TPS63030EVM-658 User's Guide

This user's guide describes the characteristics, operation, and use of the TPS63030EVM-658 evaluation module (EVM). This EVM contains the Texas Instruments TPS63030 buck-boost converter, configured with external components to regulate current through a WLED. This user's guide includes EVM specifications, recommended test setup, test results, bill of materials, and a schematic diagram.

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1 Introduction

The Texas Instruments TPS63030EVM-658 evaluation module contains a TPS63030 buck-boost converter integrated circuit (IC), supporting components, and one white light-emitting diode (WLED). The purpose of this EVM is to facilitate evaluation of the TPS63030 in a typical WLED application.

1.1 Performance Specification Summary

Table 1. Typical Performance Specification Summary

Parameter	Min	Typ	Max	Units
V_{IN}	1.8		5.5	V
V_{OUT}		3.2		V
I_{WLED}	325	350	375	mA
Overvoltage Protection Clamp Voltage		6		V

Table 1 provides a summary of the TPS63030EVM-658 performance specifications. All specifications are given for an ambient temperature of 25°C.

1.2 Modifications

To aid user customization of the EVM, the board was designed with devices having 0603 or larger footprints. Actual implementations may occupy less space. Resistor R6 may be removed to measure current through the LED.

2 TPS63030EVM-658 Setup

2.1 Input/Output Connections

The connection points and jumper positions are described in the following paragraphs.

2.1.1 J1 – V_{IN}

This header is the positive connection for the input power supply. Twist the leads to the input supply and keep them as short as possible. The input voltage must remain within the limits specified in Table 1.

2.1.2 J2 – Sense + and -

This header is low current sense lines that monitor Vin at the input capacitor.

2.1.3 J3 – GND

This header is the return connection to the input power supply.

2.1.4 J4 – LED Out

This header is voltage out of the converter to the LED

2.1.5 JP1 – Enable

This jumper connects the enable pin of the TPS63030 to either ON (enabling the TPS63030) or OFF (disabling the TPS63030). The jumper must be installed in one position only. Do not leave JP1 open.

WARNING

This EVM WLED shines brightly. Protective eyewear and use of the diffuser cover is recommended.

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3 Test Results

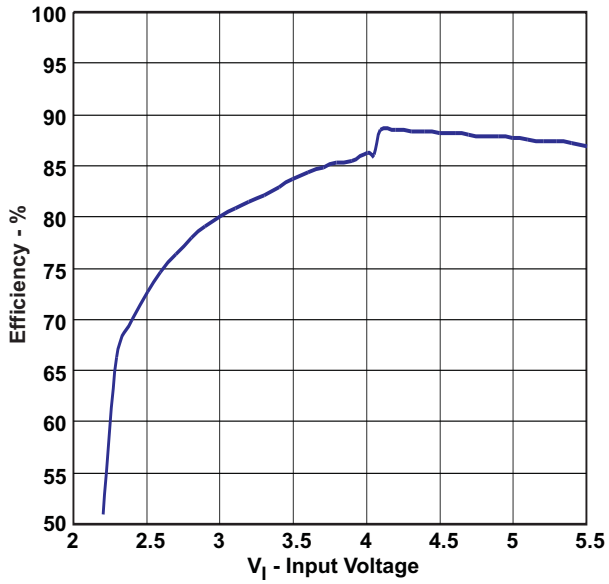


Figure 1. Efficiency vs Input Voltage

4 Design Procedure for Divider Network

The TPS63030 feedback voltage (FB) is set to 0.50 V. If this were used for current regulation, the power dissipation of the sense resistor will be high. To reduce power dissipation on the current sense resistor R3, a reference voltage of 2.5 V is summed with it, thereby reducing V_{sense} voltage and power dissipation in R3.

The first step is to choose the LED operating current and V_{sense} voltage, which determines the value for R3. There is a trade off between power dissipation on R3 and accuracy of regulation point. As V_{sense} is increased, the current regulation accuracy improves; the maximum voltage is 0.50 V. As V_{sense} is decreased, the power dissipation is reduced, but the error due to V_{ref} on resistors R1 and R2 increases.

The EVM I_{LED} is set to 350 mA with a V_{sense} voltage of 0.178 V.

$$V_{sense} = I_{LED} \times R3 = 350\,mA \times 510\,m\Omega = 0.178\ V$$

$$V_{R1} = V_{FB} - V_{sense} = 0.50\ V - 0.178\ V = 0.322\ V$$

$$V_{R2} = V_{REF} - V_{FB} = 2.5\ V - 0.50\ V = 2.00\ V$$

Choose divider current of 0.1 mA.

$$R1 = \frac{V_{R1}}{0.1\,mA} = \frac{0.322\ V}{0.1\,mA} = 3.22\,k\Omega$$

Standard value is 3.24 kΩ.

$$R2 = \frac{V_{R2}}{0.1\,mA} = \frac{2.00\ V}{0.1\,mA} = 20\,k\Omega$$

Standard value is 20 kΩ.

Output current can be increased or decreased by changing R3. For 700-mA output current, decrease R3 to 250 mΩ. Changes in the reference voltage, R1 or R2, also can be used to change the LED current.

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5 Board Layout

This section provides the board layout of the TPS63030EVM-658. A 2-layer PCB with a number of vias near the LED was used to help with the thermal dissipation of the WLED. Users must carefully design their system to handle the thermal challenges raised by the WLEDs.

Board layout is critical for all switch-mode power supplies. See the data sheet (SLVS893) for specific layout and routing guidelines.

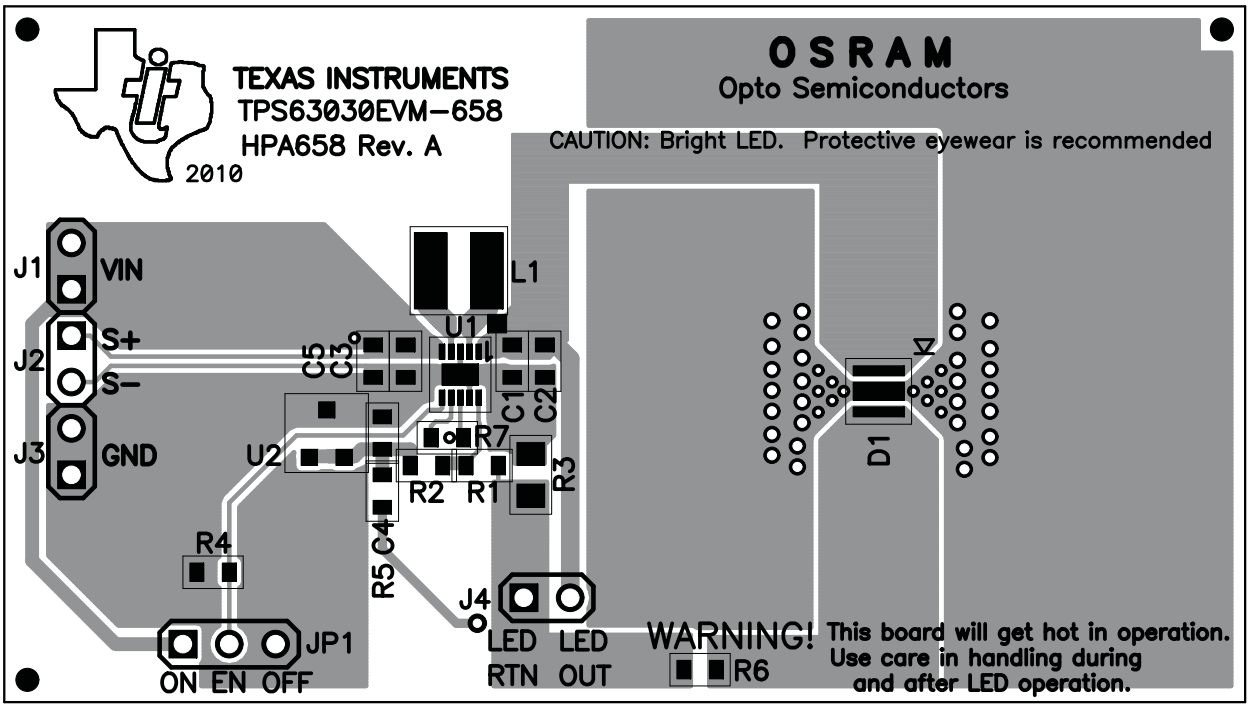


Figure 2. Assembly Layer Including Silk Screen

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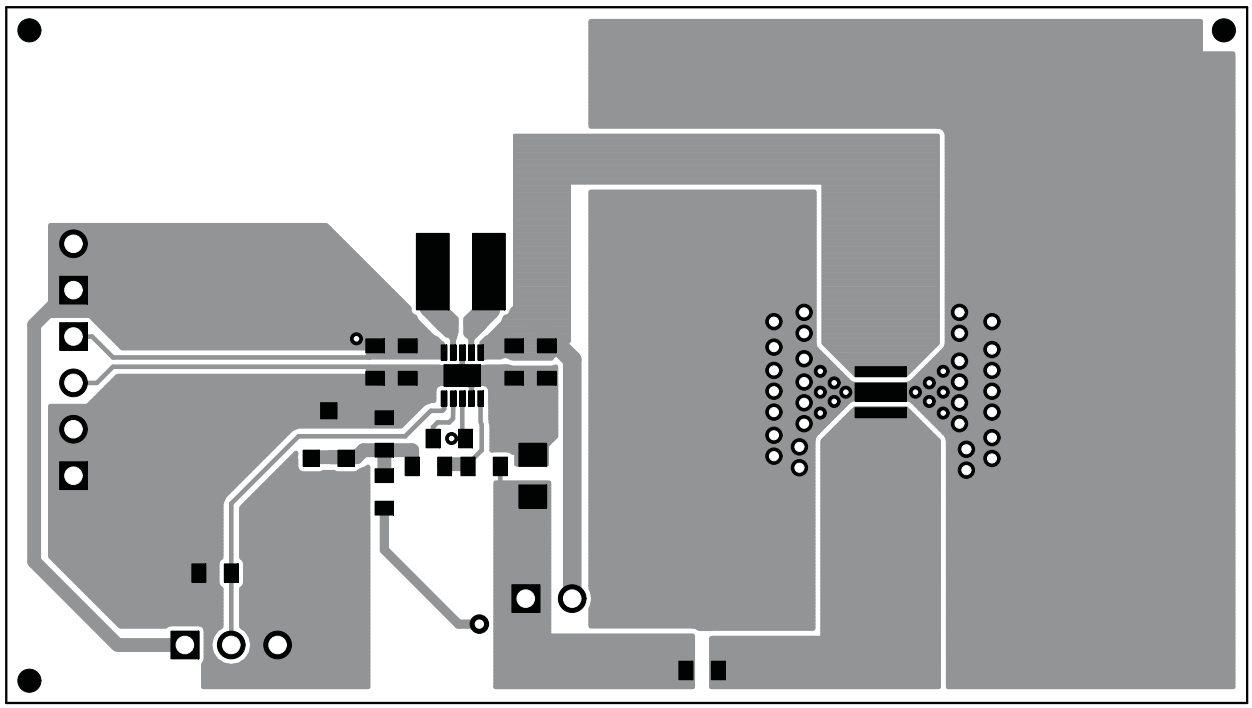


Figure 3. Top Copper Layer

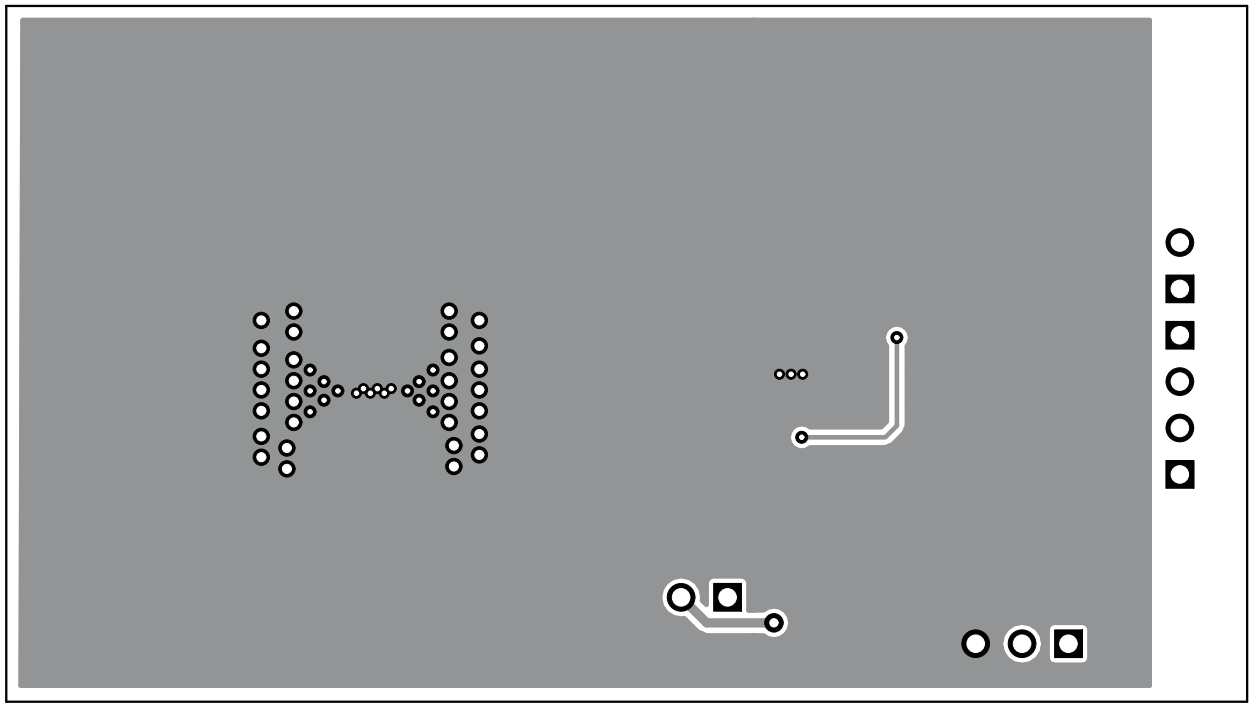


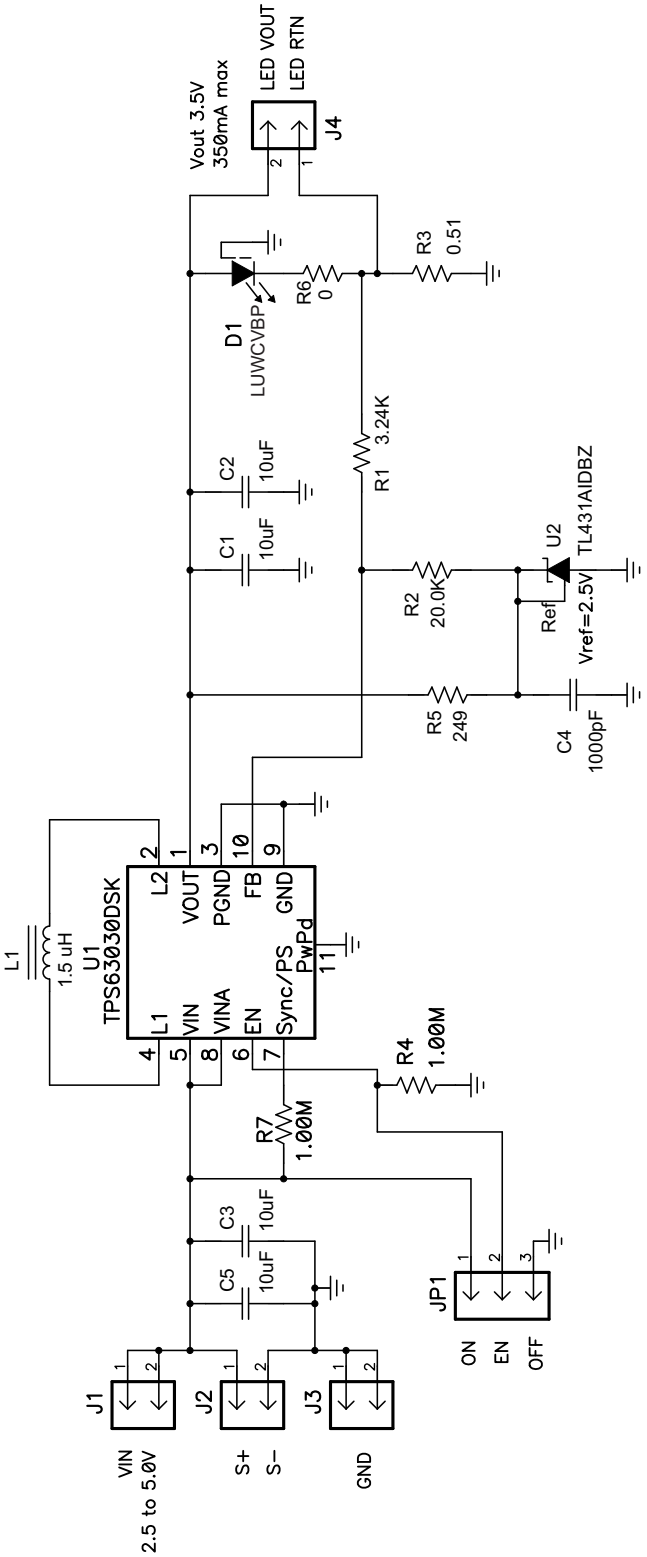
Figure 4. Bottom Copper Layer

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6 Schematic and Bill of Materials

This section contains a schematic and bill of materials for the TPS63030EVM-658.

6.1 TPS63030EVM-658 Schematic



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6.2 TPS63030EVM-658 Bill of Materials

Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
4	C1, C2, C3, C5	10uF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	GRM188R60J106ME47D	Murata
1	C4	1000pF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	D1	LUWCVBP	LED, 350mA	3.10 x 3.10 mm	LUW CVBP.CE-5L8L-GMKM-8E8G	Osram
1	L1	1.5 µH	Inductor, Power, 3.1A, 22mΩ, ±20%	0.157 x 0.157 inch	XFL4020-152ME	Coilcraft
1	R1	3.24K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	20.0K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	0.51	Resistor, Chip, 1/10W, 1%	0805	Std	Std
2	R4, R7	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	249	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TPS63030DSK	IC, DC-DC Converter	DSK	TPS63030DSK	TI
1	U2	TL431AIDBZ	IC, Precision Adjustable Shunt Regulator	SOT23-3	TL431AIDBZ	TI

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Revision History

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

Changes from Original (August 2010) to A Revision	Page
• Updated D1 in Section 6.1 from "D1 LUWCP7P" to "D1 LUWCVBP"	6
• Updated D1 line in Table 2	7

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 1.8 V to 5.5 V and the output voltage range of 3 V to 5 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 80°C. The EVM is designed to operate properly with certain components above 80°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.

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