TPS25810EVM-745 User's Guide

This user's guide is for the TPS25810EVM-745 and explains how to get up and running with the TPS25810 EVM, how to test specific features of the TPS25810, and an explanation of what happens when different types of USB type-C devices are attached to the EVM.
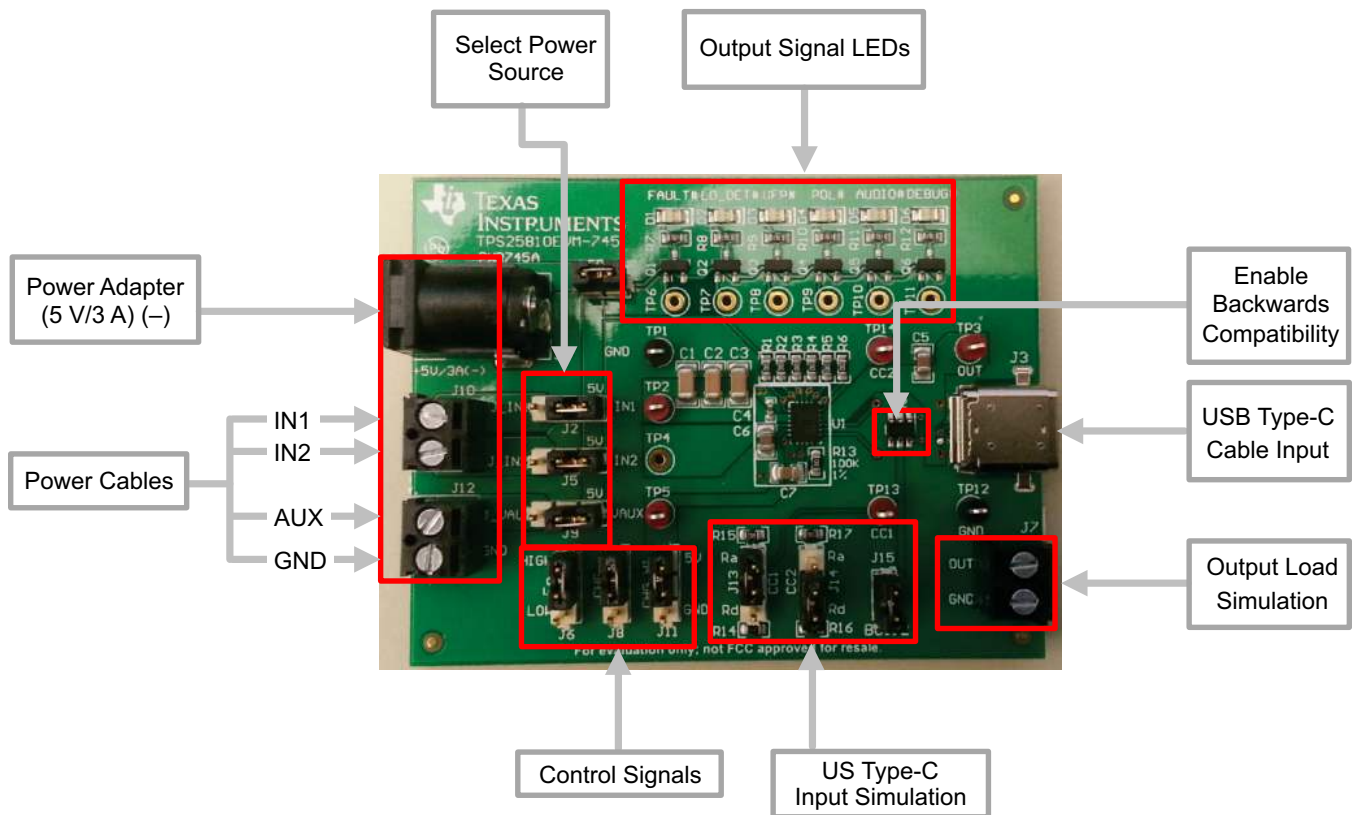

Figure 1. TPS25810EVM

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1   Introduction

The TPS25810 is a simple to use USB Type-C downstream facing port (DFP) controller with an integrated 3-A rated USB power switch. The TPS25810 also connects to the two USB Type-C configuration channels (CC) lines and monitors each line to determine if and what type of USB device has been attached. For more information on the TPS25810, refer to the data sheet (SLVSCR1).

2   Schematic
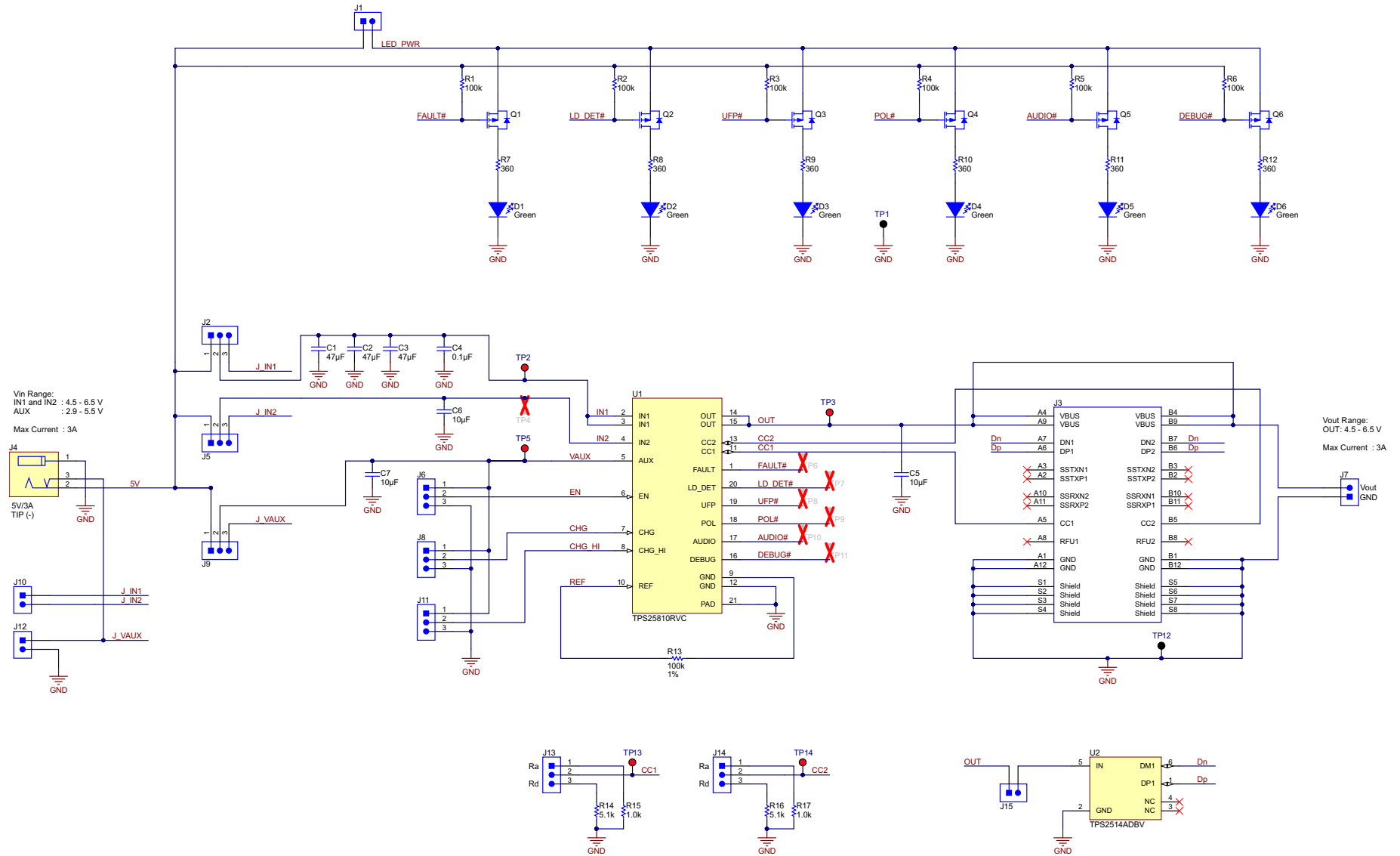
Figure 2 is the schematic of the TPS25810EVM-745.

Figure 2. TPS25810EVM-745 Schematic

3   Test Points

Table 1 lists the test points and the description of each test point.

Table 1. Test Points

TEST POINT	LABEL	DESCRIPTION
TP1	GND	Ground connection for input voltage and output signals
TP2	IN1	Input voltage
TP3	OUT	Output voltage
TP4	IN2	Input power
TP5	AUX	Auxiliary input voltage
TP6	FAULT#	Active low fault signal
TP7	LD_DET#	Active low load detect signal
TP8	UFP#	Active low UFP detect signal
TP9	POL#	Active low polarity signal
TP10	AUDIO#	Active low audio signal
TP11	DEBUG#	Active low debug signal
TP12	GND	Ground connection for output voltage
TP13	CC1	CC1 voltage
TP14	CC2	CC2 voltage

4   Powering Up the EVM

The TPS25810 has three input power sources: IN1, IN2, and AUX. IN1 and IN2 are the power lines that provide power to the OUT pins, all the way through to the USB Type-C port. The aux line is power source for the internal logic of the TPS25810. The two ways to power up these three lines are: using a 5-V/3-A power adaptor (with J4) or using the four cable inputs (J10 for IN1, IN2 and J12 for AUX, GND) to individually test different voltages for each power line. Use jumpers J2, J5, J9 in order to choose between which power source to use. See Figure 3 for jumper orientation.
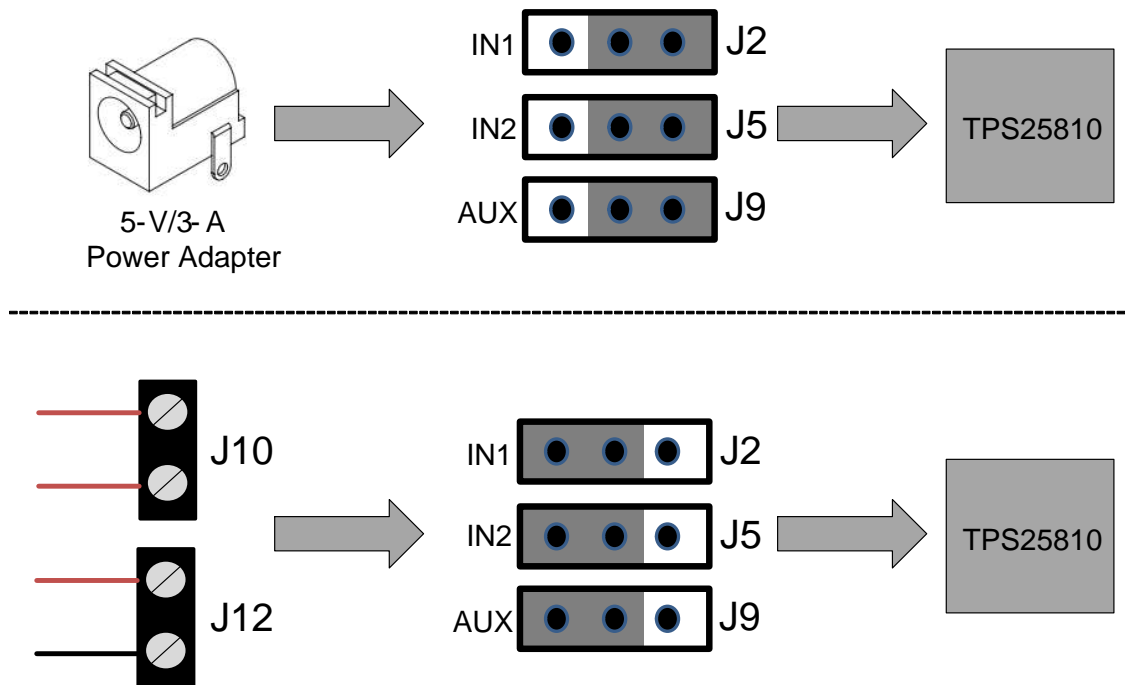

Figure 3. Choosing the Right Power Source

TI recommends a power adaptor that is a standard 2.1-mm DC power adaptor with a negative tip that can support 5 V and 3 A. An example of a power adaptor to use is the Triad Magnetics WSU050-3000-R wall power supply.

When using the four-cable input power source, make sure to stay within the specified voltage limits for each port listed in the data sheet.

4.1 Measuring TPS25810 Power Consumption

The TPS25810 is powered through the AUX pin while the IN1 and IN2 lines directly power the OUT pin of the device. Therefore an easy way to measure the power consumption is to connect an ammeter to jumper J9. Figure 4 shows how to connect the ammeter to the AUX pin and to either the power adaptor or the power cable (depending on how the EVM is powered).

When no device is connected to the USB port on the EVM, the TPS25810 only consumes 5 µA. To test this have the ammeter connected properly to jumper J9, remove jumper on J1 to disconnect the LEDs, and make sure nothing is connected to the output of the TPS25810.
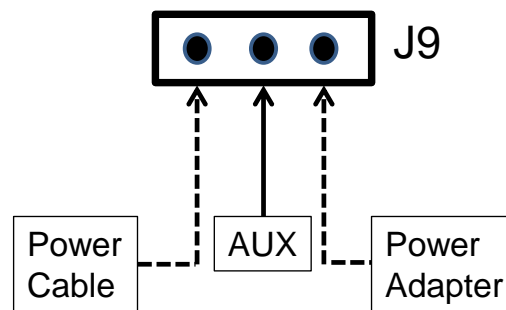
Figure 4. Connecting the Ammeter to AUX Pin and Power Source

5 Enabling and Configuring the TPS25810

5.1 Enabling and Disabling the TPS25810

The TPS25810 has an enable pin that creates a convenient way to turn on or turn off the device without interrupting the power source. On the TPS25810EVM-745 the TPS25810 can be enabled and disabled using jumper J6. See Figure 5 for enable and disable positions for jumper J6.

Figure 5. How to Enable and Disable the TPS25810 on the EVM

5.2 Configuring the Broadcast Current Limit on the TPS25810

The TPS25810 can also advertise (using the CC lines) how much current it can supply to a connected USB device. The three levels of current limits 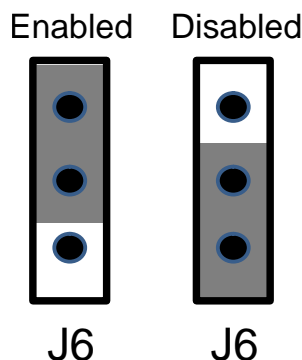that the TPS25810 can support are: STD, 1.5 A, and 3 A. To switch between these three levels, a HIGH or LOW voltage is set onto pins CHG and CHG_HI of the TPS25810. Refer to the data sheet for voltage levels required for CHG and CHG_HI to change the current limit levels. On the TPS25810EVM-745 jumpers J8 and J11 control the voltage level of CHG and CHG_HI pins respectively. Figure 6 shows how to set up the jumper connections in order to get the desired current limit broadcasted through the CC lines.
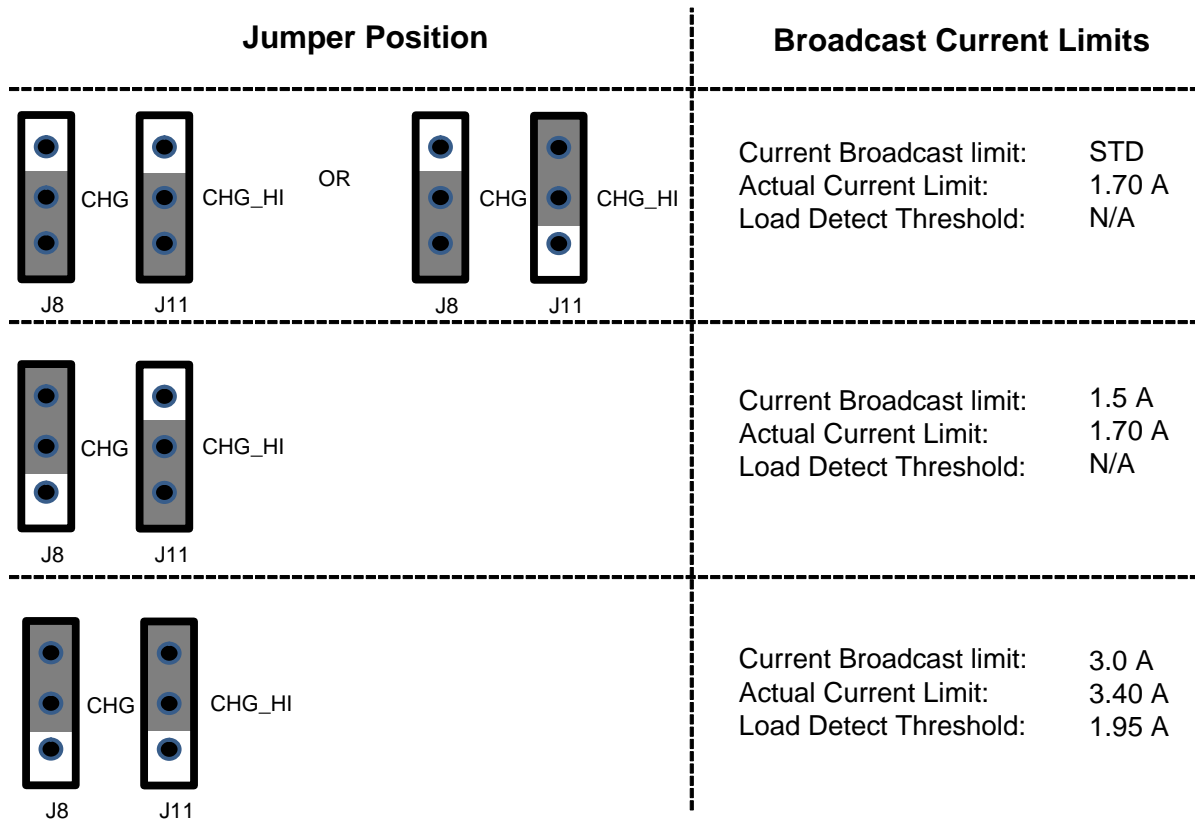

Figure 6. Jumper Connection for Each Broadcast Current Limit

6   TPS25810EVM-745 Features

The TPS25810EVM-745 allows for all the features of the TPS25810 to be tested with and without a USB Type-C cable and external device. Below are the most common types of situations that can happen with the TPS25810EVM-745 and within each section is an explanation of how to test each situation with and without external components. Keep in mind how the test jumpers J13 and J14 (which control CC1 and CC2 respectively) connect to the TPS25810 and the resistors. See Figure 7 to see how they are connected.
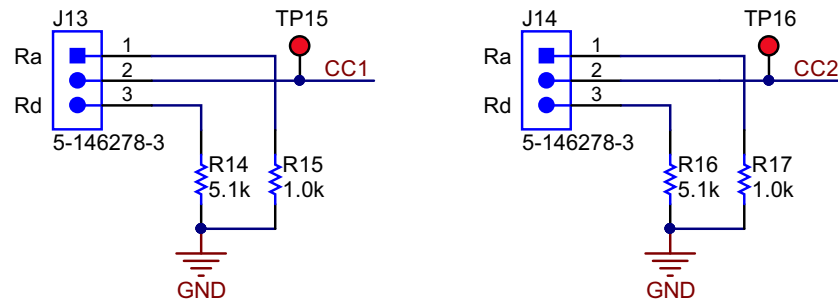

Figure 7. Schematic Showing How CC1 and CC2 are Connected to Jumpers J14 and J15 Respectively

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CAUTION

When connecting a physical USB Type-C cable into the port of the EVM make sure to disconnect the jumpers (J13, J14) and disconnect any loads on the jumper J7 (which is connected to OUT pin) in order to avoid interference on the CC lines.

6.1   No Connection to EVM

When nothing is connected to the output of the EVM then the TPS25810 will not output any power over the OUT lines. In this mode, the TPS25810 will only consume 5 µA.

In terms of replicating this on the EVM, make sure that nothing is connected to jumpers J13, J14, and J7 which control what is connected to CC1, CC2, and OUT respectively.

6.2   Connecting a DFP Device

The TPS25810 is a downstream facing port (DFP) controller and continuously monitors the CC lines to see if an upstream facing port (UFP) device is connected. The way it determines if an UFP device is connected is if the CC lines are connected to a specific set of resistors values. When connecting one DFP device to another DFP device, both devices will continue to monitor the CC lines for a valid connection and will not turn on the output lines. This can be tested on the EVM by connecting a DFP device to the TPS25810EVM-745 or by connecting 2 TPS25810EVM-745 together through the USB port.

6.3   Connecting a UFP Device

There are two types of UFP devices that can be connected to a DFP device: a powered UFP device or a nonpowered UFP device. As soon as a UFP device is connected to the EVM, the UFP# LED will light up. The way the TPS25810 detects a UFP device is by sensing if only one of the CC lines is connected to a Ra resistor value. And if the UFP device is powered than the other CC line should be connected to a Rd resistor value. The TPS25810EVM-745 will also report via the USB Type-C cable's polarity/orientation with the POL# signal and LED. To test these two types of UFP devices along with their different cable polarities on the EVM set the CC1, CC2, and OUT jumpers based on Figure 8. Figure 8 also shows how POL# and UFP# LEDs will behave based on the jumper connections.
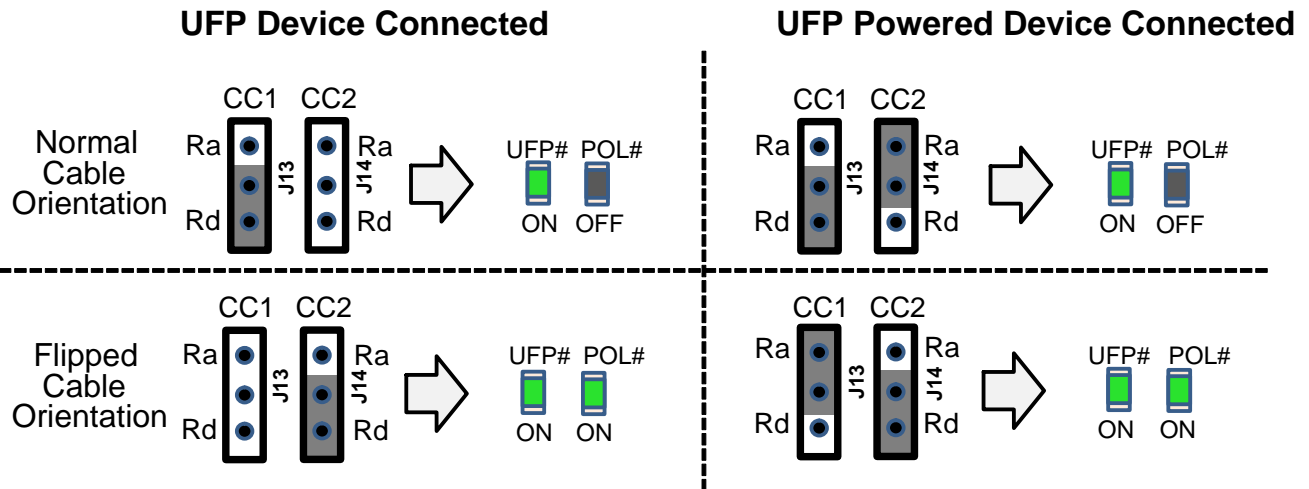
UFP Device Connected

UFP Powered Device Connected

Figure 8. Simulating an UFP Device on the TPS25810EVM-745

6.3.1 UFP Load Detect Feature

When a UFP device is connected to the TPS25810, it is also possible to test the load detect feature. The load detect feature is enabled when the CHG and CHG_HI pins are set HIGH to Vaux. Once a UFP device is connected and that device exceeds the current limit (1.95 A), the LD_DET signal will be activated. To simulate a load detect without a USB Type-C cable, it is recommended to connect a rheostat that can support up to 15 to 20 W. Since the output is around 5 V, a resistive load of 2 Ω should trigger the "LD_DET#" signal. Figure 9 shows how the LD_DET# signal/LED is activated when the OUT jumper is connected to a load that exceeds the current limit.
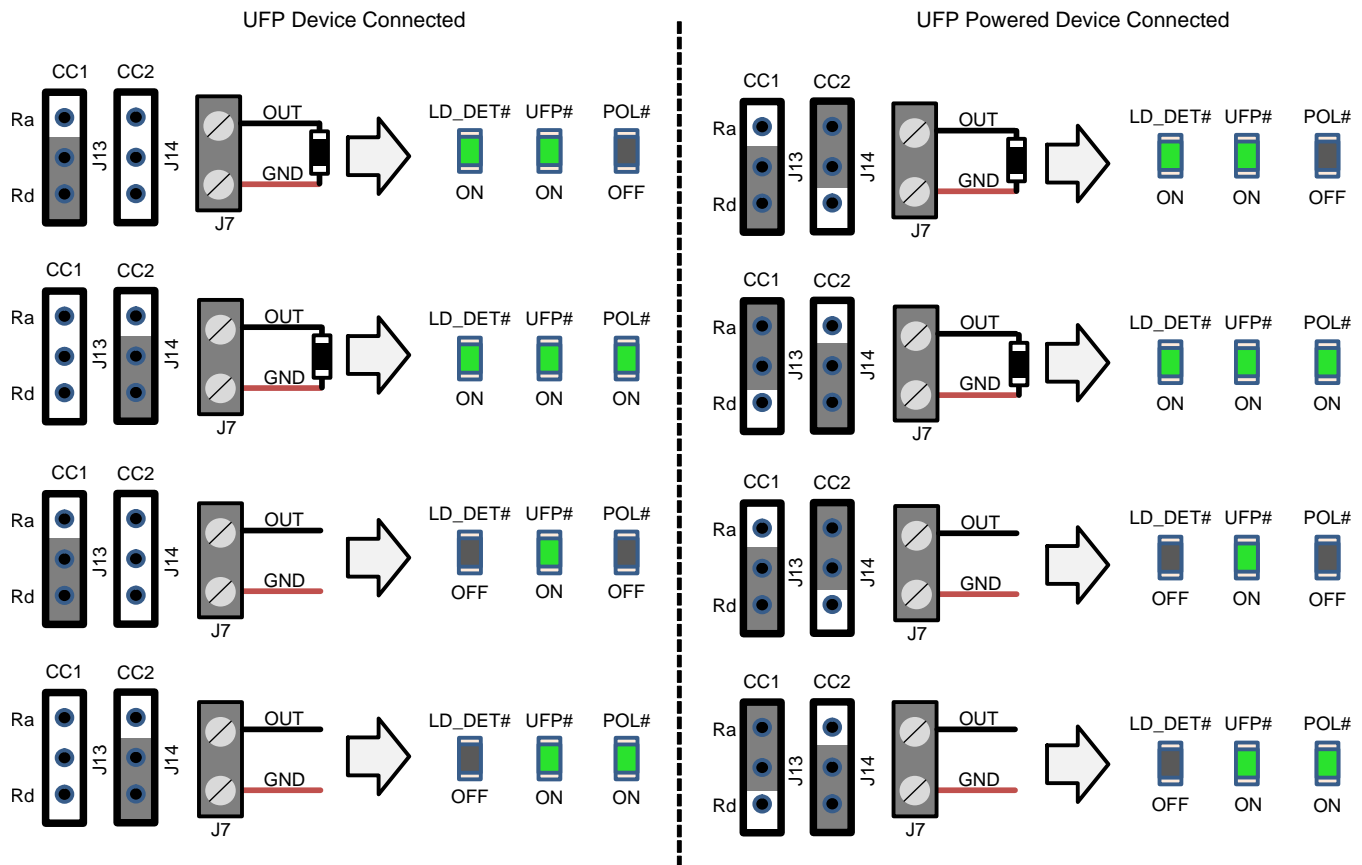
Figure 9. Simulating an UFP Device on the TPS25810EVM-745 With and Without an Output Load

6.4 Connecting a Non-UFP Powered Device

The way the TPS25810 detects a powered device is by checking if one of the CC lines is connected to a Rd resistor value. To test a connection to a non-UFP powered device on the EVM set the CC1 and CC2 jumpers and the out connection based on Figure 10. Note that the UFP# and POL# LEDs will not light up with a non-UFP powered device since no signals from the TPS25810 are triggered.
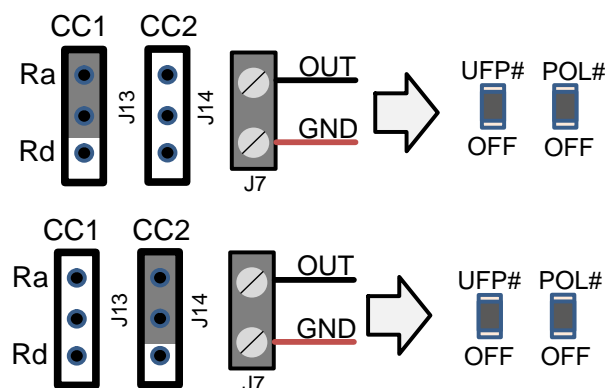

Figure 10. Simulating a Non-UFP Powered Device on the TPS25810EVM-745

6.5 Connecting an Audio Accessory Device

The TPS25810 can detect if an audio accessory device has been connected. It is detected by checking if both CC lines are connected to a Ra resistor value. This connection is unique in the sense that both Ra resistors must be connected to the CC lines within a small time frame (usually about 10 ms). The easiest way to test this mode on the TPS25810EVM-745 is by connecting an audio accessory device through the USB port. Figure 11 shows which LEDs are switch on when having both CC jumpers connected to Ra after a power cycle.

Figure 11. Simulating an Audio Accessory Device on the TPS25810EVM-745

6.6 Connecting a Debug Accessory Device

The TPS25810 can detect if a debug accessory device has been connected. It is detected by checking if both CC lines are connected to a Rd resistor value. This connection is unique in the sense that both Rd resistors must be connected to the CC lines within a small time frame (usually about 10ms). The easiest way to test this mode on the TPS25810EVM-745 is by connecting a debug accessory device through the USB port. Figure 12 shows which LEDs are switch on when having both CC jumpers connected to Rd after a power cycle.
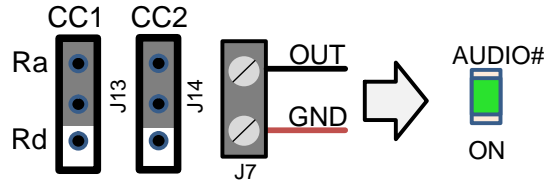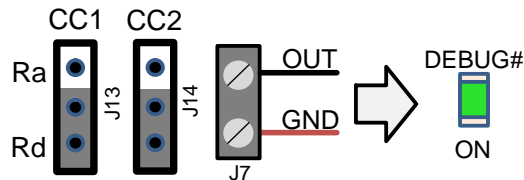

Figure 12. Simulating a Debug Accessory Device on the TPS25810EVM-745

6.7 Connecting to a Previous USB Version

The TPS25810EVM-745 supports previous USB versions with the help of the TPS2513 which will send the necessary power to devices that charge using the data lines (D+ and D–). The TPS2513 can support USB 2.0 and USB 3.0 devices. For more information about the TPS2513 refer to the TPS2513 data sheet, SLVSBY8. Note that in order to connect a previous USB version to the EVM, a USB Type-C adaptor will be needed. In order to enable or disable the TPS2513 connect or disconnect jumper J15. Figure 13 shows the schematic connection for the TPS2513 on the TPS25810EVM-745.
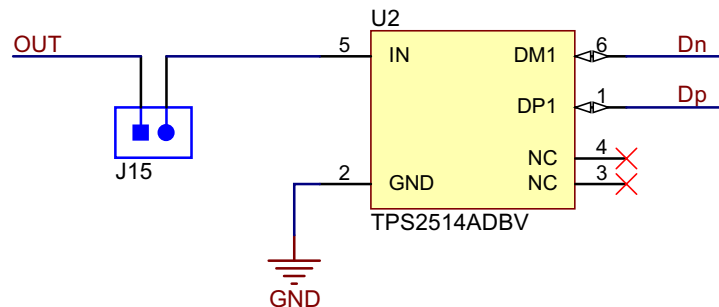

Figure 13. Schematic of TPS2514 Section

7 TPS25810 Output Signals

7.1 Fault Detected (FAULT#)

There are two conditions that can cause this fault signal to occur. Those two conditions are:

1. The output of the TPS25810 exceeds the programmed current threshold
2. The device exceeds the temperature threshold

As soon as the current and the temperature go back into normal ranges the fault is cleared and the device resumes normal operation.

Refer to *Electrical Characteristics* section located in the TPS25810 data sheet, SLVSCR1, for more information on the current and temperature thresholds.

7.2 Load Detected (LD_DET#)

When the device is in high current charging mode (set when the CHG and CHG_HI pins are pulled to Vaux or logic HIGH) the device will monitor the charging current. As soon as the current exceeds 1.95 A (typical) the LD_DET pin will be asserted.

When activated, this signal can be used to warn a microprocessor or even another TPS25810 device to avoid over current or over power from the power source.

7.3 Upstream Facing Port Connected (UFP#)

This pin is active when an upstream facing port (UFP) device is connected to the port and is communicating properly through the CC lines. Refer to Table 2 to see what conditions for the CC lines are necessary to activate this mode.

Table 2. TPS25810 Response based on Port Connection Type

TPS25810 PORT	CC1	CC2	OUT	TPS25810 RESPONSE				
				VCONN ON CC1 OR CC2	POL#	UFP#	AUDIO#	DEBUG#
Nothing Attached	OPEN	OPEN	OPEN	NO	HI-Z	HI-Z	HI-Z	HI-Z
UFP Connected	Rd	OPEN	IN1	NO	HI-Z	LOW	HI-Z	HI-Z
UFP Connected	OPEN	Rd	IN1	NO	LOW	LOW	HI-Z	HI-Z
Powered Cable/ NO UFP Connected	OPEN	Ra	OPEN	NO	HI-Z	HI-Z	HI-Z	HI-Z
Powered Cable/ NO UFP Connected	Ra	OPEN	OPEN	NO	HI-Z	HI-Z	HI-Z	HI-Z
Powered Cable/ UFP Connected	Rd	Ra	IN1	CC2	HI-Z	LOW	HI-Z	HI-Z
Powered Cable/ UFP Connected	Ra	Rd	IN1	CC1	LOW	LOW	HI-Z	HI-Z
Debug Accessory Connected	Rd	Rd	OPEN	NO	HI-Z	HI-Z	HI-Z	LOW
Audio Adapter Accessory Connected	Ra	Ra	OPEN	NO	HI-Z	HI-Z	LOW	HI-Z

7.4 Polarity (POL#)

Introduced in USB Type-C is the reversible USB port. The TPS25810 resolves the orientation of the USB Type-C plug when a UFP device is connected. When there is no UFP device connected, the POL pin will remain deasserted. Refer to Table 1 to see what conditions for the CC lines are necessary to activate this mode.

7.5   Audio Accessory Mode (AUDIO#)

USB Type-C specifications defines an audio adapter decode state which allows implementation of an analog USB Type-C to 3.5 mm headset adapter. This pin is activated when the TPS25810 detects an audio accessory device which occurs when both CC lines are attached to the Ra resistors.

7.6   Debug Accessory Mode (DEBUG#)

USB Type-C specifications supports an optional debug accessory mode used for debug only and should not be used for communicating with commercial products. The pin is asserted when both CC lines are connected to the Rd resistor. This mode can be used for factory testing or similar functional modes.

8   Board Layout

The following images show the silkscreen, top, bottom, and assembly layers of the TPS25810EVM-745.
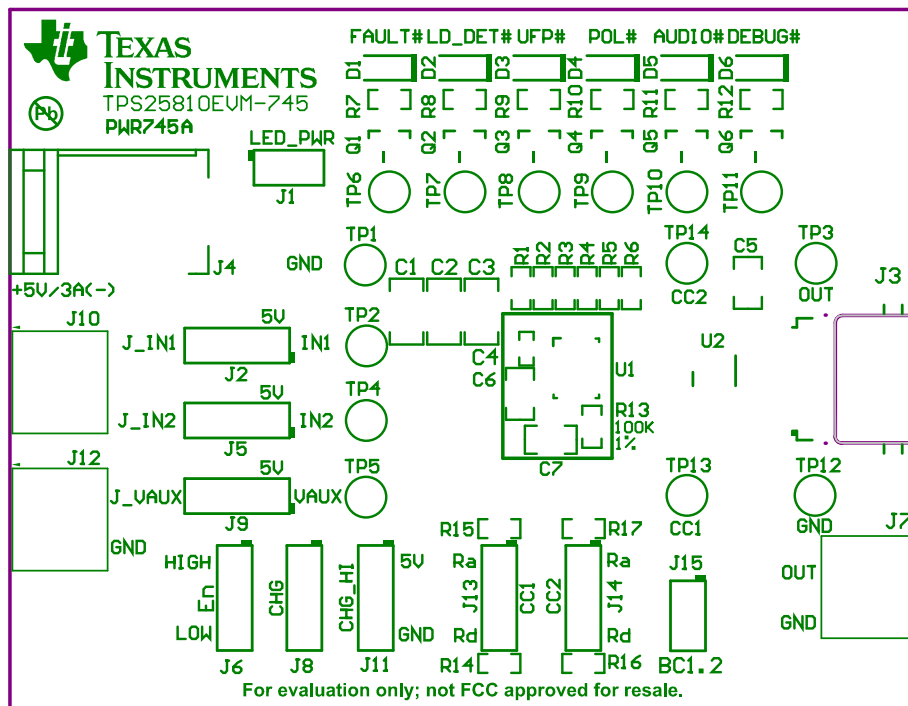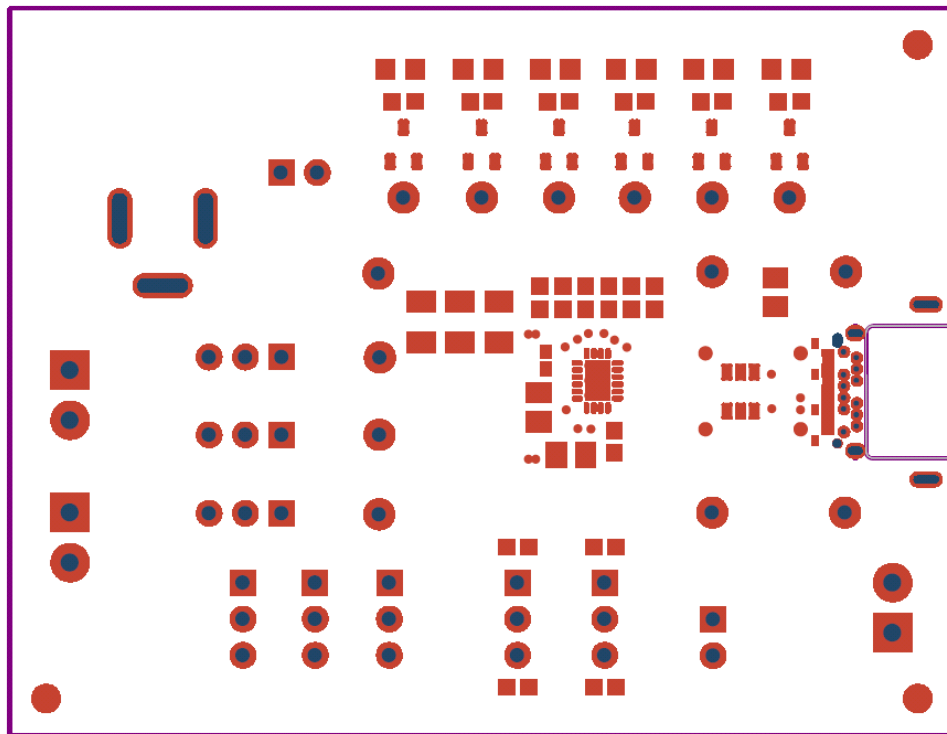

Figure 14. Top Silkscreen
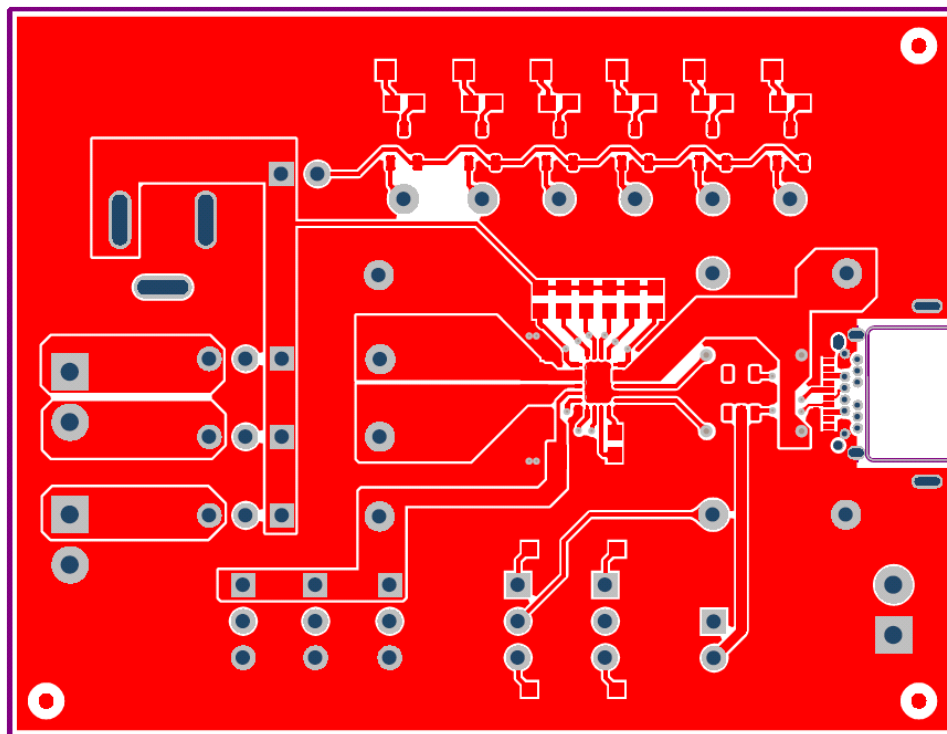
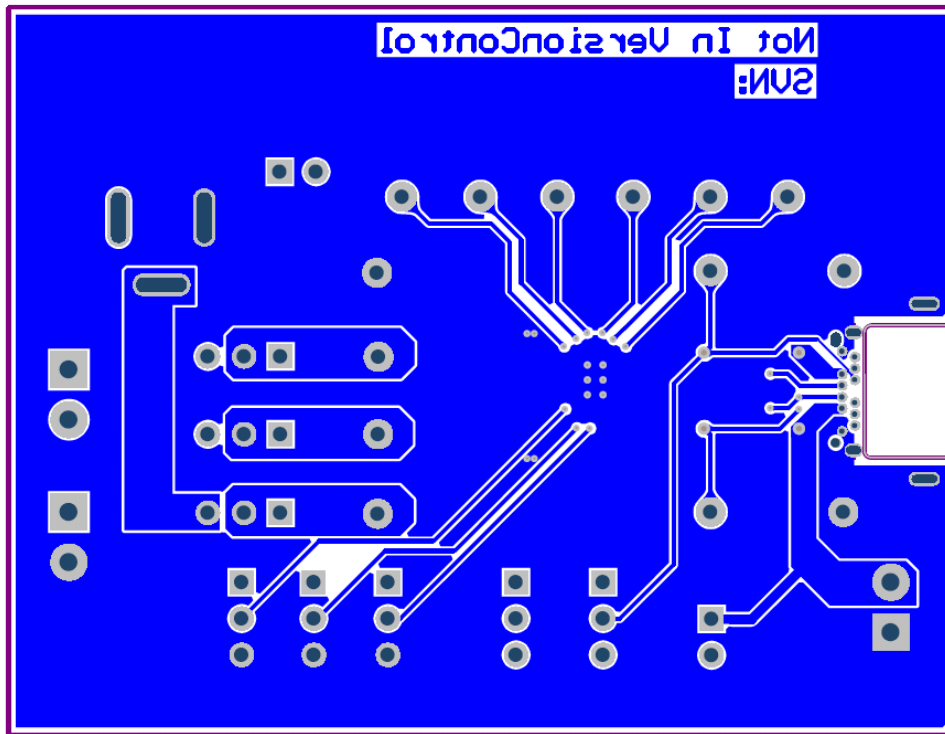**Figure 15. Top Solder Mask**

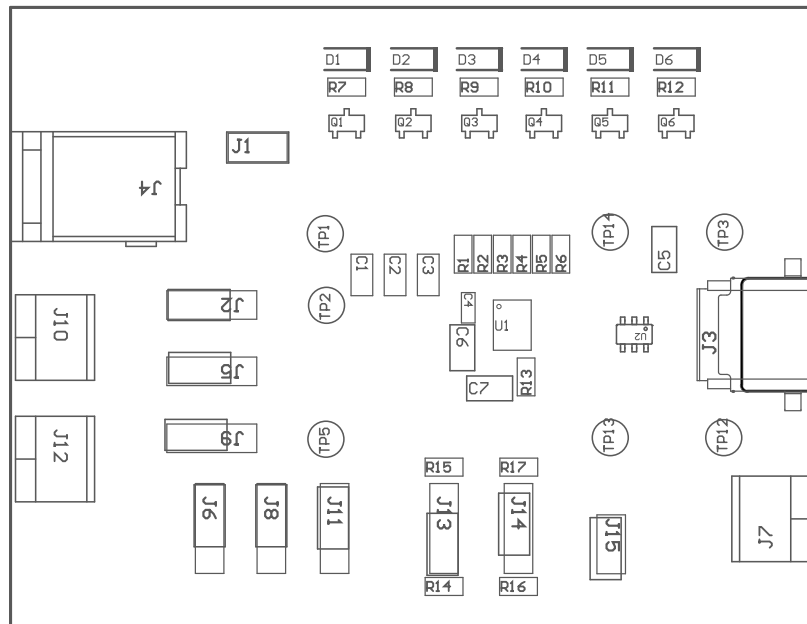**Figure 16. Top Layer**

Figure 17. Bottom Layer

Figure 18. Top Assembly

9   Bill of Materials

Table 3. Bill of Materials[1]

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
!PCB	1		Printed Circuit Board		PWR745	Any
C1, C2, C3	3	47uF	CAP, CERM, 47 µF, 10 V, +/- 10%, X5R, 1206	1206	GRM31CR61A476KE15L	MuRata
C4	1	0.1uF	CAP, CERM, 0.1 µF, 10 V, +/- 10%, X5R, 0402	0402	C1005X5R1A104K	TDK
C5, C6, C7	3	10uF	CAP, CERM, 10 µF, 16 V, +/- 20%, X5R, 0805	0805	0805YD106MAT2A	AVX
D1, D2, D3, D4, D5, D6	6	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
J1, J15	2		Header, 100mil, 2x1, Tin, TH	Header, 2x1, 100mil, TH	5-146278-2	TE Connectivity
J2, J5, J6, J8, J9, J11, J13, J14	8		Header, 100mil, 3x1, Tin, TH	Header, 3x1, 100mil, TH	5-146278-3	TE Connectivity
J3	1		Connector, Receptacle, USB Type C, R/A, TH	Connector, Receptacle, USB Type C, R/A, TH	898-43-024-90-310000	Mill-Max
J4	1		Connector, DC Jack 2.1X5.5 mm, TH	Conn, DC Jack, pin 2mm Dia.	PJ-202AH	CUI Inc.
J7, J10, J12	3		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
Q1, Q2, Q3, Q4, Q5, Q6	6	-50V	MOSFET, P-CH, -50 V, -0.13 A, SOT-23	SOT-23	BSS84-7-F	Diodes Inc.
R1, R2, R3, R4, R5, R6	6	100k	RES, 100 k, 5%, 0.1 W, 0603	0603	CRCW0603100KJNEA	Vishay-Dale
R7, R8, R9, R10, R11, R12	6	360	RES, 360, 5%, 0.1 W, 0603	0603	CRCW0603360RJNEA	Vishay-Dale
R13	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R14, R16	2	5.1k	RES, 5.1 k, 5%, 0.1 W, 0603	0603	CRCW06035K10JNEA	Vishay-Dale
R15, R17	2	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10	10	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA[2]	3M[2]
TP1, TP12	2	Black	Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
TP2, TP3, TP5, TP13, TP14	5	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
U1	1		USB Type-C DFP Controller and Power Switch with Load Detection, RVC0020A	RVC0020A	TPS25810RVC	Texas Instruments
U2	1		USB Dedicated Charging Port Controller, DBV0006A	DBV0006A	TPS2514ADBV	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
TP4, TP6, TP7, TP8, TP9, TP10, TP11	0	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone

[1]   Unless otherwise noted, all parts may be substituted with equivalents.
[2]   Alternate part number: SNT-100-BK-G; Alternate manufacturer: Samtec

10   PCB Layout Recommendations

- Keep input capacitors as close as possible to the IC
- USB protocol recommends having an input capacitance of 120µF
- The resistor attached to the reference pin and ground pin of the device has several requirements:
  - It is recommended to have a 1% 100-kΩ resistor.
  - It should be connected to pins REF and GND (pin 9 and pin 10 respectively). Note that there are two GND pins, the pin closest to the REF pin is the correct pin to connect to.
  - The connection between the resistor and the GND pin should be isolated from the GND plane. See Figure 19.
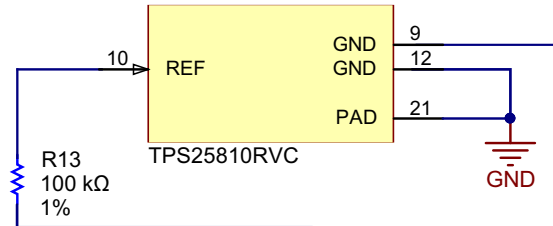

Figure 19.

- Pullup resistors should be 100 kΩ
- Keep the CC lines close to the same length
- Have the input and output traces as short as possible and wide enough for 3A (6A is using two TPS25810)

Revision History

Changes from Original (September 2015) to A Revision   **Page**

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

    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 and conditions 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 and conditions 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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

    2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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:*

        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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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２４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/lsds/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。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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 WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (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 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 AND CONDITIONS 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 MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

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 AND CONDITIONS. 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 ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, 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 ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS 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.

IMPORTANT NOTICE

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