

# TPS92612 40-V, 150-mA Single-Channel Linear LED Driver and Constant-Current Source With Protection

## 1 Features

- Single-channel high-precision current source:
  - $\pm 4.6\%$  Current accuracy from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
  - Current adjustable by external sense resistor
  - Up to 150 mA maximum current
- Wide input-voltage range: 4.5 V – 40 V
- Brightness control by input PWM duty cycle
- Low dropout voltage (current-sense voltage drop included)
  - Maximum dropout: 150 mV at 10 mA
  - Maximum dropout: 400 mV at 70 mA
  - Maximum dropout: 700 mV at 150 mA
- Low quiescent current: typical 200  $\mu\text{A}$
- Protection:
  - LED short-circuit protection with auto-recovery
  - Thermal shutdown
- Support heat sharing with external resistor
- Operating junction temperature range:  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$

## 2 Applications

- LED driver, constant current source, or current limiter for:
  - Washer and dryer
  - Refrigerator and freezer
  - Gas detector
  - Factory automation and control
  - Building automation
  - Medical

## 3 Description

With LEDs being widely used as a light source, simple LED drivers are more and more popular. Compared to discrete solutions, a low-cost monolithic solution lowers system-level component counts and significantly improves current accuracy and reliability.

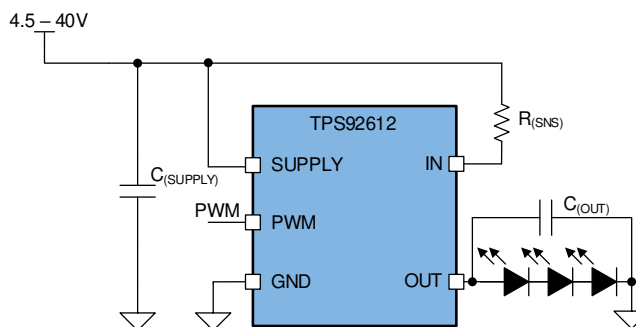
The TPS92612 device is a single-channel high-side linear LED driver operating from a wide range supply. It is a simple, yet elegant solution to deliver constant current for a single LED string. It can support off-board LED connection with long cables. The TPS92612 device can also be used as a general constant current source or current limiter in other applications.

### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS92612	SOT-23 (5)	2.9 mm × 1.6 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Typical Application Diagram



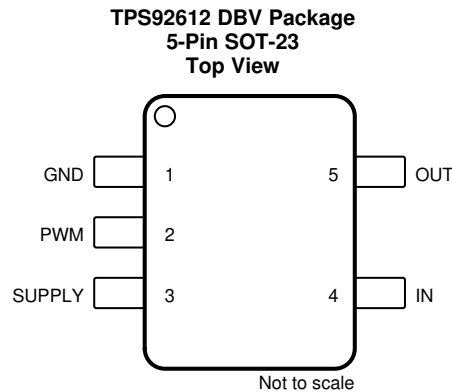
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## 4 Revision History

DATE	REVISION	NOTES
April 2020	*	Initial release.

## 5 Pin Configuration and Functions



### Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO. TPS92612		
GND	1	—	Ground
IN	4	I	Current input
OUT	5	O	Constant-current output
PWM	2	I	PWM input
SUPPLY	3	I	Device supply voltage

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating ambient temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
High-voltage input	IN, PWM, SUPPLY	-0.3	45	V
High-voltage output	OUT	-0.3	45	V
IN to OUT	$V_{(IN)} - V_{(OUT)}$	-0.3	45	V
SUPPLY to IN	$V_{(SUPPLY)} - V_{(IN)}$	-0.3	1	V
Operating junction temperature, $T_J$		-40	150	°C
Storage temperature, $T_{stg}$		-40	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	All pins	±2000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	All pins	±500
			Corner pins (3, 4, and 5)	±750

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.  
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating ambient temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
SUPPLY	Device supply voltage	4.5		40	V
IN	Sense voltage	4.4		40	V
PWM	PWM inputs	0		40	V
OUT	Driver output	0		40	V
Operating ambient temperature, $T_A$		-40		125	°C

### 6.4 Thermal Information

THERMAL METRIC		TPS92612			UNIT
		DBV (SOT23)			
		5 PINS			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	200.7			°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	104.4			°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	45.6			°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	17.5			°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	45.2			°C/W

### 6.5 Electrical Characteristics

 $V_{(SUPPLY)} = 5\text{ V to }40\text{ V}$ ,  $T_J = -40^\circ\text{C to }+150^\circ\text{C}$  unless otherwise noted

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
<b>BIAS</b>							
$V_{(POR\_rising)}$	Supply voltage POR rising threshold				3.2	4	V
$V_{(POR\_falling)}$	Supply voltage POR falling threshold			2.2	3		V
$I_{(Quiescent)}$	Device standby current	PWM = HIGH		0.1	0.2	0.25	mA
<b>LOGIC INPUTS (PWM)</b>							
$V_{IL(PWM)}$	Input logic-low voltage, PWM			1.045	1.1	1.155	V
$V_{IH(PWM)}$	Input logic-high voltage, PWM			1.16	1.2	1.24	V
<b>CONSTANT-CURRENT DRIVER</b>							
$I_{(OUT)}$	Device output-current range	100% duty cycle		4		150	mA
$V_{(CS\_REG)}$	Sense-resistor regulation voltage	$T_A = 25^\circ\text{C}$ , $V_{(SUPPLY)} = 4.5\text{ V to }18\text{ V}$		94	98	102	mV
		$T_A = -40^\circ\text{C to }+125^\circ\text{C}$ , $V_{(SUPPLY)} = 4.5\text{ V to }18\text{ V}$		93.5	98	102.5	
$R_{(CS\_REG)}$	Sense-resistor value			0.66		24.5	$\Omega$
$V_{(DROPOUT)}$	Voltage dropout from SUPPLY to OUT	$V_{(CS\_REG)}$ voltage included, current setting of 10 mA			120	150	mV
		$V_{(CS\_REG)}$ voltage included, current setting of 70 mA			250	400	
		$V_{(CS\_REG)}$ voltage included, current setting of 150 mA			430	700	
<b>DIAGNOSTICS</b>							
$V_{(SG\_th\_rising)}$	Channel output $V_{(OUT)}$ short-to-ground rising threshold			1.14	1.2	1.26	V
$V_{(SG\_th\_falling)}$	Channel output $V_{(OUT)}$ short-to-ground falling threshold			0.82	0.865	0.91	V
$I_{(Retry)}$	Channel output $V_{(OUT)}$ short-to-ground retry current			0.64	1.08	1.528	mA
<b>THERMAL PROTECTION</b>							
$T_{(TSD)}$	Thermal shutdown junction temperature threshold			157	172	187	°C
$T_{(TSD\_HYS)}$	Thermal shutdown junction temperature hysteresis				15		°C

### 6.6 Timing Requirements

		MIN	NOM	MAX	UNIT
$t_{(PWM\_delay\_rising)}$	PWM rising edge delay, 50% PWM voltage to 10% of output current closed loop, $t_2 - t_1$ as shown in <a href="#">Figure 1</a>	10	17	25	$\mu\text{s}$

Timing Requirements (continued)

		MIN	NOM	MAX	UNIT
$t_{(PWM\_delay\_falling)}$	PWM falling edge delay, 50% PWM voltage to 90% of output current open loop, $t_5 - t_4$ as shown in Figure 1	15	21	30	$\mu s$
$t_{(DEVICE\_STARTUP)}$	SUPPLY rising edge to 10% output current at 50-mA set current, $t_8 - t_7$ as shown in Figure 1		100	150	$\mu s$
$t_{(SG\_deg)}$	Output short-to-ground detection deglitch time	80	125	175	$\mu s$
$t_{(TSD\_deg)}$	Thermal over temperature deglitch timer		50		$\mu s$
$t_{(Recover\_deg)}$	Fault recovery deglitch timer	8.5	16	25	$\mu s$

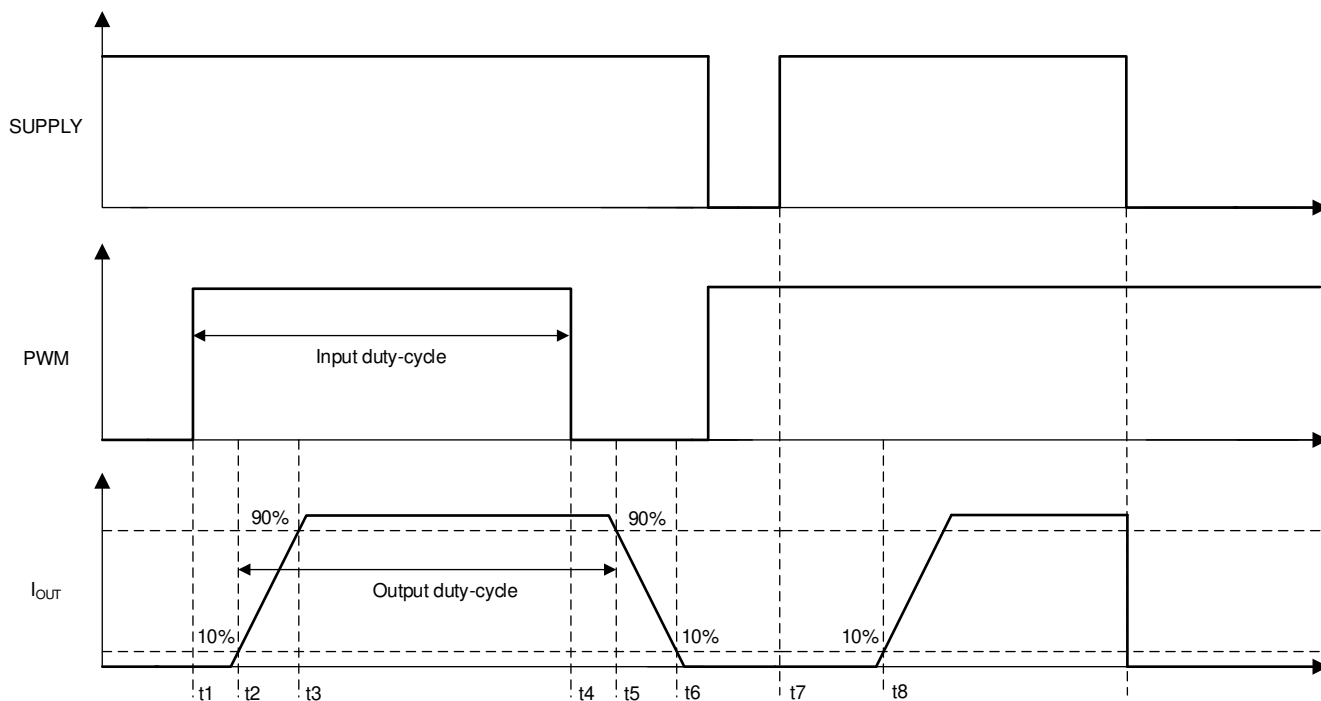


Figure 1. Output Timing Diagram

6.7 Typical Characteristics

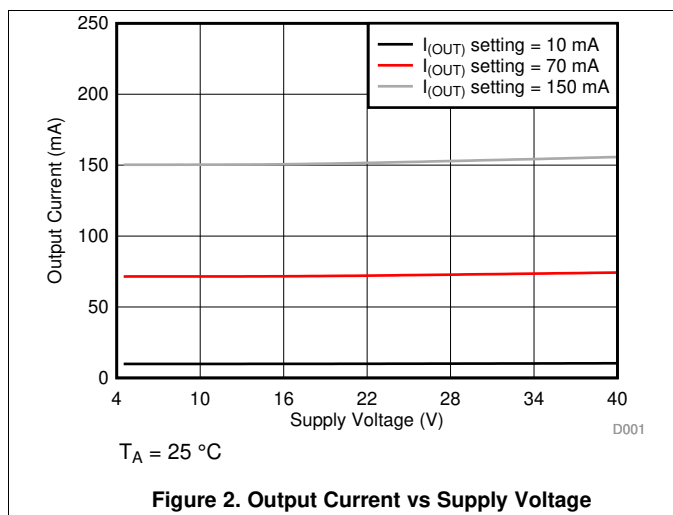


Figure 2. Output Current vs Supply Voltage

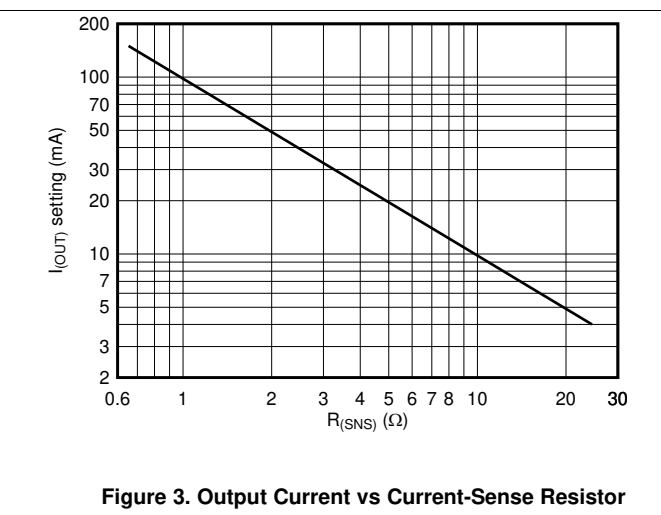


Figure 3. Output Current vs Current-Sense Resistor

Typical Characteristics (continued)

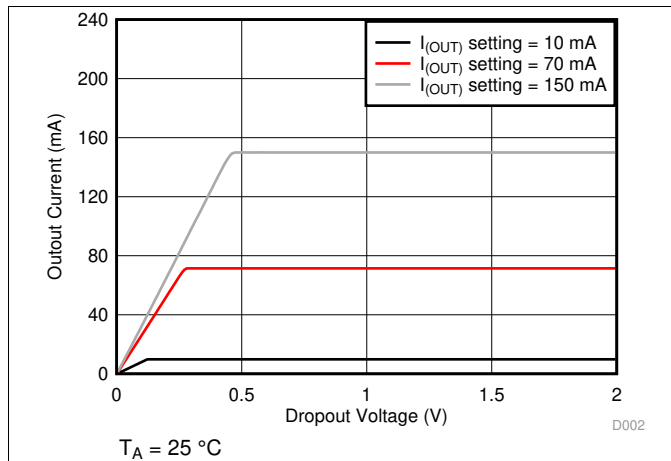


Figure 4. Output Current vs Dropout Voltage

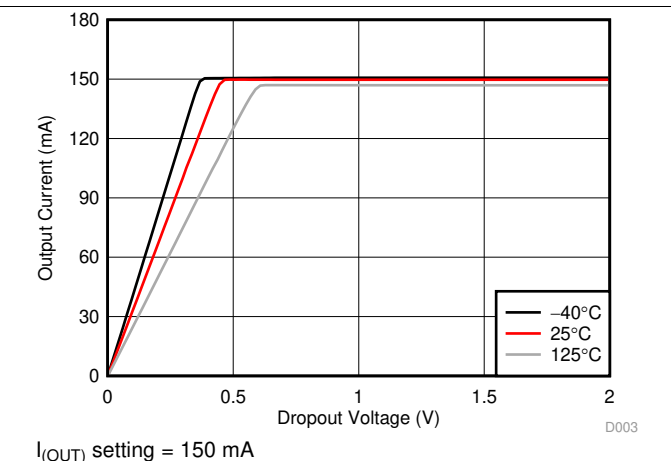


Figure 5. Output Current vs Dropout Voltage

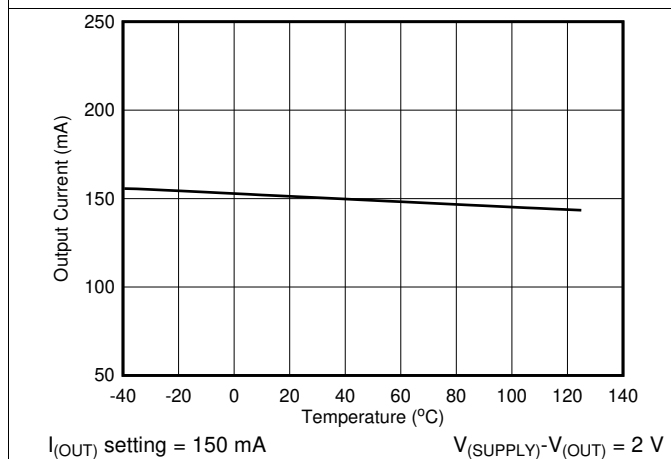


Figure 6. Output Current vs Temperature

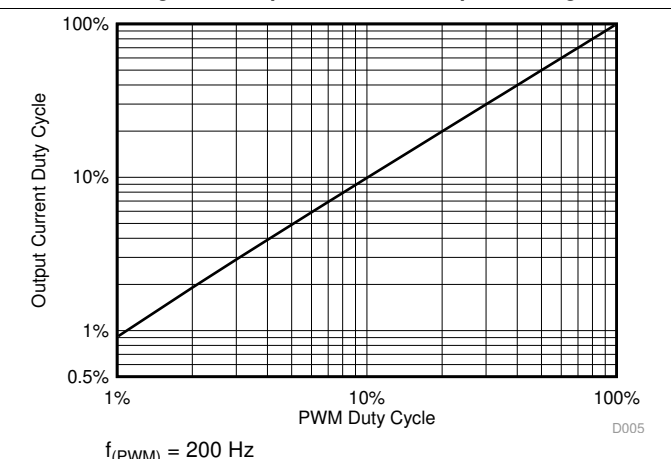


Figure 7. PWM Output Duty Cycle vs Input Duty Cycle

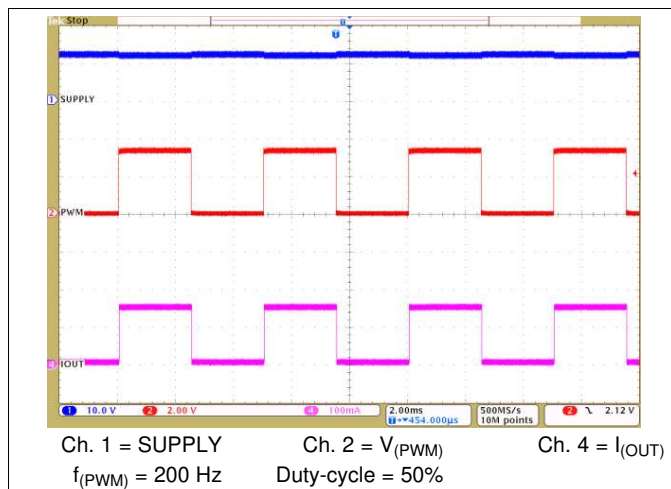


Figure 8. PWM Dimming at 200 Hz

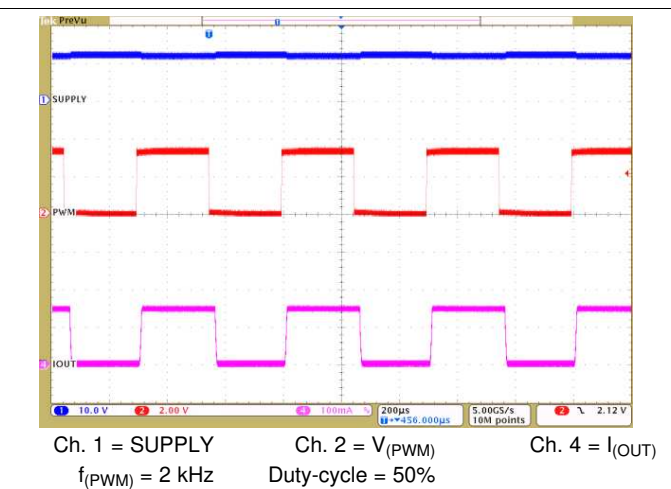
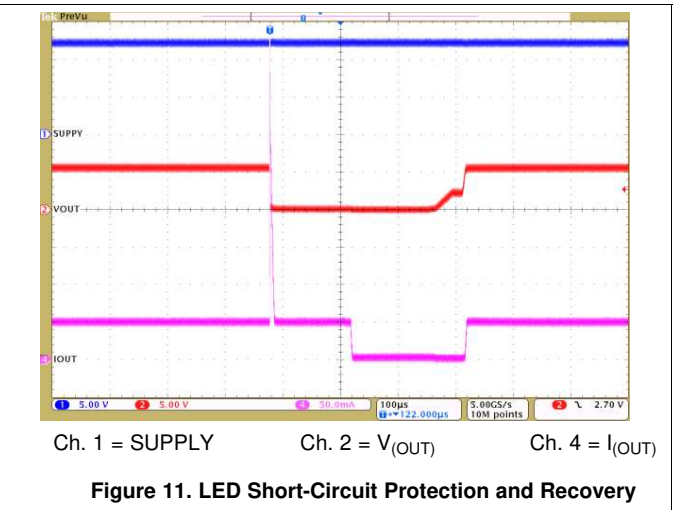
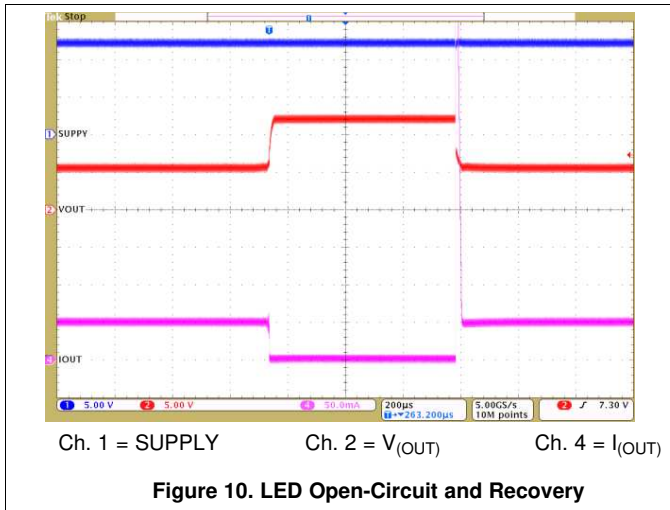


Figure 9. PWM Dimming at 2 kHz

Typical Characteristics (continued)



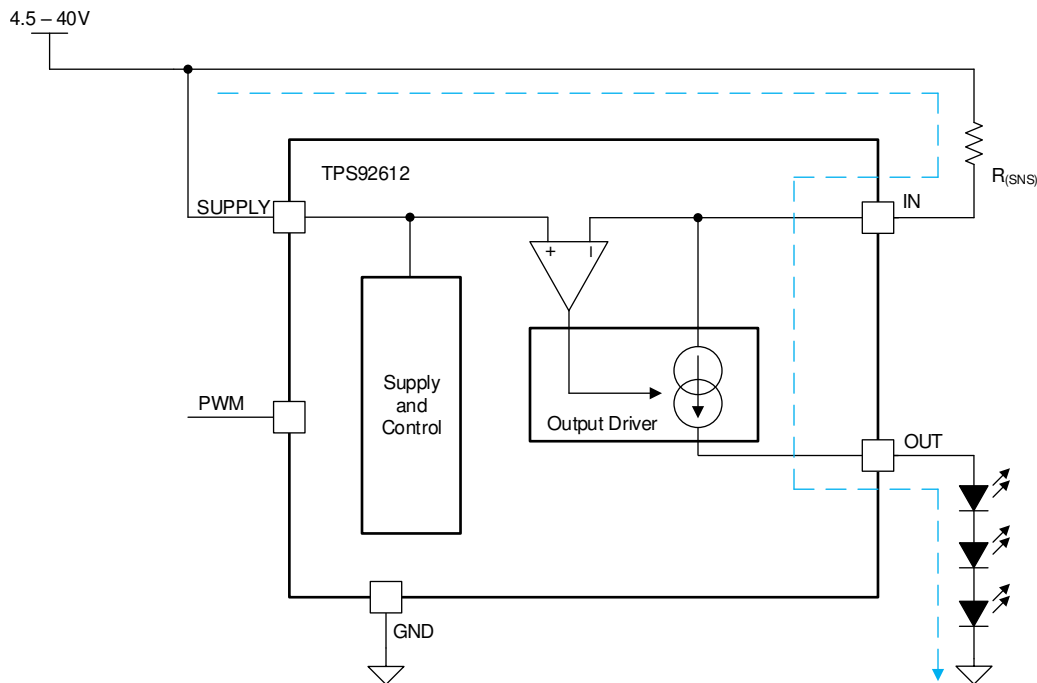
## 7 Detailed Description

### 7.1 Overview

The TPS92612 device is a single-channel linear LED driver providing a simple current source with protection.

The output current at OUT pin can be set by an external  $R_{(SNS)}$  resistor. Current flows from the supply through the  $R_{(SNS)}$  resistor into the integrated current regulation circuit and to the output through OUT pin. Brightness can be controlled by PWM pin.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Device Bias

##### 7.3.1.1 Power-On Reset (POR)

The TPS92612 device has an internal power-on-reset (POR) function. When power is applied to the SUPPLY pin, the internal POR holds the device in the reset condition until  $V_{(SUPPLY)}$  reaches  $V_{(POR\_rising)}$ .

#### 7.3.2 Constant-Current Driver

The TPS92612 device is a high-side constant-current driver. The device controls the output current through regulating the voltage drop on an external high-side current-sense resistor,  $R_{(SNS)}$ . An integrated error amplifier drives an internal power transistor to maintain the voltage drop on the current-sense resistor  $R_{(SNS)}$  to  $V_{(CS\_REG)}$  and therefore regulates the current output to target value. When the output current is in regulation, the current value can be calculated by using [Equation 1](#).

$$I_{(OUT)} = \frac{V_{(CS\_REG)}}{R_{(SNS)}}$$

where

- $V_{(CS\_REG)} = 98 \text{ mV}$  (typical) (1)



## Feature Description (continued)

When the SUPPLY-to-OUT voltage difference is below the required dropout voltage,  $V_{(\text{DROPOUT})}$ , at a given output current, the TPS92612 is not able to deliver enough current output as set by the value of  $R_{(\text{SNS})}$ , and the voltage across the current-sense resistor  $R_{(\text{SNS})}$  is less than  $V_{(\text{CS\_REG})}$ .

### 7.3.3 PWM Control

The pulse width modulation (PWM) input of the TPS92612 functions as enable for the output current. When the voltage applied on the PWM pin is higher than  $V_{\text{IH}(\text{PWM})}$ , the output current is enabled. When the voltage applied on PWM pin is lower than  $V_{\text{IL}(\text{PWM})}$ , the output current is disabled. Besides output current enable and disable function, the PWM input of TPS92612 also supports adjustment of the average current for LED brightness control. TI recommends a 200 Hz – 2 kHz PWM signal for brightness control, which is out of visible frequency range of human eyes.

### 7.3.4 Protection

#### 7.3.4.1 Short-to-GND Protection

The TPS92612 device has OUT short-to-GND protection. The device monitors the  $V_{(\text{OUT})}$  voltage when the output current is enabled and compares it with the internal reference voltage to detect a short-to-GND failure. If  $V_{(\text{OUT})}$  falls below  $V_{(\text{SG\_th\_falling})}$  longer than the deglitch time of  $t_{(\text{SG\_deg})}$ , the device asserts the short-to-GND fault. During the deglitching time period, if  $V_{(\text{OUT})}$  rises above  $V_{(\text{SG\_th\_rising})}$ , the timer is reset.

Once the device has detected a short-to-GND fault, the device turns off the output channel and retries automatically by sourcing a small current  $I_{(\text{retry})}$  from IN to OUT to pull up the loads continuously, regardless of the state of the PWM input. Once auto retry detects output voltage rising above  $V_{(\text{SG\_th\_rising})}$ , the device clears the short-to-GND fault and resumes normal operation.

#### 7.3.4.2 Over Temperature Protection

The TPS92612 device monitors device junction temperature. When the junction temperature reaches thermal shutdown threshold  $T_{(\text{TSD})}$ , the output shuts down. Once the junction temperature falls below  $T_{(\text{TSD})} - T_{(\text{TSD\_HYS})}$ , the device recovers to normal operation.

## 7.4 Device Functional Modes

### 7.4.1 Undervoltage Lockout, $V_{(\text{SUPPLY})} < V_{(\text{POR\_rising})}$

When the TPS92612 device is in undervoltage lockout mode, the device disables all functions until the supply rises above the  $V_{(\text{POR\_rising})}$  threshold.

### 7.4.2 Normal State, $V_{(\text{SUPPLY})} \geq 4.5 \text{ V}$

The device regulates output current in normal state. With enough voltage drop across SUPPLY and OUT, the device is able to drive the output in constant-current mode.

## 8 Application and Implementation

### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 8.1 Application Information

The TPS92612 device is a constant-current regulator which can be used as a LED driver, general constant-current source or current limiter in industrial applications.

Thermal performance is one of the design challenges for linear devices. To increase current-driving capability, the device supports heat sharing using an external parallel resistor, as shown in [Figure 15](#). This technique provides the low-cost solution of using external resistors to minimize thermal accumulation on the device itself, and still keeps high accuracy of the total current output.

### 8.2 Typical Application

#### 8.2.1 Single LED Driver

The TPS92612 offers a cost-effective and easy-to-use solution for LED driver applications. PWM input can be adopted for LED brightness adjust and LED ON/OFF control. The device also supports off-board LED connection with long cables.

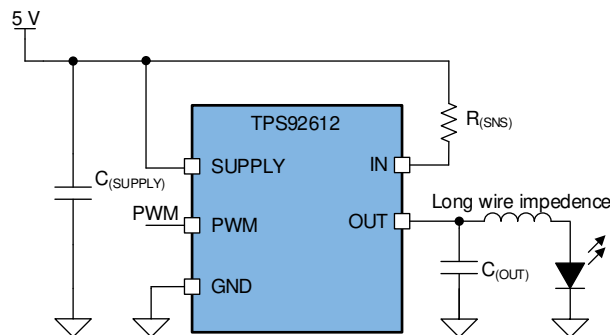


Figure 12. Typical Application Diagram

##### 8.2.1.1 Design Requirements

The input voltage is  $5\text{ V} \pm 5\%$ . LED maximum forward voltage  $V_{F\_MAX} = 2.5\text{ V}$ , minimum forward voltage  $V_{F\_MIN} = 1.9\text{ V}$ , current  $I_{(LED)} = 150\text{ mA}$ . LED is connected to device OUT pin through a 1-m long wire.

##### 8.2.1.2 Detailed Design Procedure

**STEP 1:** Determine the current setting resistor,  $R_{(SNS)}$  value by using [Equation 2](#).

$$R_{(SNS)} = \frac{V_{(CS\_REG)}}{I_{(LED)}} = 0.653\Omega$$

where

- $V_{(CS\_REG)} = 98\text{ mV}$  (typical)
- $I_{(LED)} = 150\text{ mA}$

(2)

**STEP 2:** Power consumption analysis for the worst application conditions.

### Typical Application (continued)

Normally the thermal analysis is necessary for linear LED-driver applications to ensure that the operation junction temperature of TPS92612 is well managed. The total power consumption on the TPS92612 itself is one important factor determining operation junction temperature, and it can be calculated by using Equation 3. Based on the worst-case analysis for maximum power consumption on device, consider either optimizing PCB layout for better power dissipation as [Layout](#) describes or adding an extra heat-sharing resistor as described in [Single-Channel LED Driver With Heat Sharing](#).

$$P_{(DEV)} = (V_{(SUPPLY)} - V_{(CS\_REG)} - V_{(OUT)}) \times I_{(LED)} + V_{(SUPPLY)} \times I_{(Quiescent)}$$

$$P_{(DEV\_MAX)} = (5.25 - 0.098 - 1.9) \times 0.15 + 5.25 \times 0.00025 = 0.489W$$

where

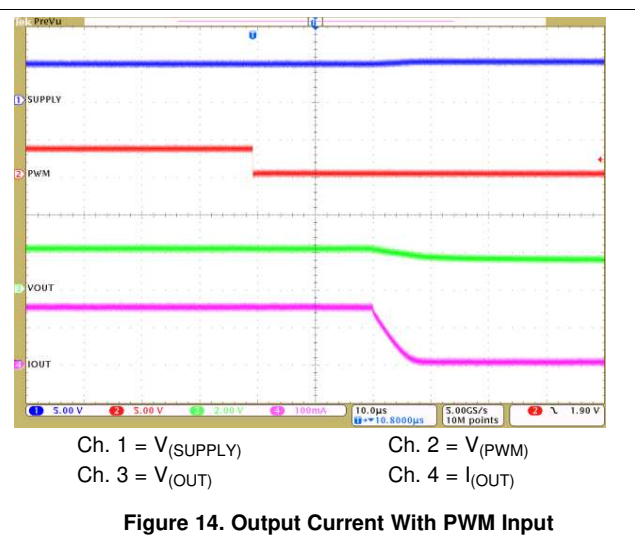
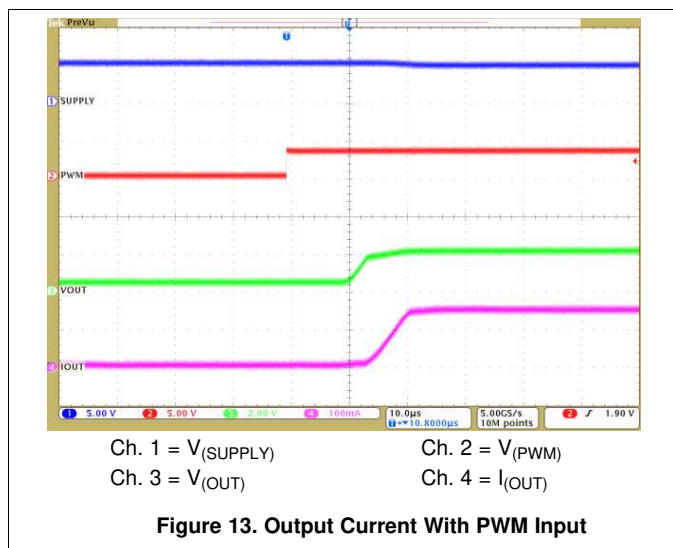
- $V_{(CS\_REG)} = 98\text{ mV}$  (typical)
  - $I_{(Quiescent)} = 250\text{ }\mu\text{A}$  (maximum)
- (3)

In this application, the calculated result for maximum power consumption on the TPS92612 is 0.489 W at  $V_{(SUPPLY)} = 5.25\text{ V}$  and  $I_{(LED)} = 150\text{ mA}$  conditions.

TI recommends to add capacitors  $C_{(SUPPLY)}$  at SUPPLY and  $C_{(OUT)}$  at OUT. TI recommends one 1- $\mu\text{F}$  capacitor plus one 100-nF decoupling ceramic capacitor close to the SUPPLY pin for  $C_{(SUPPLY)}$  and a 10-nF ceramic capacitor close to the OUT pin for  $C_{(OUT)}$ . The larger capacitor for  $C_{(SUPPLY)}$  or  $C_{(OUT)}$  is helpful for EMI and ESD immunity; however, large  $C_{(OUT)}$  takes a longer time to charge up the capacitor and may affect PWM dimming performance.

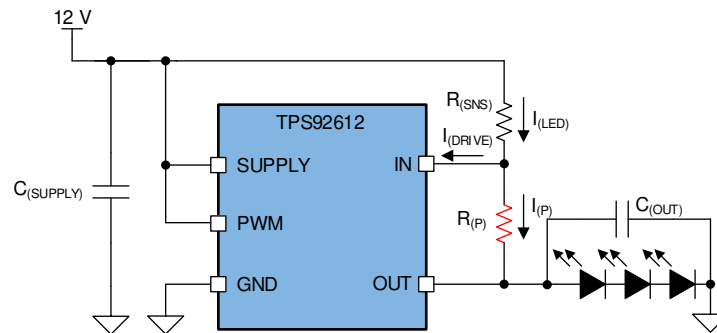
#### 8.2.1.3 Application Curve

A 1- $\mu\text{H}$  inductor is connected between OUT and the LED to simulate the 1-m long cable.



#### 8.2.2 Single-Channel LED Driver With Heat Sharing

Using parallel resistors, thermal performance can be improved by balancing current between the TPS92612 device and the external resistors as follows. As the current-sense resistor controls the total LED string current, the LED string current  $I_{(LED)}$  is set by  $V_{(CS\_REG)} / R_{(SNS)}$ , while the TPS92612 current  $I_{(DRIVE)}$  and parallel resistor current  $I_{(P)}$  combine to the total current.

**Typical Application (continued)**

**Figure 15. Heat Sharing With a Parallel Resistor**
**8.2.2.1 Design Requirements**

The input voltage range is  $12\text{ V} \pm 10\%$ , LED maximum forward voltage  $V_{F\_MAX} = 2.5\text{ V}$ , minimum forward voltage  $V_{F\_MIN} = 1.9\text{ V}$ , current  $I_{(LED)} = 150\text{ mA}$ .

**8.2.2.2 Detailed Design Procedure**

In linear LED driver applications, the input and output voltage variation generates the most of the thermal concerns. The resistor current  $I_{(P)}$ , as indicated by Ohm's law, depends on the voltage across the external resistors. The TPS92612 controls the driver current  $I_{(DRIVE)}$  to attain the desired total current. If  $I_{(P)}$  increases, the TPS92612 device decreases  $I_{(DRIVE)}$  to compensate, and vice versa. The parallel-resistor takes highest current and generates maximum heat at maximum supply voltage and minimum LED-string forward voltage.

The parallel resistor value must be carefully calculated to ensure that 1) thermal dissipation for both the TPS92612 device and the resistor is within their thermal dissipation limits, and 2) device current at high voltage drop condition is above the minimal output-current requirement.

**STEP 1:** Determine the current setting resistor,  $R_{(SNS)}$  value by using [Equation 4](#).

$$R_{(SNS)} = \frac{V_{(CS\_REG)}}{I_{(LED)}} = 0.653\Omega$$

where

- $V_{(CS\_REG)} = 98\text{ mV}$  (typical)
  - $I_{(LED)} = 150\text{ mA}$
- (4)

The calculated result for  $R_{(SNS)}$  is  $0.653\ \Omega$ .

**STEP 2:** Calculate the parallel resistor,  $R_{(P)}$  value by using [Equation 5](#).

The parallel resistor  $R_{(P)}$  is recommended to consume 50% of the total current at maximum supply voltage and minimum LED-string forward voltage.

$$R_{(P)} = \frac{V_{(SUPPLY)} - V_{(CS\_REG)} - V_{(OUT)}}{0.5 \times I_{(LED)}} = \frac{13.2 - 0.098 - 3 \times 1.9}{0.5 \times 0.15} \approx 100\Omega$$

where

- $V_{(CS\_REG)} = 98\text{ mV}$  (typical)
  - $I_{(LED)} = 150\text{ mA}$
- (5)

The calculated result for  $R_{(P)}$  is about  $100\ \Omega$  at  $V_{(SUPPLY)} = 13.2\text{ V}$ .

**STEP 3:** Power consumption analysis for the worst application conditions.

The total device power consumption can be calculated by [Equation 6](#).

### Typical Application (continued)

$$P_{(DEV)} = \left( V_{(SUPPLY)} - V_{(CS\_REG)} - V_{(OUT)} \right) \times \left( I_{(LED)} - \frac{V_{(SUPPLY)} - V_{(CS\_REG)} - V_{(OUT)}}{R_{(P)}} \right) + V_{(SUPPLY)} \times I_{(Quiescent)}$$

$$P_{(DEV\_MAX)} = (13.2 - 0.098 - 3 \times 1.9) \times \left( 0.15 - \frac{13.2 - 0.098 - 3 \times 1.9}{100} \right) + 13.2 \times 0.00025 = 0.566W$$

where

- $V_{(CS\_REG)} = 98 \text{ mV}$  (typical)
- $I_{(Quiescent)} = 250 \text{ }\mu\text{A}$  (maximum)

The calculated maximum power consumption on the TPS92612 device is 0.566 W at  $V_{(SUPPLY)} = 13.2 \text{ V}$ ,  $V_{(OUT)} = 3 \times 1.9 \text{ V} = 5.7 \text{ V}$  and  $I_{(LED)} = 150 \text{ mA}$ .

The power consumption on resistor  $R_{(P)}$  can be calculated through [Equation 7](#).

$$P_{(RP)} = \frac{\left( V_{(SUPPLY)} - V_{(CS\_REG)} - V_{(OUT)} \right)^2}{R_{(P)}}$$

$$P_{(RP\_MAX)} = \frac{(13.2 - 0.098 - 3 \times 1.9)^2}{100} = 0.548W$$

where

- $V_{(CS\_REG)} = 98 \text{ mV}$  (typical)

The calculated maximum power consumption on the 100  $\Omega$ ,  $R_{(P)}$  parallel resistor is 0.548 W at  $V_{(SUPPLY)} = 13.2 \text{ V}$  and  $V_{(OUT)} = 3 \times 1.9 \text{ V} = 5.7 \text{ V}$ .

TI recommends adding capacitors  $C_{(SUPPLY)}$  at SUPPLY and  $C_{(OUT)}$  at OUT. One 1- $\mu\text{F}$  capacitor plus one 100-nF decoupling ceramic capacitor close to the SUPPLY pin is recommended for  $C_{(SUPPLY)}$ , and a 10-nF ceramic capacitor close to the OUT pin is recommended for  $C_{(OUT)}$ . The larger capacitor for  $C_{(SUPPLY)}$  or  $C_{(OUT)}$  is helpful for EMI and ESD immunity, however large  $C_{(OUT)}$  takes a longer time to charge up the capacitor and could affect PWM dimming performance.

Note that the parallel resistor path cannot be shut down by PWM or fault protection. If PWM control is required, TI recommends an application circuit as shown in [Figure 16](#). A NPN bipolar transistor with a base current-limiting resistor,  $R_1$ , can modulate the output current together with the device PWM function. The resistor value of  $R_1$  needs to be calculated based on the applied PWM voltage and  $\beta$  value of selected NPN transistor.

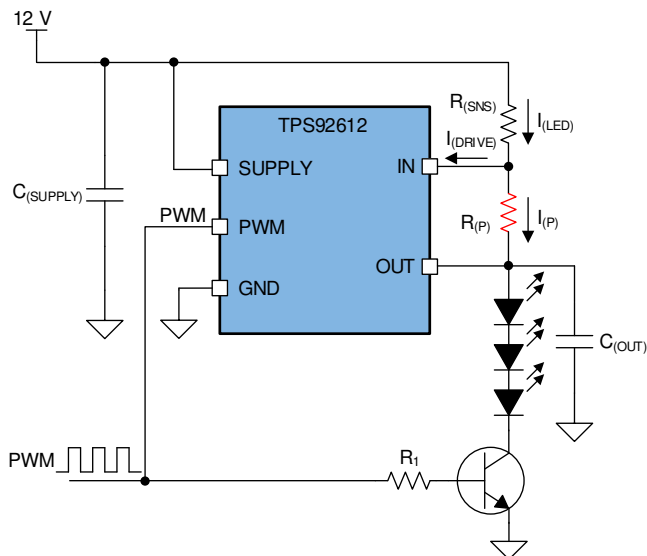
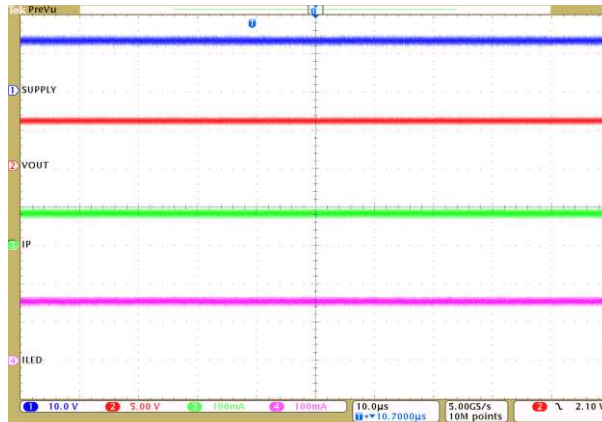


Figure 16. PWM Control With Heat Sharing Resistor

## Typical Application (continued)

### 8.2.2.3 Application Curve



Ch. 1 =  $V_{(SUPPLY)}$    Ch. 2 =  $V_{(OUT)}$    Ch. 3 =  $I_{(P)}$    Ch. 4 =  $I_{(LED)}$

**Figure 17. Constant Output Current With Heat Sharing Resistor**

## 9 Power Supply Recommendations

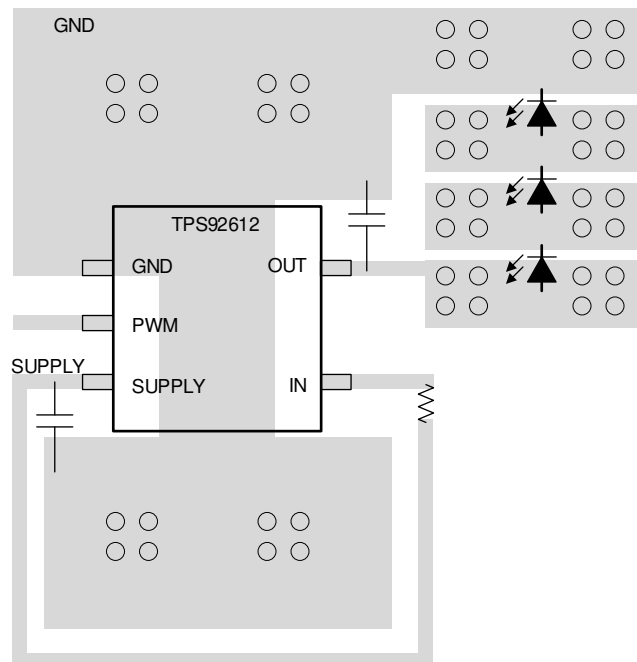
The TPS92612 is designed to operate from a power system within the range specified in the [Recommended Operating Conditions](#). The SUPPLY input must be protected from reverse voltage and overvoltage over 40 V. The impedance of the input supply rail must be low enough that the input voltage transient does not cause drop below LED string required forward voltage. If the input supply is connected with long wires, additional bulk capacitance may be required in addition to normal input capacitor.

## 10 Layout

### 10.1 Layout Guidelines

Thermal dissipation is the primary consideration for TPS92612 layout. TI recommends good thermal dissipation area beneath the device for better thermal performance.

### 10.2 Layout Example



**Figure 18. TPS92612 Example Layout Diagram**

## 11 Device and Documentation Support

### 11.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 11.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 11.3 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 11.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 11.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS92612DBVR	ACTIVE	SOT-23	DBV	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	22SF	Samples

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TPS92612 :**

- Automotive: [TPS92612-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS92612DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS92612DBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0

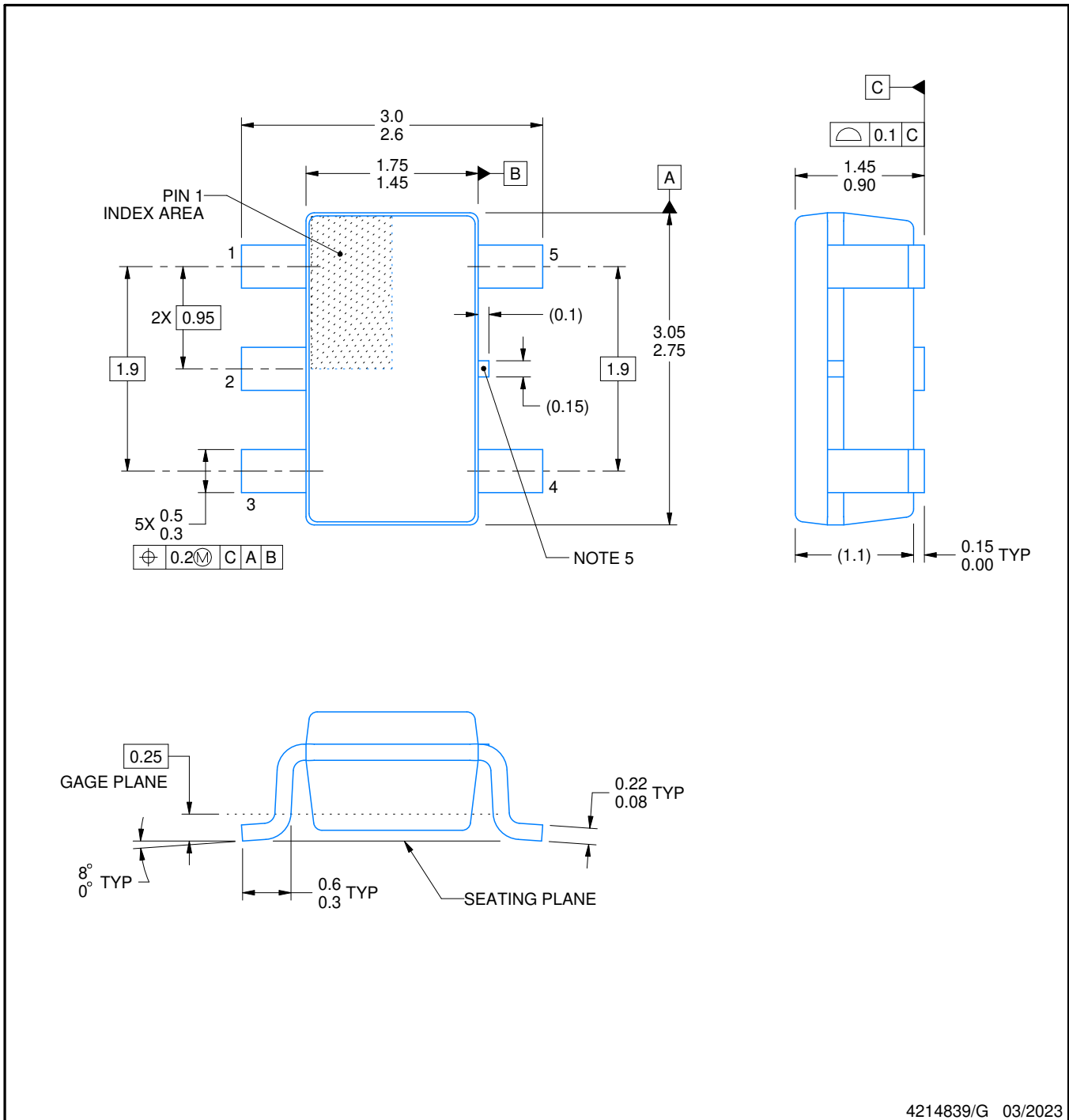
DBV0005A



# PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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## NOTES:

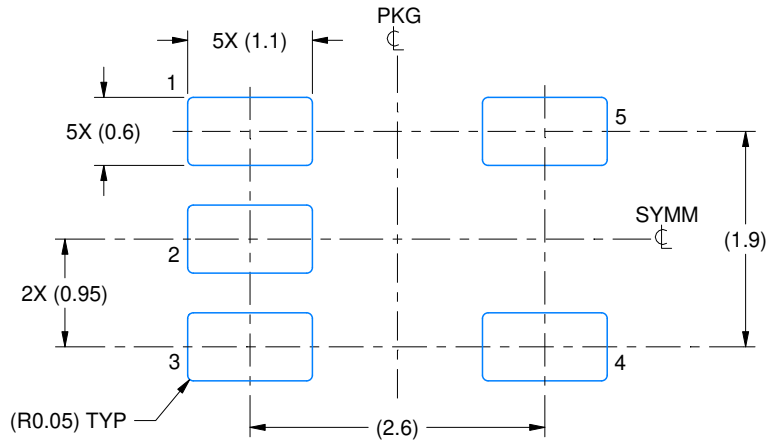
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

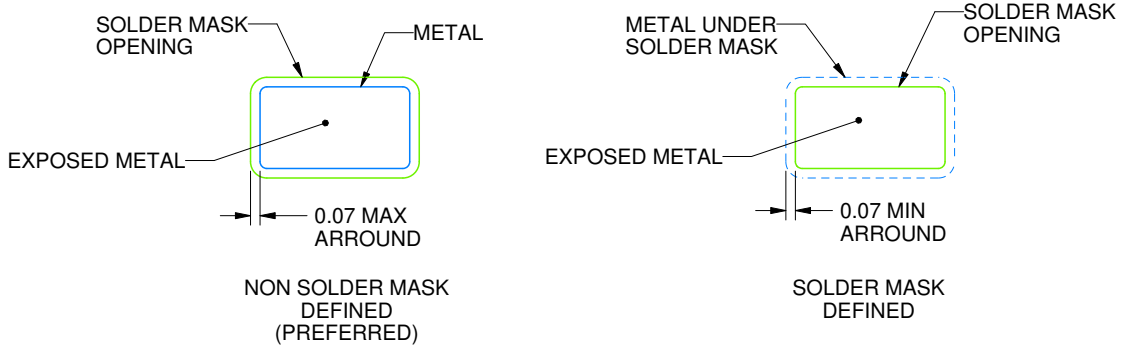
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

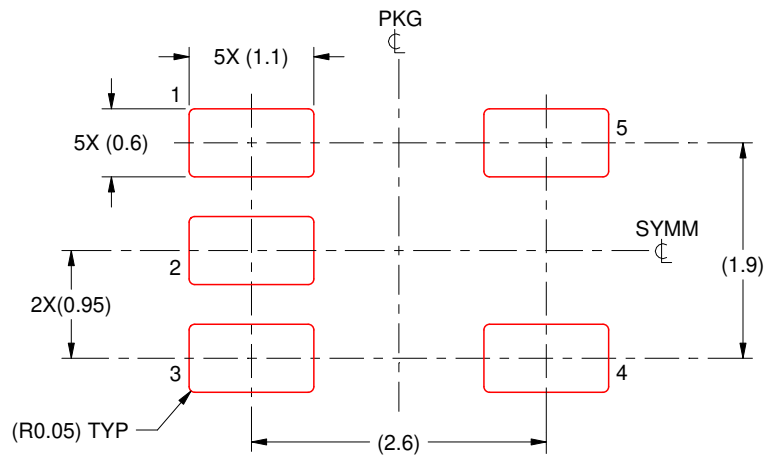
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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