TL4242EVM-543

The TL4242EVM-543 evaluation module is designed to evaluate the TL4242 integrated circuit in a typical LED application. This user's guide provides a connector and test point description, the schematic of the EVM, bill of materials, and board layout.

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1 Introduction

Texas Instruments TL4242EVM-543 evaluation module contains a TL4242 integrated circuit (IC), supporting passive components and three OSRAM LEDs in series. The purpose of this EVM is to facilitate evaluation of the TL4242 in a typical LED application.

1.1 Description

The Texas Instruments TL4242EVM-543 evaluation module (EVM) helps designers evaluate the operation and performance of the TL4242. This device is an integrated, adjustable, constant-current source, driving loads up to 500 mA. The output current can be adjusted via an external resistor. The device is designed to supply high-power LEDs under the severe conditions of automotive applications and architectural lighting.

The TL4242 IC is capable of operating at input voltages up to 42 V. Due to thermal considerations, the EVM may not allow an input voltage this high. Section 4.2 provides more details.

1.2 Applications

- Automotive applications
- Architectural lighting

1.3 Features

- Adjustable constant current up to 500 mA (±5%)
- Wide input voltage range up to 42 V
- Low drop voltage
- Open-load detection
- Overtemperature protection
- Short-circuit proof
- Reverse-polarity proof
- Wide temperature range:–40°C to 150°C
- Additional key features of the EVM (not IC features)
  - Adjustable LED current

2 TL4242EVM-543 Schematic

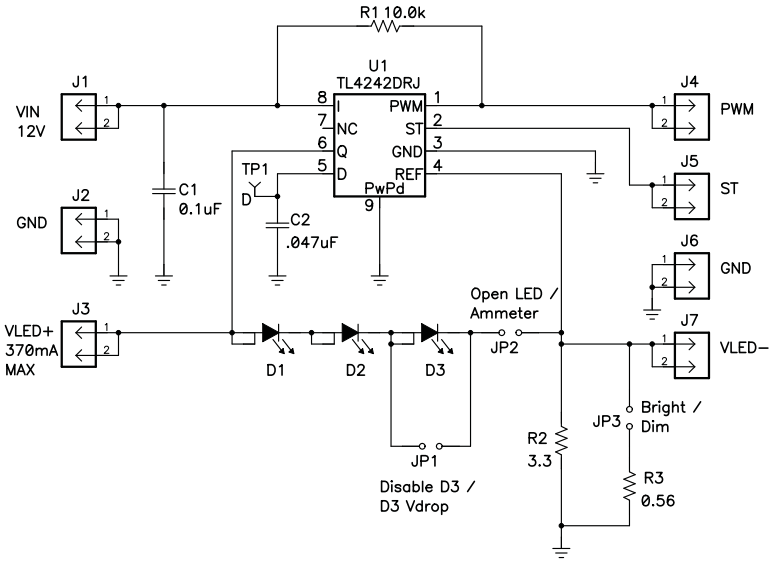

Figure 1. TL4242EVM-543 Schematic

3 Connector and Test Point Descriptions

3.1 Enable Jumpers/Switches

3.1.1 J1 – V_{IN}

This is the positive input supply voltage.

3.1.2 J2 – GND

This is the return connection to the input power supply.

3.1.3 J3 – VLED+

When using external LEDs, connect anode to VLED+.

3.1.4 J4 – PWM

This is a high-impedance input to the TL4242 IC. When this signal is logic high, the output is enabled. When this signal is logic low, the output is disabled. Leaving the pin open defaults it to logic high.

3.1.5 J5 – ST

The status output of the LED driver (ST) detects an open-load condition, enabling supervision of correct LED operation.

3.1.6 J6 – GND

This is the return connection for PWM and ST pins.

3.1.7 J7 – VLED–

When using external LEDs, connect cathode to VLED–.

3.1.8 JP1 – Disable D3

When installed, D3 is shorted, allowing the user to evaluate performance with two LEDs.

3.1.9 JP2 – Open LED

When removed, JP2 allows the user to evaluate external LEDs.

3.1.10 JP3 – Bright/Dim

This jumper switches between the bright and dim settings of the LEDs. When shorted, the bright setting is activated.

4 TL4242EVM Assembly Drawings and Layout

4.1 Board Design and Layout

The following figures (Figure 2 through Figure 4) show the design of the TL4242EVM-543 printed-circuit board (PCB). The EVM has been designed using a two-layer, 2-oz, copper-clad circuit board 2.75 in. × 3.2 in. with all components in an active area 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 TL4242 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.

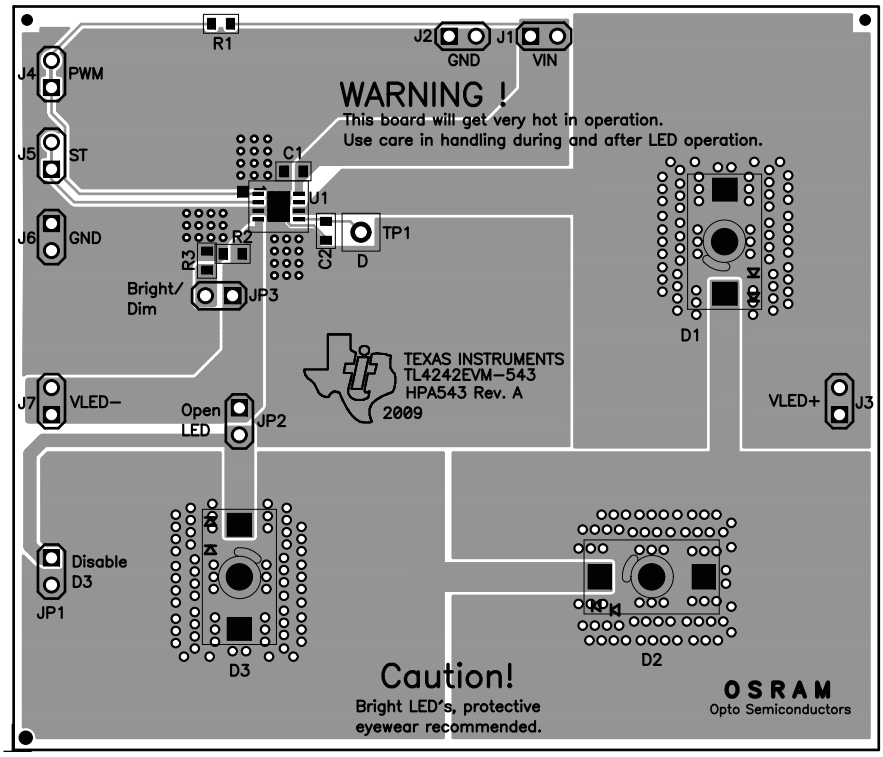

Figure 2. TL4242EVM-543 Component Placement (Viewed From Top)

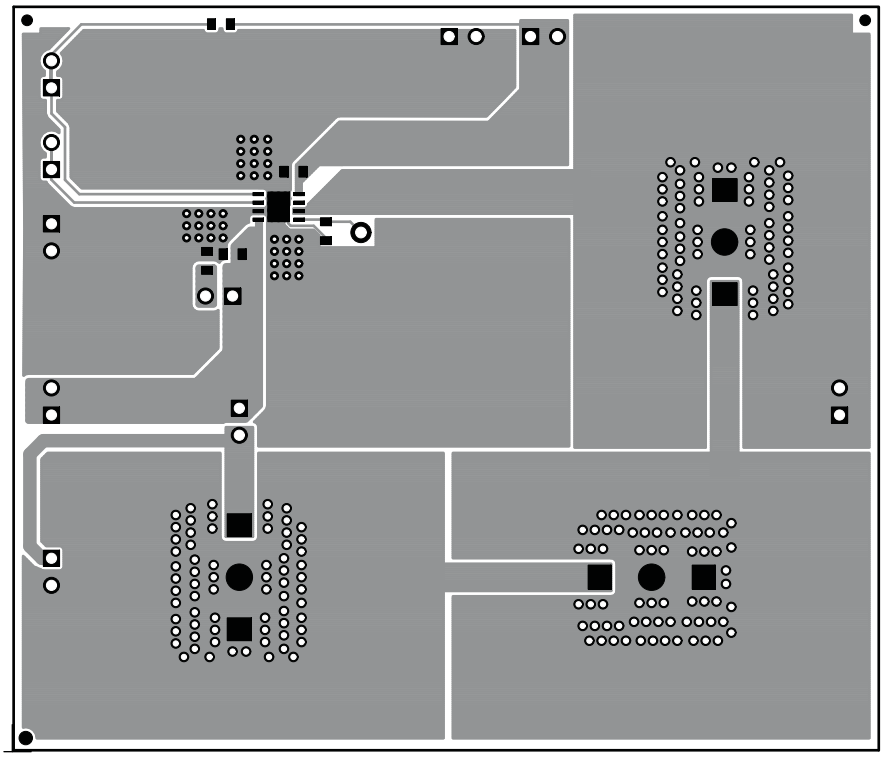

Figure 3. TL4242EVM-543 Top Copper (Viewed From Top)

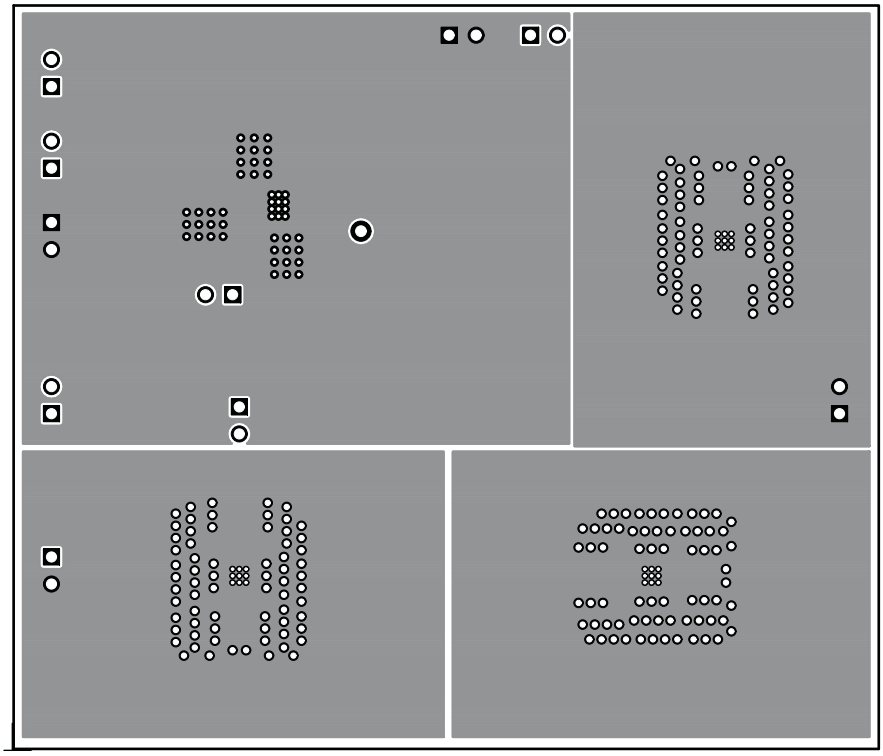

Figure 4. TL4242EVM-543 Bottom Copper (Viewed From Bottom)

4.2 Power Dissipation and Thermal Considerations

Figure 6 illustrates the thermal performance of the TL4242EVM-543 at 357-mA output current and 12-V input. Under these conditions, the maximum temperature on the EVM is 58.4°C at the IC junction. The power dissipation of the IC is described by Equation 1.

$$P_{IC} = \left[Vin - n \times V_{LED} - V_{REF}\right] \times I_{LEDs} \times D + V_{in} \times I_q \quad (1)$$

Where:

- n = Number of LEDs
- V_{LED} = Voltage drop across one LED
- V_{REF} = Reference voltage, typically 177 mV
- D = Duty cycle (0-1) of the PWM signal applied to J4
- I_q = TL4242 quiescent current

In order to manage the power dissipation, the voltage drop, ($V_{in} – n \times V_{LED} – V_{REF}$), of the IC needs to be controlled, especially at high currents. Figure 5 illustrates the maximum input voltages at various LED currents to limit the IC junction temperature to 140°C. If input voltages greater than these are desired, the customer can add external LEDs to reduce the voltage drop across the IC. Another option is to incorporate a heat-sinking mechanism to the EVM.

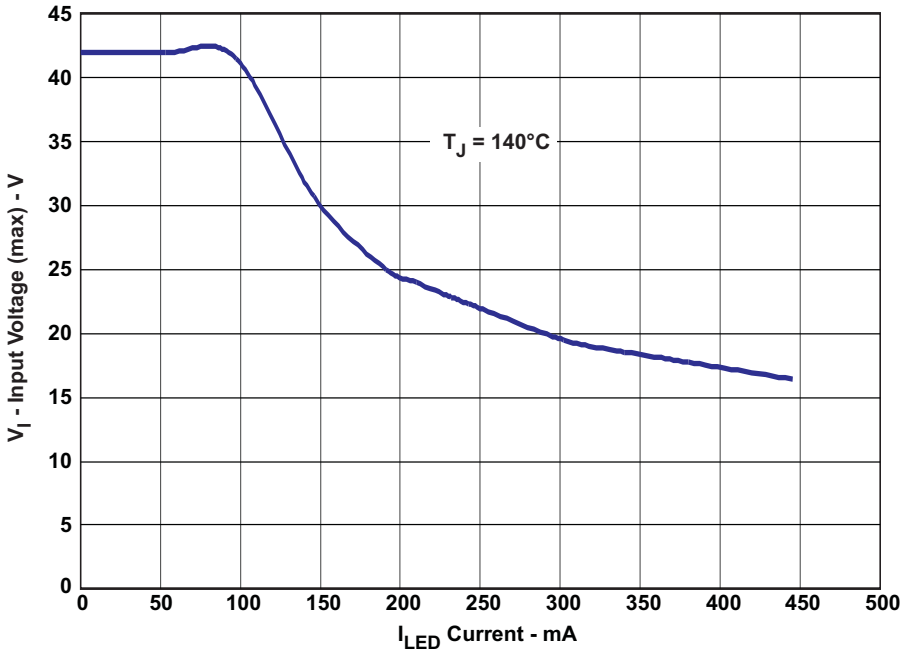

Figure 5. TL4242EVM-543 Maximum Vin vs LED Current

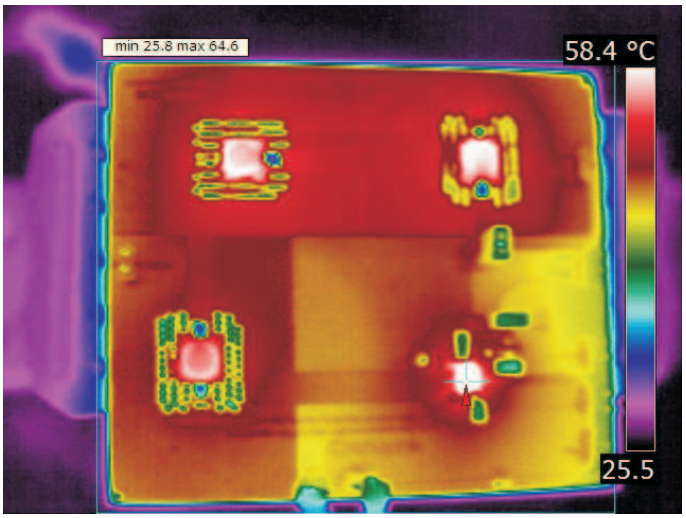

Figure 6. TL4242EVM-543 Top Infrared at V_{in} = 12 V, I_{LED} = 357 mA (Viewed From Top)

5 Bill of Materials

Table 1. Bill of Materials

Qty	Ref Des	Value	Description	Size	MFR	Part Number
1	C1	100nF	Capacitor, Ceramic, Low Inductance, 50 V, X5R, 20%	0603	Std	Std
1	C2	47nF	Capacitor, Ceramic, Low Inductance, 16 V, X5R, 10%	0603	Std	Std
3	D1, D2, D3	LW W5SM-xxxx-5K8L	Diode, LED White, 500-mA, 1x000-mcd	0.244 × 0.441 in.	Osram	LW W5SM-xxxx-5K8L
7	J1 - J7	PEC02SAAN	Header, 2 pin, 100mil spacing	0.100 in. × 2	Sullins	PEC02SAAN
3	JP1, JP2, JP3	PEC02SAAN	Header, 2 pin, 100mil spacing	0.100 in. × 2	Sullins	PEC02SAAN
1	R1	10k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	3.3	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	0.56	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TL4242DRJ	IC, Adj. LED Driver	WSON	TI	TI4242DRJ

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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. Maximum output voltage is 42 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 160°C. The EVM is designed to operate properly with certain components above 160°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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