TPS25741EVM-802 and TPS25741AEVM-802 Evaluation Module User Guide for Desktops

This user's guide describes the TPS25741 and TPS25741A evaluation module (TPS25741EVM-802 and TPS25741AEVM-802). The TPS25741EVM-802 and TPS25741AEVM-802 contain evaluation and reference circuitry for the TPS25741 and TPS25741A, which are dedicated USB Type-C™ power delivery (PD) source controllers. The TPS25741 and TPS25741A devices support multiplexing of two existing input voltage rails onto VBUS. This feature is uniquely suitable for desktop applications where 5 V and 12 V (or 5 V and 9 V) already exist. These EVMs are designed to highlight the mux feature, by using 2 Buck converters to create 5 V and 12 V (or 5 V and 9 V) and then multiplex between them. The EVMs are also designed to support port power management (PPM) for dual-port applications, by connecting two EVMs together. In addition, this EVM supports BC1.2 charging using the TPS2514A connected to the DP and DM line.

This EVM features a barrel jack input with reverse voltage protection to allow for easy demonstration using a 24-V, 60-W output adapter.

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1 Introduction

The TPS25741EVM-802 and TPS25741AEVM-802 allow performance evaluation of the TPS25741 and TPS25741A devices in a desktop-like application. Note that the two Buck converters are only used to generate stable 5 V and 12 V/20 V (or 5 V and 9 V/15 V) power rails, in the same manner as desktops. The TPS25741 and TPS25741A devices can be powered from the input of the DC/DC converter and do not require an external LDO. The 5-V converter will not turn ON unless an upstream facing port (UFP) is inserted. The 12-V converter is always on but will not be multiplexed onto VBUS until 12-V contract is made.

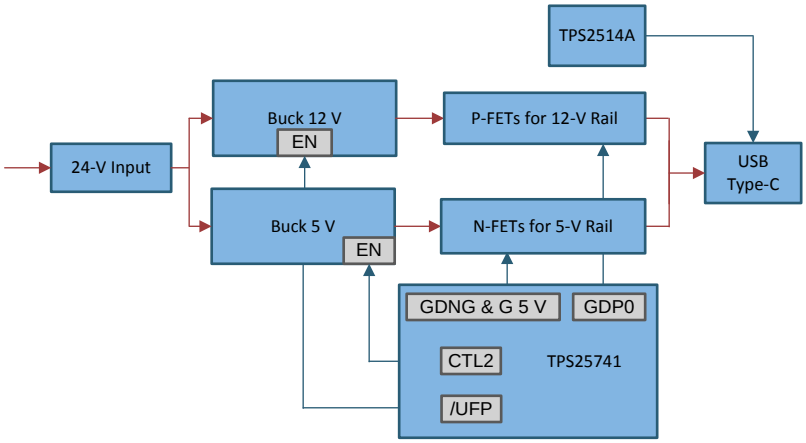


Figure 1. TPS25741EVM Block Diagram

1.1 Features

This EVM supports the following features:

- USB Type-C PD communication protocol via CC1 and CC2 pins.
- 2 output voltage selection depending on request.
  - 5 V, 12 V or 5 V, 20 V for TPS25741EVM-802
  - 5 V, 9 V or 5 V, 15 V for TPS25741AEVM-802
- Up to 3-A output current for all voltage levels, the default is 3 A.
- Smooth voltage transitions per USB PD2.0 specification.

1.2 Applications

This EVM is used for the following applications:

- Desktop
- Monitor
- PC Docking
- USB power delivery adaptors with data

1.3 Electrical Specifications

Table 1 lists the EVM electrical specifications.

Table 1. TPS25741 and TPS25741A EVM Electrical and Performance Specifications at 25°C

Characteristic	TPS25741EVM-802	TPS25741AEVM-802
Input Voltage Range (Recommended)	22 V to 28 V	22 V to 28 V
Input Voltage Range (Abs Max)	0 V to 28 V	0 V to 28 V
Operating Output Current	Default: 3 A Configurable to 5 A	Default: 3 A Configurable to 5 A
Overcurrent Protection	Default: 4.2 A Configurable to 6.3 A	Default: 4.2 A Configurable to 6.3 A
Output Voltages	5 V, 12 V, 20 V	5 V, 9 V, 15 V
Advertised Voltages	5 V, 12 V, 20 V	5 V, 9 V, 15 V
Advertised Current	3 A (default)	3 A (default)

2 Description

Referring to the schematics in Figure 3 and Figure 4, a 24-V DC input is applied at the J11 terminals or J9 and J13 connectors. There are two DC_DC output nodes, which are regulated by two separate TPS54531 (U1, U4) and associated circuitry.

A USB Type-C UFP is plugged in at J12. When the TPS25741 or TPS25741A detects the UFP via CC1 or CC2, then Q7 will be turned on by GDNG. If a 5-V contract is established, Q8 will be turned on by G5V, so 5 V will be applied onto the VBUS. If a 12-V contract is established, Q8 is turned off first and then Q3 and Q4 are turned on by GDPG, so 12 V will be applied onto the VBUS. The voltage request is processed by the TPS25741 or TPS25741A and then is relayed by gate drivers (GDNG, G5V, GDPG). The relationship between the VBUS and gate drivers is shown in Figure 2.

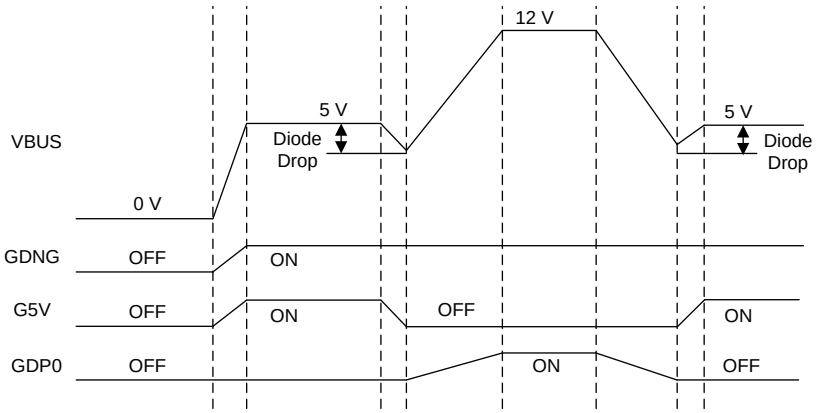


Figure 2. Switching Between 5 V and 12 V Using GDNG, G5V, and GDPG

The DC-DC converter can also implement a power saving feature when in unattached status. U4 is not enabled until a valid UFP is inserted. By using the enable pin of TPS54531, power consumption can be minimized. To configure U4 as always on, remove R45 and R51 and install R21.

For more information and detailed design information, refer to the TPS25741 and TPS25741A data sheet (SLVSDJ5).

3 Schematic

Figure 3 and Figure 4 illustrate the EVM schematics.

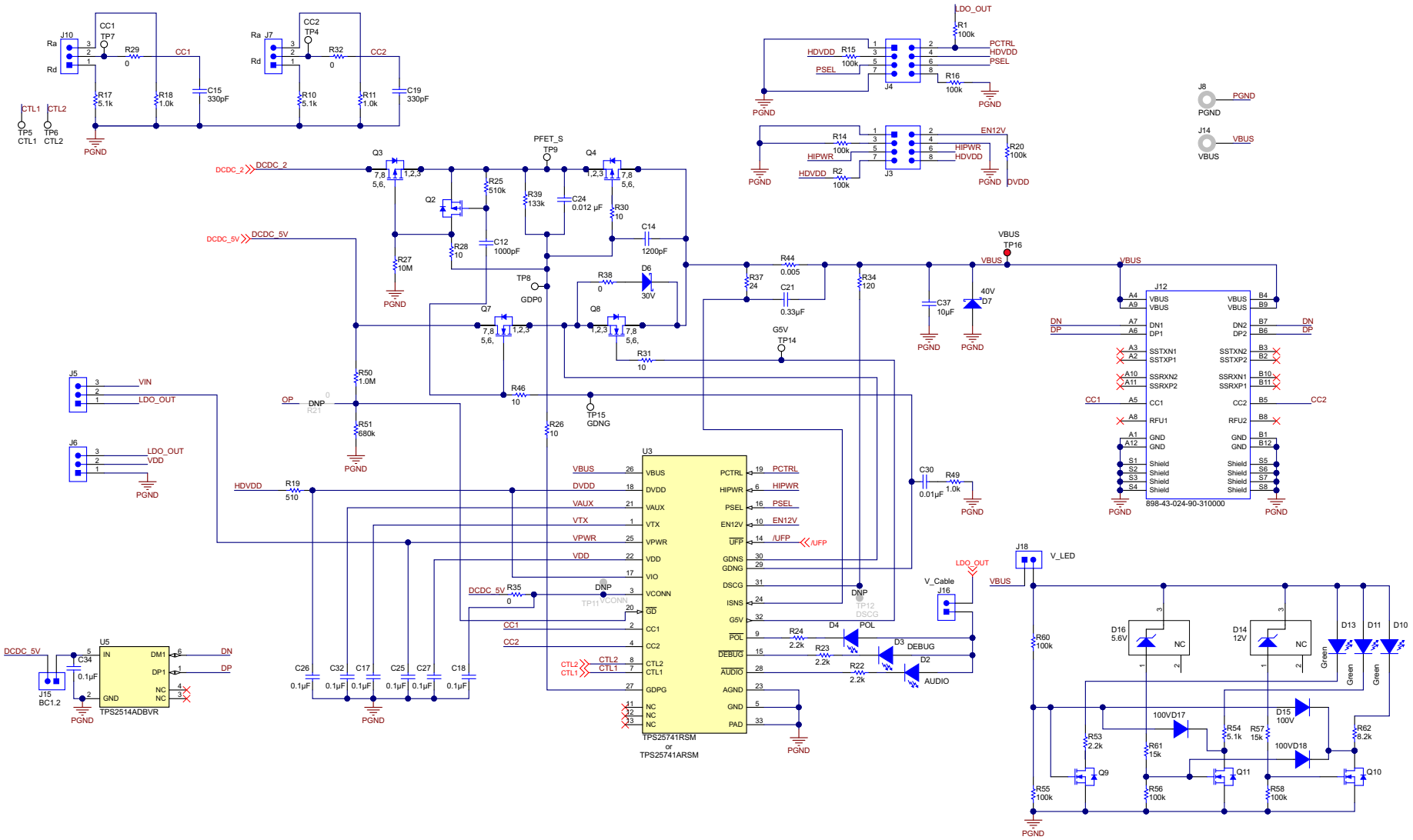


Figure 3. TPS54531 Buck Power Supply (TPS25741EVM-802 Values Shown)

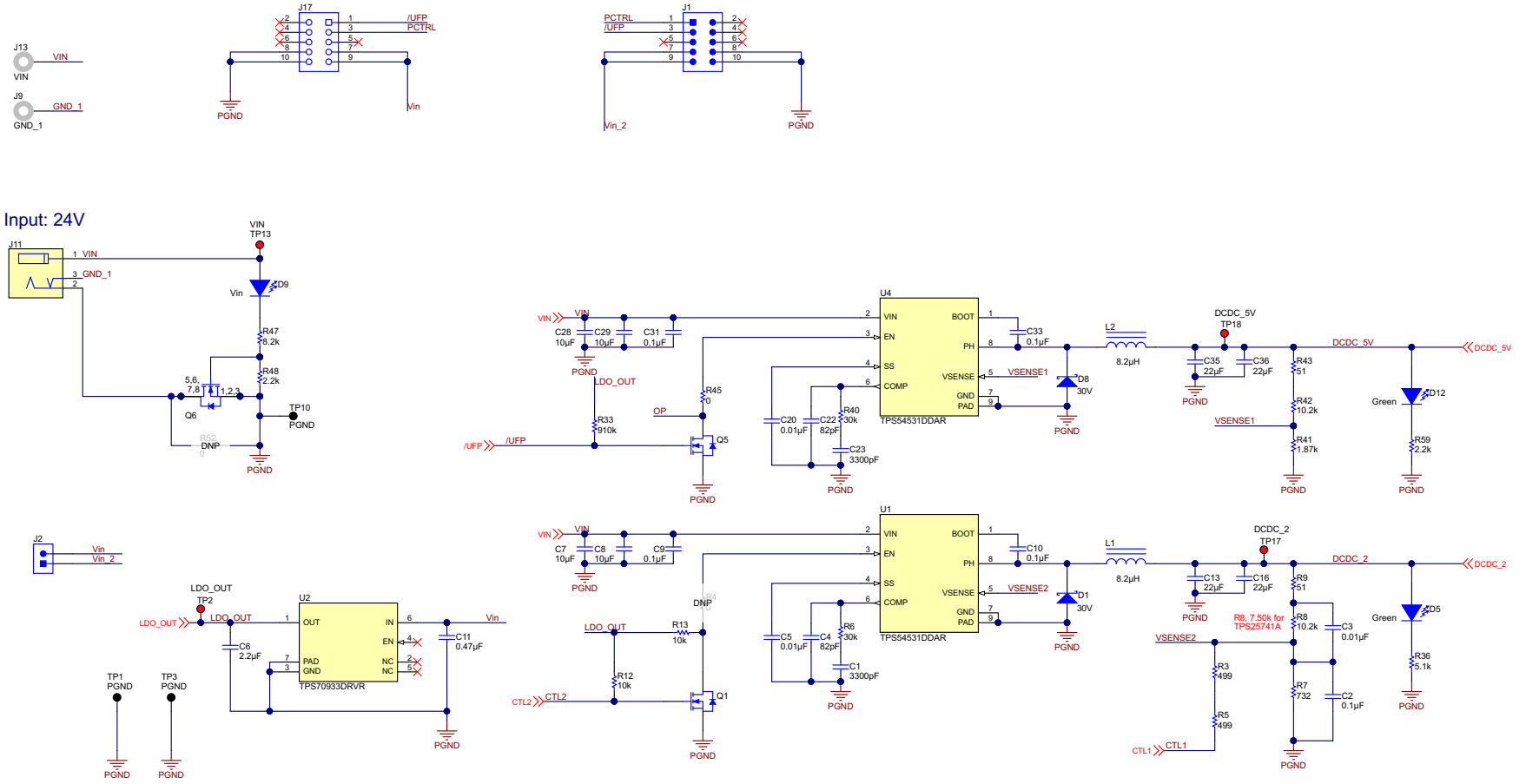


Figure 4. TPS25741 (TPS25741EVM-802 Values Shown)

4 Configuring the EVM

4.1 Physical Access

Table 2 lists the TPS25741EVM connector and functionality, Table 3 describes the default jumper configuration, and Table 4 describes the test point availability.

Table 2. Connector and LED Functionality

Connector	Label	Description
J13	VIN	Power bus input. Apply bus input voltage between J13 and J9.
J14	VBUS	Output voltage that is applied to the VBUS of the USB Type-C cable. J14 along with J8 can be used to apply an external load.
J9, J8	GND	Power bus input return connector
J11	J11	Barrel jack input from an AC to DC power supply
J12	J12	USB Type-C receptacle
D9	VIN	This Green LED indicates input power supply
D12, D5	DCDC_5V, DCDC_2	The two Green LEDs indicate whether upstream DCDCs are on
D2, D3, D4	AUDIO DEBUG POL	D2 indicates when the AUDIO accessary adaptor is inserted D3 indicates when the DEBUG accessary adaptor is inserted D4 indicates when the UFP is inserted on positive orientation
D13, D11, D10	5 V 9 V/12 V 15 V/20 V	D13 indicates when output voltage is 5 V D11 indicates when output voltage is 9 V or 12 V D10 indicates when output voltage is 15 V or 20 V

Table 3. Jumper Functionality

Jumper	Label	Description
J4	PSEL/PCTRL	Used to program the PSEL and PCTRL pins of the TPS25741 and TPS25741A. This advertises the power level to the UFP. Install a single shunt in the P1, P2, P3, or P4 position. Optionally, a second shunt can be installed in the PCTRL position. The position locations are shown in Figure 5 and also on the PCB silk screen near J4. P1 position: PSEL = 93 W P2 position (default): PSEL = 65 W P3 position: PSEL = 45 W P4 position: PSEL = 36 W PCTRL position (shunt installed): PMAX = PSEL/2 PCTRL position (no shunt installed-default): PMAX = PSEL
J3	HIPWR/ENMV	Used to program the HIPWR and EN12V/EN9V pins of the TPS25741 and TPS25741A. This advertises maximum voltage and maximum current to the UFP. Install a single shunt in the H1, H2, H3, or H4 position. Optionally, a second shunt can be installed in the EN12V position. The position locations are shown in Figure 4 and also on the PCB silk screen near J3. V1 = 5 V, V2 = 9 V or 12 V, V3 = 15 V or 20 V EN12V or EN9V = HIGH (no shunt installed-default) => V1 and V2 EN12V or EN9V = LOW (shunt installed) => No V2 H1 position: V3 and IMAX = 5 A (OCP = 6.3 A) H2 position: => V3 and IMAX = 3 A (OCP = 4.2 A) H3 position: No V3 and IMAX = 5 A (OCP = 6.3 A) H4 position (default): No V3 and IMAX = 3 A (OCP = 4.2 A) Advertised current at Vx => Ix = min(PMAX/Vx, IMAX)
J16	V_Cable	Used to disconnect D2, D3, D4
J18	V_LED	Used to disconnect D10, D11, D13
J15	BC 1.2	Used to enable or disable the BC1.2 function
J5	VPWR	Used to select power source for VPWR
J6	VPDD	Used to select power source for VDD
J10, J7	CC1, CC2	Used to put Ra or Rd to CC lines
J1, J17		Used to connect two EVMs together to enable PPM
J2		Used to enable two EVMs to share a single power supply when doing PPM

Table 4. Test Points

<table>
<tr><th>J7</th><th>J8</th><th>Description</th></tr>
<tr><td>TP13</td><td>VIN</td><td>Input voltage</td></tr>
<tr><td>TP18</td><td>DCDC_5V</td><td>Output of the 5 V Buck</td></tr>
<tr><td>TP17</td><td>DCDC_2</td><td>Output of the higher voltage Buck</td></tr>
<tr><td>TP1/TP3 /TP10</td><td>GND</td><td>Output ground test points</td></tr>
<tr><td>TP7, TP4</td><td>CC1, CC2</td><td>CC lines test points</td></tr>
<tr><td>TP8/TP9</td><td>GDPG/PFET_S</td><td>PFETs Drain and Source test points</td></tr>
<tr><td>TP14/TP15</td><td>G5V/GDNG</td><td>NFETs Gate test points</td></tr>
<tr><td>TP5, TP6</td><td>CTL1, CTL2</td><td>Control signals coming from the TPSP25741 and TPS25741A that adjust the output voltage of the buck boost converter based on the following table:
<table>
<tr><th>Voltage Contained in PDO Requested by UFP</th><th>CTL2 State</th><th>CTL1 State</th></tr>
<tr><td>5 V</td><td>High-z</td><td>High-z</td></tr>
<tr><td>12 V or 9 V</td><td>Low</td><td>High-z</td></tr>
<tr><td>20 V or 15 V</td><td>Low</td><td>Low</td></tr>
</table>
NOTE: DCDC_2 voltage is changed dynamically from V2 to V3 (or V3 to V2) by CTL1. For V1 to V3 (or V3 to V1) transitions, a momentary pause at V2 may be observed in the VBUS waveform. To inhibit the momentary pause at V2, the CTL1 signal may be connected to GND to default DCDC_2 at the V3 voltage instead of the V2 voltage. For this configuration, use a jumper wire from TP5 to TP1, TP3, or TP10.</td></tr>
<tr><td>TP11</td><td>VCONN</td><td>VCONN test points</td></tr>
<tr><td>TP16</td><td>VBUS</td><td>Voltage that is applied to the VBUS of the USB Type-C receptacle and cable</td></tr>
</table>

4.2 Setting Advertisement Levels with J4 and J3

The advertised power, voltages, and currents can be configured using J4 and J3 as shown in Figure 5.

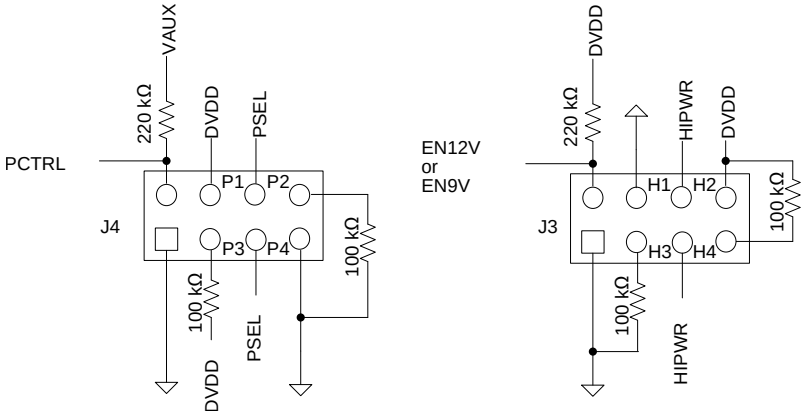


Figure 5. Setting Advertisement Levels with J4 and J3

4.3 Equipment Setup

The following is required to set up the equipment:

- Power supply capable of 24 V and preferably 3 A (72 W)
- Resistive or electronic load
- PD-capable UFP to negotiate voltages.
- USB Type-C cable

5 Operation

Use the following steps to operate the EVM:

- Turn on the input power supply to 24 V.
- Connect the UFP to the TPS25741 or TPS25741A EVM through a USB Type-C cable.
- Make desired voltage requests from the UFP to TPS25741 or TPS25741A EVM.
- Connect load between J8 and J14 as desired to test features and other performance.

6 Test Results

This section provides typical performance waveforms for the TPS25741EVM-802 and TPS25741AEVM-802 with V_{IN} = 24 V at different load conditions. Actual performance data is affected by measurement techniques and environmental variables; therefore, these curves are presented for reference and may differ from actual results obtained.

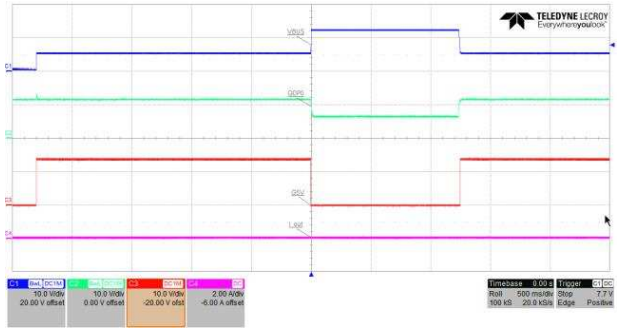


Figure 6. Mux Between 5 V and 12 V at No Load

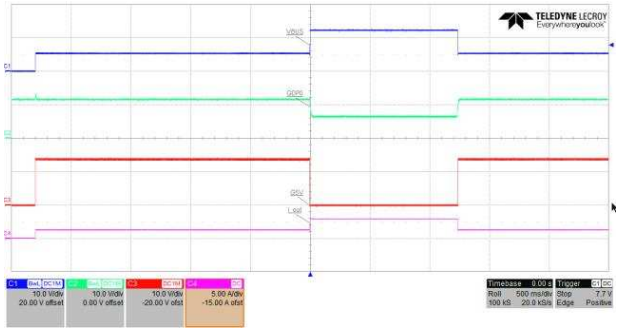


Figure 7. Mux Between 5 V and 12 V at 3 A

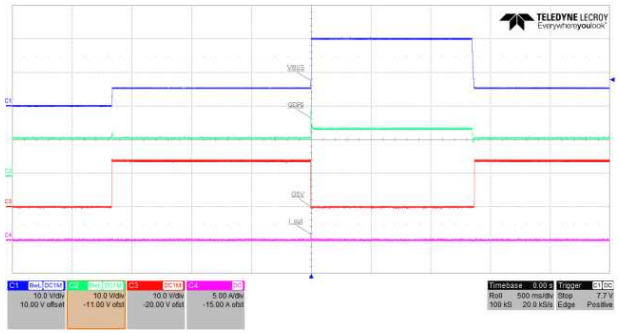


Figure 8. Mux Between 5 V and 20 V at No Load

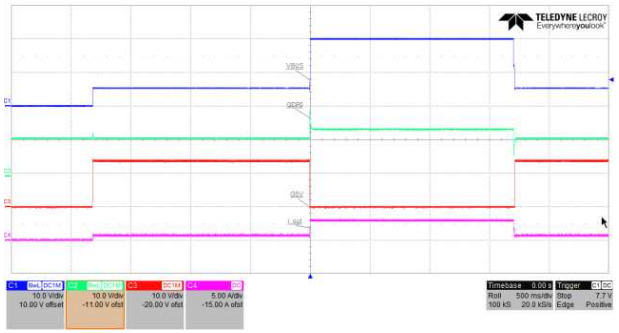


Figure 9. Mux Between 5 V and 20 V at 3 A

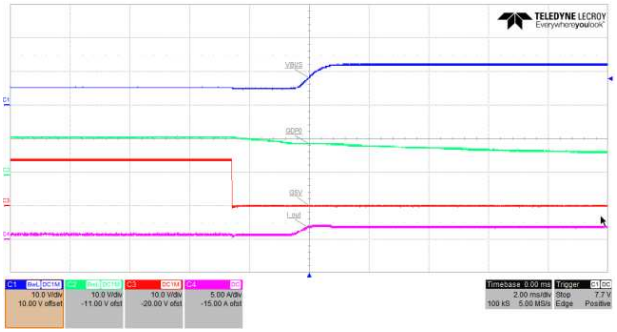


Figure 10. 5-V to 12-V Transition

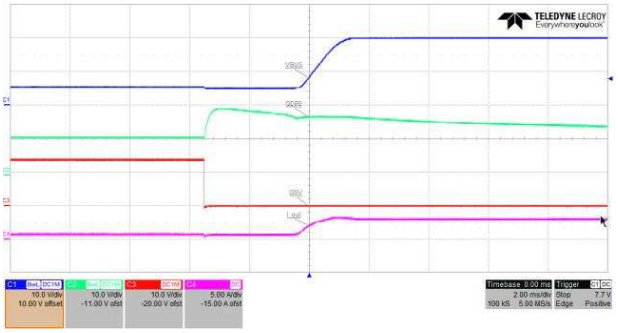


Figure 11. 5-V to 20-V Transition

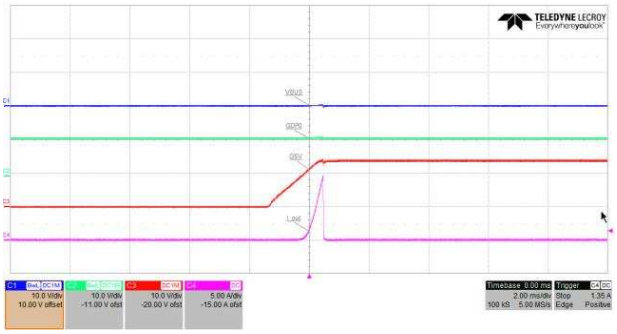


Figure 12. Start Into Short on Output

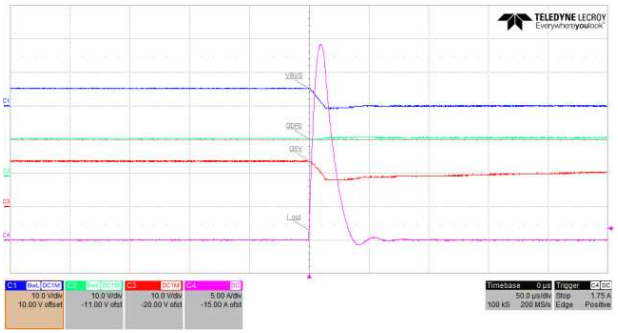


Figure 13. Hot Short on Output 5 V

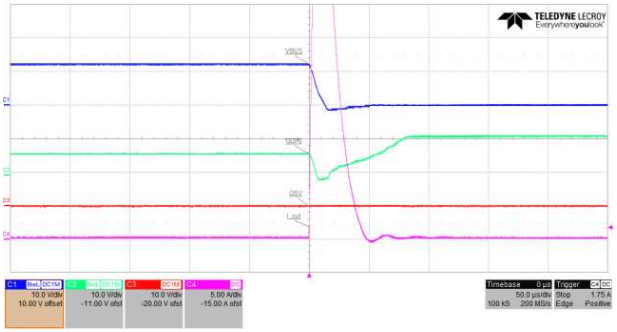


Figure 14. Hot Short on Output 12 V

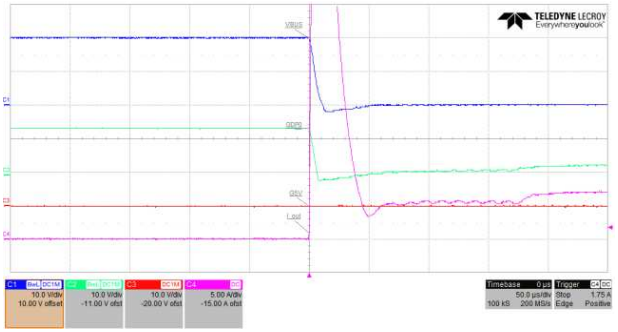


Figure 15. Hot Short on Output 20 V

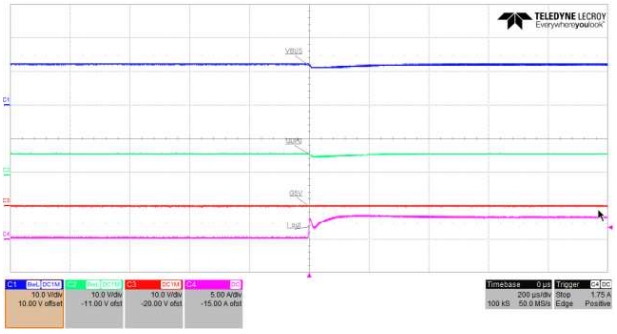


Figure 16. Load Step From 0 A to 3 A (12 V)

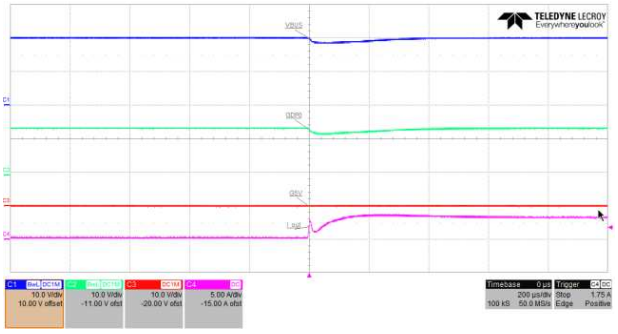


Figure 17. Load Step From 0 A to 3 A (20 V)

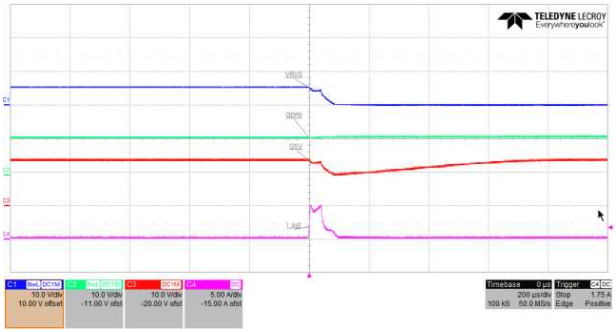


Figure 18. 5.5-A Load Step Triggers OCP (5 V)

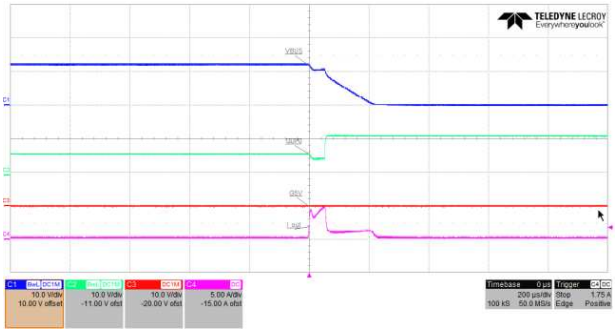


Figure 19. 5.5-A Load Step Triggers OCP (12 V)

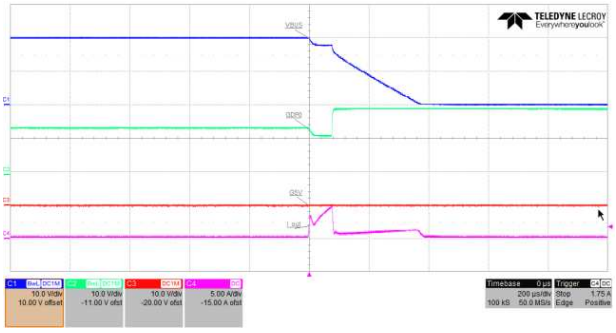
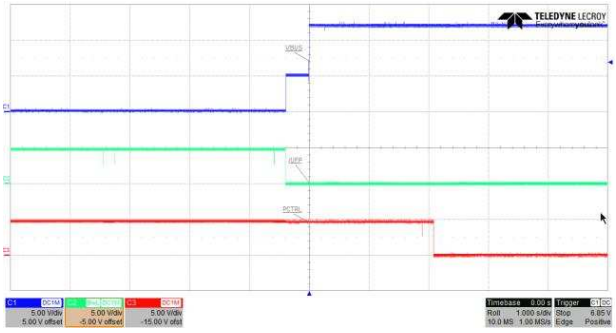


Figure 20. 5.5-A Load Step Triggers OCP (20 V)



One port for MacBook®, the other for legacy smart-phone.

Figure 21. Port Power Management

Figure 22. VCONN With 200-mA Load

Figure 23. VCONN OCP

7 Board Layout Image

Figure 24 through Figure 28 illustrate the top layer assembly drawing and PCB layout images.

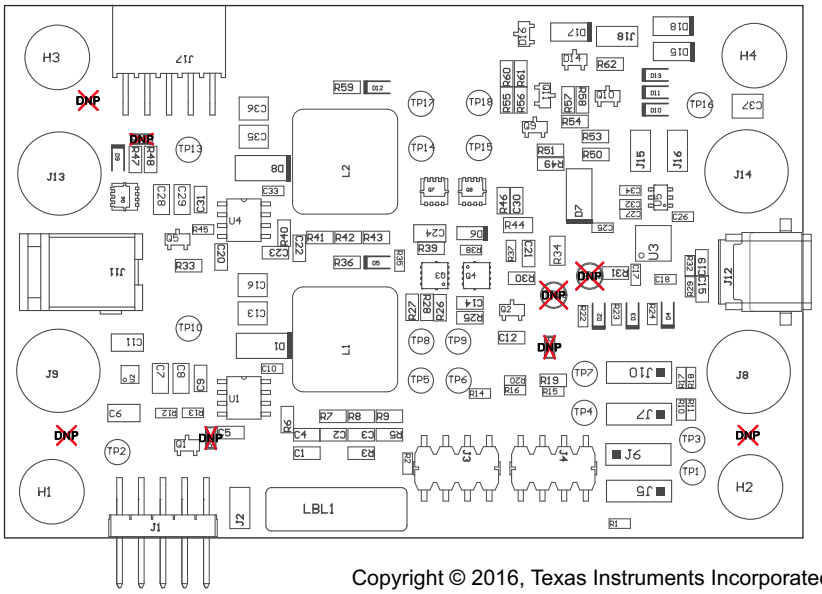


Figure 24. Top Layer Assembly

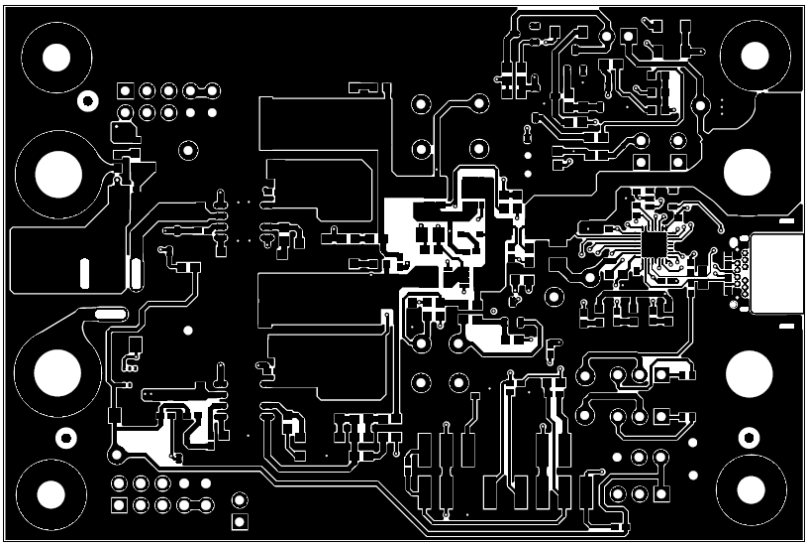


Figure 25. Top Layer

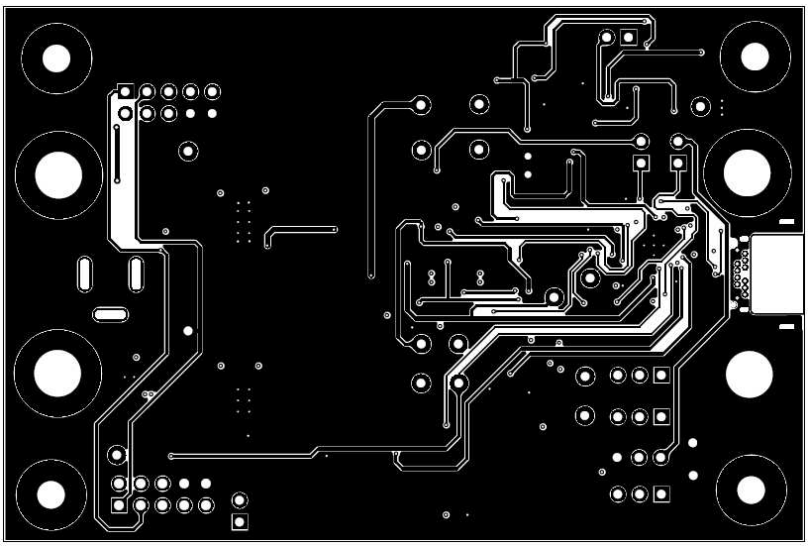


Figure 26. Signal Layer 1

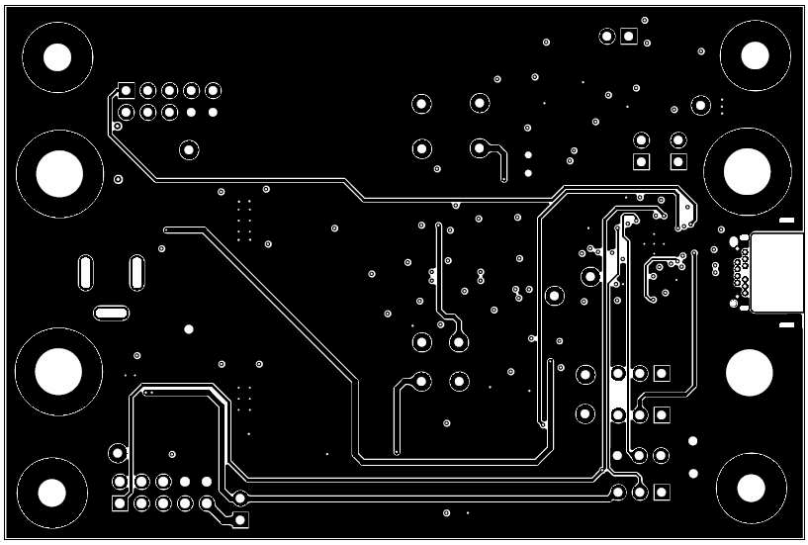


Figure 27. Signal Layer 2

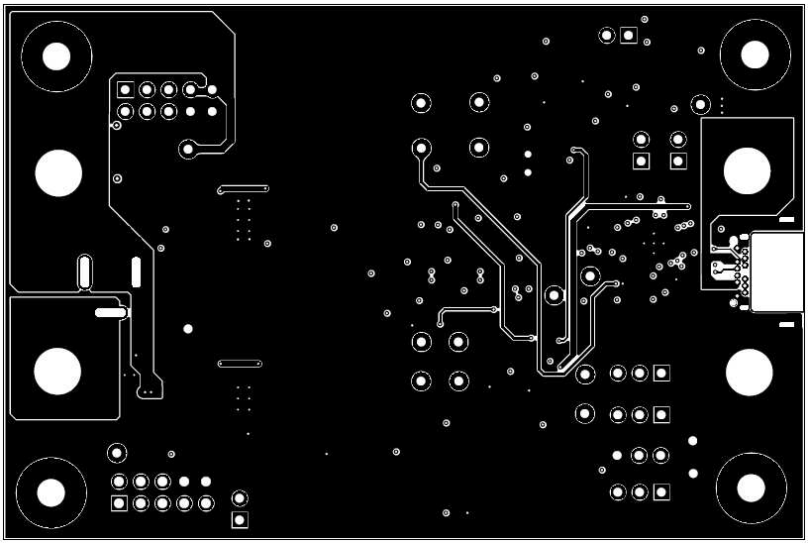


Figure 28. Bottom Layer

8 Bill of Materials

Table 5 lists the EVM BOM.

Table 5. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		PWR802	Any	-	-
C1, C23	2	3300pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603C332K5RACTU	Kemet		
C2	1	0.1uF	CAP, CERM, 0.1 µF, 25 V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX		
C3, C5, C20	3	0.01uF	CAP, CERM, 0.01 µF, 25 V, +/- 5%, C0G/NP0, 0603	0603	C0603H103J3GACTU	Kemet		
C4, C22	2	82pF	CAP, CERM, 82 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A820JAT2A	AVX		
C6	1	2.2uF	CAP, CERM, 2.2 µF, 16 V, +/- 10%, X5R, 0805	0805	0805YD225KAT2A	AVX		
C7, C8, C28, C29	4	10uF	CAP, CERM, 10 µF, 50 V, +/- 10%, X5R, 1206	1206	C3216X5R1H106K160AB	TDK		
C9, C31	2	0.1uF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603	885012206095	Wurth Elektronik		
C10, C33	2	0.1uF	CAP, CERM, 0.1 µF, 16 V, +/- 10%, X5R, 0402	0402	GRM155R61C104KA88D	Murata		
C11	1	0.47uF	CAP, CERM, 0.47 µF, 50 V, +/- 10%, X7R, 0805	0805	UMK212B7474KG-T	Taiyo Yuden		
C12	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603C102K5RACTU	Kemet		
C13, C16, C35, C36	4	22uF	CAP, CERM, 22 µF, 25 V, +/- 20%, X5R, 1210	1210	12103D226MAT2A	AVX		
C14	1	1200pF	CAP, CERM, 1200 pF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H122KA01D	Murata		
C15, C19	2	330pF	CAP, CERM, 330 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A331JAT2A	AVX		
C17, C18, C25, C26, C27, C32, C34	7	0.1uF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0402	0402	C1005X7R1H104K050BB	TDK		
C21	1	0.33uF	CAP, CERM, 0.33 µF, 25 V, +80/-20%, Y5V, 0603	0603	C0603C334Z3VACTU	Kemet		
C24	1	0.012uF	CAP, CERM, 0.012 µF, 50 V, +/- 10%, X7R, 0805	0805	08055C123KAT2A	AVX		
C30	1	0.01uF	CAP, CERM, 0.01 µF, 50 V, +/- 5%, X7R, 0603	0603	C0603C103J5RACTU	Kemet		
C37	1	10uF	CAP, CERM, 10 µF, 25 V, +/- 10%, X7R, 1210	1210	12103C106KAT2A	AVX		
D1, D8	2	30V	Diode, Schottky, 30 V, 5 A, SMA	SMA	RB080L-30TE25	Rohm		
D2	1	AUDIO	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik		
D3	1	DEBUG	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik		
D4	1	POL	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik		
D5, D10, D11, D12, D13	5	Green	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik		
D6	1	30V	Diode, Schottky, 30 V, 0.8 A, SOD-323	SOD-323	CUS08F30,H3F	Toshiba		
D7	1	40V	Diode, Schottky, 40 V, 3 A, SMA	SMA	B340A-13-F	Diodes Inc.		
D9	1	Vin	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik		
D14	1	12V	Diode, Zener, 12 V, 225 mW, SOT-23	SOT-23	BZX84C12LT1G	ON Semiconductor		
D15, D17, D18	3	100V	Diode, Ultrafast, 100 V, 0.15 A, SOD-123	SOD-123	1N4148W-7-F	Diodes Inc.		
D16	1	5.6V	Diode, Zener, 5.6 V, 225 mW, SOT-23	SOT-23	BZX84B5V6LT1G	ON Semiconductor		
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply		
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone	-	-
J1	1		Header, 2.54mm, 5x2, Gold, R/A, TH	Header, 2.54mm, 5x2, R/A, TH	61301021021	Wurth Elektronik		

Table 5. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
J2, J15, J16, J18	4		Header, 100mil, 2x1, Tin, TH	Header, 2x1, 100mil, TH	5-146278-2	TE Connectivity		
J3, J4	2		Header, 2.54mm, 4x2, Gold, SMT	Header, 2.54mm, 4x2, SMT	TSM-104-01-L-DV	Samtec		
J5, J6, J7, J10	4		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec		
J8, J9, J13, J14	4		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone		
J11	1		Connector, DC Jack 2.1X5.5 mm, TH	Conn, DC Jack, pin 2mm Dia.	PJ-202AH	CUI Inc.		
J12	1		Connector, Receptacle, USB Type-C, R/A, TH	Connector, Receptacle, USB Type-C, R/A, TH	898-43-024-90-310000	Mill-Max		
J17	1		Connector, Receptacle, 100mil, 5x2, Gold plated, R/A, TH	5x2 R/A Header Receptacle	PPPC052LJBN-RC	Sullins Connector Solutions		
L1, L2	2	8.2uH	Inductor, Shielded Drum Core, Ferrite, 8.2uH, 6.25A, 0.014 ohm, SMD	WE-PD-L	744771008	Wurth Elektronik eiSos		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady	-	-
Q1, Q5, Q9, Q10, Q11	5	60V	MOSFET, N-CH, 60 V, 0.17 A, SOT-23	SOT-23	2N7002-7-F	Diodes Inc.		None
Q2	1	-60V	MOSFET, P-CH, -60 V, -0.3 A, SOT-23	SOT-23	BSH201,215	NXP Semiconductor		None
Q3, Q4	2	-30V	MOSFET, P-CH, -30 V, -35 A, PowerPAK 1212	PowerPAK 1212	SI7625DN-T1-GE3	Vishay-Siliconix		None
Q6, Q7, Q8	3	30V	MOSFET, N-CH, 30 V, 20 A, SON 3.3x3.3mm	SON 3.3x3.3mm	CSD17579Q3A	Texas Instruments		None
R1, R2, R14, R15, R16, R20	6	100k	RES, 100 k, 0.5%, 0.063 W, 0402	0402	CRCW0402100KDHEDP	Vishay-Dale		
R3, R5	2	499	RES, 499, 1%, 0.1 W, 0603	0603	CRCW0603499RFKEA	Vishay-Dale		
R6, R40	2	30k	RES, 30 k, 5%, 0.1 W, 0603	0603	CRCW060330K0JNEA	Vishay-Dale		
R7	1	732	RES, 732, 1%, 0.1 W, 0603	0603	CRCW0603732RFKEA	Vishay-Dale		
R8, R42	2	10.2k	RES, 10.2 k, 1%, 0.1 W, 0603	0603	CRCW060310K2FKEA	Vishay-Dale		
R9, R43	2	51	RES, 51, 5%, 0.1 W, 0603	0603	CRCW060351R0JNEA	Vishay-Dale		
R10, R17	2	5.1k	RES, 5.1 k, 5%, 0.063 W, 0402	0402	CRCW04025K10JNED	Vishay-Dale		
R11, R18	2	1.0k	RES, 1.0 k, 5%, 0.063 W, 0402	0402	CRCW04021K00JNED	Vishay-Dale		
R12, R13	2	10k	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ103X	Panasonic		
R19	1	510	RES, 510, 5%, 0.1 W, 0603	0603	CRCW0603510RJNEA	Vishay-Dale		
R22, R23, R24	3	2.2k	RES, 2.2 k, 5%, 0.063 W, 0402	0402	CRCW04022K20JNED	Vishay-Dale		
R25	1	510k	RES, 510 k, 5%, 0.1 W, 0603	0603	CRCW0603510KJNEA	Vishay-Dale		
R26, R28, R30, R31, R46	5	10	RES, 10, 5%, 0.25 W, 0603	0603	CRCW060310R0JNEAHP	Vishay-Dale		
R27	1	10Meg	RES, 10 M, 5%, 0.1 W, 0603	0603	CRCW060310M0JNEA	Vishay-Dale		
R29, R32, R35, R38, R45	5	0	RES, 0, 5%, 0.063 W, 0402	0402	ERJ-2GE0R00X	Panasonic		
R33	1	910k	RES, 910 k, 5%, 0.1 W, 0603	0603	CRCW0603910KJNEA	Vishay-Dale		
R34	1	120	RES, 120 ohm, 5%, 0.25W, 1206	1206	CRCW1206120RJNEA	Vishay-Dale		
R36, R54	2	5.1k	RES, 5.1 k, 5%, 0.1 W, 0603	0603	CRCW06035K10JNEA	Vishay-Dale		
R37	1	24	RES, 24, 5%, 0.063 W, 0402	0402	CRCW040224R0JNED	Vishay-Dale		

Table 5. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R39	1	133k	RES, 133 k, 1%, 0.1 W, 0603	0603	CRCW0603133KFKEA	Vishay-Dale		
R41	1	1.87k	RES, 1.87 k, 1%, 0.1 W, 0603	0603	CRCW06031K87FKEA	Vishay-Dale		
R44	1	0.005	RES, 0.005, 1%, 0.5 W, 1206	1206	WSL12065L000FEA18	Vishay-Dale		
R47, R62	2	8.2k	RES, 8.2 k, 5%, 0.1 W, 0603	0603	RC0603JR-078K2L	Yageo America		
R48, R53, R59	3	2.2k	RES, 2.2 k, 5%, 0.1 W, 0603	0603	RC0603JR-072K2L	Yageo America		
R49	1	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	0603	CRCW06031K00JNEA	Vishay-Dale		
R50	1	1.0Meg	RES, 1.0 M, 5%, 0.1 W, 0603	0603	CRCW06031M00JNEA	Vishay-Dale		
R51	1	680k	RES, 680 k, 5%, 0.1 W, 0603	0603	CRCW0603680KJNEA	Vishay-Dale		
R55, R56, R58, R60	4	100k	RES, 100 k, 5%, 0.1 W, 0603	0603	CRCW0603100KJNEA	Vishay-Dale		
R57, R61	2	15k	RES, 15 k, 5%, 0.1 W, 0603	0603	CRCW060315K0JNEA	Vishay-Dale		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP3, TP10	3	Black	Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone		
TP2, TP13, TP16, TP17, TP18	5	Red	Test Point, TH, Miniature, Red	Keystone5000	5000	Keystone	-	-
TP4, TP5, TP6, TP7, TP8, TP9, TP14, TP15	8	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		
U1, U4	2		5-A, 28-V Input, Step-Down SWIFT™ DC-DC Converter With Eco-mode™, DDA0008E	DDA0008E	TPS54531DDAR	Texas Instruments	TPS54531DDA	Texas Instruments
U2	1		150-mA, 3.3-V, 1-µA IQ Voltage Regulators with Enable, DRV0006A	DRV0006A	TPS70933DRVR	Texas Instruments	TPS70933DRVT	Texas Instruments
U3	1		USB PD Baseband and USB Type-C Power Controller, RSM0032B	RSM0032B	TPS25741RSM	Texas Instruments		Texas Instruments
U5	1		USB Dedicated Charging Port Controller, DBV0006A	DBV0006A	TPS2514ADBVR	Texas Instruments	TPS2514ADBVT	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
R4, R21, R52	0	0	RES, 0, 5%, 0.063 W, 0402	0402	ERJ-2GE0R00X	Panasonic		
TP11	0	Red	Test Point, TH, Miniature, Red	Keystone5000	5000	Keystone	-	-
TP12	0	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		
Notes:			Unless otherwise noted in the Alternate Part Number or Alternate Manufacturer columns, all parts may be substituted with equivalents.					

Revision History

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

Changes from Original (July 2016) to A Revision **Page**

- Reversed the voltages in the two Buck blocks and changed the device name to TPS2514A in the *TPS25741EVM Block Diagram*. 3
- Changed *Output Voltages* and *Advertised Voltages* in the TPS25741AEVM-802 column from 5 V, 12 V, 20 V to 5 V, 9 V, 15 V of the *TPS25741 and TPS25741A EVM Electrical and Performance Specifications at 25°C* table. 4
- Changed value on C24 to 0.012 from 0.027 µF in the *TPS54531 Buck Power Supply* schematic. 5
- Changed the *Description* column of the J3 row in the *Jumper Functionality* table. 7
- Added a **NOTE** to the TP5, TP6 row in the *Description* column of the *Test Points* table. 8
- Changed the capacitor values in the C24 row to 0.012 µF from 0.027 µF, and changed the *Part Number* to 08055C123KAT2A in the ***BOM***. 15

STANDARD TERMS FOR EVALUATION MODULES

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 semiconductors 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.

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*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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/lsds/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。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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

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

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

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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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3.4 *European Union*

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

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

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

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.

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8. *Limitations on Damages and Liability:*

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