User's Guide
SLVU261–January 2009

TPS61500EVM-369

This user's guide describes the characteristics, operation, and use of the TPS61500EVM-369 evaluation module (EVM). This EVM contains the Texas Instruments TPS61500 boost converter, configured with external components to regulate current through a string of WLEDs. 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 TPS61500EVM-369 evaluation module contains a TPS61500 boost converter IC, supporting active and passive components, and 5 white light-emitting diodes (WLEDs) in series. The goal of this EVM is to facilitate evaluation of the TPS61500 in a typical WLED application.

1.1 Performance Specification Summary

Table 1 provides a summary of the TPS61500EVM-369 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Typical Performance Specification Summary

	Conditions	Min	Typ	Max	Units
V_{IN}	JP2 shorted, JP3 shorted	2.9		12	V
	JP2 shorted, JP3 open	4		15	V
V_{OUT}	JP2 shorted, JP3 open		15.5		V
	JP2 shorted, JP3 shorted		12.5		V
I_{WLED}	JP2 shorted	498	513	528	mA
Overvoltage Protection Clamp Voltage	JP2 open		20		V

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.

2 TPS61500EVM-369 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. The leads to the input supply should be twisted and kept as short as possible. The input voltage should remain within the limits specified in Table 1.

2.1.2 J2 – GND

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

2.1.3 J3 – V_{OUT}

This header is the positive output of the device.

2.1.4 J4 – GND

This header is the return connection for the load.

2.1.5 J5 – FB

This header is connected to the FB pin of the TPS61500, which is regulated to 0.2 V typical. This point is also connected to the anode of the last WLED in the on-board WLED string.

2.1.6 JP1 – Enable

This jumper connects the enable pin of the TPS61500 to either V_{IN} (enabling the TPS61500) or GND (disabling the TPS61500). The jumper must be installed in one position only. Do not leave JP1 open.

2.1.7 JP2 – Open WLED

Installing this jumper connects the on-board WLED string to the output of the TPS61500. Removing this jumper without connecting the external WLEDs between J3 and J5 simulates the condition of an open WLED and will activate the TPS61500's overvoltage protection circuitry to clamp the output at 20V typical.

2.1.8 JP3 – Short WLED D2

Installing this jumper takes WLED D2 out of the current path on the output and thereby reduces the output power and output voltage. Note that the input voltage range is less in this mode of operation as described in Table 1.

WARNING

This EVM has several WLEDs that shine brightly. Protective eyewear and use of the diffuser cover is recommended.

3 Test Results

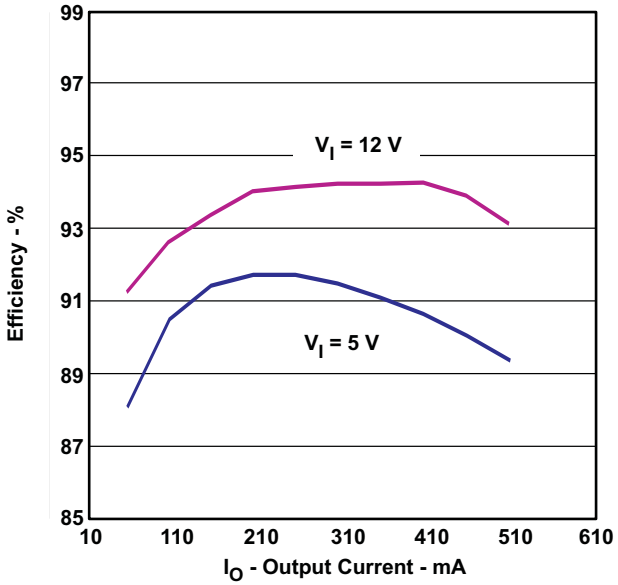


Figure 1. Efficiency vs. Output Current Using Analog Dimming

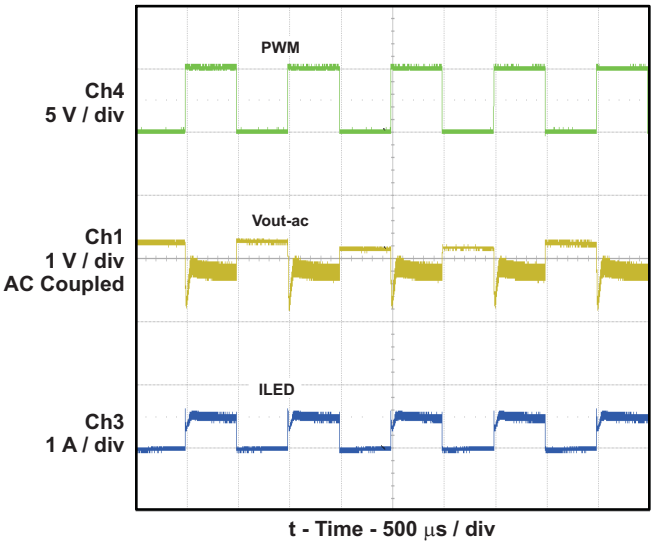


Figure 2. PWM Dimming at V_{IN} = 5 V (With Optional PWM Dimming Components Q1, Q2, R6 and R9 Installed)

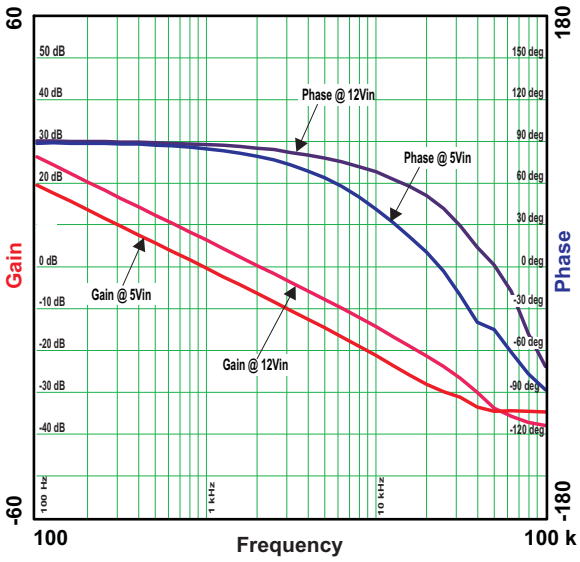


Figure 3. Control Loop Response

4 Board Layout

This section provides the board layout of the TPS61500EVM-369. A 4-layer PCB was used to help with the thermal dissipation of the WLEDs. Even with the low thermal impedance from the WLEDs to the internal layers, the entire PCB acts as a heatsink and so the board and especially the WLEDs get very hot. The user 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.

CAUTION

WLEDs are very bright. Protective eye wear is recommended.

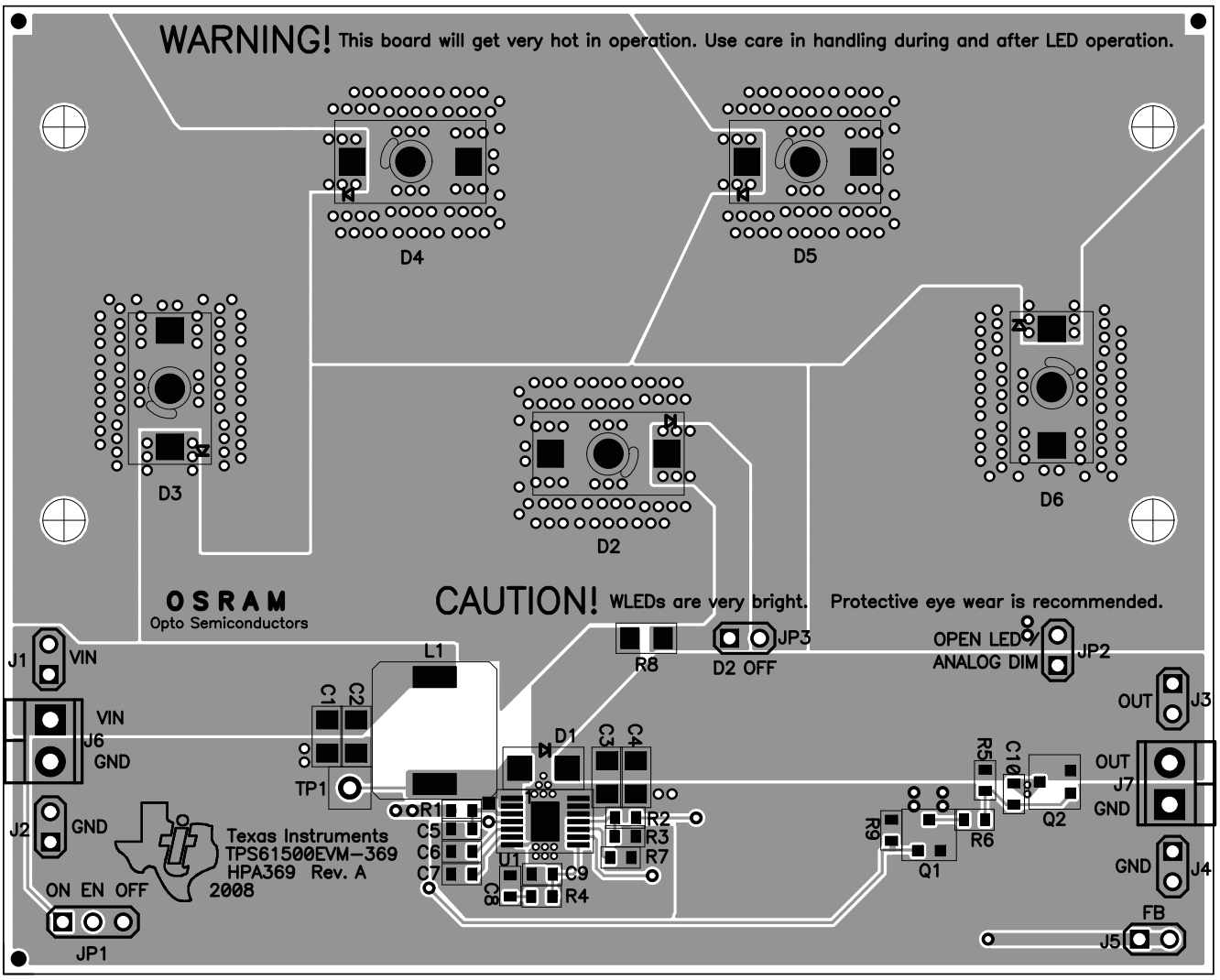


Figure 4. Assembly Layer inlcuding Silk Screen

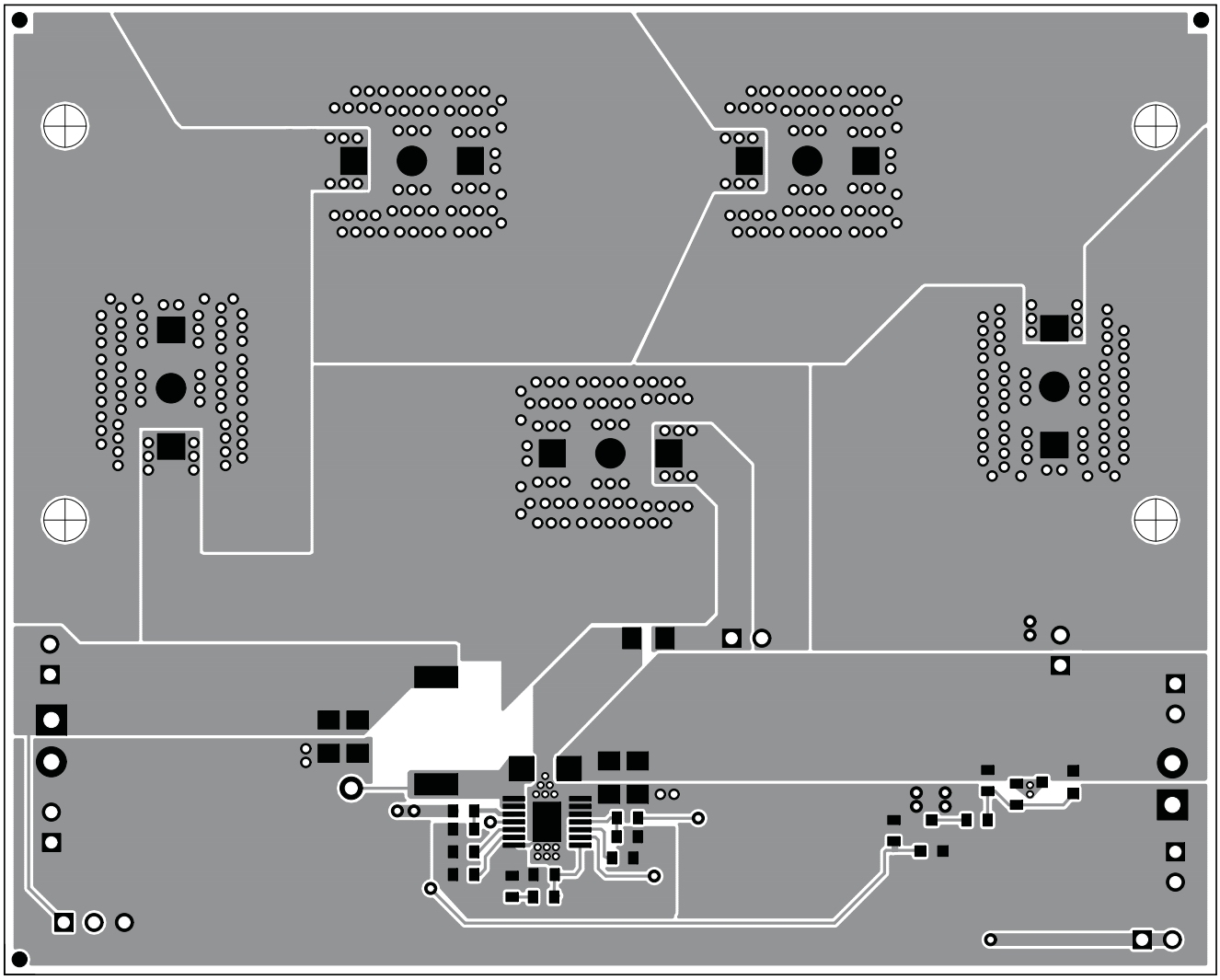


Figure 5. Top Copper Layer

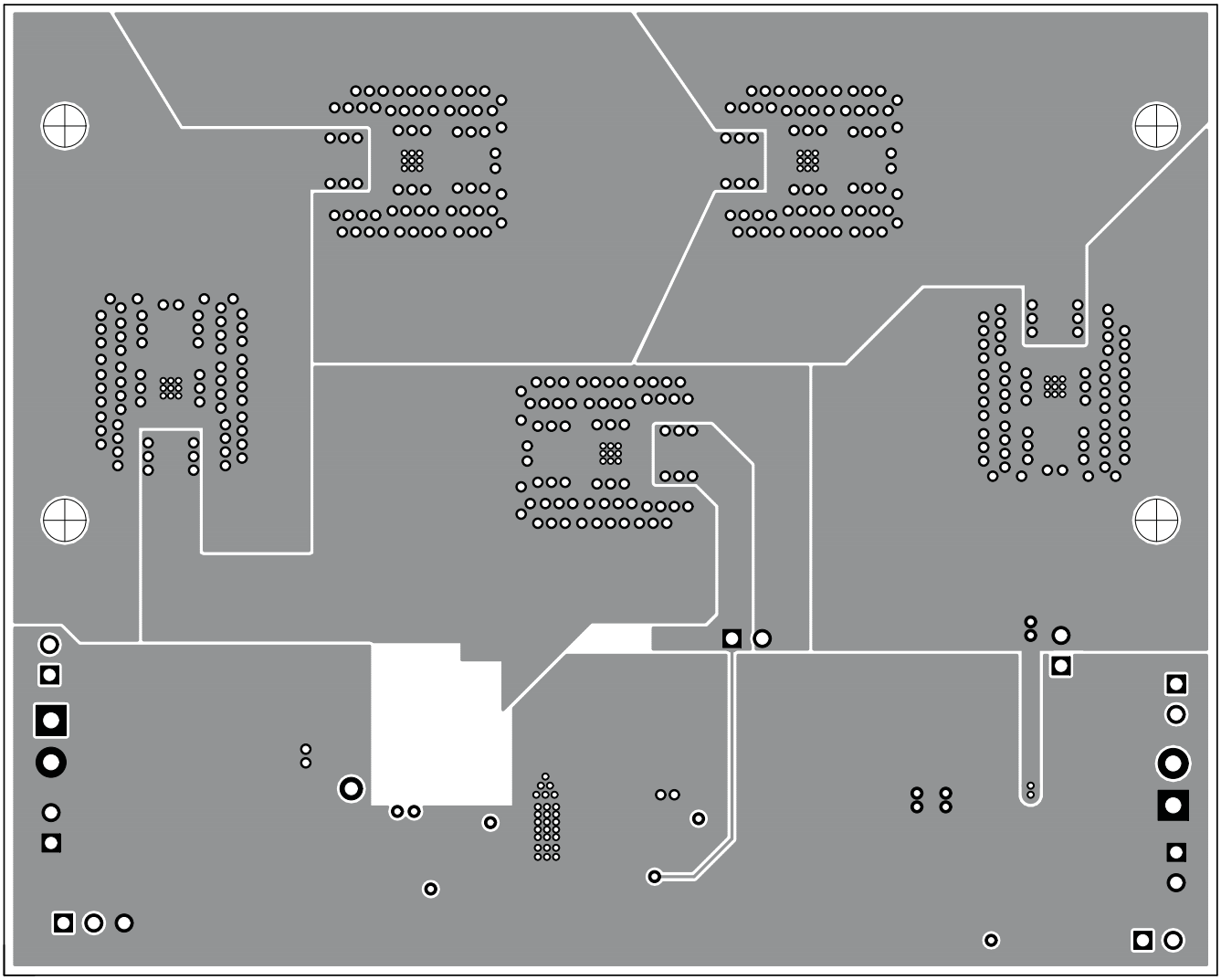


Figure 6. Bottom Copper Layer

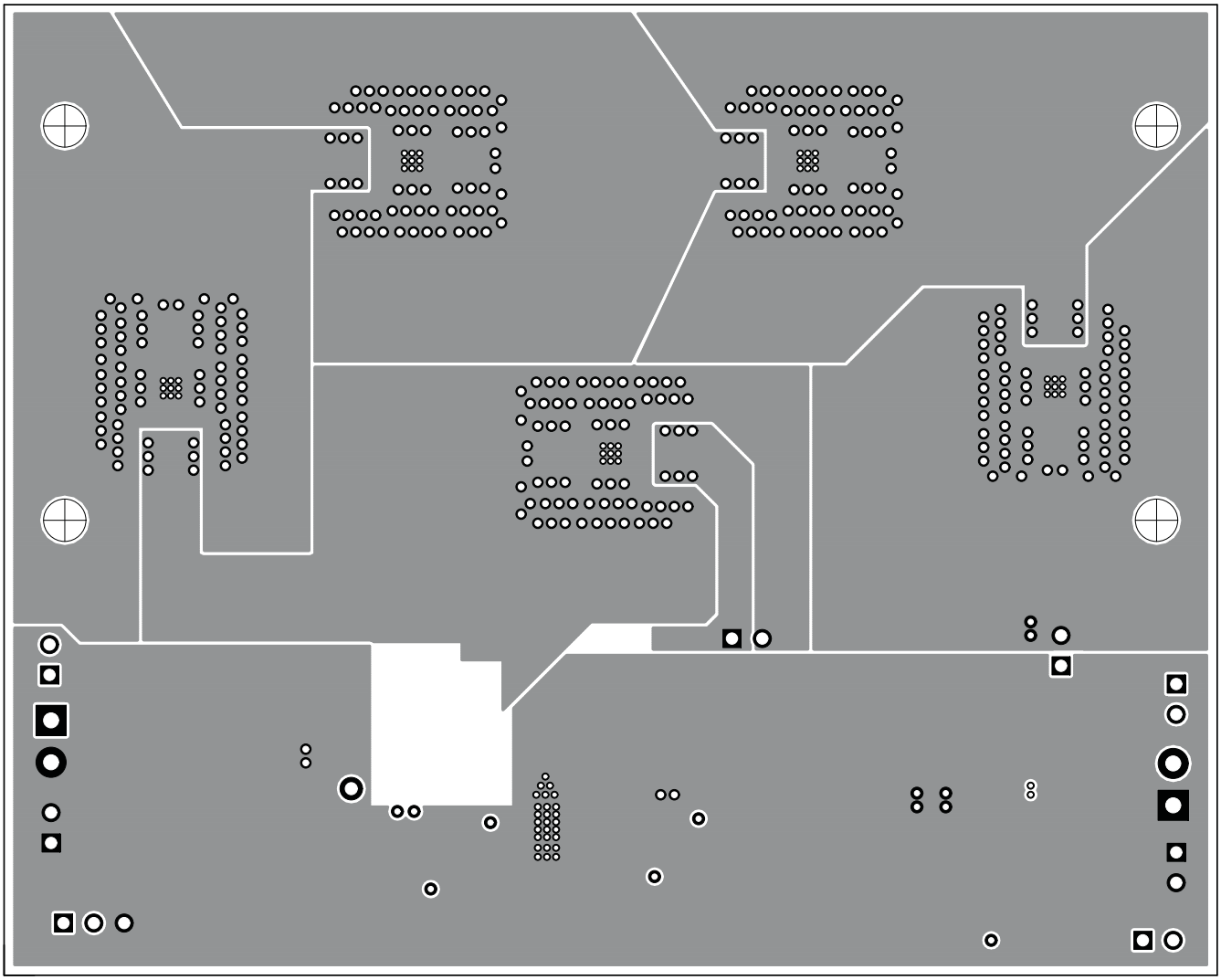


Figure 7. Internal Layer 1

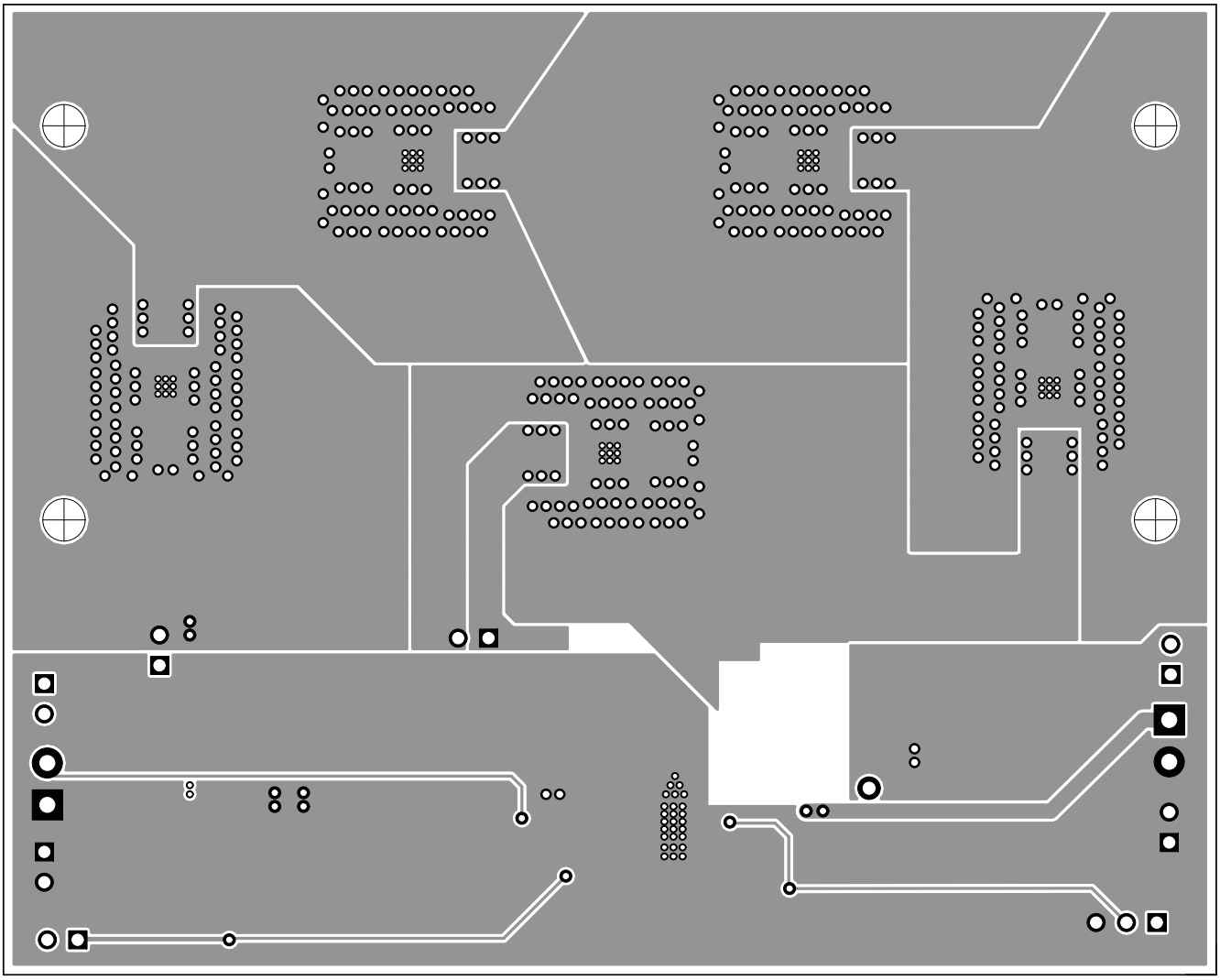
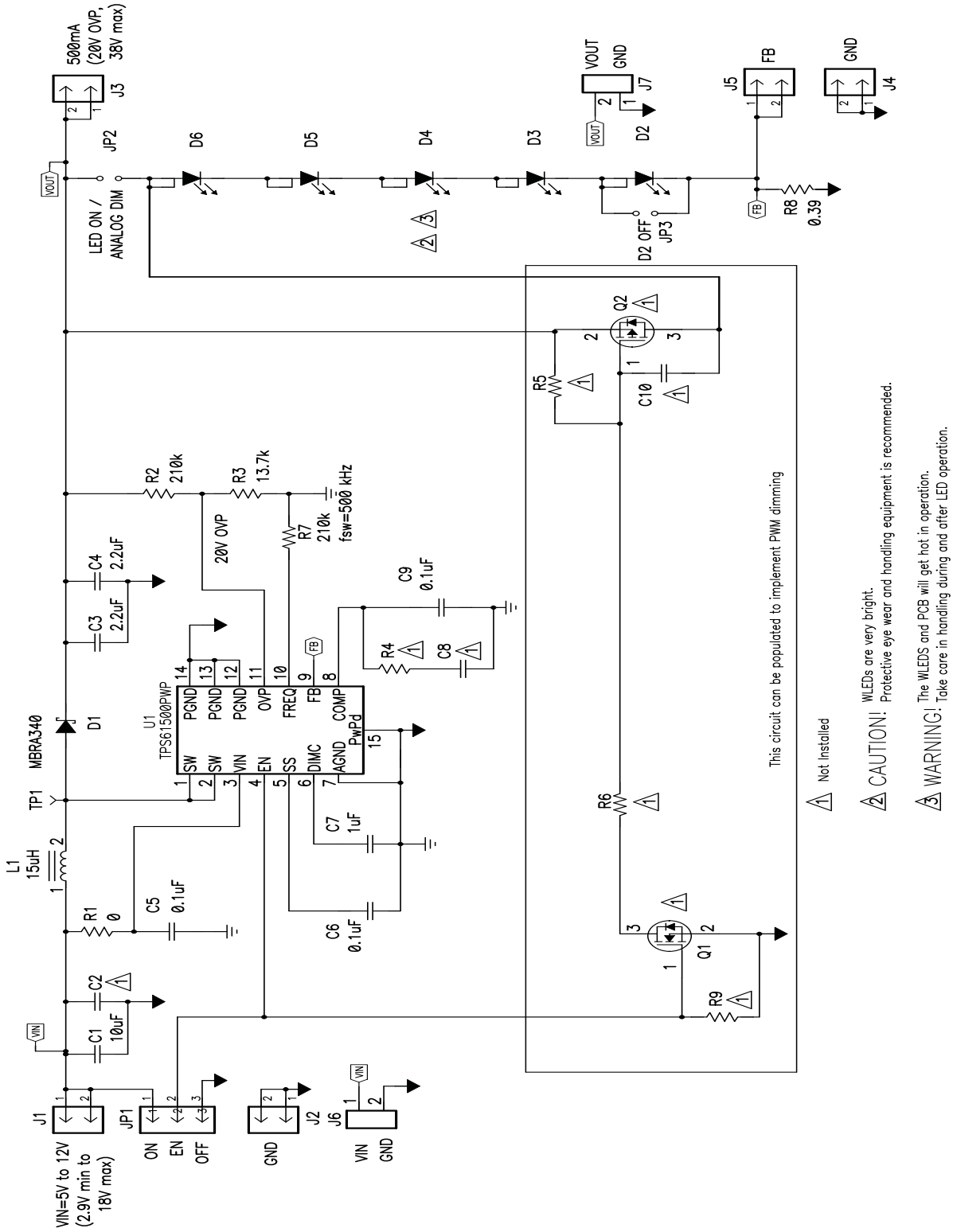


Figure 8. Internal Layer 2

5 Schematic and Bill of Materials

This section contains a schematic and bill of materials for the TPS61500EVM-369.

5.1 TPS61500EVM-369 Schematic



5.2 TPS61500EVM-369 Bill of Materials

Table 2. Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10uF	Capacitor, Ceramic, 25V, X5R, 20%	1206	STD	STD
0	C2	Open	Capacitor, Ceramic, 25V, X5R, 20%	1206	STD	STD
2	C3, C4	2.2uF	Capacitor, Ceramic, 50V, X5R, 10%	1206	STD	STD
1	C5	0.1uF	Capacitor, Ceramic, 25V, X5R, 20%	0603	STD	STD
2	C6, C9	0.1uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	STD	STD
1	C7	1uF	Capacitor, Ceramic, 10V, X5R, 20%	0603	STD	STD
0	C8, C10	Open	Capacitor, Ceramic, 10V, X5R, 10%	0603	STD	STD
1	D1	MBRA340	Diode, Schottky, 3A, 40V	SMA	MBRA340	On Semi
5	D2, D3, D4, D5, D6	"LW W5SM"	Diode, LED White, 500-mA, 17000-mcd	0.244 x 0.441 inch	LW W5SM	Osram
5	J1, J2, J3, J4, J5	PTC36SAAN	Header, Male 2-pin, 100mil spacing, (36-pin strip)	0.100 inch x 2	PTC36SAAN	Sullins
2	J6, J7	ED1514	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	ED1514	OST
1	JP1	PTC36SAAN	Header, Male 3-pin, 100mil spacing, (36-pin strip)	0.100 inch x 3	PTC36SAAN	Sullins
2	JP2, JP3	PTC36SAAN	Header, 2 pin, 100mil spacing, (36-pin strip)	0.100 inch x 2	PTC36SAAN	Sullins
1	L1	15uH	Inductor, SMT, 3.1A, 42milliohm	0.382 X 0.394 inch	VLF10040T-150M3R1	TDK
0	Q1	Open	MOSFET, N-ch, 60-V, 115-mA, 1.2-Ohms	SOT23	2N7002DICT	Vishay-Liteon
0	Q2	Open	MOSFET, Pch, -40V, 3.0A	SOT-23	SI2319DS	Vishay
1	R1	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R2, R7	210k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	13.7k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R4, R5	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R6,R9	1k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R8	0.39	Resistor, Chip, 1/4W, 1%	1206	ERJ-8RQFR39V	Panasonic
1	TP1	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	U1	TPS61500PWP	IC, High Voltage/Current Bosst Converter	HTSSOP-14	TPS61500PWP	TI
1	--		PCB, 4.0" x 3.2" x 0.062"		HPA369	Any
3	--		Shunt, 100-mil, Black	0.100	929950-00	3M
1	--	MCH002	Plexi-glass, smoked	1.7"x 4.0"x 0.125" THK	MCH002	Any
4	--	3464	Aluminum spacer	0.25" tall	3464	Keystone
4	--	PMS 632 0063 SL	Screw, zinc plated steel, pan head slotted	6-32 x 0.625"	PMS 632 0063 SL	Building fasteners
4	--	HNZ632	Hex nut, zinc plated steel	6-32	HNZ632	Building fasteners

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.9 V to 15 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.

The EVM printed circuit board gets very hot during operation. Use care in handling during and after LED operation. WLEDs are very bright; protective eye wear is recommended.

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 125°C. The EVM is designed to operate properly with certain components above 125°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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