Texas Instruments

User's Guide
SLVU421–December 2010

TPS61199EVM-598 Evaluation Module for TPS61199 White LED Driver for LCD Monitor Backlighting

This user's guide describes the characteristics, operation, and use of the TPS61199 evaluation module (EVM). This EVM contains the Texas Instruments TPS61199, a WLED power solution providing up to eight independently regulated current outputs using a single inductor step-up (boost) converter. The current outputs are ideal for driving a WLED backlight in notebook/laptop computers. This user's guide includes EVM specifications, recommended test setup, bill of materials, and a schematic diagram.

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1 Applications

The TPS61199 is an excellent solution for computer notebook and monitor LCD display backlighting.

2 TPS61199EVM-598 Electrical Performance Specifications

Table 1 provides a summary of the TPS61199EVM-598 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. TPS61199EVM-598 Electrical Performance Specifications

Parameter		Notes and Conditions [(1)]	Min	Typ	Max	Unit
Input Characteristics						
V_{IN}	Input voltage		8		30	V
EN, PWM	Logic high		2		20	V
EN, PWM	Logic low				0.8	V
I_{q_VIN}	Input quiescent current	EN=high, PWM=low, no switching, V_{IN} = 30 V, No load			1.5	mA
V_{IN_UVLO}	Input UVLO	V_{IN} ramp down		6.5	7	V
		V_{IN} hysteresis		0.3		
Output Characteristics						
V_{OUT}	V(TP1)	J6 connected to 8 strings of 17 WLEDs, JP1 shorted, JP4-11 pins 1-2 shorted, EN/PWM = VDD	50		53	V
		J6 connected to 8 strings of 17 WLED, JP1 open, JP4-11 pins 1-2 shorted, EN/PWM = VDD, OVP active			60	V
I_{OUT}	I(JP1) = 8 X IFBx	V_{IN} = 12 V, R_{ISET} = 40.6 kΩ, PWM = VDD		480		mA
System Characteristics						
f_S	Oscillator frequency	R_{FSW} = 160 kΩ	0.4	0.5	0.6	MHz

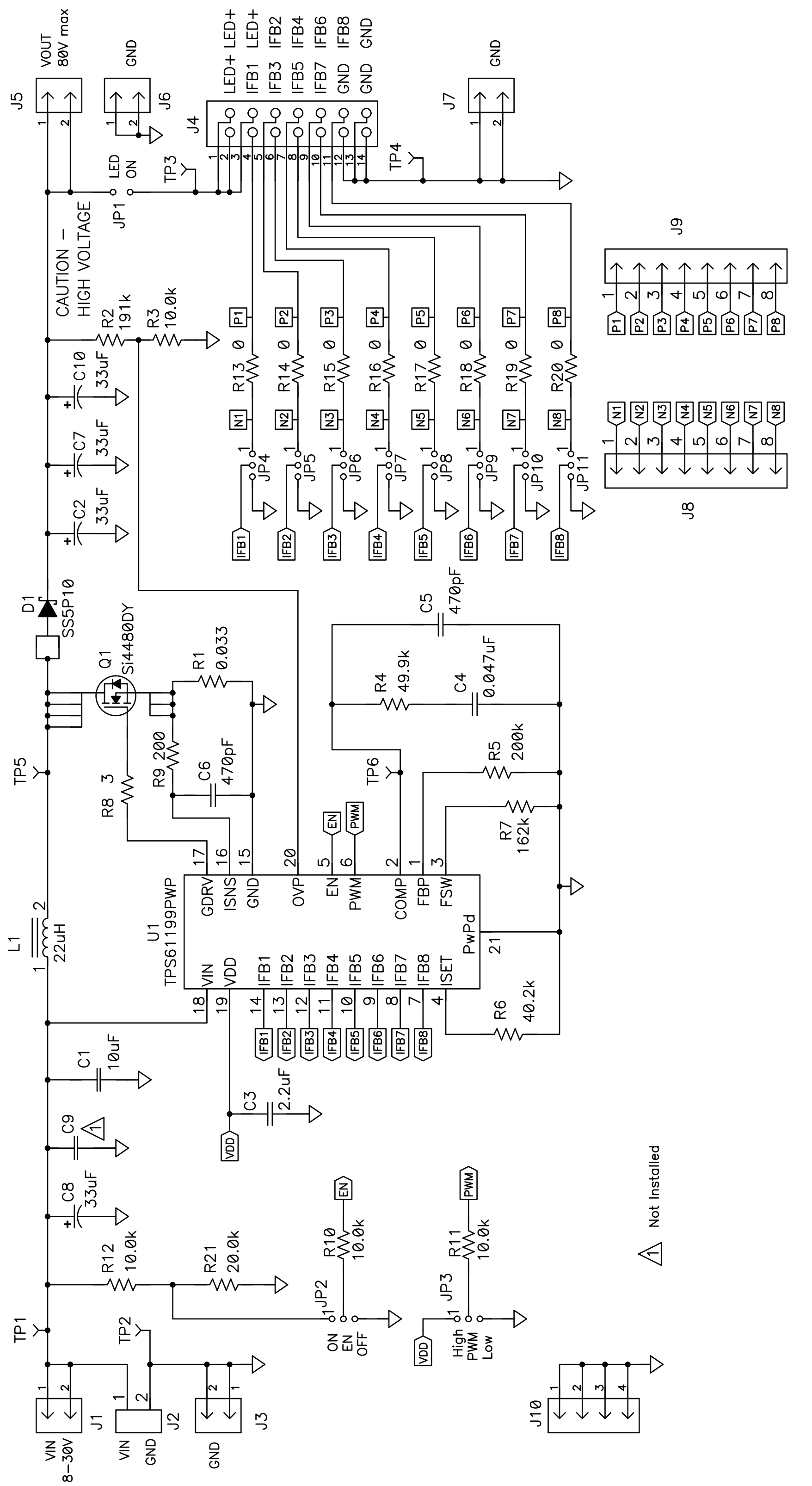
(1) The user can estimate the input current by solving the power balance equation, eff = $P_{OUT}/P_{IN} = (V_O \times I_O)/(V_{IN} \times I_{IN})$, for I_{IN} and estimating the efficiency to be a conservative 85%. For example, for V_O = 51 V, V_{IN} = 8 V and I_O = 8 × 60 mA = 480 mA, I_{IN} = (51 V × 480 mA)/(8 V × 0.85) = 3.6 A

3 Modifications

See the data sheet (SLVSAN3) when changing components such as R6 to set the LED current or R2 and R3 to set the OVP threshold. To aid in such customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space.

Note that changing components can improve or degrade EVM performance. For example, using inductors with larger saturation current rating allows the use of lower input voltages.

4 Schematic and Bill of Materials



NOTE: For Reference Only, See Table 2 specific Values

Figure 1. HPA598EVM Schematic

Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10 µF	Capacitor, Ceramic, 50V, X7R, 10%	1210	Std	Std
4	C2, C7, C8, C10	33 µF	Capacitor, Electrolytic, 100VDC, 20%	8 x 11.5 mm	UPW2A330MPD6	Nichicon
1	C3	2.2 µF	Capacitor, Ceramic, 10V, X7R, 10%	0805	Std	Std
1	C4	0.047 µF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
2	C5, C6	470 pF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
0	C9	Open	Capacitor, Ceramic	1210	Std	Vishay
1	D1	SS5P10 Alt. PDS5100H	Diode, High Current, Schottky Barrier, 5A, 100V	TO-277	SS5P10-M3/86A Alt. PDS5100H	Vishay Alt. Diodes Inc
5	J1, J3, J5-J7	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	J2	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	ED555/2DS	OST
1	J4	N2514-6002-RB	Connector, Male Straight 2x7 pin, 100mil spacing, 4 Wall	0.100 inch x 2x7	N2514-6002-RB	3M
2	J8, J9	PEC08SAAN	Header, Male 8-pin, 100mil spacing	0.100 inch x 8	PEC08SAAN	Sullins
1	J10	PEC04SAAN	Header, Male 4-pin, 100mil spacing,	0.100 inch x 4	PEC04SAAN	Sullins
1	JP1	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
10	JP2-JP11	PEC03SAAN	Header, 3-pin, 100mil spacing	0.100 inch x 3	PEC03SAAN	Sullins
1	L1	22 µH	Inductor, SMT, 3.6A, 43.2 mΩ	0.485 sq inch	CDRH127NP-220MC Alt. MSS1278-223ML	Sumida Alt. Coilcraft
1	Q1	SI4480DY Alt. FDS3590	MOSFET, N-ch, 80V, 6A, 35 mΩ	SO8	SI4480DY-T1-E3 Alt. FDS3590	Vishay Alt. Fairchild
1	R1	0.033	Resistor, Chip, 1/2W, 1%	1812	Std	Std
1	R2	191k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
4	R3, R10-R12	10k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	49.9K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	200K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	40.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R7	162k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R8	3	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R9	200	Resistor, Chip, 1/16W, 1%	0603	Std	Std
8	R13-R20	0	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R21	20k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
4	TP1, TP3, TP5, TP6	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
2	TP2, TP4	5001	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	5001	Keystone
1	U1	TPS61199PWP	IC, WLED Driver for LCD Monitors Backlighting	HTSSOP	TPS61199PWP	TI
11	–		Shunt, 100-mil, Black	0.100	929950-00	3M
1			PCB, 2.05 x 3.675 x 0.062 inch		HPA598	Any

5 Connector and Test Point Descriptions

5.1 Input/Output Connections

The connections points are described in the following paragraphs.

5.1.1 J1 – VIN

This header is the positive connection to the input power supply. Twist the input supply and GND leads to the input supply and keep them as short as possible.

5.1.2 J2 – VIN/GND

This header provides a high current positive and return connection to the input power supply. Twist the input supply leads and keep them as short as possible.

5.1.3 J3 – GND

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

5.1.4 J4 – 14-Pin Connector

This header facilitates connecting the TPS61199EVM-598 to the load using a 14-pin ribbon cable. The load must be created by the user with WLEDs or properly sized resistors.

5.1.5 J5 – VOUT

This header connects to the board's VOUT plane.

5.1.6 J6, J7, and J10 – GND

These headers connect to the board's GND plane.

5.1.7 J8 and J9

By changing R13-R20 from 0 ohms to a small resistor, these headers allow the user to measure the voltage across each resistor and therefore the current into each IFBx pin individually. They also provide the user easy connection to the IFBx pins if a ribbon cable into J4 is not used.

5.1.8 JP1 – LED ON

The user can remove the shunt on this jumper and connect the high side of the load to J5. Installing the shunt on this jumper connects the output of the boost converter to J4. Removing the jumper removes the load connected to J4 from the boost converter feedback path and causes the integrated circuit's (IC) overvoltage protection circuitry to activate. Instead of the shunt, the user can place an ammeter across the jumper to measure the total output current (i.e., 8×IFBx).

5.1.9 JP2 – EN

Installing the shunt on this jumper to ON sets the ENABLE pin voltage to VIN scaled down with a resistor divider, thereby enabling the IC's boost converter. Connecting it to OFF pulls EN to ground, which disables the IC's boost converter.

5.1.10 JP3 – PWM

Installing the shunt on this jumper to VDD sets the current sinks to 100% current and therefore any attached LEDs to full brightness. The user must connect an external PWM signal or use JP3 to take PWM to a logic high (above 2 V but no higher than 20 V) in order to enable the current sinks.

5.1.11 JP4 – JP11

The user can use the shunt to tie the IFBx pin to JPx and then connect J8 or J9 to the low side of the external resistors or WLEDs. Alternatively, the user can connect J4 to the load. For strings that are not used, the user should tie the applicable IFBx pin to GND using these jumpers.

6 Test Requirements and Setup

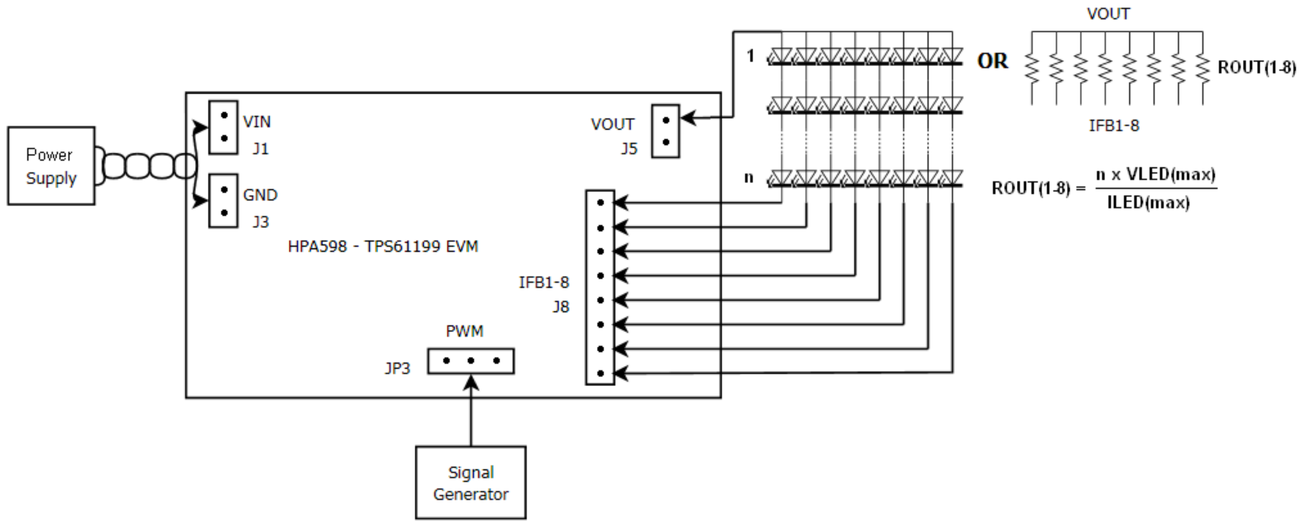


Figure 2. TPS61199EVM Test Setup

6.1 Hardware Requirements

1. This EVM requires an external power supply capable of providing up to 30 V at 4 A.
2. If dimming via an external PWM signal is desired, then a function generator capable of providing at least a 2-V amplitude PWM signal between 100 Hz to 22 kHz is required to avoid screen flickering and maintain dimming linearity.
3. A load using resistors or WLEDs is required. The resistance required in each string is chosen using the output voltage and desired current in each string. The output voltage is determined by the sum of the maximum forward voltage drop of all "n" WLEDs in one string. R_{OUT} = (n × $V_{LED(MAX)}$)/$I_{LED(MAX)}$. For example, if there are n=14 LEDs with $V_{LED(MAX)}$ = 3.6 V, $I_{LED(MAX)}$ = 60 mA, then R_{OUT} = (14 × 3.6 V)/60 mA = 840 Ω → 845 Ω next highest standard value.
4. Digital multimeters capable of measuring voltages and currents are recommended.
5. An oscilloscope is also recommended.

6.2 Hardware Setup

- Connect a power supply capable of supplying up to 30 V at 4 A between VIN and GND (J2 or J1 and J3). Do not turn on the power supply.
- Either set JP2 ON or connect a second logic signal or power supply capable of providing at least 2-V voltage to the high-impedance EN pin of JP2.
- J5 must be connected directly or through an ammeter to the high side of the load. The low side of each string in the load must then be connected to IFBx using J8 or J9. Alternatively, JP1 must be connected directly or through an ammeter. Alternatively, a load can be connected to J4 using a 14-pin ribbon cable.
- Properly configure JP4-JP11 so that each IFB line either connects directly to the J8 connector or to GND. Unused IFBx lines must have the appropriate JP4-JP11 jumpers shunted to ground.
- To turn on the LEDs at full LED current and brightness, install JP3's shunt to VDD.
- To dim the LEDs by PWM dimming, connect the function generator to the PWM pin of JP3.

7 TPS61199EVM-598 Assembly Drawings and Layout

The following figures (Figure 3 through Figure 5) show the design of the TPS61199EVM-598 printed-circuit board (PCB). The EVM has been designed using a two-layer, 2-oz, copper-clad circuit board, 52.070 mm × 93.345 mm, with all components on the top side and all active traces to the top and bottom layers to allow the user to easily view, probe, and evaluate the TPS61199 control IC in a practical, double-sided application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space-constrained systems.

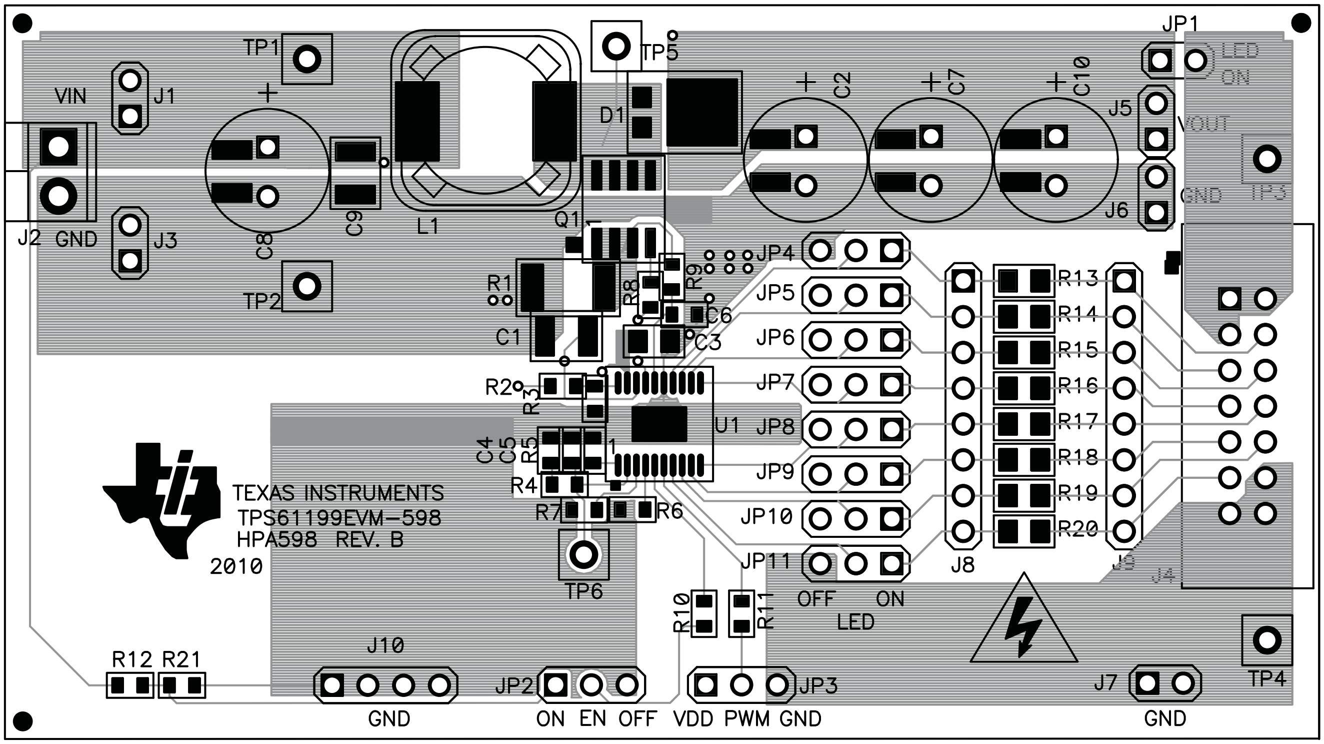


Figure 3. TPS61199EVM-598 Component Placement, Viewed From Top

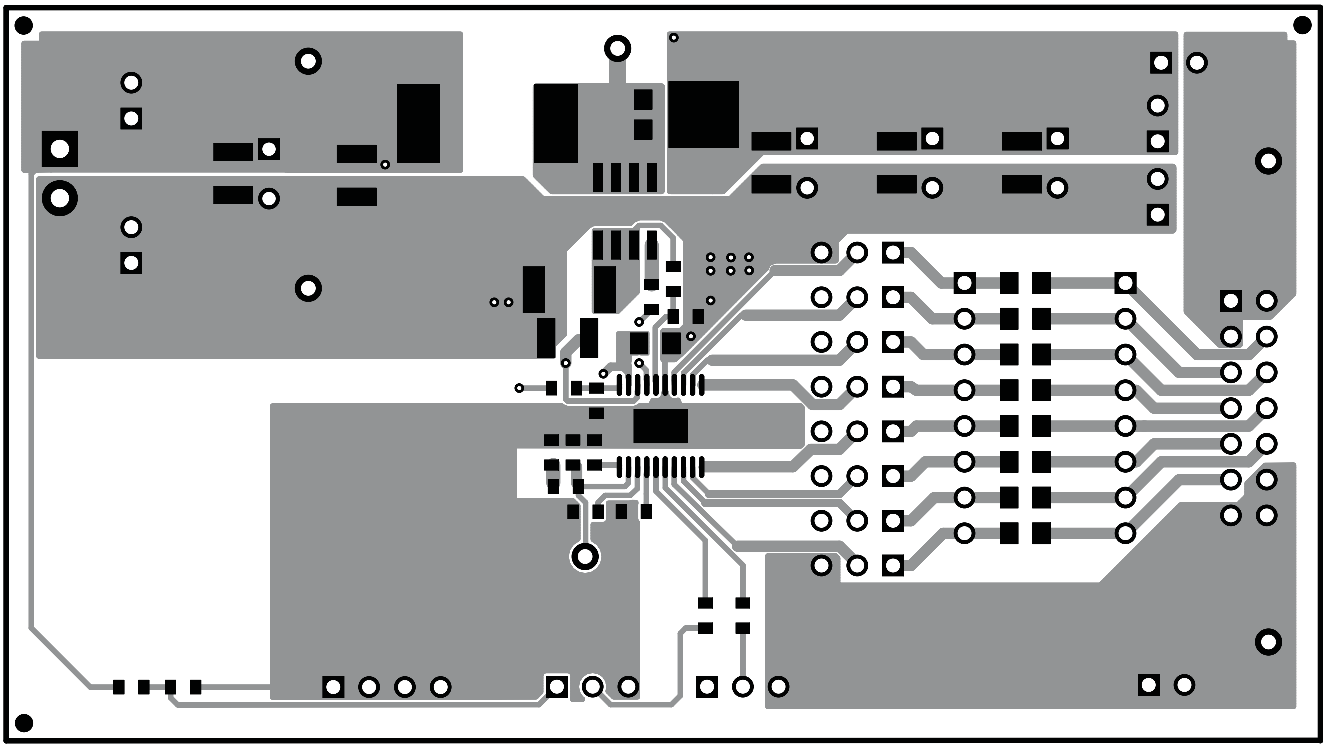


Figure 4. TPS61199EVM-598 Top Copper, Viewed From Top

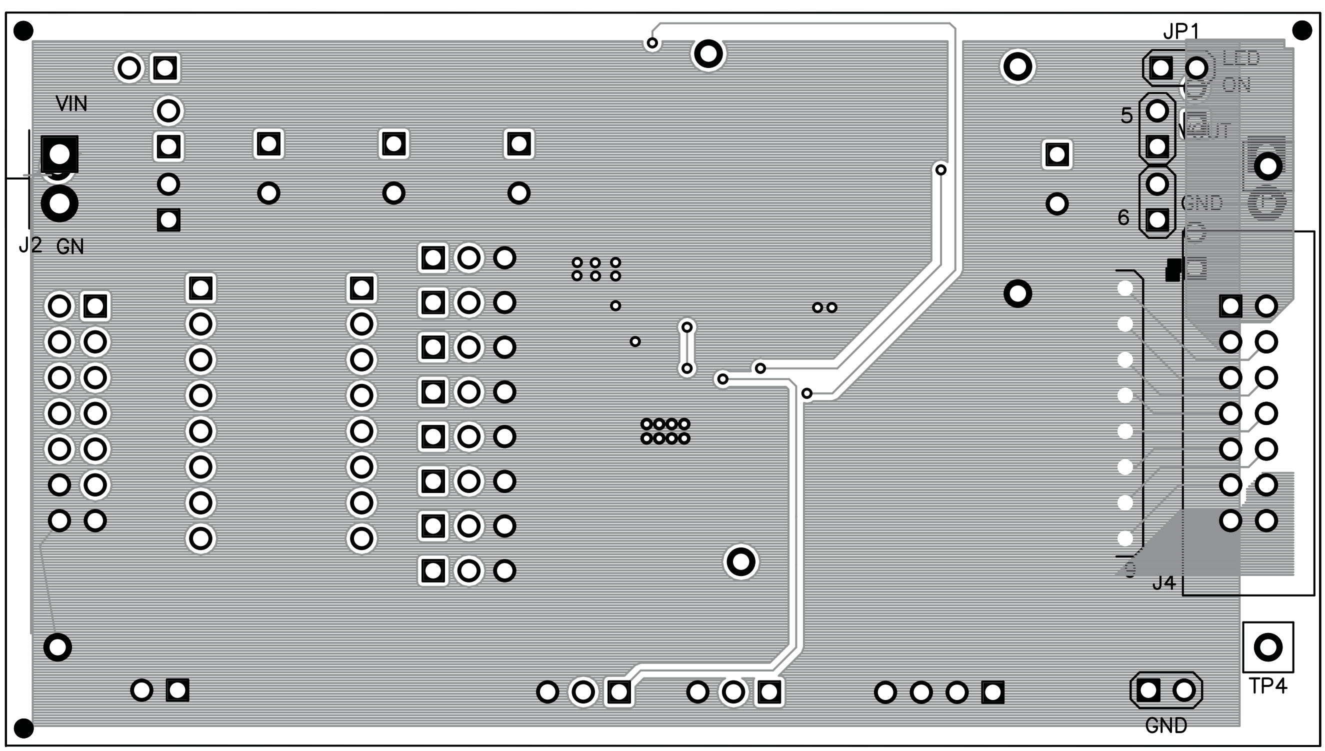


Figure 5. TPS61199EVM-598 Bottom Copper, Viewed From Bottom

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 8 V to 30 V and the output voltage range of 0 V to 100 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 150° C. The EVM is designed to operate properly with certain components above 150° 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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