THE DATASHEET OF

TPS92550EVM/NOPB

AN-2208 TPS92550 450mA 36V LED Driver Micro-Module Evaluation Board

1 Introduction

The TPS92550 Constant Current Buck LED Driver Micro-Module drives maximum 450mA LED current up to 10 LEDs in a single string (maximum 14W). It integrates all the power components including the power inductor. The TPS92550 provides a full turn-key , highly efficient solution for wide range of single string LED lighting applications with up to 96% power efficiency. The TPS92550 accepts an input voltage ranging from 4.5V to 36V and delivers a highly accurate 350mA LED current as default. The LED current is adjustable from 300mA to 450mA by charging a single external resistor.

The module operates at constant switching frequency (400kHz) with low Electro Magnetic Interference(EMI) complying with EN55015 standard. The module has fast control loop to realize fine LED current pulse yielding 256–step PWM dimming resolution at 240Hz for general lighting. Protection features include thermal shutdown, input under-voltage lockout, LED open-circuit and short-circuit protections. The TPS92550 Micro-Module is available in PFM 7 pin power package.

2 Board Specifications

- V_{IN} = 4.5V to 36V
- I_{LED} = 350mA (default I_{LED} setting, refer to Table 4 for other I_{LED} settings)
- I_{LED} = 300mA to 450mA
- Designed on two layers, all two layers are 2oz. copper weight.

3 Evaluation Board Design For I_{LED} Setting and EMI

The evaluation board schematic is shown as Figure 3. The default LED current is set at 350mA. By proper setting the resistor values of RIADJ and RVREF (They are not in place but solder pads are reserved), the LED current can be adjusted from 300mA to 450mA, please refer to Figure 1 and Figure 2 for their setting values. The evaluation board is tested and passes radiated emissions standards (EN55015), please refer to Figure 30, Figure 31, Figure 33, Figure 34, Figure 36, and Figure 37 for the performance.

NOTE: the COUT capacitor (2.2µF) on board is critical to suppress the Electro Magnetic Interference(EMI) for the performance as shown.

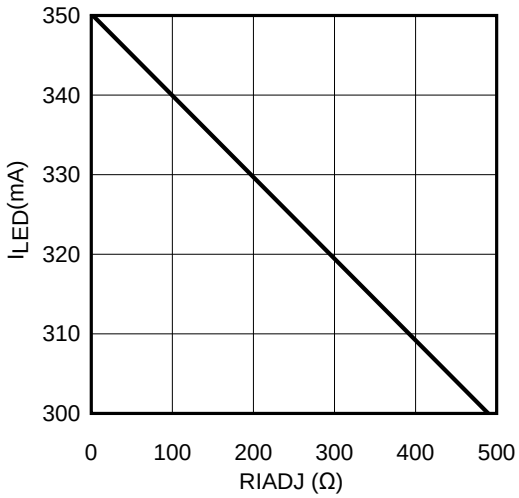

Figure 1. LED current vs. RIADJ
RVREF = open

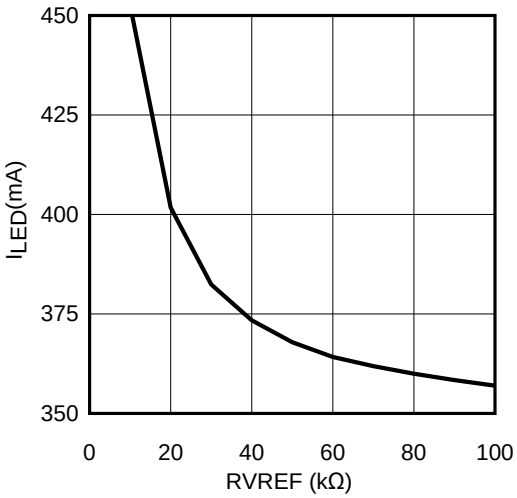

Figure 2. LED current vs. RVREF
RIADJ = 0Ω

4 Complete Circuit Schematic

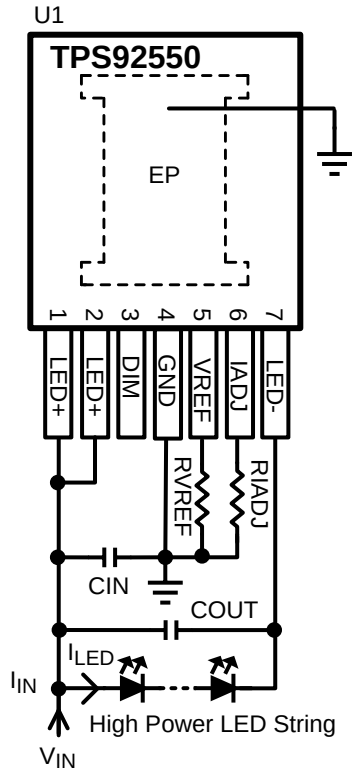

Figure 3. Complete Evaluation Board Schematic

Table 1. Bill of Materials for Evaluation Board, V_{IN} = 24V, I_{LED} = 300mA, No of LED = 2–7

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	499Ω	0603	Vishay	CRCW0603499RFKEA	1
RVREF	No connection	N/A	N/A	N/A	0

Table 2. Bill of Materials for Evaluation Board, V_{IN} = 24V, I_{LED} = 350mA, No of LED = 2–7

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	0Ω	0603	Vishay	CRCW06030000Z0EA	1
RVREF	No connection	N/A	N/A	N/A	0

Table 3. Bill of Materials for Evaluation Board, V_{IN} = 24V, I_{LED} = 450mA, No of LED = 2–7

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	0Ω	0603	Vishay	CRCW06030000Z0EA	1
RVREF	10.5kΩ	0603	Vishay	CRCW060310K5FKEA	1

Table 4. Example for I_{LED} Setting

R_{IADJ}(Ω)	R_{VREF}(Ω)	I_{LED}(mA)
499	OPEN	300
SHORT	OPEN	350
SHORT	10.5k	450

5 Connection Diagram

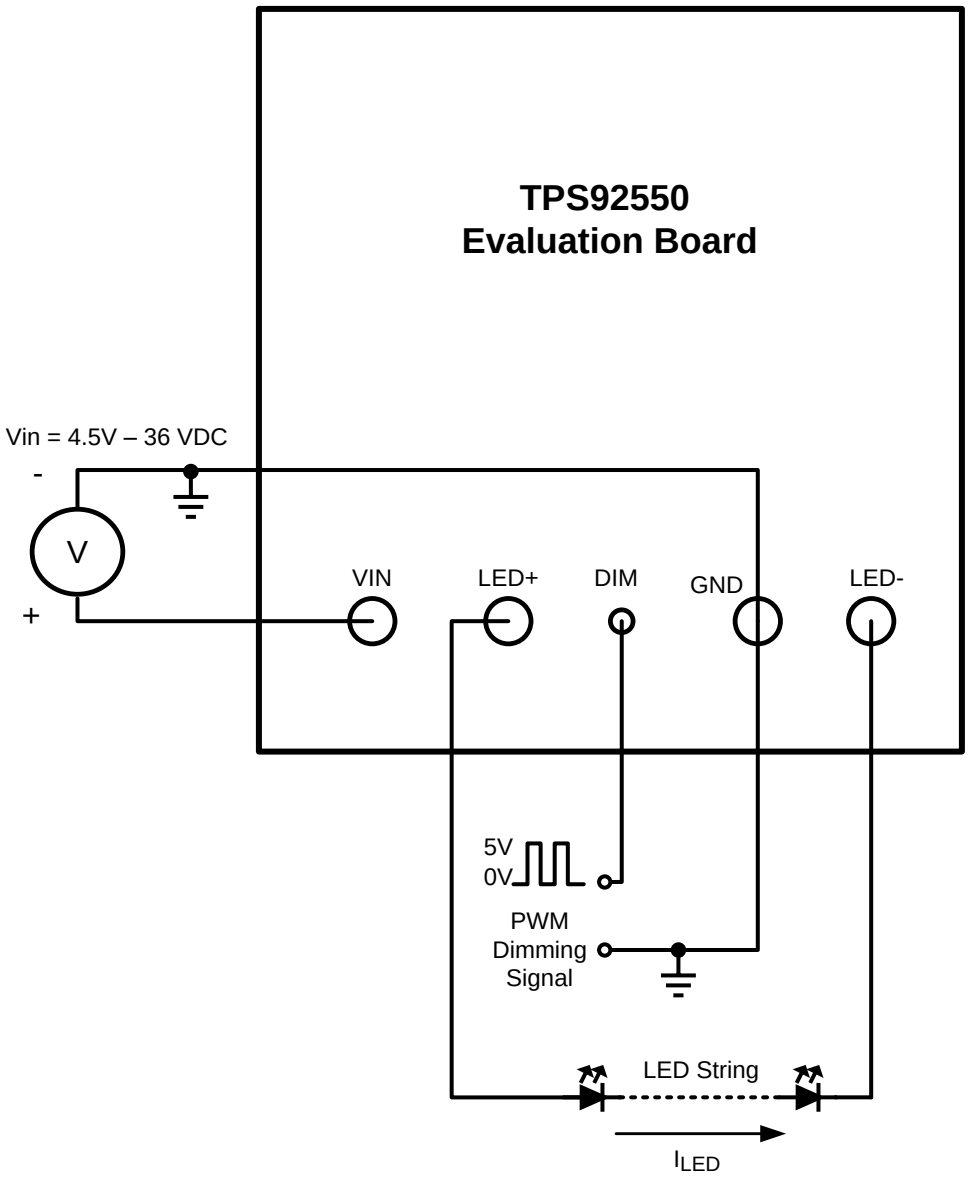

Figure 4. Connection Diagram Setup

Terminal Designation	Description
VIN	Power Supply positive(+ve) connection
GND	Power supply negative(-ve) connection
LED+	Connect to cathode of the serial LED string
LED-	Connect to anode of the serial LED string
DIM	PWM dimming signal input

6 Typical Performance Characteristics

Unless otherwise specified, the following conditions apply: V_{IN} = 24V, C_{IN} is a 2.2µF 100V X7R ceramic capacitor for driving 2–7 power LEDs with I_{LED} = 350mA. Single LED forward voltage used is 3.2V. T_A = 25°C for efficiency curves and waveforms.

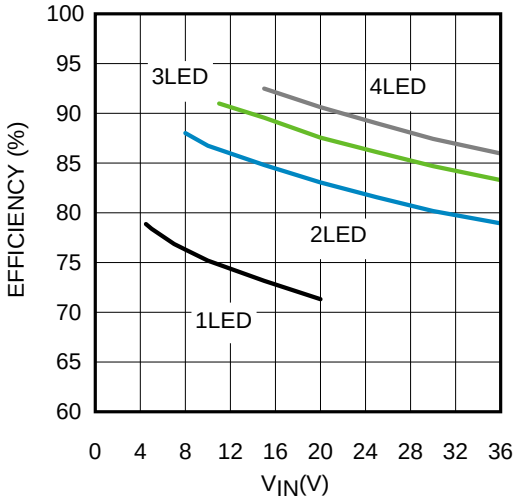

Figure 5. Efficiency vs. V_{IN}, I_{LED} = 350mA

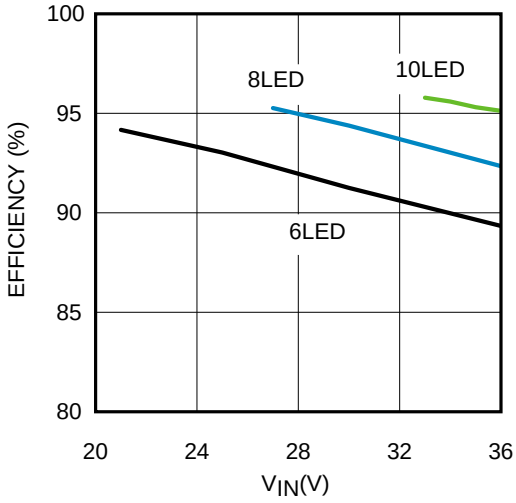

Figure 6. Efficiency vs. V_{IN}, I_{LED} = 350mA

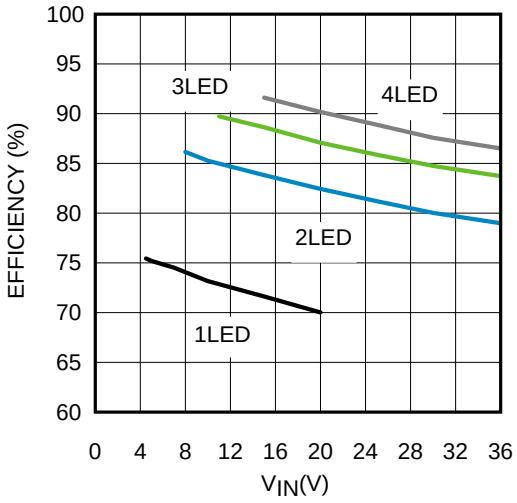

Figure 7. Efficiency vs. V_{IN}, I_{LED} = 450mA

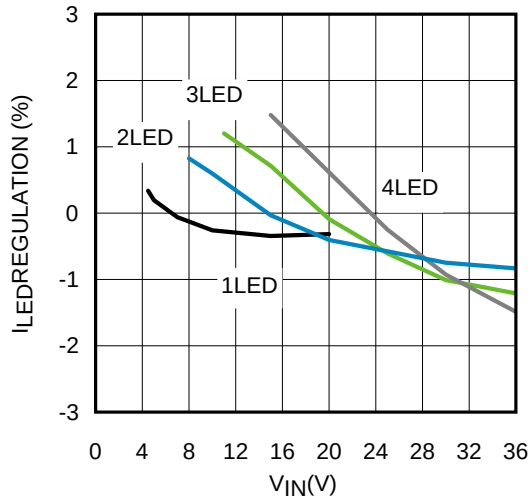

Figure 8. I_{LED} Regulation vs. V_{IN}, I_{LED} = 350mA

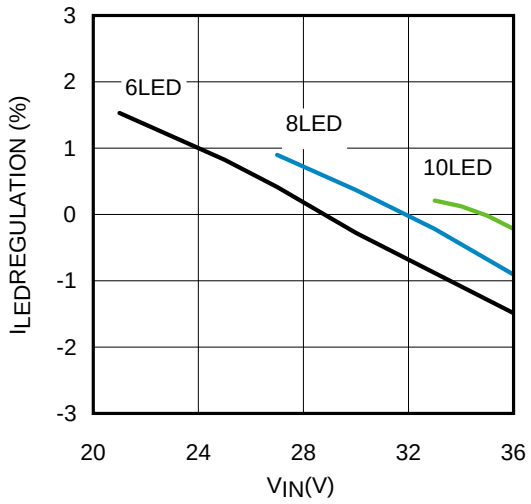

Figure 9. I_{LED} Regulation vs. V_{IN}, I_{LED} = 350mA

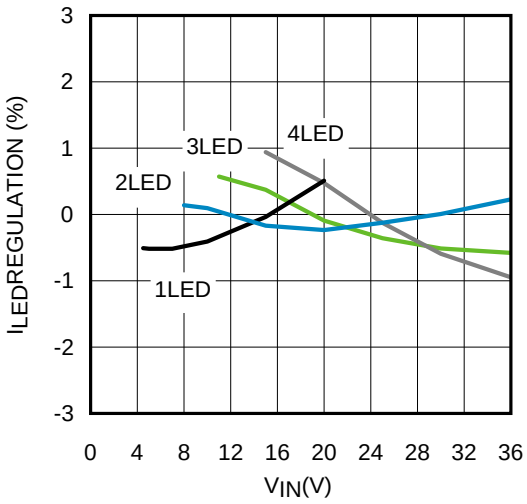

Figure 10. I_{LED} Regulation vs. V_{IN}, I_{LED} = 450mA

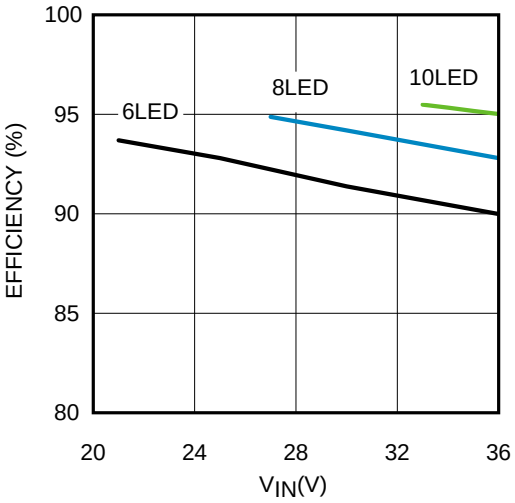

Figure 11. Efficiency vs. V_{IN}, I_{LED} = 450mA

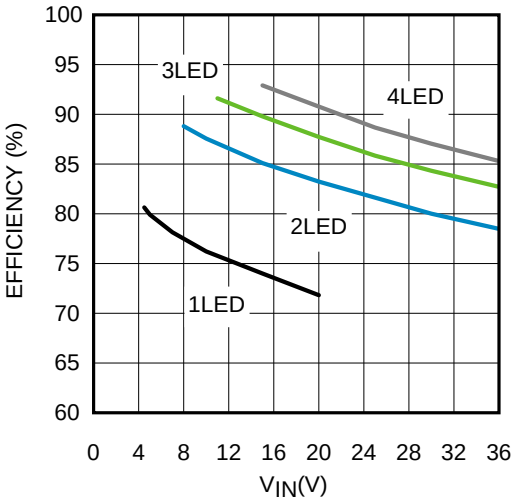

Figure 12. Efficiency vs. V_{IN}, I_{LED} = 300mA

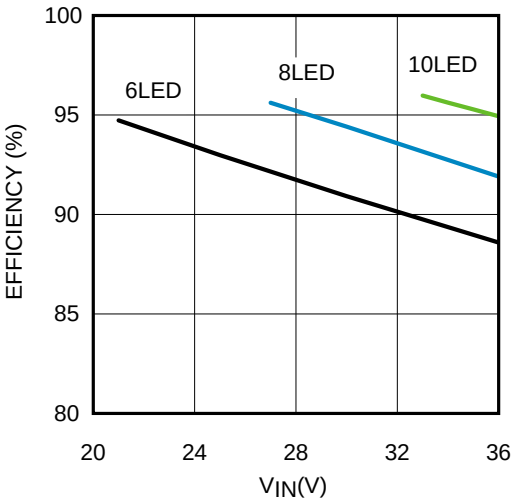

Figure 13. Efficiency vs. V_{IN}, I_{LED} = 300mA

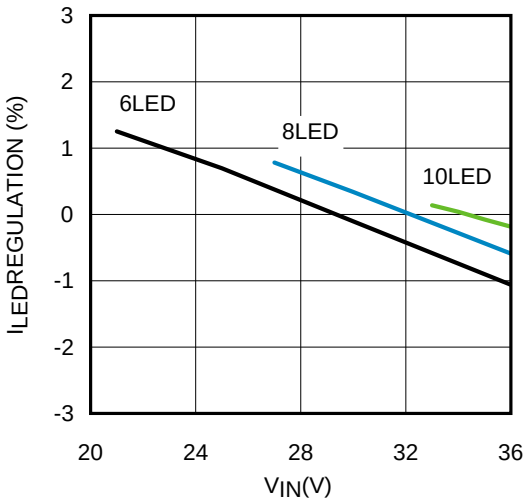

Figure 14. I_{LED} Regulation vs. V_{IN}, I_{LED} = 450mA

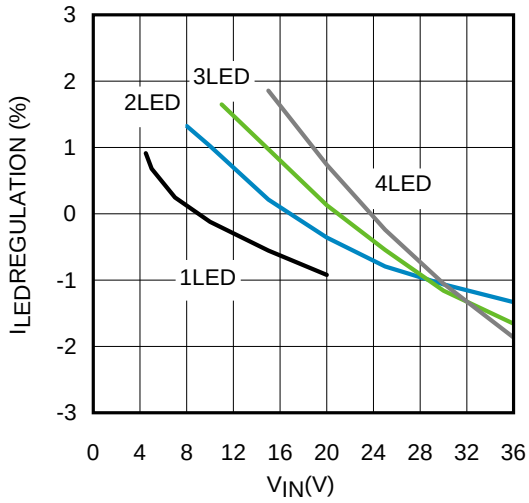

Figure 15. I_{LED} Regulation vs. V_{IN}, I_{LED} = 300mA

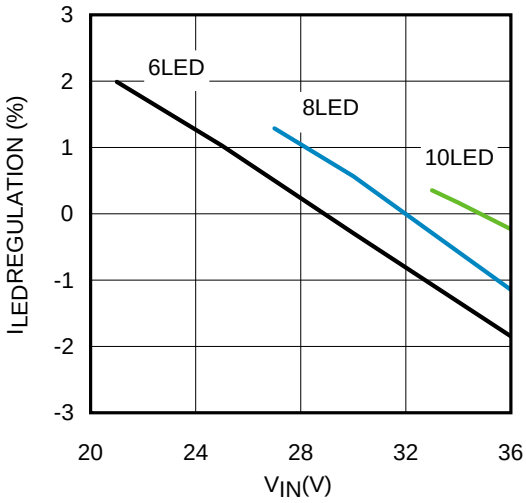

Figure 16. I_{LED} Regulation vs. V_{IN}, I_{LED} = 300mA

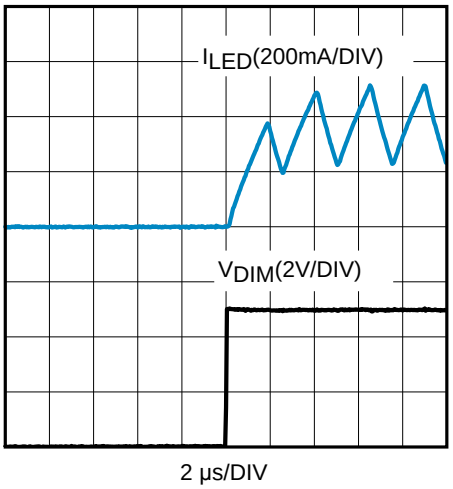

Figure 17. LED Current with PWM Dimming V_{DIM} Rising (without COUT capacitor)

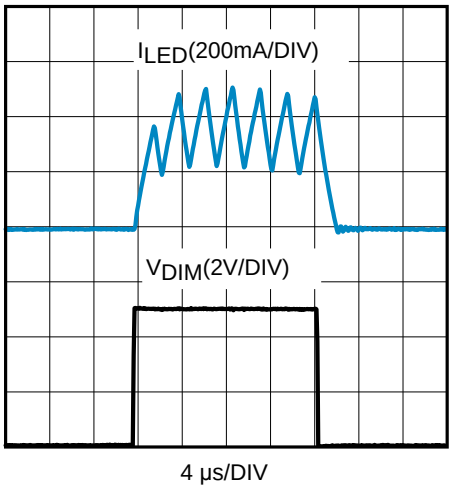

Figure 18. LED Current with PWM Dimming 16µs dimming pulse (without COUT capacitor)

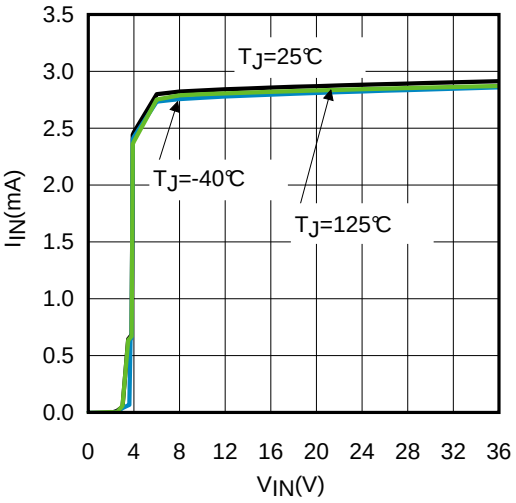

Figure 19. I_{IN} vs. V_{IN} LED = open , DIM = open

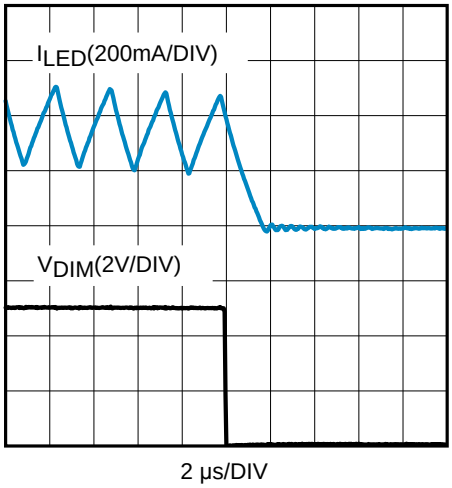

Figure 20. LED Current with PWM Dimming V_{DIM} Falling (without COUT capacitor)

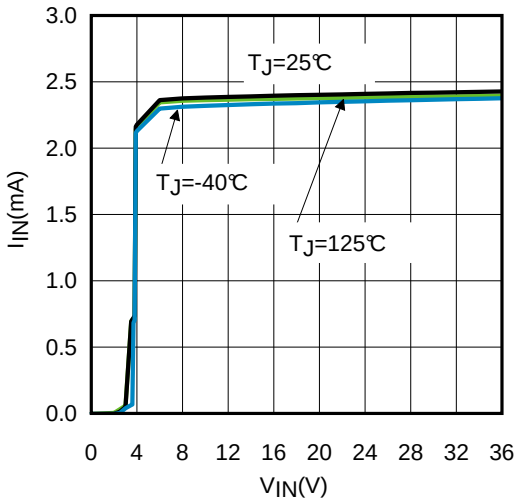

Figure 21. I_{IN} vs. V_{IN}
V_{DIM} = 0V

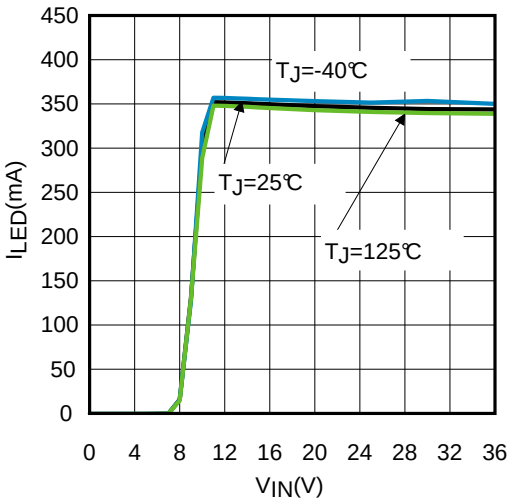

Figure 22. I_{LED} vs. V_{IN}
3LED

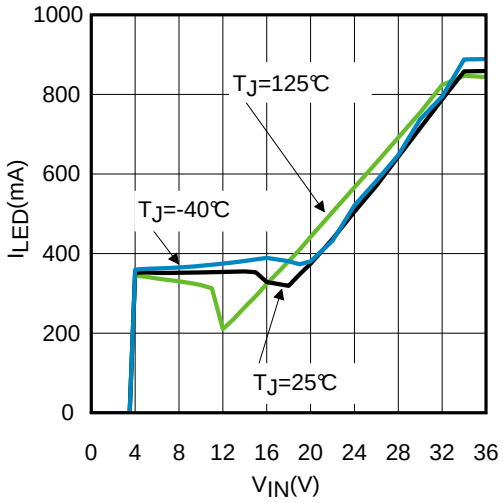

Figure 23. I_{LED} vs. V_{IN}
V_{LED} = 0V, DIM = open

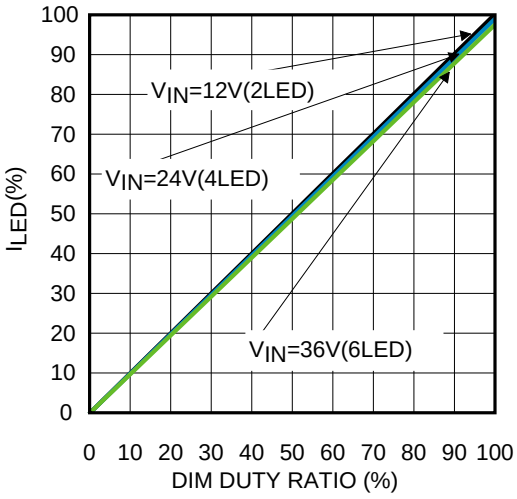

Figure 24. I_{LED} vs. Dimming Duty Ratio

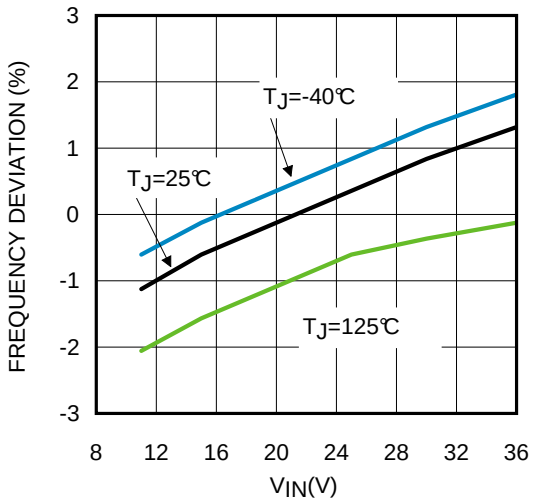

Figure 25. Frequency Deviation vs. V_{IN} 400kHz

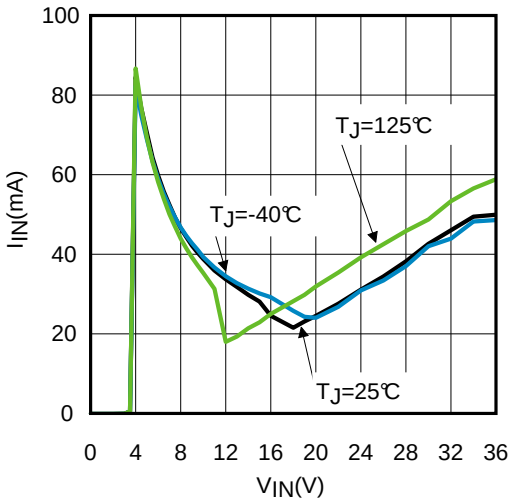

Figure 26. I_{IN} vs. V_{IN} V_{LED} = 0V, DIM = open

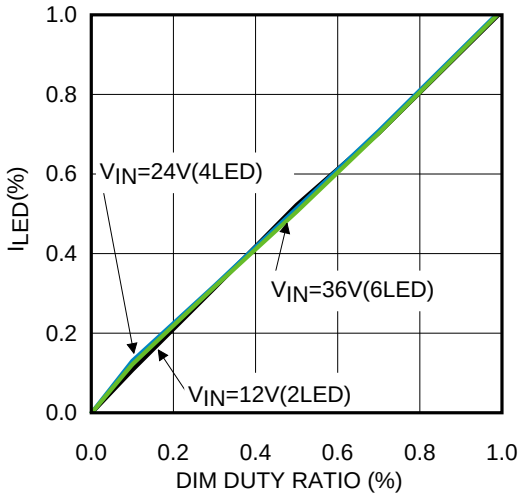

Figure 27. I_{LED} vs. Dimming Duty Ratio

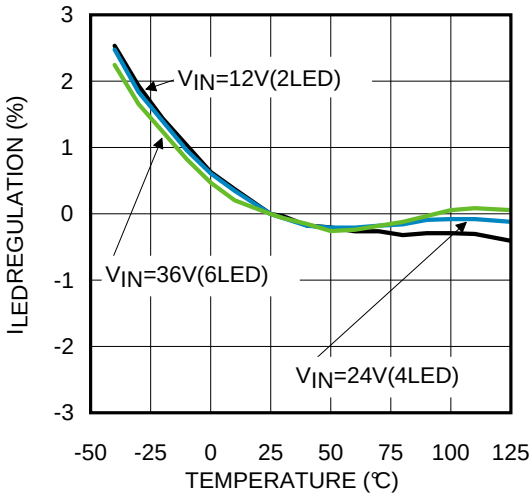

Figure 28. I_{LED} Regulation vs. Temperature

7 Circuit Example 1: Complies with EN55015 Radiated Emissions

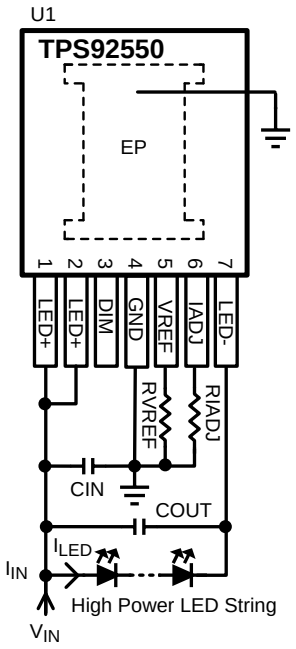

Figure 29. Component Schematic, V_{IN} = 36V, I_{LED} = 300mA , No. of LED = 10, Complies with EN55015 Radiated Emissions

Table 5. Bill of Materials

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	499Ω	0603	Vishay	CRCW0603499RFKEA	1
RVREF	No connection	N/A	N/A	N/A	0

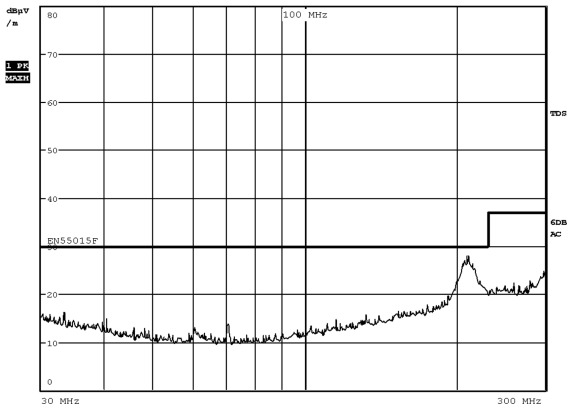

Figure 30. Complies with EN55015 Radiated Emissions
(HORI. / HEIGHT=3.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 300mA , No. of LED = 10
Tested on TPS92550 Evaluation Board

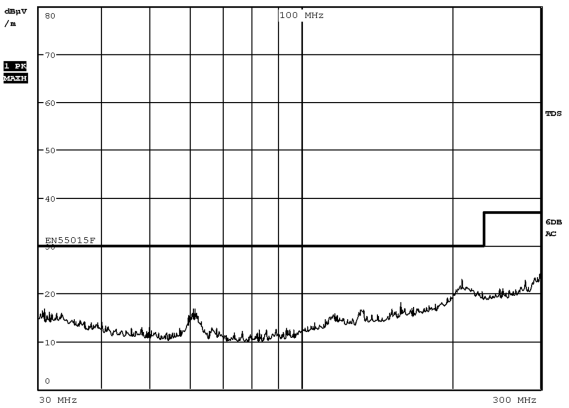

Figure 31. Complies with EN55015 Radiated Emissions
(VERT. / HEIGHT=1.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 300mA, No. of LED = 10
Tested on TPS92550 Evaluation Board

8 Circuit Example 2: Complies with EN55015 Radiated Emissions

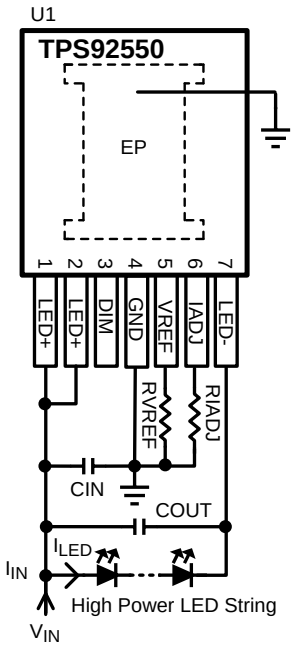

Figure 32. Component Schematic, V_{IN} = 36V, I_{LED} = 350mA , No. of LED = 10, Complies with EN55015 Radiated Emissions

Table 6. Bill of Materials

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	0Ω	0603	Vishay	CRCW06030000Z0EA	1
RVREF	No connection	N/A	N/A	N/A	0

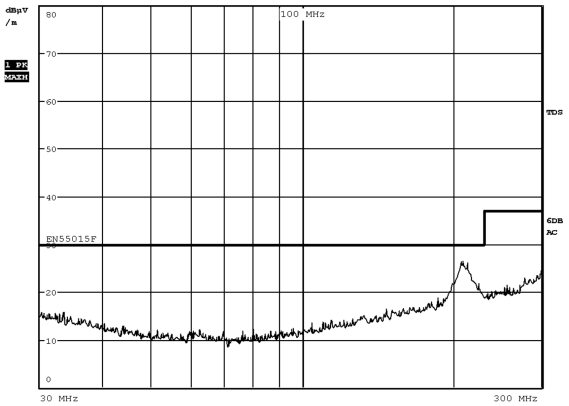

Figure 33. Complies with EN55015 Radiated Emissions
(HORI. / HEIGHT=3.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 350mA , No. of LED = 10
Tested on TPS92550 Evaluation Board

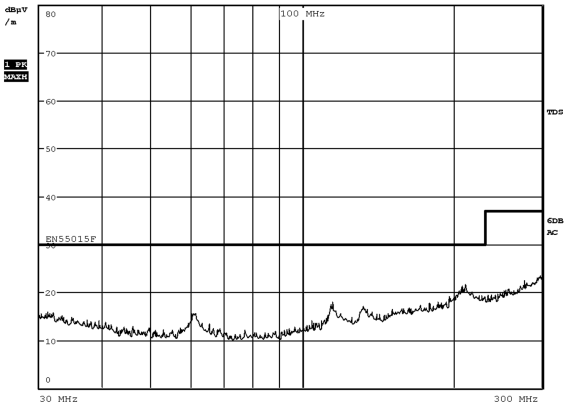

Figure 34. Complies with EN55015 Radiated Emissions
(VERT. / HEIGHT=1.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 350mA, No. of LED = 10
Tested on TPS92550 Evaluation Board

9 Circuit Example 3: Complies with EN55015 Radiated Emissions

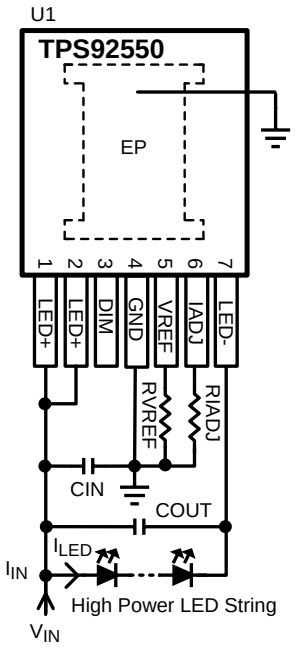

Figure 35. Component Schematic, V_{IN} = 36V, I_{LED} = 450mA , No. of LED = 10, Complies with EN55015 Radiated Emissions

Table 7. Bill of Materials

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	LED Micro-Module Driver	PFM-7	Texas Instruments	TPS92550	1
CIN	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
COUT	2.2 µF, X7R, 100V	1210	Murata	GRM32ER72A225KA35L	1
RIADJ	0Ω	0603	Vishay	CRCW06030000Z0EA	1
RVREF	10.5kΩ	0603	Vishay	CRCW060310K5FKEA	1

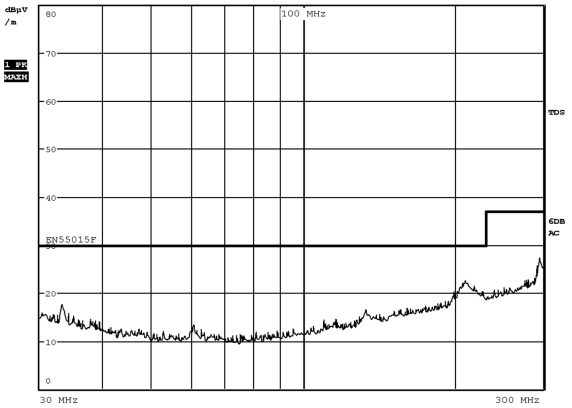

Figure 36. Complies with EN55015 Radiated Emissions
(HORI. / HEIGHT=3.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 450mA , No. of LED = 10
Tested on TPS92550 Evaluation Board

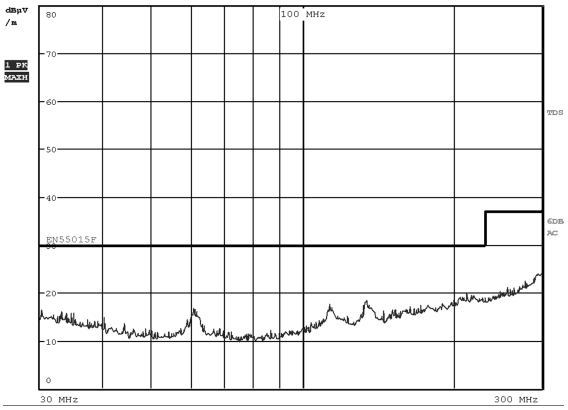

Figure 37. Complies with EN55015 Radiated Emissions
(VERT. / HEIGHT=1.0m / RANGE=10m)
V_{IN} = 36V, I_{LED} = 450mA, No. of LED = 10
Tested on TPS92550 Evaluation Board

10 PCB Layout Diagram

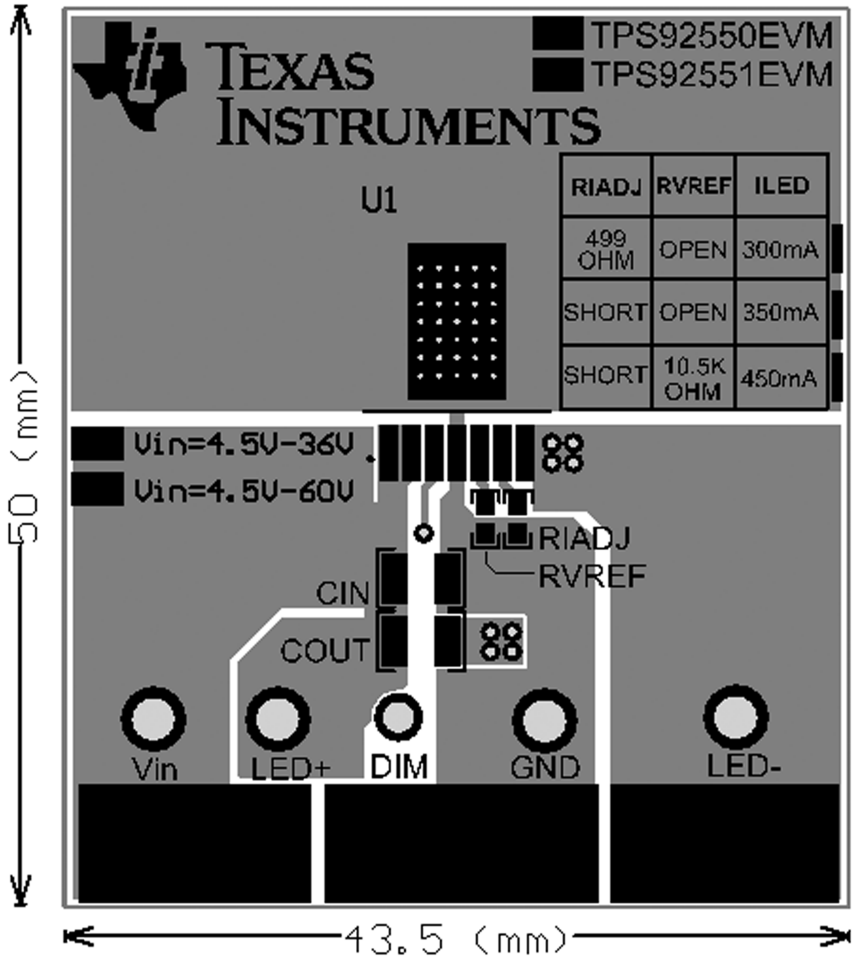

Figure 38. Top Layer and Top Overlay

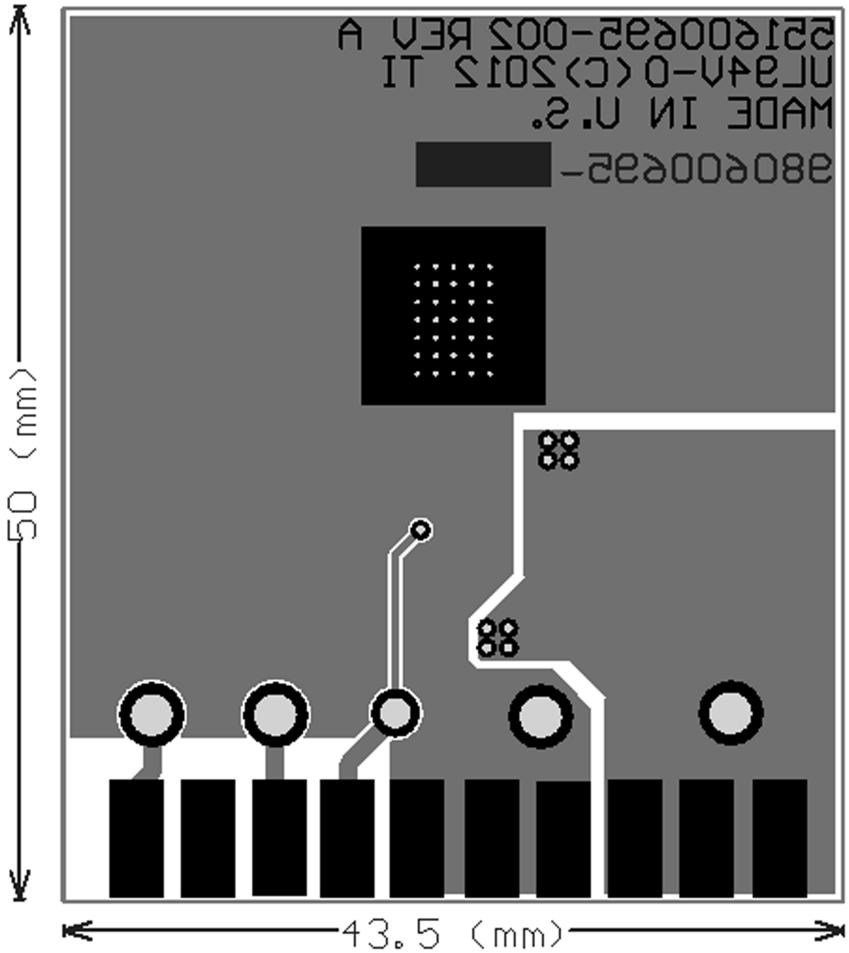

Figure 39. Bottom Layer and Bottom Overlay

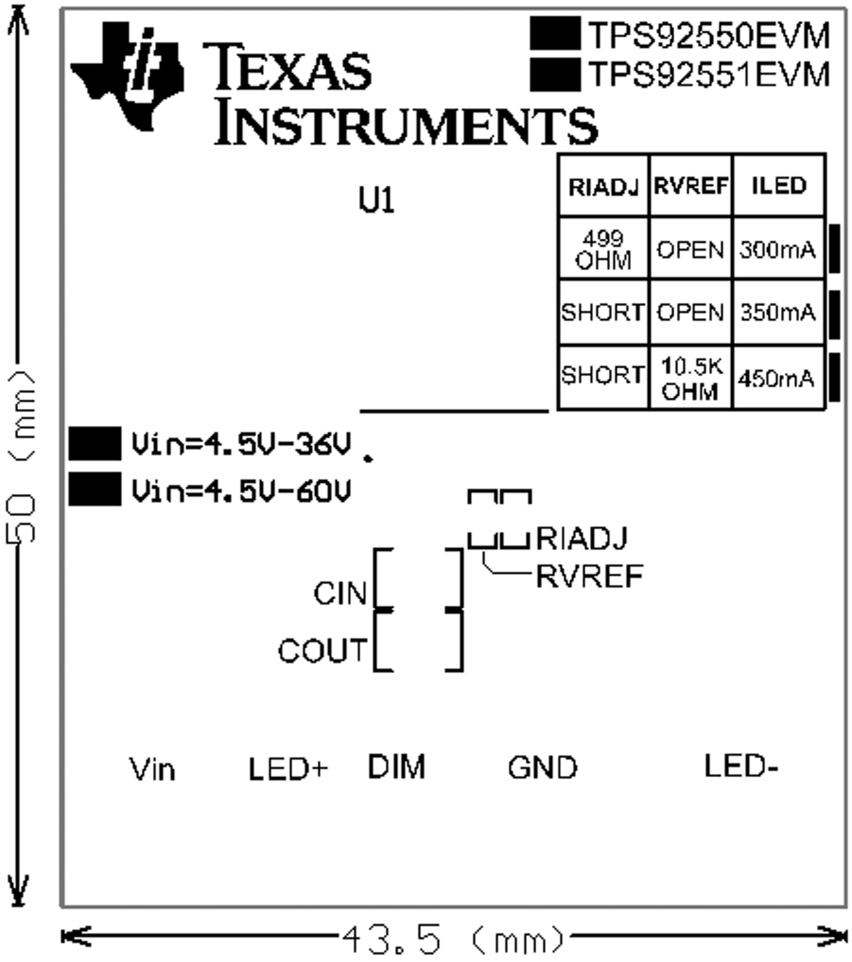

Figure 40. Top Overlay

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