TPS25820 and TPS25821 Evaluation Module

User's Guide

Literature Number: SLVUAZ3A
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TPS25820 and TPS25821 Evaluation Module

This user's guide is for the TPS25820 and TPS25821 Evaluation Modules (hereafter referred to as TPS25820/21EVM) and explains how to get up and running with the TPS25820/21EVM. The EVM allows the user to test specific features of the TPS25820 device by lighting-up signals LEDs and measuring test points voltages to demonstrate what happens when different types of USB Type-C™ devices are attached to the USB Type-C port on the EVM. Note that this EVM does not support BC1.2 charging. A TPS2514A can be added to DP and DM lines of the USB Type-C connector for BC1.2 charging support. The TPS25820/21EVM is built with a TPS25820. The TPS25820 has the same functionality of the TPS25821 with the only difference being VCONN. The TPS25821 does not supply VCONN when an electronically marked cable is connected unlike the TPS25820.

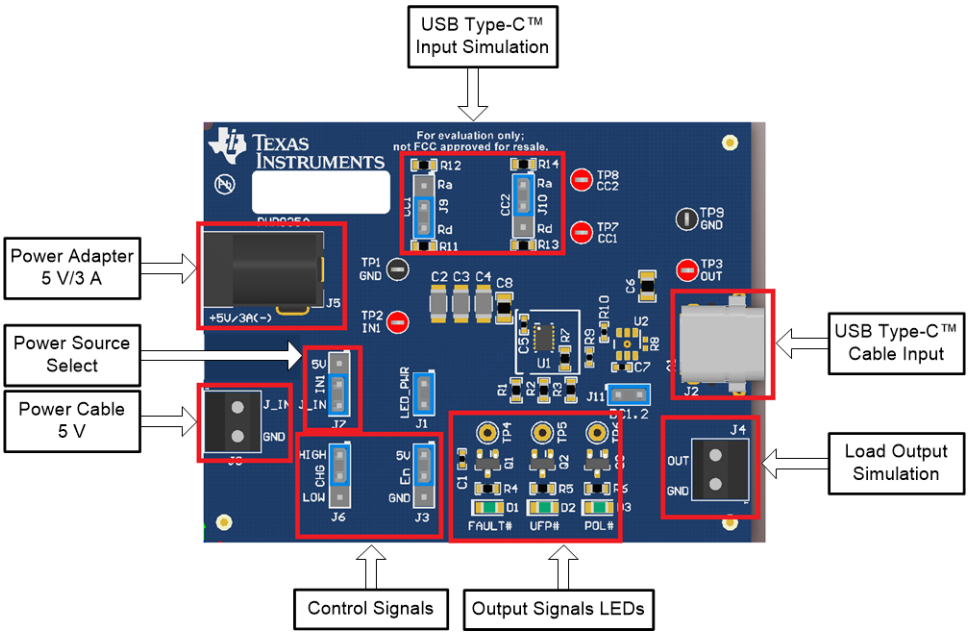

Figure 1. TPS25820/21EVM

1 Introduction

The TPS25820 device is a simple to use USB Type-C controller with an integrated 1.5-A rated USB VBUS power switch. The TPS25820 device meets the source requirements as defined in the USB Type-C specification and implements the source state machine for the detection of USB Type-C device attach/detach, connection orientation, and attached device type. For more information about the TPS25820 and TPS25821 devices, see the *TPS25820, TPS25821 USB Type-CTM 1.5-A Source Controller and Power Switch* data sheet.

2 Schematic

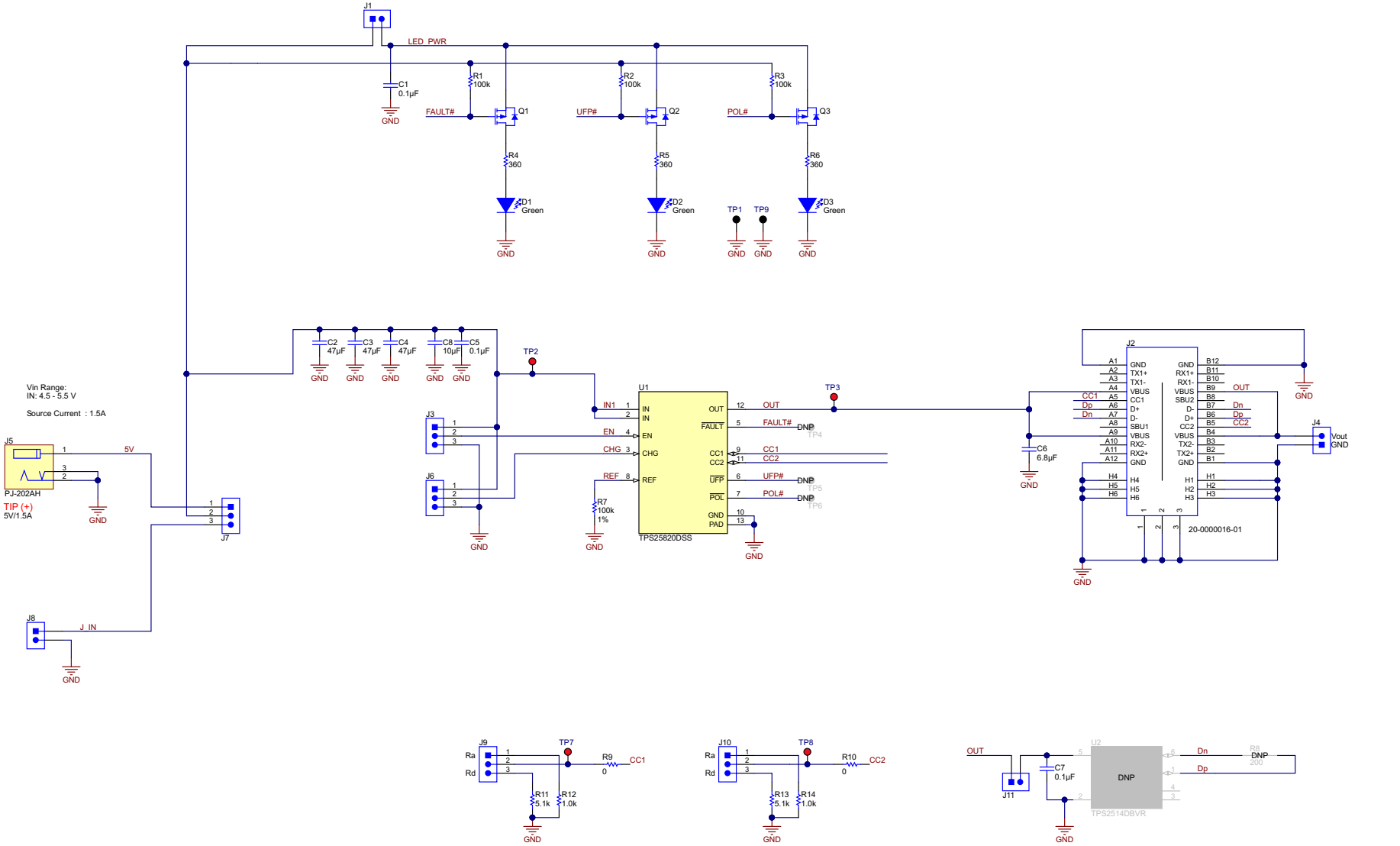

Figure 2. TPS25820 EVM Schematic

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 connecting for input and output signals
TP2	IN1	Input Voltage
TP3	OUT	Output Voltage
TP4	FAULT#	Active low fault signal
TP5	UFP#	Active low Sink (SNK) detect signal
TP6	POL#	Active low polarity signal
TP7	CC1	CC1 Voltage
TP8	CC2	CC2 Voltage

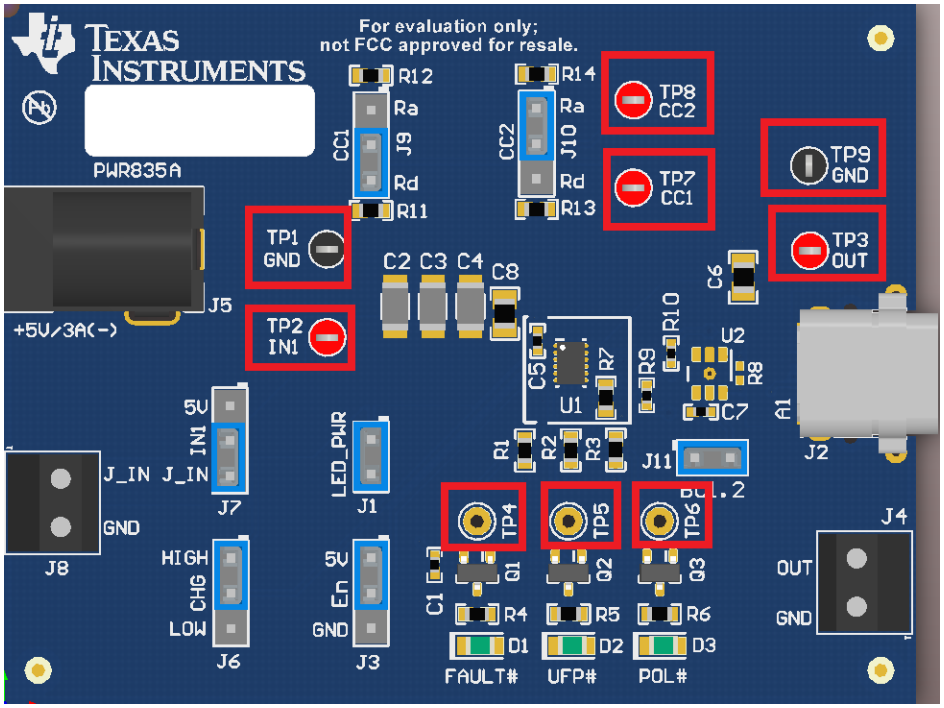

Figure 3. Test Points

4 Powering Up the EVM

The TPS25820/21EVM has two input-power Sources: a 5-V/3-A barrel jack adapter or a power supply through J8 connector. These two power Sources provide power to the TPS25820 device IN pin by setting jumper J7 either to barrel jack or to J1_IN as shown in Figure 4.

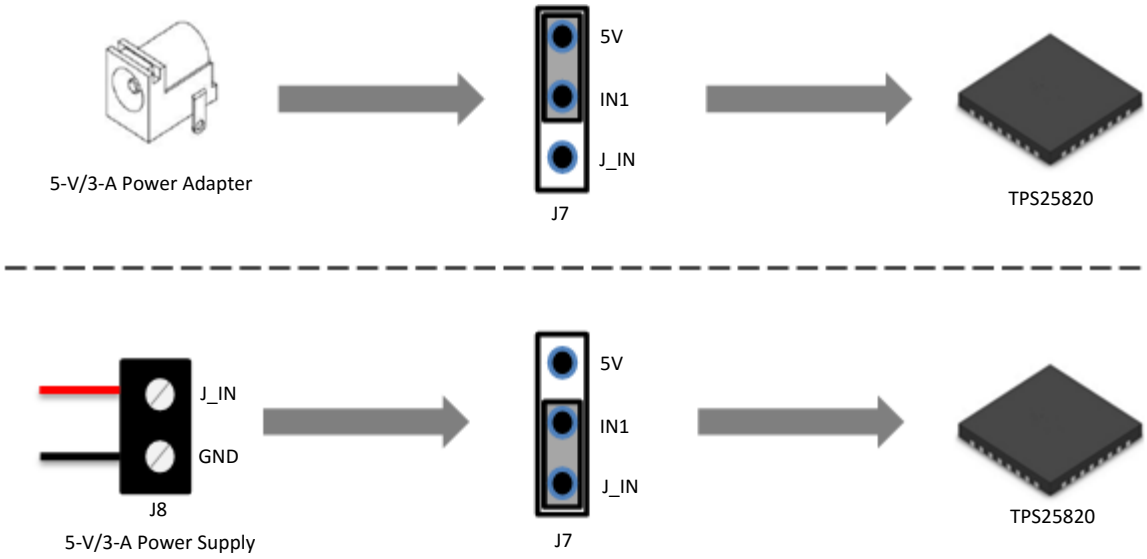

Figure 4. Choosing the Right Power Source

TI recommends a power adaptor that is a standard 2.1-mm DC power adaptor with a positive tip that can support 5-V and 3-A. An example of a power adaptor to use is the WSU050-3000 wall power supply. When using a power supply through J8 connector as a power source, make sure to stay within the specified voltage limits for each pin listed in the data sheet

4.1 Measuring TPS25820 Device Power Consumption

The TPS25820 device is powered through IN pin which is the same pin that powers OUT pin, thus the easy way to measure power consumption is to connect an ammeter to jumper J7 on the EVM. Figure 5 shows how to connect the Ammeter to IN1 pin through J7 jumper (depending on how the EVM is powered). For accurate power consumption measurements, remove jumpers J1 and J11 powering output signals LEDs and BC1.2 device respectively.

When no Sink is attached to the USB port on the EVM, the TPS25820 consumes only 1 μA. To test this, have the Ammeter connected properly to jumper J7, remove jumper J1 to disconnect output signals LEDs, jumper J11 to disconnect TPS2514A device, jumpers J9 and J10 to disconnect Rd resistors for CC lines, and make sure nothing is connected to the USB port.

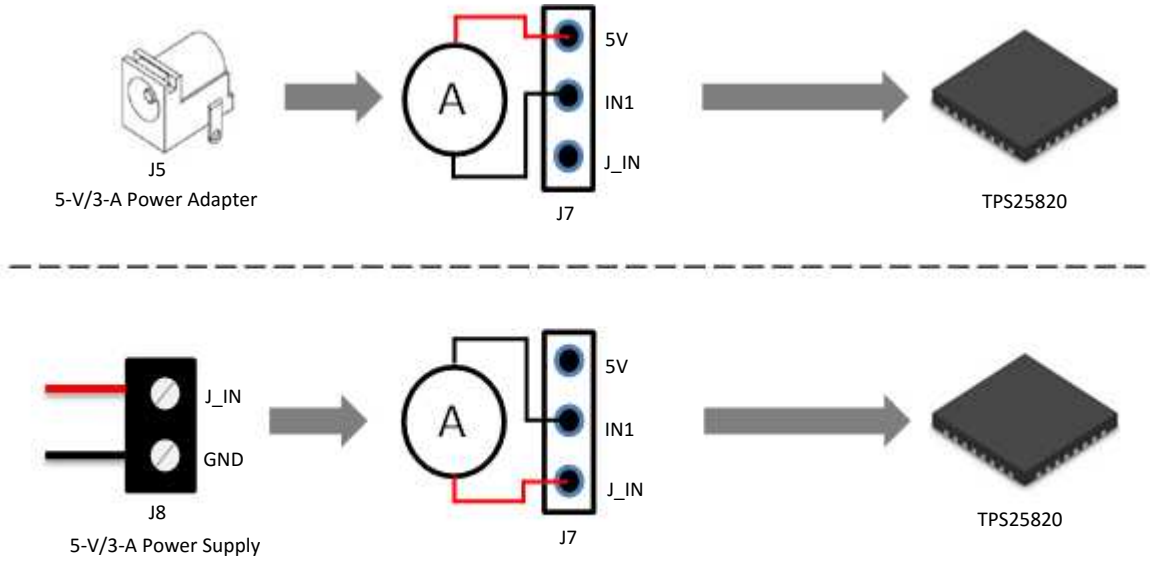

Figure 5. Connecting the Ammeter to IN1 Pin and Pre-Selected Power Source

5 Enabling and Configuring the TPS25820

5.1 Enabling and Disabling the TPS25820

The TPS25820 has an enable pin that creates a convenient way to turn on or off the device without interrupting the power Source. Jumper J3 on the TPS25820/21EVM can be used to enable or disable TPS25820 device, Figure 6 shows enable and disable positions for this jumper.

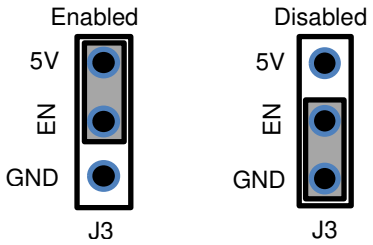

Figure 6. How to Enable and Disable TPS25820 Device on the EVM

5.2 Configuring the Broadcasted Current Limit for the TPS25820 Device

TPS25820 device can advertise (using CC lines) how much current it can supply to the attached Sink device. The two current limits that the TPS25820 device support are: STD and 1.5-A. Jumper J6 allows switching between these two current limit levels by either setting the jumper to 5-V (High) or to GND (Low) which in turn sets CHG pin on the TPS25820 device to change the current limit advertisement level. Figure 7 shows how to set Jumper J6 to advertise the desired current limit broadcast through the CC lines.

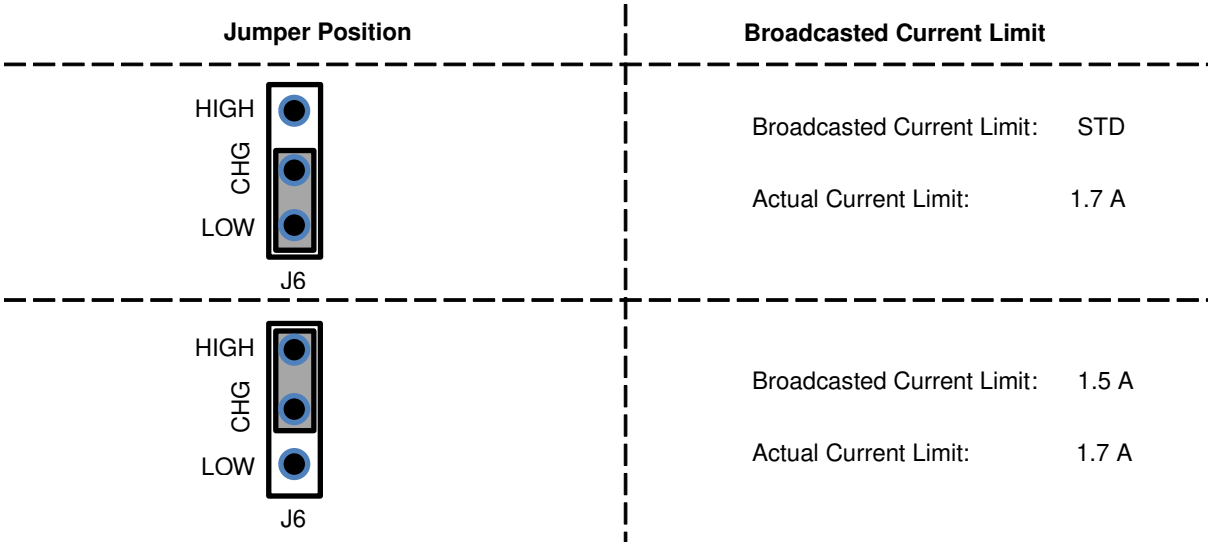

Figure 7. Jumper J6 Setting for Each Broadcasted Current Level

6 TPS25820/21EVM Features

The TPS25820/21EVM allows for all the features of the TPS25820 device to be tested without a USB Type-C Cable and external Sink device. This section lists the most common types of situations that can happen with the TPS25820/21EVM and within each section is an explanation of how to test each situation with and without external components. Remember how the test jumpers J9 and J10 (which control CC1 and CC2, respectively) connect to the TPS25820 device and the resistors. Figure 8 shows how these resistors are connected.

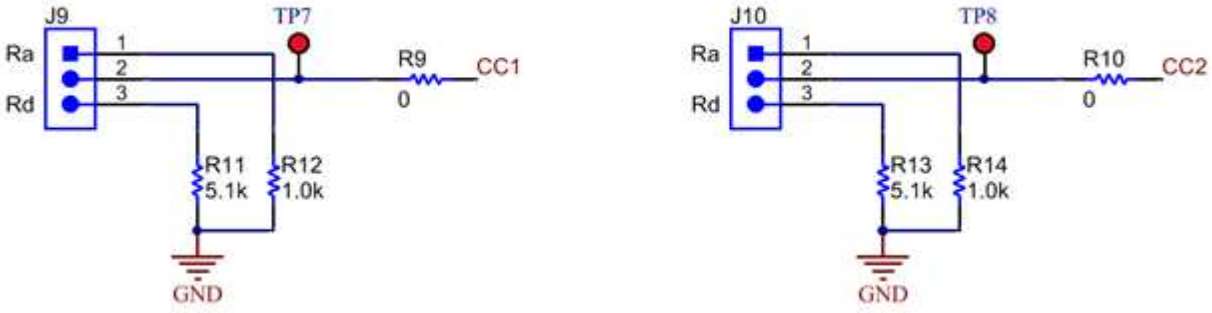

Figure 8. Schematic Showing How CC1 and CC2 are Connected to Jumpers J9 and J10

CAUTION

When connecting a physical USB Type-C Cable into the port of the EVM, make sure to disconnect jumpers (J9, J10) and disconnect any loads on J4 connector (which is connected to OUT pin) in order to avoid interference on the CC lines

6.1 No Connection on the EVM

When nothing is connected to the output of the TPS25820/21EVM, the TPS25820 will not output any power over the OUT pin. In this mode the TPS25820 device will consume only 1 μA.

In order to replicate this mode on the EVM, make sure that jumpers J1, J9, J10, and J11 are left open (not set to any position) so that power goes only to the TPS25820 device.

6.2 Connecting a Source (SRC) Device

The TPS25820 device is a Source and it continuously monitors the CC lines to detect if an SINK device is attached. The way it determines if a SINK is attached by monitoring the voltages on CC lines to see if these voltages get pulled down by an Rd resistors values. Connecting SOURCE device such as the TPS25820 to another SOURCE device will not turn on the output of the TPS25820 device since both Sources will continue to monitor their CC lines for a valid connection (Rd pull-down resistors). This can be tested on the TPS25820/21EVM by connecting a known Source device to the USB Type-C port on the EVM or by connecting two TPS25820/21EVMs via a USB Type-C cable.

6.3 Connecting a Sink (SNK) Device

A Sink device can be attached to a Source device such as the TPS25820 via a standard USB Type-C cable or a full-featured USB Type-C cable. The TPS25820 device detects that a Sink is attached by sensing if any of the CC lines is pulled down by an Rd resistor value. If a Sink with a full-featured USB Type-C cable is attached, then one CC line will be pulled down by an Rd resistor value while the other CC line will be pulled down by a Ra resistor value, thus the TPS25820 device will supply VCONN on the CC line with the Ra resistor value. The TPS25820/21EVM will report the polarity of the Sink device attached to its USB port via POL# LED when a flipped USB Type-C cable is connected. To replicate those two types of Sink connections along with their cable polarity orientations on the TPS25820/21EVM, set jumpers J9 (controls CC1) and J10 (controls CC2) based on Figure 9. Figure 9 shows UFP# and POL# signals LEDs behavior based on jumper J9 and J10 settings.

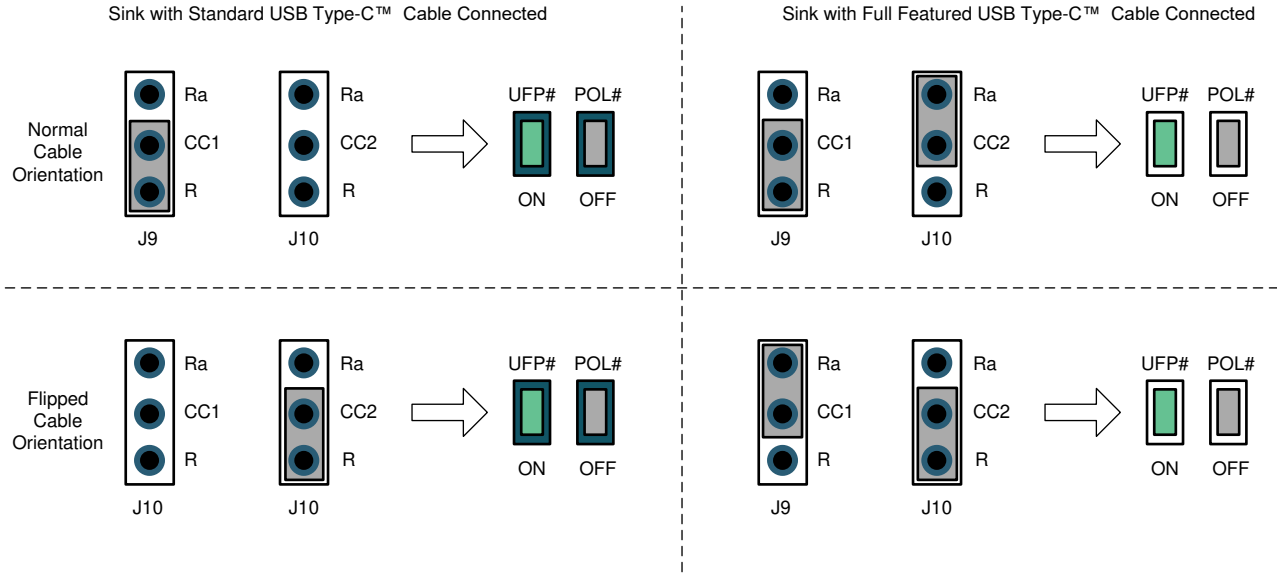

Figure 9. Simulating a Sink (SNK) Device Connected to TPS25820/21EVM

6.4 Connecting a Full-Featured USB Type-C™ Cable

The way the TPS25820 device detects a Sink device is attached is by checking if either of the CC lines is connected to Rd resistor value, connecting only a full-featured USB Type-C cable to the port on the EVM will not light-up UFP# and POL# LEDs since TPS25820 Sink attached signal will not be triggered. To replicate such connection on the TPS25820 EVM, set jumpers J9 or J10 to apply Ra resistor value to CC line as shown in Figure 10. Note that the UFP# and POL# LEDs will not light up.

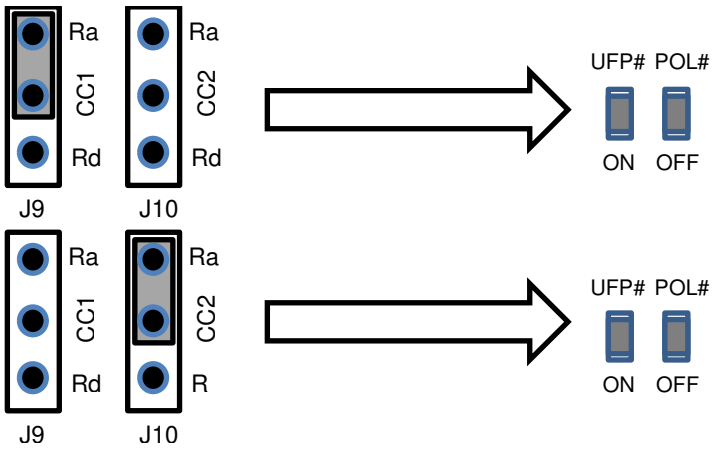

Figure 10. Connecting a Full-Featured USB Type-C™ Cable to TPS25820/21EVM

6.5 Legacy Charging Support

The TPS25820/21EVM supports legacy USB charging scheme via TPS2514A device which supports legacy battery charging schemes such as BC1.2. For more information about the TPS2514A device, refer to the TPS2514A data sheet. Note that in order to connect legacy USB device to the TPS25820/21EVM, a USB Type-C cable adaptor will be needed. Jumper J11 is used to enable or disable the TPS2514A device. Figure 11 shows the schematic connection for the TPS2514A device. Note that the TPS2514A is not populated on the TPS25820/21EVM and would need to be in order to support USB charging schemes.

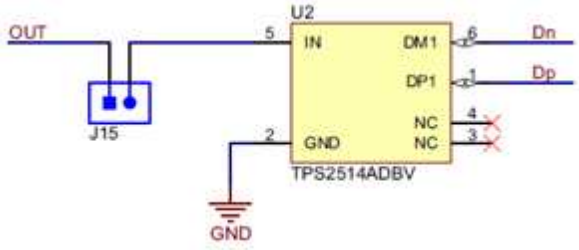

Figure 11. Schematic of TPS2514A Device Section

7 TPS25820/21EVM Output Signals LEDs Operation

7.1 FAULT Detected (FAULT# LED)

There are two conditions that can cause this fault signal to occur and lights up FAULT# LED; those conditions are:

1. The output of the TPS25820 exceeds the actual current limit.
2. The TPS25820 device exceeds the Rising threshold temperature for device shutdown or Rising threshold temperature for OUT/VCONN switches shutdown in current limit.

As soon as the current and the temperature go back to their normal ranges, the fault signal is cleared, FAULT# LED will turn off, and the device resumes normal operation. Refer to Electrical Characteristics section located in the TPS25820 data sheet, for more information on the current and temperature thresholds.

7.2 Sink (SNK) device attached Detected (UFP# LED)

UFP# LED will turn on as soon as a Sink device is attached to the USB Type-C port and is communicating properly through the CC lines. See Table 2 to determine the necessary conditions for the CC lines to activate this signal.

Table 2. TPS25820 Responses Based on Port Connection Type

TPS25820 USB Type-C™ Port	CC1	CC2	OUT	TPS25820 Responses		
				VCONN on CC1 or CC2	POL#	UFP#
Nothing Attached	OPEN	OPEN	OPEN	NO	HI-Z	HI-Z
SINK Attached	Rd	OPEN	IN1	NO	HI-Z	LOW
SINK Attached	OPEN	Rd	IN1	NO	LOW	LOW
Powered Cable/NO SINK Attached	OPEN	Ra	OPEN	NO	HI-Z	HI-Z
Powered Cable/NO SINK Attached	Ra	OPEN	OPEN	NO	HI-Z	HI-Z
Powered Cable/SINK Attached	Rd	Ra	IN1	CC2	HI-Z	LOW
Powered Cable/SINK Attached	Ra	Rd	IN1	CC1	LOW	LOW

7.3 Flipped USB Type-C™ Cable Detected (POL# LED)

Polarity signal was introduced in USB Type-C plug connection since you can insert USB Type-C cable in either orientation. The TPS25820 device detects the orientation of the USB Type-C Cable attached by lighting up POL# LED when a Sink device with Flipped USB Type-C Cable is attached. Refer to Table 2 to see what conditions for the CC lines are necessary to activate this signal.

8 TPS25820 EVM Board Layout

The following images show the silkscreen, top, bottom, and assembly layers of the TPS25820/21EVM-xxx

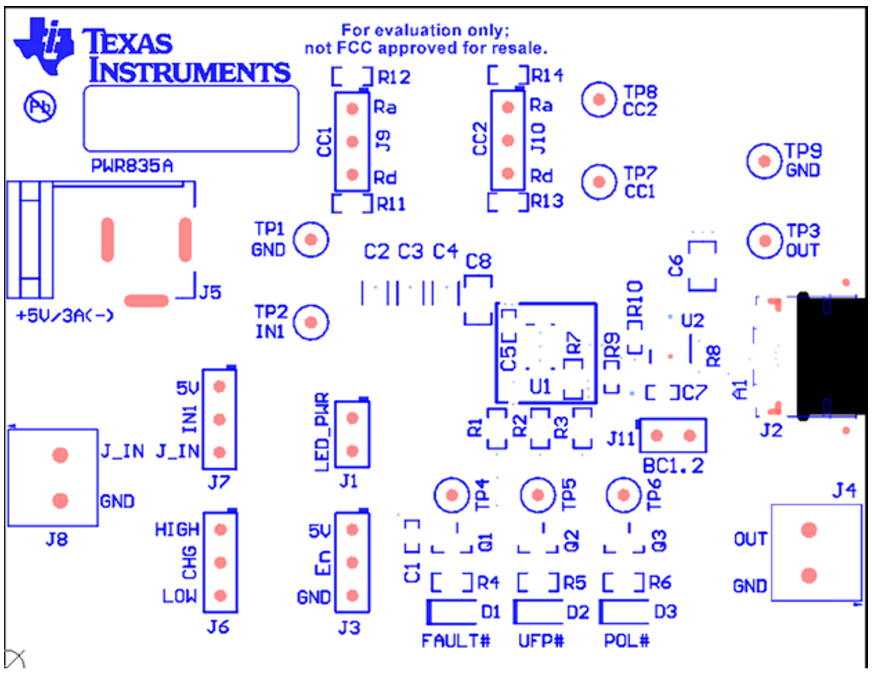

Figure 12. Top Silkscreen

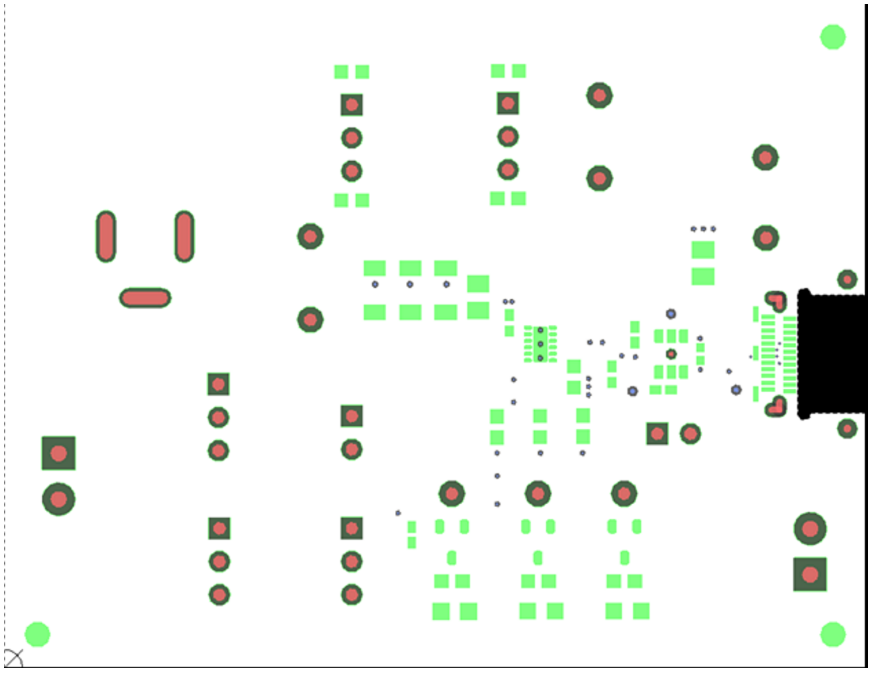

Figure 13. Top Solder Mask

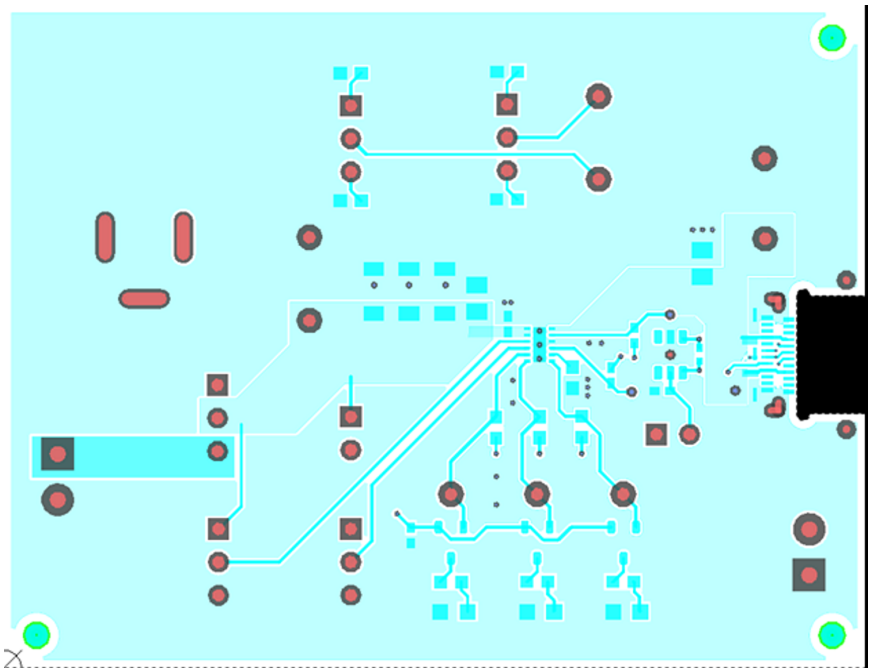

Figure 14. Top Layer

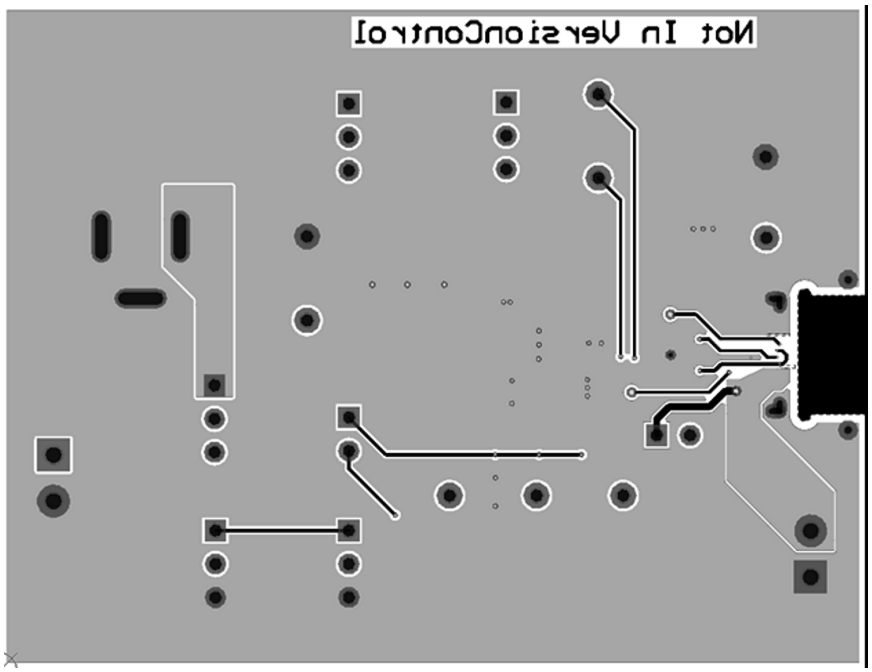

Figure 15. Bottom Layer

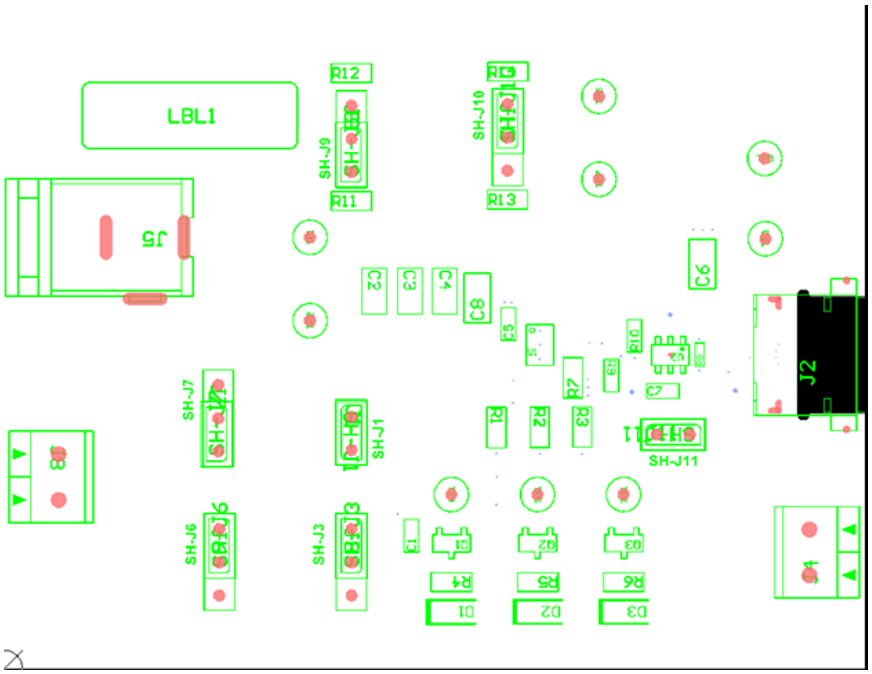

Figure 16. Top Assembly

9 Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C2, C3, C4	3	47uF	CAP, CERM, 47 µF, 10 V, +/- 10%, X5R, 1206	1206	GRM31CR61A476KE15L	Murata
C6	1	6.8uF	CAP, CERM, 6.8 µF, 25 V, +/- 10%, X5R, 0805	0805	C2012X5R1E685K125AC	TDK
C8	1	10uF	CAP, CERM, 10 µF, 16 V, +/- 20%, X5R, 0805	0805	0805YD106MAT2	AVX
D1, D2, D3	3	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
J1, J11	2		Header, 100mil, 2x1, Tin, TH	Header, 2x1, 100mil, TH	5-146278-2	TE Connectivity
J2	1		Connector, Receptacle, USB Type-C, R/A, SMT	Connector, Receptacle, USB Type-C, SMT	20-0000016-01	Lintes Technology
J3, J6, J7, J9, J10	5		Header, 100mil, 3x1, Tin, TH	Header, 3x1, 100mil, TH	5-146278-3	TE Connectivity
J4, J8	2		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J5	1		Connector, DC Jack 2.1X5.5 mm, TH	Conn, DC Jack, pin 2mm Dia.	PJ-202AH	CUI Inc.
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, Q2, Q3	3	-50V	MOSFET, P-CH, -50 V, -0.13 A, SOT-23	SOT-23	BSS84-7-F	Diodes Inc.
R1, R2, R3	3	100k	RES, 100 k, 5%, 0.1 W, 0603	0603	CRCW0603100KJNEA	Vishay-Dale
R4, R5, R6	3	360	RES, 360, 5%, 0.1 W, 0603	0603	CRCW0603360RJNEA	Vishay-Dale
R7	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R9, R10	2	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R11, R13	2	5.1k	RES, 5.1 k, 5%, 0.1 W, 0603	0603	CRCW06035K10JNEA	Vishay-Dale
R12, R14	2	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
SH-J1, SH-J3, SH-J6, SH-J7, SH-J9, SH-J10, SH-J11	7		Shunt, 2.54 mm Gold Blue	Shunt, 2.54 mm Blue	60900213621	Wurth Elektronik
TP1, TP9	2	Black	Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
TP2, TP3, TP7, TP8	4	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
U1	1		USB Type-C 1.5 A DFP Controller and Power Switch, DSS0012B	DSS0012B	TPS25820DSS	Texas Instruments
U2	1		USB Dedicated Charging Port Controller, DBV0006A (SOT-23-6)	DBV0006A	TPS2514DBV	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
R8	0	200	RES, 200, 1%, 0.063 W, 0402	0402	CRCW0402200RFKED	Vishay-Dale
TP4, TP5, TP6	0	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone

10 PCB Layout Recommendations

- Keep input capacitors as close as possible to IC.
- USB protocol recommends having an input capacitance of 120 μF.
- Pullup resistors recommended being 100 kΩ.
- Keep CC lines close to the same length.
- Have the IN and OUT traces as short as possible and wide enough for 1.5-A (3-A if using two TPS25820.
- The resistor attached to the REF pin and GND pin of the device has two requirements:
  - The connection between the resistor and the GND pin should be isolated from the GND plane.
  - Place the resistor as close as possible to REF pin.

11 Trademarks

Revision History

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

Changes from Original (September 2017) to A Revision	Page
• Added TPS25821 evaluation module to the user's guide.	4
• Changed caption on Figure 8.	9
• Updated Figure 9	10

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.

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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 DEGREDATION 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/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。

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のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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

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

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/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。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.

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, INDEMITY 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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