the USB-C/PD port.
C_SBU1	TP9	Connector side of SBU1 of the PD controller, located between the protection device and the USB-C/PD port.
C_SBU2	TP10	Connector side of SBU2 of the PD controller, located between the protection device and the USB-C/PD port.

Table 2-3. Test Point Information (continued)

Designator	Net Label	Description
GATE_VBUS	TP12	Connected to the N-ch MOSFET that has the source tied to VBUS.
GATE_VSYS	TP13	Connected to the N-ch MOSFET that has the source tied to VSYS.
Current Sense	TP21, TP22	Test point for current sense shunt resistor.

2.6 Switches and Push Buttons

Table 2-4. Switch and Push Button Information

Designator	Label	Description
SW1	Reset	Push-button to pull the RST of the Raspberry 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 the web browser used is Google Chrome®, Firefox®, or Safari®. The TI Cloud Agent must also be installed as a browser extension on the PC if use of this software is desired. When the application is launched, instructions appear for installing the TI Cloud Agent. The software can also be run natively on the PC. If running the software natively on the PC is desired, then the GUI Composer Runtime must be installed natively. To install the GUI Composer Runtime, click on the downward-facing arrow inside one of the applications listed in the TI Gallery, and look toward the bottom set of links that appear. After selecting the native operating system, open the installer and follow the prompts to install the program. For more information on how to install and utilize the GUI with the TPS25752AEVM evaluation module, see the GUI user guide.

4 Hardware Design Files

4.1 Schematics

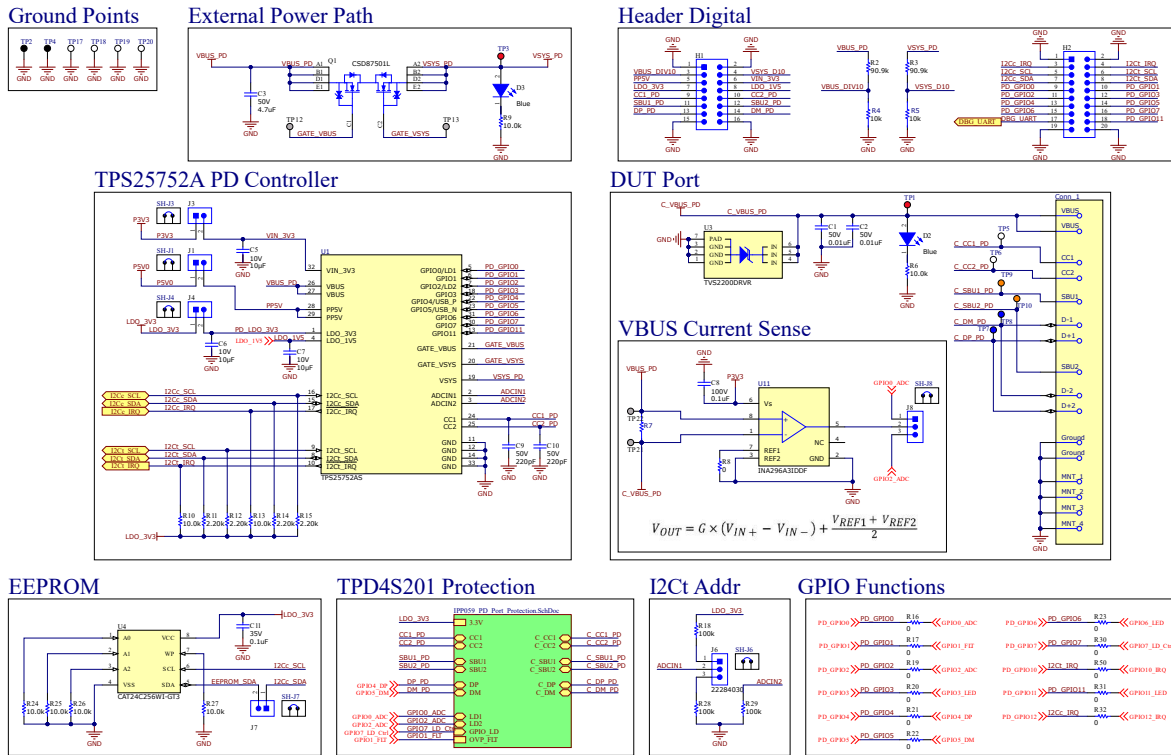


Figure 4-1. PD Controller Schematic

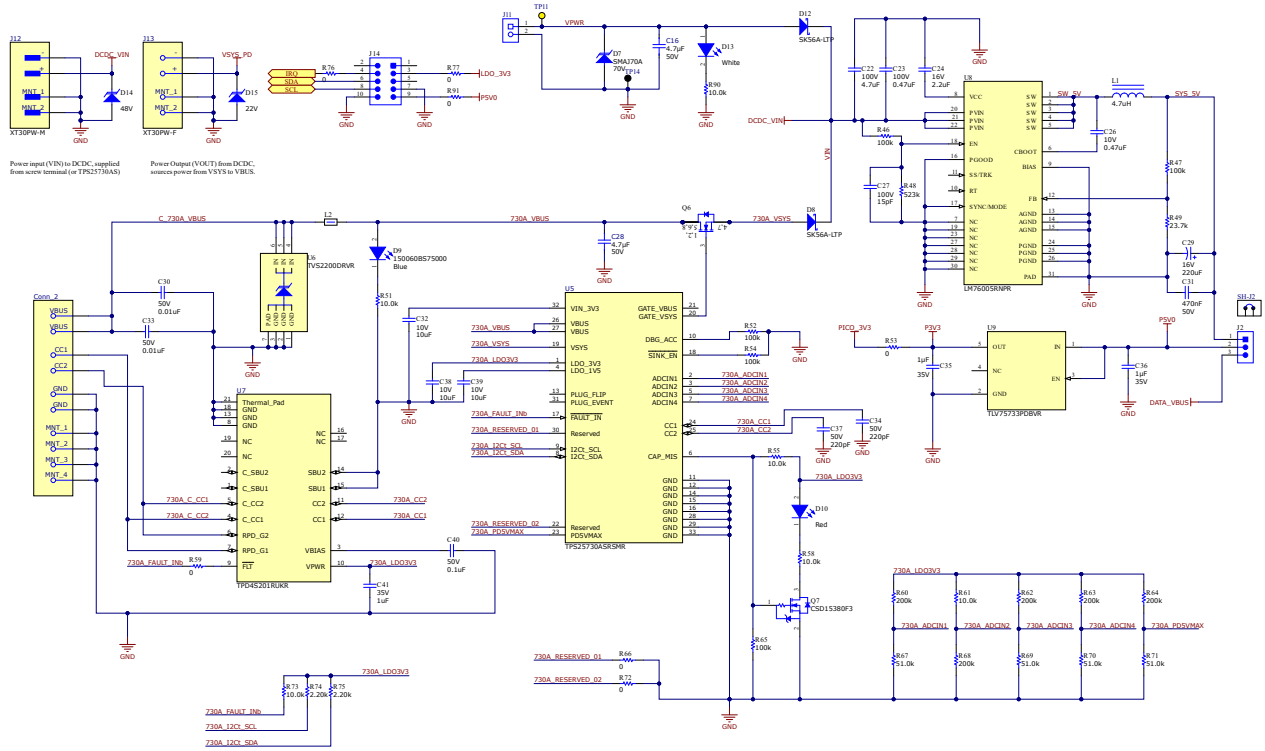


Figure 4-2. Power Tree Schematic

4.2 PCB Layouts

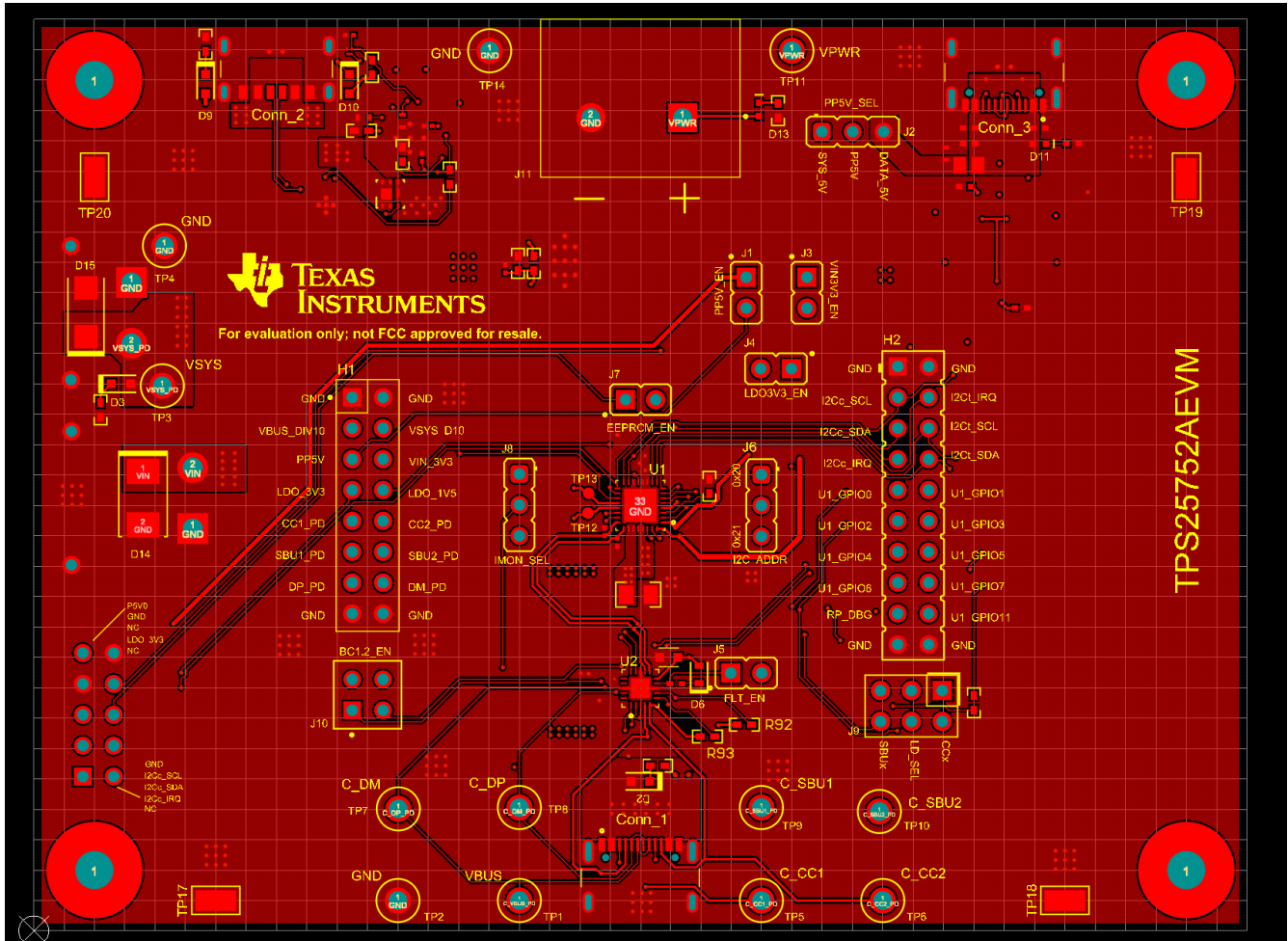


Figure 4-4. Top Layer

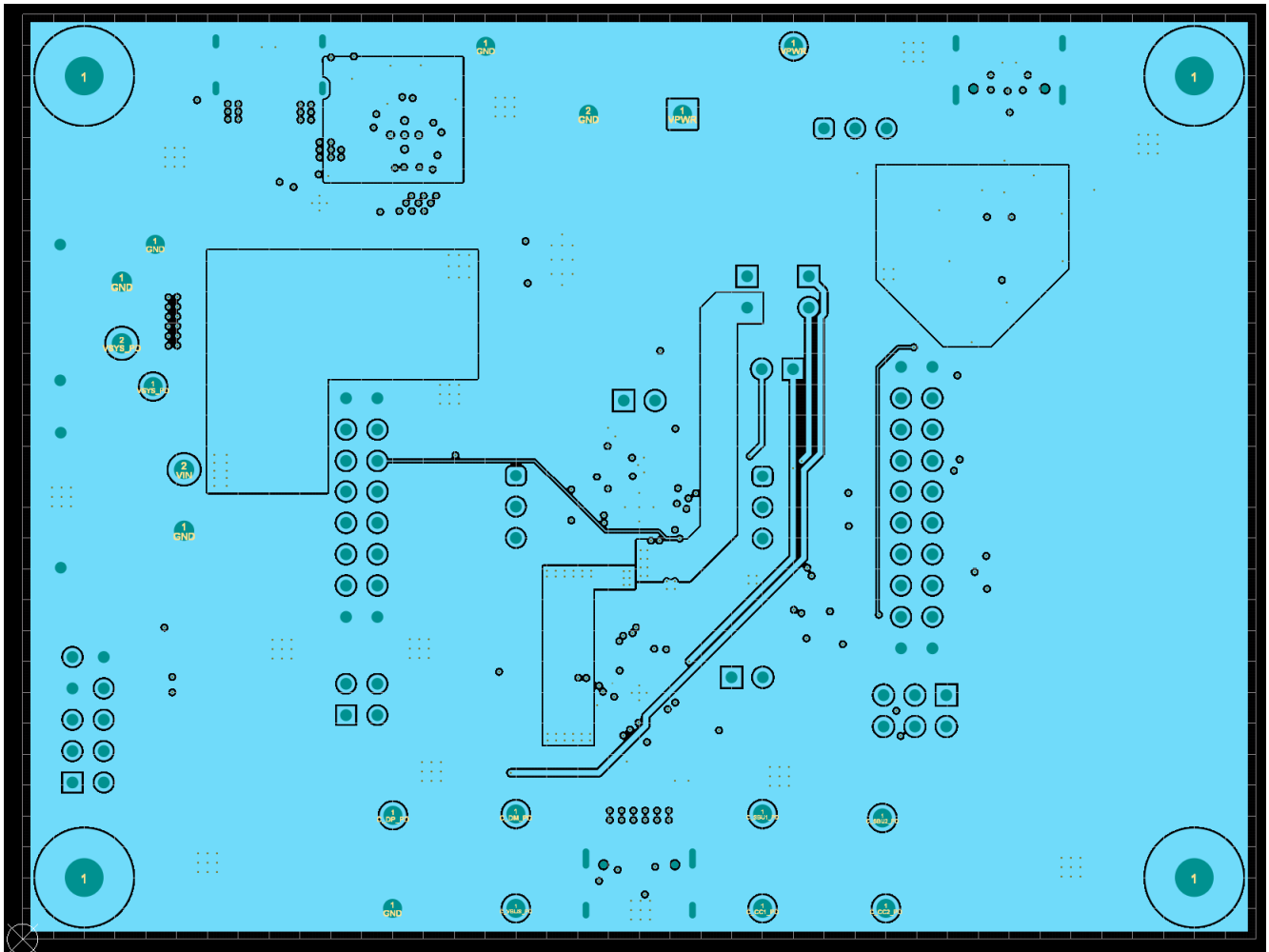


Figure 4-5. Power Layer

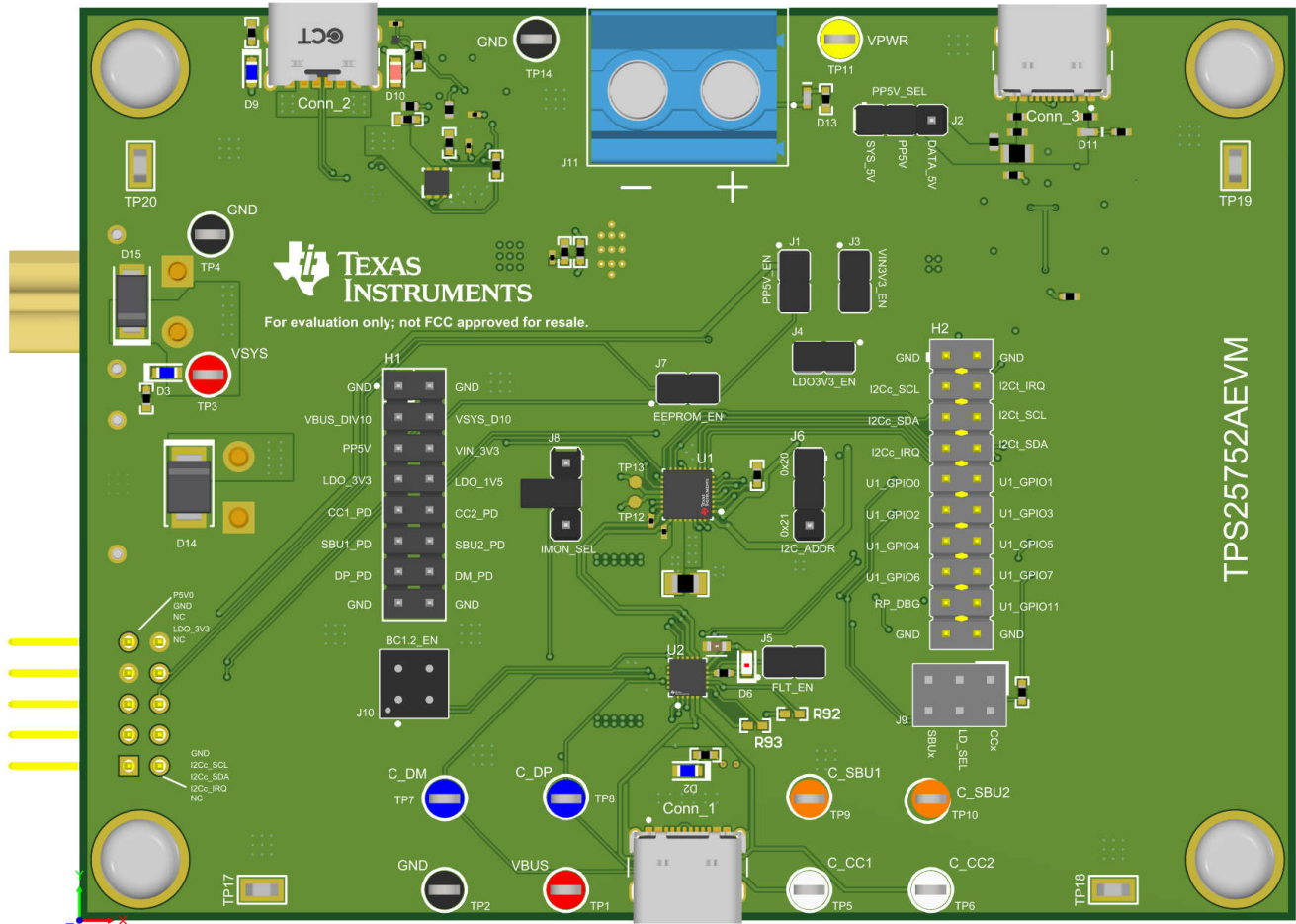


Figure 4-8. 3D View

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials (BOM)

Designator	Description	Part Number	Manufacturer
C1, C2, C30, C33, C58, C59	CAP, CERM, 0.01 μ F, 50V, \pm 5%, X7R, 0402	C0402C103J5RACTU	Kemet
C3	CAP, CERM, 4.7 μ F, 50V, \pm 10%, X5R, 0805	C2012X5R1H475K125AB	TDK
C5, C6, C7	CAP, CERM, 10 μ F, 10V, \pm 20%, X5R, 0402	CC0402MRX5R6BB106	Yageo
C8	CAP, CERM, 0.1 μ F, 100V, \pm 10%, X5R, 0402	GRM155R62A104KE14D	MuRata
C9, C10, C34, C37	CAP, CERM, 220pF, 50V, \pm 10%, X7R, AEC-Q200 Grade 1, 0201	CGA1A2X7R1H221K030BA	TDK
C11	CAP, CERM, 0.1 μ F, 35V, \pm 10%, X5R, 0402	GMK105BJ104KV-F	Taiyo Yuden
C12, C14	1 μ F \pm 10% 50V Ceramic Capacitor X7R 0603 (1608 Metric)	8.85012E+11	Würth Electronics
C13, C15	100nF \pm 10% 50V Ceramic Capacitor X7R 0402 (1005 Metric)	0402B104K500HI	NextGen Components
C16, C28	Chip Multilayer Ceramic Capacitors for General Purpose, 0805, 4.7 μ F, X7R, 15%, 10%, 50V	GRM21BZ71H475KE15L	Murata
C22	CAP, CERM, 4.7 μ F, 100V, \pm 10%, X7S, 1210	C3225X7S2A475K200AE	TDK
C23	CAP, CERM, 0.47 μ F, 100V, \pm 10%, X7S, 0805	C2012X7S2A474K125AB	TDK
C24	CAP, CERM, 2.2 μ F, 16V, \pm 10%, X6S, 0402	C1005X6S1C225K050BC	TDK
C26	CAP, CERM, 0.47 μ F, 10V, \pm 10%, X5R, 0402	GRM155R61A474KE15D	MuRata
C27	CAP, CERM, 15pF, 100V, \pm 5%, C0G/NP0, 0201	GRM0335C2A150JA01D	MuRata
C29	CAP, TA, 220 μ F, 16V, \pm 20%, 0.1 Ω , SMD	TPSE227M016R0100	AVX
C31	CAP, CERM, 0.47 μ F, 50V, \pm 10%, X7R, 0603	C1608X7R1H474K080AC	TDK
C32, C38, C39	CAP, CERM, 10 μ F, 10V, \pm 20%, X5R, 0402	CL05A106MP5NUNC	Samsung Electro-Mechanics
C35, C36	CAP, CERM, 1 μ F, 35V, \pm 10%, X7R, AEC-Q200 Grade 1, 0603	CGA3E1X7R1V105K080AC	TDK
C40	CAP, CERM, 0.1 μ F, 50V, \pm 10%, X5R, 0402	C1005X5R1H104K050BB	TDK
C41	CAP, CERM, 1 μ F, 35V, \pm 10%, X5R, 0402	GRM155R6YA105KE11D	MuRata
C42, C45, C46, C52, C53	CAP, CERM, 2.2 μ F, 6.3V, \pm 20%, X5R, 0402	JMK105BJ225MV-F	Taiyo Yuden
C43, C44, C47, C48, C49, C50, C51, C54	CAP, CERM, 0.1 μ F, 10V, \pm 10%, X7R, AEC-Q200 Grade 1, 0402	C0402C104K8RACAUTO	Kemet
C55, C56	CAP, CERM, 12pF, 25V, \pm 5%, C0G/NP0, 0402	GRM1555C1E120JA01D	MuRata
C57	CAP, CERM, 10 μ F, 10V, \pm 20%, X5R, 0402	0402ZD106MAT2A	AVX
C60	CAP, CERM, 1 μ F, 10V, \pm 20%, X5R, 0402	CC0402MRX5R6BB105	Yageo America
Conn_1, Conn_3	Connector USB 2.0 Type-C Horizontal SMT	6.29722E+11	Würth Electronics
Conn_2	24 (6+18 Dummy) Position USB-C (USB TYPE-C) USB 2.0 Receptacle Connector	USB4125-GF-A-0190	GCT
D2, D3, D9	LED, Blue, SMD	150060BS75000	Würth Elektronik
D6	LED, Red, SMD	TLMS1000-GS08	Vishay-Semiconductor
D7	Diode, TVS, Uni, 70V, 113Vc, 400W, 3.5A, SMA	SMAJ70A	Littelfuse
D8, D12	Diode, Schottky, 60V, 5A, SMA	SK56A-LTP	Micro Commercial Components

Table 4-1. Bill of Materials (BOM) (continued)

Designator	Description	Part Number	Manufacturer
D10	LED, Red, SMD	150060RS75000	Würth Elektronik
D11, D13	LED, White, SMD	LW QH8G-Q2S2-3K5L-1	OSRAM
D14	Diode, TVS, Uni, 48V, 77.4Vc, SMB	SMBJ48A-13-F	Diodes Inc.
D15	Diode, TVS, Uni, 22V, 35.5Vc, 400W, 11.3A, SMA	SMAJ22A	Littelfuse
H1	Connector Header Through Hole 16 position 0.100" (2.54mm)	TSW-108-07-T-D	Samtec
H2	Header, 10x2, 2.54mm, Tin, TH	TSW-110-07-T-D	Samtec
H3, H4, H5, H6	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	B&F Fastener Supply
H7, H8, H9, H10	Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone
J1, J3, J4, J5, J7	Header, 100mil, 2x1, Gold, TH	PBC02SAAN	Sullins Connector Solutions
J2, J6, J8	Header, 2.54mm, 3x1, Tin, TH	22284030	Molex
J9	Header, 100mil, 3x2, Tin, TH	PEC03DAAN	Sullins Connector Solutions
J10	Header, 100mil, 2x2, Tin, TH	PEC02DAAN	Sullins Connector Solutions
J11		TB005-762-02BE	CUI Devices
J12	Socket, DC supply, XT30, male, PIN: 2, on PCBs, THT, yellow, 15A, 500V	XT30PW-M	Amass
J13	Socket, DC supply, XT30, female, PIN: 2, on PCBs, THT, yellow, 15A	XT30PW-F	Amass
J14	Header, 2.54mm, 5x2, Gold, R/A, TH	TSW-105-09-G-D-RA	Samtec
L1	Inductor, Shielded, Composite, 4.7µH, 10.5A, 0.0144Ω, AEC-Q200 Grade 1, SMD	XAL6060-472MEB	Coilcraft
L2, L3	Ferrite Bead, 22Ω at 100MHz, 6A, 0805	742792021	Würth Elektronik
Q1	MOSFET, 2-CH, N-CH, 30V, A, YJG0010A (PICOSTAR-10)	CSD87501L	Texas Instruments
Q6	MOSFET, N-CH, 30V, 22A, DQK0006C (WSON-6)	CSD17571Q2	Texas Instruments
Q7	MOSFET, N-CH, 20V, 0.5A, YJM0003A (PICOSTAR-3)	CSD15380F3	Texas Instruments
R2, R3	RES, 90.9k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW040290K9FKED	Vishay-Dale
R4, R5	10kΩ ±1% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Thick Film	CRCW040210K0FKEDC	Vishay
R6, R9, R51, R55, R58, R90	RES, 10.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW040210K0FKED	Vishay-Dale
R7	6.5mΩ ±1% 1W Chip Resistor 1206 (3216 Metric) Anti-Sulfur, Automotive AEC-Q200, Current Sense, Moisture Resistant, Pulse Withstanding Metal Element	WSLP12066L500FEA	Vishay
R8, R16, R17, R19, R20, R21, R22, R23, R30, R31, R32, R38, R39, R44, R50, R56, R57, R59, R66, R72, R78, R79, R80, R81	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW04020000Z0ED	Vishay-Dale
R10, R13, R24, R25, R26, R27	RES, 10.0k, 1%, 0.05W, 0201	CRCW020110K0FKED	Vishay-Dale
R11, R12, R14, R15, R74, R75	RES, 2.20k, 1%, 0.05W, 0201	CRCW02012K20FKED	Vishay-Dale
R18, R28, R29	RES, 100k, 1%, 0.1W, 0402	ERJ-2RKF1003X	Panasonic
R40, R41, R42, R43	RES, 100k, 1%, 0.063W, 0402	RC1005F104CS	Samsung Electro-Mechanics

Table 4-1. Bill of Materials (BOM) (continued)

Designator	Description	Part Number	Manufacturer
R45, R86	RES, 10k, 5%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW040210K0JNED	Vishay-Dale
R46, R47	RES, 100k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW0402100KFKED	Vishay-Dale
R48	RES, 523k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW0402523KFKED	Vishay-Dale
R49	RES, 23.7k, 1%, 0.1W, AEC-Q200 Grade 0, 0402	ERJ-2RKF2372X	Panasonic
R52, R54, R65	RES, 100k, 1%, 0.05W, 0201	RC0201FS-7D100KL	Yageo America
R53	RES, 0, 5%, 0.125W, AEC-Q200 Grade 0, 0805	ERJ-6GEY0R00V	Panasonic
R60, R62, R63, R64, R68	RES, 200k, 1%, 0.05W, 0201	CRCW0201200KFKED	Vishay-Dale
R61, R73	RES, 10.0k, 1%, 0.05W, 0201	RC0201FR-0710KL	Yageo America
R67, R69, R70, R71	RES, 51.0k, 1%, 0.05W, 0201	RC0201FR-0751KL	Yageo America
R83, R88	RES, 1.00k, 1%, 0.0625W, 0402	RC0402FR-071KL	Yageo America
R84, R85	RES, 5.11k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW04025K11FKED	Vishay-Dale
R87, R89	RES, 100k, 1%, 0.0625W, 0402	RC0402FR-07100KL	Yageo America
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	Shunt, 100mil, Flash Gold, Black	SPC02SYAN	Sullins Connector Solutions
SH-J9, SH-J10	4 (2 x 2) Position Shunt Connector Black Open Top 0.100" (2.54mm) Gold	60910213421	Würth Electronics
SW1	SWITCH TACTILE SPST-NO 0.02A 15V	EVPAAM02W	Panasonic
TP1, TP3	Test Point, Compact, Red, TH	5005	Keystone Electronics
TP2, TP4, TP14	Test Point, Compact, Black, TH	5006	Keystone Electronics
TP5, TP6	Test Point, Compact, White, TH	5007	Keystone Electronics
TP7, TP8	Test Point, Compact, Blue, TH	5122	Keystone Electronics
TP9, TP10	Test Point, Compact, Orange, TH	5008	Keystone Electronics
TP11	Test Point, Compact, Yellow, TH	5009	Keystone Electronics
TP17, TP18, TP19, TP20	Test Point, Miniature, SMT	5015	Keystone Electronics
U1	USB Type-C® and USB PD Controller With Integrated Power Switches Optimized for Power Applications	TPS25752AS	Texas Instruments
U2, U7	USB Type-C® 28V SPR Port Protector: Short-to-VBUS Overvoltage and IEC ESD Protection	TPD4S201RUKR	Texas Instruments
U3, U6	22V Precision Surge Protection Clamp, DRV0006A (WSON-6)	TVS2200DRVR	Texas Instruments
U4	256kb I2C CMOS Serial EEPROM, SOIC-8	CAT24C256WI-GT3	ON Semiconductor
U5	USB Type-C® and USB PD Controller With Integrated Power Switches Optimized for Power Applications	TPS25730ASRSMR	Texas Instruments
U8	3.5V to 60V 5A Synchronous Step-Down Voltage Regulator, RNP0030A (WQFN-30)	LM76005RNPR	Texas Instruments
U9	500mA, Low IQ, Small Size, Low Dropout Regulator, DBV0005A (SOT-23-5)	TLV75733PDBVR	Texas Instruments
U10	ARM® Cortex®-M0+ – Microcontroller IC 32-Bit Dual-Core 133MHz External Program Memory 56-QFN (7x7)	SC0914(13)	Raspberry Pi

Table 4-1. Bill of Materials (BOM) (continued)

Designator	Description	Part Number	Manufacturer
U11	-4V to 110V, Bidirectional, 1MHz, 5V/ μ s, Ultra-Precise Current Sense Amplifier, SOT23-8	INA296A3IDDF	Texas Instruments
U12	5V Precision Surge Protection Clamp, DRV0006A (WSON-6)	TVS0500DRVR	Texas Instruments
U13	ESD Solution for Super-Speed (6 Gbps) USB 3.0 Interface, 2 Channels, -40 to +85°C, 3-pin SOT (DRT), Green (Rohs and No Sb/Br)	TPD2EUSB30DRTR	Texas Instruments
U14	FLASH – NOR Memory IC 16Mb (2M x 8) SPI – Quad I/O 133MHz 6ns 8-USON (2x3)	W25Q16JVUXIQ	Winbond
U16	USB Type C Short-to-VBUS and IEC ESD Protector for the CC Pins, YFF0009ALAL (DSBGA-9)	TPD2S300YFF	Texas Instruments
Y1	Crystal, 12MHz, 30ppm, SMD	7M-12.000MAHE-T	TXC Corporation
R76, R77, R91, R92, R93	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	CRCW04020000Z0ED	Vishay-Dale

5 Additional Information

5.1 Known Hardware or Software Issues

- The current sense circuitry is currently not populated and will be revised at a later date once support is added in the GUI configuration tool

5.2 Trademarks

E2E™ is a trademark of Texas Instruments.

USB Type-C® is a registered trademark of USB Implementers Forum.

Raspberry Pi® is a registered trademark of Raspberry Pi Ltd.

Google Chrome® is a registered trademark of Google LLC.

Firefox® is a registered trademark of Mozilla Foundation.

Safari® is a registered trademark of Apple Inc.

All trademarks are the property of their respective owners.

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1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductor products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 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.

【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。

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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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