Using the TPS2511EVM-141

User's Guide

Literature Number: SLUU945
June 2012

TPS2511EVM-141 USB Dedicated Charging Port Controller and Power Switch Evaluation Module

1 Introduction

This user's guide describes the evaluation module (EVM) for the TPS2511. TPS2511 is a USB dedicated charging port controller and current limiting power switch.

2 Description

The TPS2511EVM allows reference circuit evaluation of the TI TPS2511 USB dedicated charging port controller and current limiting power switch.

2.1 Features

- Supports a USB DCP with D+ and D- Lines Sorted for BC1.2 Devices
- Supports a USB DCP with D+ and D- Lines Connected to 2.7 V and 2.0 V or 2.0 V and 2.7 V
- Supports a USB DCP with D+ and D- Lines Connected to 1.2 V and 1.2 V
- Automatically Switch D+ and D- Lines Connections for an Attached Device
- Hiccup Mode for Output Short Circuit Protection
- Provides $\overline{CS}$ Pin for USB Cable Compensation
- Programmable Current Limit (ILIM_SET)
- Accurate ±10% Current Limit at 2.3 A (typ)
- 70-mΩ (typ) High-Side MOSFET

2.2 Applications

- Vehicle USB Power Charger
- AC-to-DC Wall Adapter with USB Port
- Other USB Charger

3 EVM Block Diagram

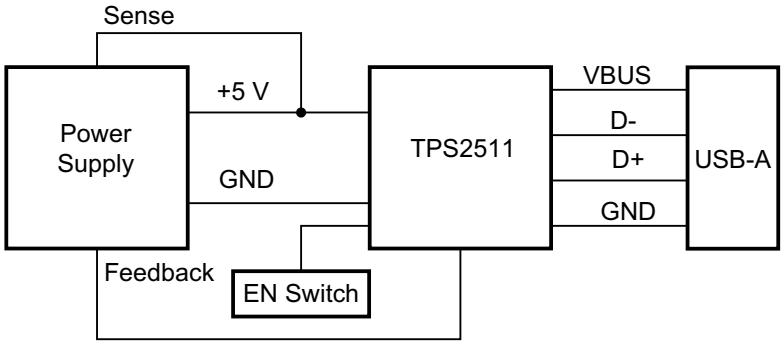

Figure 1. TPS2511EVM-141 EVM Block Diagram

4 Glossary of Terms

- Charging Downstream Port (CDP)
  - A downstream port that complies with the USB 2.0 definition of a host or a hub and additionally defines a handshake on DP and DM to identify a BC 1.1 compliant host to a BC 1.1 compliant portable device.
  - BC 1.1 allows a high-speed portable device to draw 900 mA and a low speed or full speed device to draw 1500 mA.
  - BC 1.2 intention is to allow all devices to draw 1500 mA.
  - BC 1.2 corrects BC 1.1 to ensure USB host provides 5 V at > 1500 mA.
- Standard Downstream Port (SDP)
  - USB 2.0 defined port currently adopted by most USB ports.
  - Portable device is allowed to draw 100 mA initially and request additional current over USB communications in 100-mA steps up to a maximum of 500 mA.
  - USB host required to provide at least 500 mA at 5 V.
  - Portable device must draw less than 2.5 mA when in USB suspend due to the absence of USB communications.
- Dedicated Charging Port (DCP) as defined in BC 1.1
  - BC 1.1 defines a dedicated charging port as a downstream port on a device that outputs power through a USB connector, but is not capable of enumerating a downstream device.
  - Wall adapter must source between 500 mA and 1500 mA.
  - Portable device may attempt to draw 1800 mA in order to force the wall adapter into constant-current mode.
  - BC 1.2 intention is to allow DCP to current limit above 1800 mA.
- YD and T 1591-2006, updated 2009
  - PROC Telecommunications Standard .
  - Defines wall-adapter requirements.
  - Rated current between 500 mA to 1500 mA with defined I-V curve.

5 Schematic

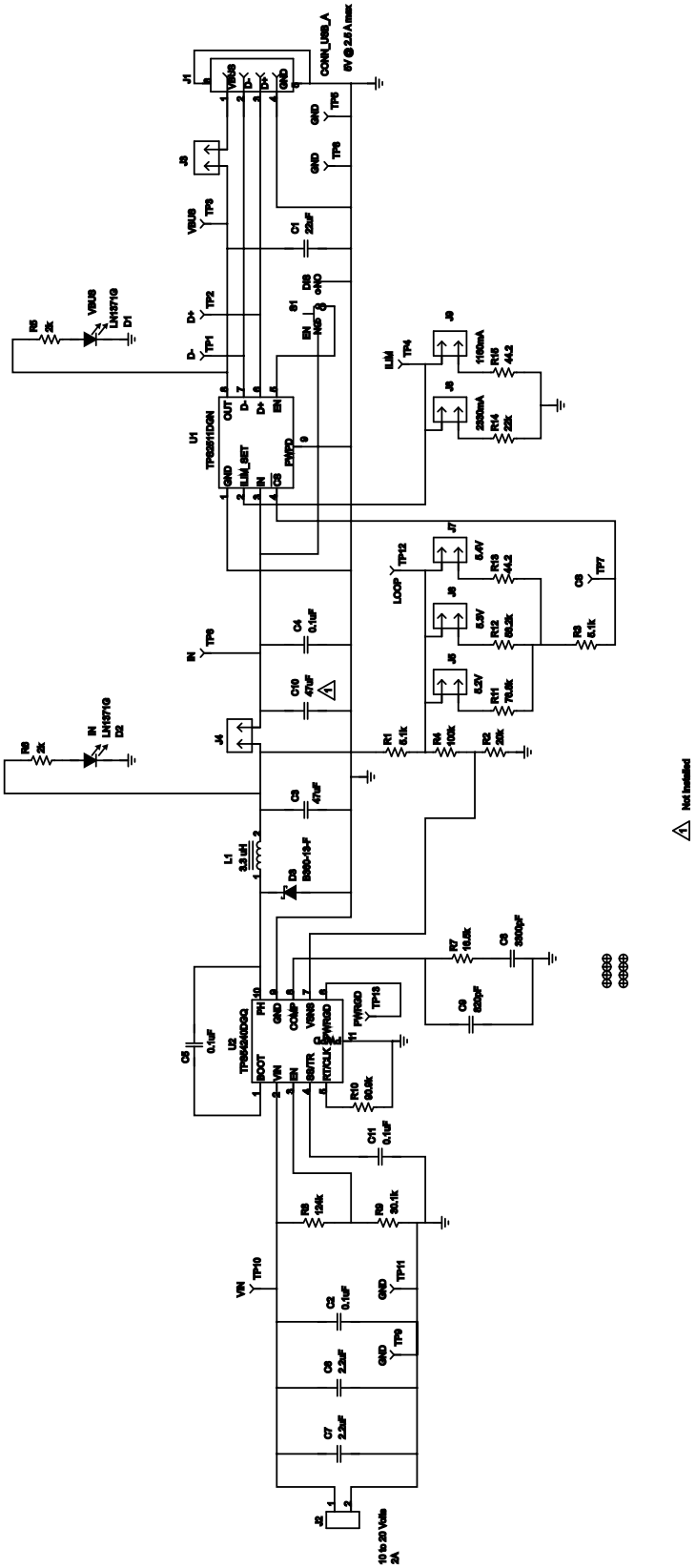

Figure 2. TPS2511EVM-141 Schematic

6 Physical Access

Table 1 defines the TPS2511EVM-141 connector functionality, Table 2 defines the test point availability and Table 3 describes the jumper functionality.

Table 1. Connector Functionality

CONNECTOR	FUNCTIONALITY
J2	10-V to 20-V, power-input polarity screened on EVM
J1	USB power output connector

Table 2. Test Points

TEST POINT	LABEL	DESCRIPTION
TP1	D-	Data - OUT
TP2	D+	Data + OUT
TP3	VBUS	Converter voltage out
TP4	ILIM	USB output current limit
TP5	GND	GND
TP6	VIN	Voltage input to controller
TP7	$\overline{CS}$	USB cable compensation
TP8	GND	GND
TP9	GND	GND
TP10	VPS	Input voltage power supply
TP11	GND	GND
TP12	LOOP	Converter stability measurement
TP13	PWRGD	Converter power good

Table 3. Jumpers

JUMPER	LABEL	DESCRIPTION
J3	VBUS	Connects V_{BUS} T_{OUSB} output connector
J4	VIN	Connects the converter output voltage to TPS2511 input
J5	5.2 V	During $\overline{CS}$ VIN increased to 5.2 V
J6	5.3 V	During $\overline{CS}$ VIN increased to 5.3 V
J7	5.4 V	During $\overline{CS}$ VIN increased to 5.4 V
J8	2330 mA	ILIM set to 2330 mA
J9	1160 mA	ILIM set to11 60 mA

7 Switches

Switch S1 enables and disables the TPS2511 controller. The switch positions are screened on the PC board.

8 Test Setup

The starting setup for the EVM is shown in Figure 3.

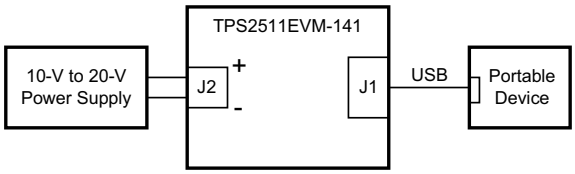

Figure 3. Test Setup

Set the input voltage power supply to 12 V, ±0.1 V and the current limit to 3 A. Turn off the power supply. Connect the input-power supply to J2; + and - positions are noted on the PWR141 circuit-board silk screen.

Install jumpers J3, J4, J5, and J9. Set switch S1 to EN and turn on the 12-V power supply, The VIN LED and the VBUS LED is on. VIN, TP6, measures 5.0 V, ±0.2 V.

Connect the portable device to the USB connector. If the portable device is charged so that the $\overline{CS}$ line is false, VIN, TP6, measures 5.0 V, ±0.1 V. If the portable device is discharged, $\overline{CS}$ is true and VIN, TP6, measures 5.2 V ±0.1 V to keep the output VBUS, TP3, approximately 5.2 V.

9 EVM Assembly Drawings and PCB Layout

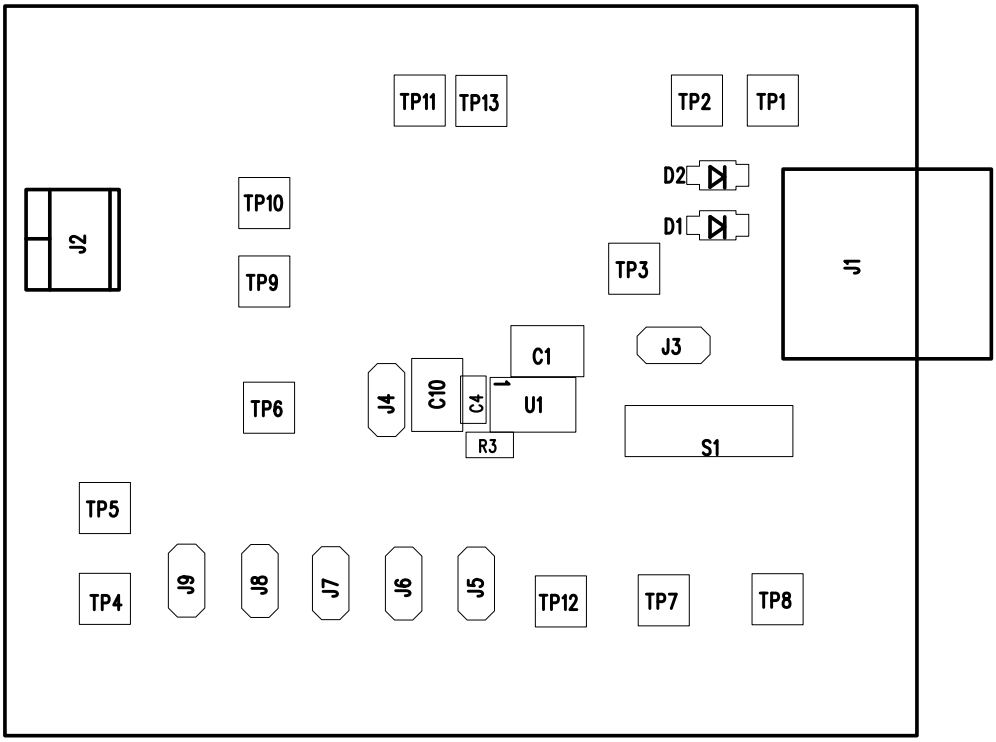

Figure 4. TPS2511EVM-141 Layer 1

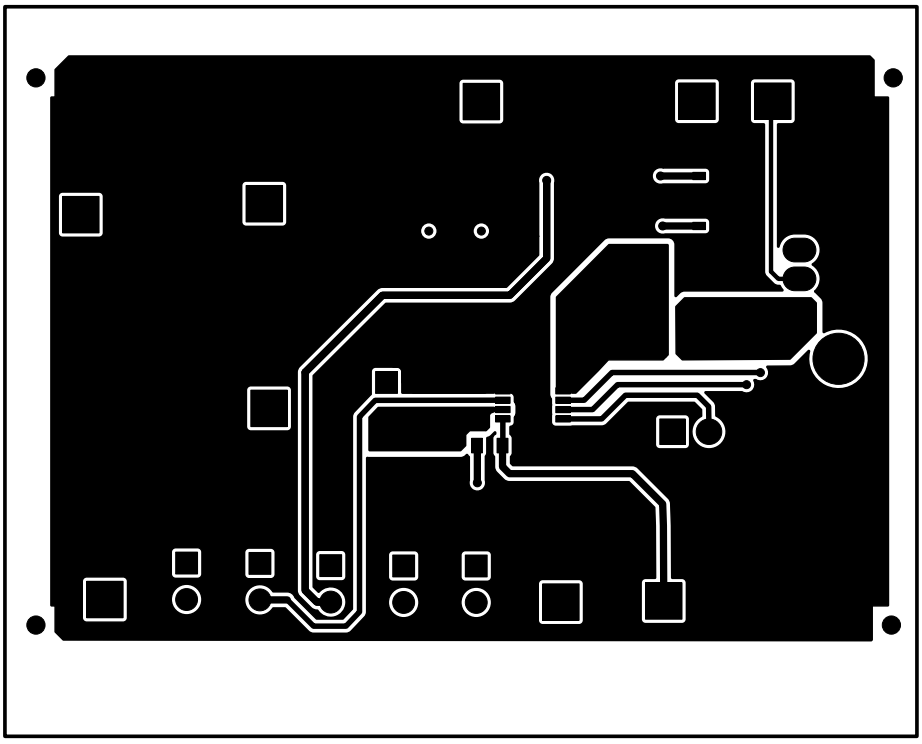

Figure 5. TPS2511EVM-141 Layer 2

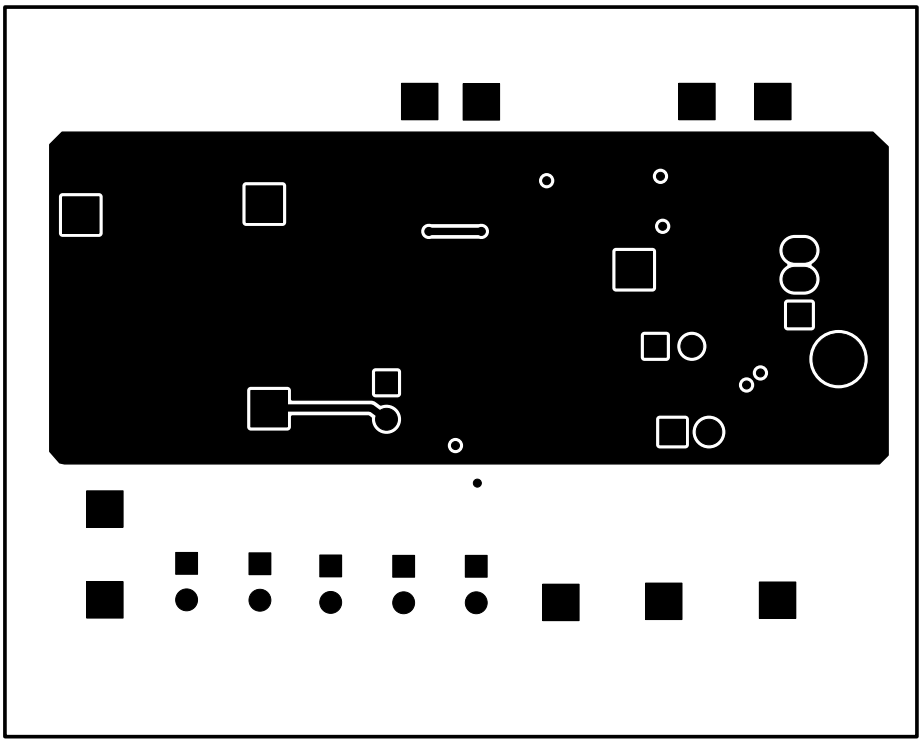

Figure 6. TPS2511EVM-141 Layer 3

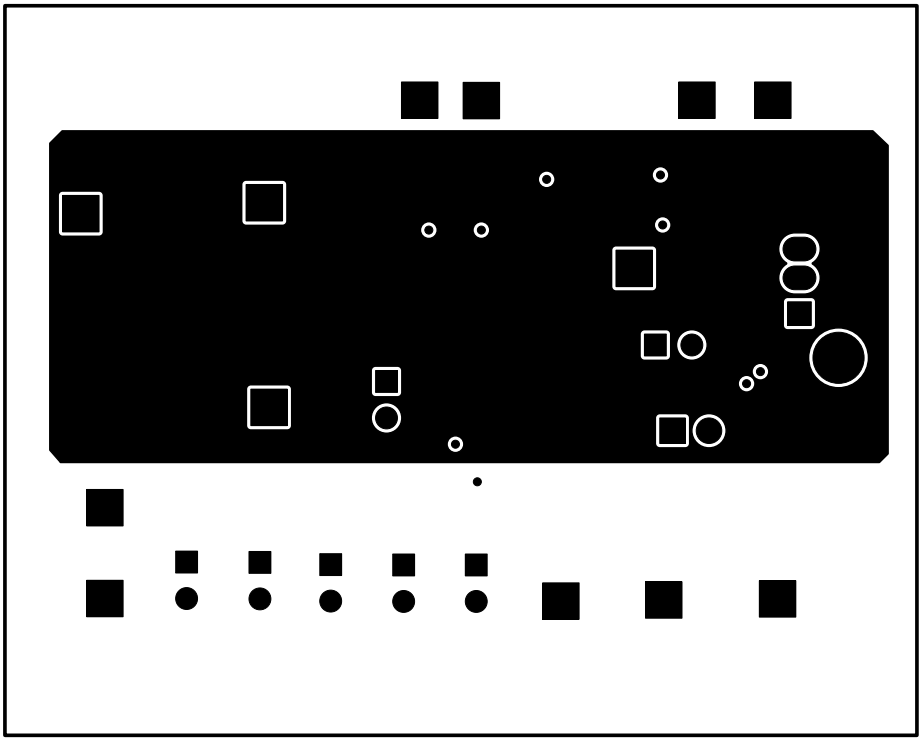

Figure 7. TPS2511EVM-141 Layer 4

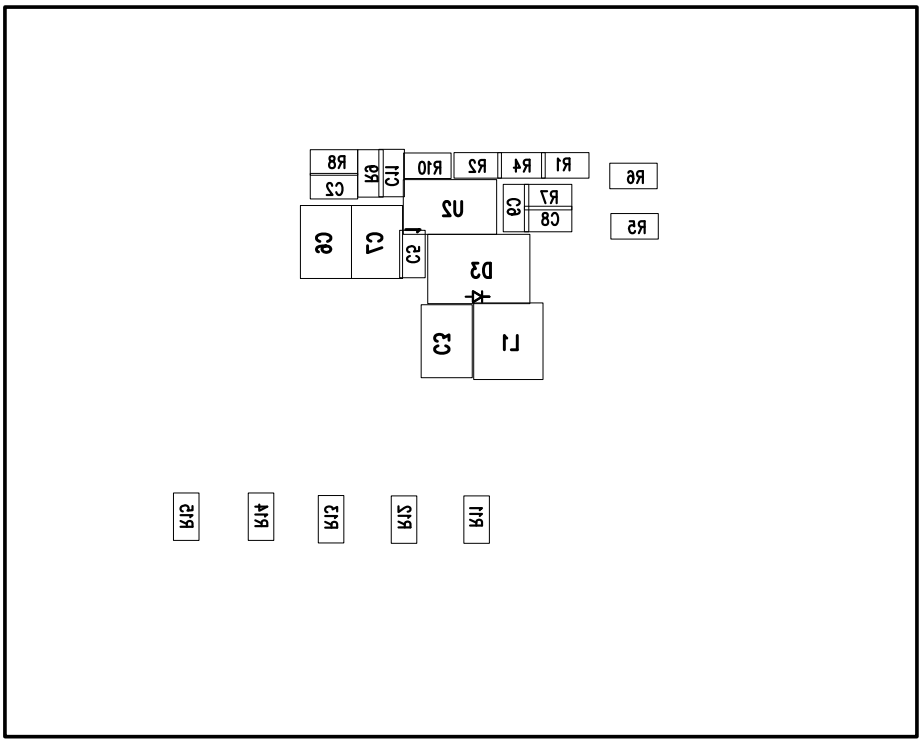

Figure 8. Bottom Layer

10 List of Materials

Table 4. TPS2511EVM-141 List of Materials

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
1	C1	Capacitor, ceramic chip, 10 V, X7R, ±10%, 22 µF, 1210	Std	STD
4	C2 C4-5 C11	Capacitor, ceramic, 35 V, X7R, 10%, 0.1 µF, 0603	STD	STD
2	C3 C10	Capacitor, ceramic chip, 10 V, ,X5R, ±10%, 47 µF, 1210	Std	STD
2	C7 C6	Capacitor, ceramic chip, 100 V, X7R, ±10%, 2.2 µF, 1210	Std	STD
1	C8	Capacitor, ceramic, 35 V, X7R, 10%, 3300 pF, 0603	STD	STD
1	C9	Capacitor, ceramic, 35 V, X7R, 10%, 820 pF, 0603	STD	STD
2	D1-2	Diode, LED, green, 20 mA, 0.9 mcd, 0.068 inch x 0.049 inch	LN1371G-(TR)	Panasonic
1	D3	Diode, Schottky, 60 V, 3 A, SMB	B360B-13-F	Diodes
2	FIDO1-4, FIDO5-8	FIDO		
1	J1	Connector, USB TH, 14.0 mm x 14.0 mm	C-292303-4	Tyco
1	J2	Terminal block, 2 pin, 6 A, 3.5 mm, 0.27 inch x 0.25 inch	ED555/2DS	OST
7	J3-9	Header, male 2 pin, 100-mil spacing, 0.100 inch x 2 inch	PEC02SAAN	Sullins
1	L1	Inductor, power, 2.9 A, 34.8 mΩ, ±30%, 3.3 µH, 0.157 inch x 0.157 inch	XFL4020-332ME	Coilcraft
2	R1 R3	Resistor, chip, 1/10 W, 1%, 5.1 kΩ, 0603	Std	Std
1	R10	Resistor, chip, 1/10 W, 1%, 90.9 kΩ, 0603	Std	Std
1	R11	Resistor, chip, 1/10 W, 1%, 76.8 kΩ, 0603	Std	Std
1	R12	Resistor, chip, 1/10 W, 1%, 56.2 kΩ, 0603	Std	Std
1	R13	Resistor, chip, 1/10 W, 1%, 43.5 kΩ, 0603	Std	Std
1	R14	Resistor, chip, 1/10 W, 1%, 22 kΩ, 0603	Std	Std
1	R15	Resistor, chip, 1/10 W, 1%, 44 kΩ, 0603	Std	Std
1	R2	Resistor, chip, 1/10 W, 1%, 20 kΩ, 0603	Std	Std
1	R4	Resistor, chip, 1/10 W, 1%, 100 kΩ, 0603	Std	Std
2	R5-6	Resistor, chip, 1/10 W, 1%, 2 kΩ, 0603	Std	Std
1	R7	Resistor, chip, 1/10 W, 1%, 16.5 kΩ, 0603	Std	Std
1	R8	Resistor, chip, 1/10 W, 1%, 124 kΩ, 0603	Std	Std
1	R9	Resistor, chip, 1/10 W, 1%, 30.1 kΩ, 0603	Std	Std
1	S1	Switch, SPDT, slide, PC mount, 500 mA, 0.400 inch x 0.100 inch	09.03201.02	EAO
13	TP1-13	Test point, white, thru hole, 5012, 0.125 inch x 0.125 inch	5012	Keystone
1	U1	Intelligent USB Charging Controller with Current Limiting, MSOP	TPS2511DGN	TI
1	U2	3.5-V to 42-V Stepdown SWIFT, DC-to-DC Converter with ECO-Mode, MSOP-10	TPS54240DGQ	TI
1	--	PCB, 2 inch x 2.5 inch x 0.064 inch	PWR141	Any
4	--	Shunt, 100-millimeter, black, 0.100 inch	929950-00	3M

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 7 V and the output voltage range of 0 V to 7 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 145°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
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WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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