

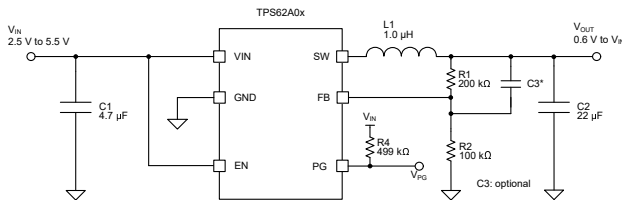
# TPS62A0x 和 TPS62A0xA 采用 SOT-563 和 SOT23 封装的 1A 和 2A 高效同步降压转换器

## 1 特性

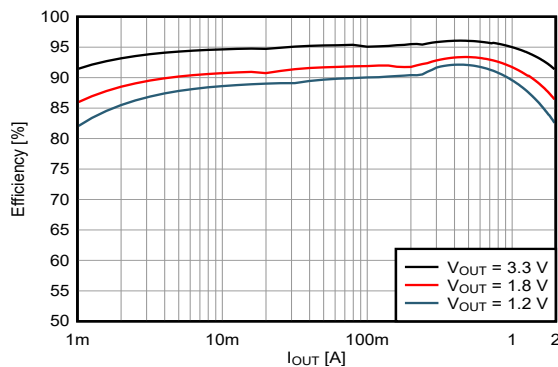
- 输入电压范围为 2.5V 至 5.5V
- 0.6V 至  $V_{IN}$  可调节输出电压范围
- $180\text{m}\Omega/120\text{m}\Omega$  低  $R_{DS(ON)}$  开关 (1A DRL)
- $100\text{m}\Omega/67\text{m}\Omega$  低  $R_{DS(ON)}$  开关 (1A DDC, 2A)
- $< 23\mu\text{A}$  静态电流
- 1% 反馈精度 ( $0^\circ\text{C}$  至  $125^\circ\text{C}$ )
- 100% 模式运行
- 2.4MHz 开关频率
- 支持节电模式或 PWM 选项
- 电源正常状态输出引脚 (可选)
- 短路保护 (HICCUP)
- 内部软启动
- 有源输出放电
- 热关断保护
- 与 TLV62585 (DRL) 引脚对引脚兼容
- 与 TLV62569 (DDC) 引脚对引脚兼容

## 2 应用

- 机顶盒、电视应用
- IP 网络摄像头、多功能打印机
- 无线路由器、固态硬盘
- 电池供电的应用
- 通用负载点电源



典型应用



效率与输出电流间的关系曲线 (电压为  $5V_{IN}$  时)  
(TPS62A02x)

## 3 说明

TPS62A0x 系列器件是同步直流/直流降压转换器，经过优化可实现高效率 and 紧凑型设计尺寸。此器件集成了能够传送高达 2A 输出电流的开关。在中等负载至重负载条件下，该器件在脉宽调制 (PWM) 模式下以 2.4MHz 开关频率运行。在轻载情况下，这些器件自动进入节能模式 (PSM)，从而在整个负载电流范围内保持高效率。关断时，电流消耗量也最低。该器件系列的 TPS62A0xA 型号在整个负载电流范围内以强制 PWM 模式运行。

TPS62A0x 器件通过一个外部电阻分压器提供可调节输出电压。内部软启动电路可限制启动期间的浪涌电流。内置的其他特性包括过流保护、热关断保护和电源正常指示 (可选)。这些器件采用 SOT563 和 SOT23-6 封装。

### 封装信息

| 器件型号                      | 封装 <sup>(1)</sup>         | 封装尺寸 <sup>(2)</sup> |
|---------------------------|---------------------------|---------------------|
| TPS62A01x                 | DRL ( SOT-563 , 6 )       | 1.60mm × 1.60mm     |
|                           | DDC ( SOT-23 , 6 )<br>(3) | 2.90mm × 2.80mm     |
| TPS62A02x                 | DRL ( SOT-563 , 6 )       | 1.60mm × 1.60mm     |
|                           | DDC ( SOT-23 , 6 )        | 2.90mm × 2.80mm     |
| TPS62A02Nx <sup>(3)</sup> | DRL ( SOT-563 , 6 )       | 1.60mm × 1.60mm     |

- (1) 有关更多信息，请参阅节 11。
- (2) 封装尺寸 (长 × 宽) 为标称值，并包括引脚 (如适用)。
- (3) 预发布信息 (非量产数据)。

### 器件信息

| 器件型号 <sup>(1)</sup>       | 运行模式    | 输出电流 | 引脚 6 |
|---------------------------|---------|------|------|
| TPS62A01                  | PSM、PWM | 1A   | PG   |
| TPS62A01A                 | FPWM    |      |      |
| TPS62A02                  | PSM、PWM | 2A   | OUT  |
| TPS62A02A                 | FPWM    |      |      |
| TPS62A02N <sup>(2)</sup>  | PSM、PWM |      |      |
| TPS62A02NA <sup>(2)</sup> | FPWM    |      |      |

- (1) 请参阅器件比较表。
- (2) 预发布信息 (非量产数据)。



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## 4 Device Comparison Table

| Device Number                 | Output Current | Package    | Operation Mode | Pin 6 |     |
|-------------------------------|----------------|------------|----------------|-------|-----|
| TPS62A01DRLR                  | 1A             | SOT-563, 6 | PSM, PWM       | PG    |     |
| TPS62A01ADRLR                 |                |            | FPWM           |       |     |
| TPS62A02DRLR                  | 2A             |            | PSM, PWM       |       | OUT |
| TPS62A02ADRLR                 |                |            | FPWM           |       |     |
| TPS62A02NDRLR <sup>(1)</sup>  |                |            | PSM, PWM       |       |     |
| TPS62A02NADRLR <sup>(1)</sup> |                |            | FPWM           |       |     |
| TPS62A01PDDCR <sup>(1)</sup>  | 1A             | SOT-23, 6  | PSM, PWM       | PG    |     |
| TPS62A01APDDCR <sup>(1)</sup> |                |            | FPWM           |       |     |
| TPS62A02PDDCR                 | 2A             |            | PSM, PWM       |       |     |
| TPS62A02APDDCR                |                |            | FPWM           |       |     |

(1) Preview information (not Production Data).

## 5 Pin Configuration and Functions

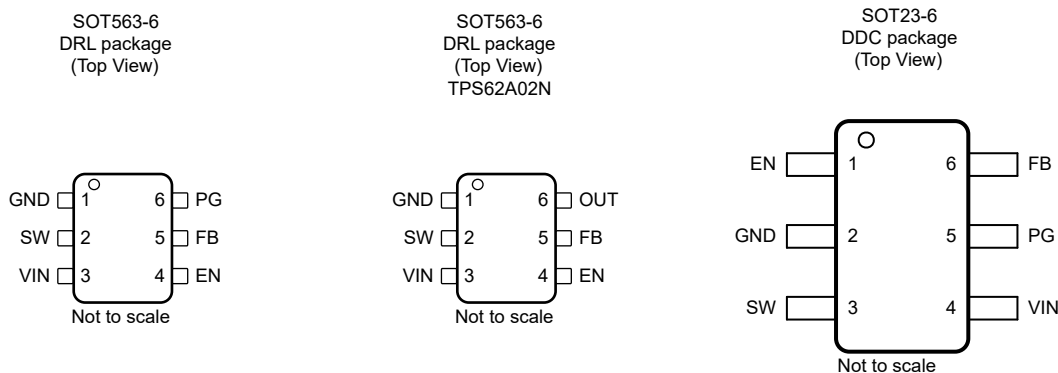


图 5-1. 6-Pin DRL SOT-563 Package (Top View), 6-Pin DDC SOT-23 package (Top View)

表 5-1. Pin Functions

| Pin Number         |          |         | Type <sup>(1)</sup> | Description                                                                                                                                                 |
|--------------------|----------|---------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name               | SOT563-6 | SOT23-6 |                     |                                                                                                                                                             |
| EN                 | 4        | 1       | I                   | Device enable logic input. Logic high enables the device. Logic low disables the device and turns the device into shutdown. Do not leave the pin floating.  |
| FB                 | 5        | 6       | I                   | Feedback pin for the internal control loop. Connect this pin to an external feedback divider.                                                               |
| GND                | 1        | 2       | G                   | Ground pin.                                                                                                                                                 |
| PG                 | 6        | 5       | O                   | Power-good open-drain output pin. The pullup resistor cannot be connected to any voltage higher than 5.5V. If unused, leave the pin open or connect to GND. |
| OUT <sup>(2)</sup> |          | /       | I                   | Output voltage sense pin.                                                                                                                                   |
| SW                 | 2        | 3       | O                   | Switch pin connected to the internal FET switches and inductor terminal. Connect the inductor of the output filter to this pin.                             |
| VIN                | 3        | 4       | I                   | Input voltage pin. Connect the input capacitor as close as possible between V <sub>IN</sub> and GND.                                                        |

(1) I = Input, O = Output, G = Ground.

(2) Only for TPS62A0xN versions.

## 6 Specifications

### 6.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

|                            |                                | MIN   | MAX       | UNIT |
|----------------------------|--------------------------------|-------|-----------|------|
| Pin voltage <sup>(2)</sup> | VIN, EN, PG                    | – 0.3 | 6.5       | V    |
|                            | SW, DC                         | – 0.3 | VIN + 0.3 | V    |
|                            | SW, transient < 10 ns          | – 3.0 | 10        | V    |
|                            | FB                             | – 0.3 | 3         | V    |
| TJ                         | Operating junction temperature | – 40  | 150       | °C   |
| Tstg                       | Storage temperature            | – 55  | 150       | °C   |

(1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

(2) All voltage values are with respect to the network ground terminal.

### 6.2 ESD Ratings

|        |                         |                                                                       | VALUE | UNIT |
|--------|-------------------------|-----------------------------------------------------------------------|-------|------|
| V(ESD) | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>     | ±2000 | V    |
|        |                         | Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±500  |      |

(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 junction temperature range (unless otherwise noted)

|     |                                     |                     | MIN  | NOM | MAX | UNIT |
|-----|-------------------------------------|---------------------|------|-----|-----|------|
| VIN | Input supply voltage range          |                     | 2.5  |     | 5.5 | V    |
| VOU | Output voltage range                |                     | 0.6  |     | VIN | V    |
| IOU | Output current range                | TPS62A01            | 0    |     | 1   | A    |
| IOU | Output current range <sup>(1)</sup> | TPS62A02            | 0    |     | 2   | A    |
| L   | Effective inductance                |                     |      | 1.0 |     | μH   |
| COU | Output capacitance                  | VOU < 1.2 V         |      | 44  |     | μF   |
| COU | Output capacitance                  | 1.2 V ≤ VOU < 1.8 V |      | 22  |     | μF   |
| COU | Output capacitance                  | VOU ≥ 1.8 V         |      | 10  |     | μF   |
| IPG | Power Good input current capability |                     | 0    |     | 1   | mA   |
| TJ  | Operating junction temperature      |                     | – 40 |     | 125 | °C   |

(1) Operating continuously at 2-A with input voltages < 3.3V or at ambient temperatures > 85 °C might result in thermal shutdown, per EVM measurements.

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                            | TPS62A0x | TPS62A0x | UNIT |
|-------------------------------|--------------------------------------------|----------|----------|------|
|                               |                                            | DRL      | DDC      |      |
|                               |                                            | 6 PINS   | 6 PINS   |      |
| RθJA                          | Junction-to-ambient thermal resistance     | 157.3    | 132.1    | °C/W |
| RθJC(top)                     | Junction-to-case (top) thermal resistance  | 92.2     | 74.9     | °C/W |
| RθJB                          | Junction-to-board thermal resistance       | 45.6     | 45.5     | °C/W |
| ψJT                           | Junction-to-top characterization parameter | 4.0      | 25.5     | °C/W |

## 6.4 Thermal Information (续)

| THERMAL METRIC <sup>(1)</sup> |                                              | TPS62A0x | TPS62A0x | UNIT |
|-------------------------------|----------------------------------------------|----------|----------|------|
|                               |                                              | DRL      | DDC      |      |
|                               |                                              | 6 PINS   | 6 PINS   |      |
| $\psi_{JB}$                   | Junction-to-board characterization parameter | 45.0     | 45.1     | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) report.

## 6.5 Electrical Characteristics

$T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{IN} = 2.5\text{ V}$  to  $5.5\text{ V}$ . Typical values are at  $T_J = 25^{\circ}\text{C}$  and  $V_{IN} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER                     |                                                       | TEST CONDITIONS                                                                           | MIN | TYP  | MAX | UNIT          |
|-------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------|-----|------|-----|---------------|
| <b>SUPPLY</b>                 |                                                       |                                                                                           |     |      |     |               |
| $I_{Q(VIN)}$                  | VIN quiescent current                                 | Non-switching; $V_{EN} = \text{High}$ ; $V_{FB} = 610\text{ mV}$ ; TPS62A01xDRL           |     | 20   |     | $\mu\text{A}$ |
| $I_{Q(VIN)}$                  | VIN quiescent current                                 | Non-switching; $V_{EN} = \text{High}$ ; $V_{FB} = 610\text{ mV}$ ; TPS62A01xDDC; TPS62A02 |     | 23   |     | $\mu\text{A}$ |
| $I_{SD(VIN)}$                 | VIN shutdown supply current                           | $V_{EN} = \text{Low}$                                                                     |     | 0.01 | 2   | $\mu\text{A}$ |
| <b>UVLO</b>                   |                                                       |                                                                                           |     |      |     |               |
| $V_{UVLO(R)}$                 | VIN UVLO rising threshold                             | $V_{IN}$ rising                                                                           | 2.3 | 2.4  | 2.5 | V             |
| $V_{UVLO(F)}$                 | VIN UVLO falling threshold                            | $V_{IN}$ falling                                                                          | 2.2 | 2.3  | 2.4 | V             |
| <b>ENABLE</b>                 |                                                       |                                                                                           |     |      |     |               |
| $V_{EN(R)}$                   | EN voltage rising threshold                           | EN rising; enable switching                                                               | 1.2 |      |     | V             |
| $V_{EN(F)}$                   | EN voltage falling threshold                          | EN falling, disable switching                                                             |     |      | 0.4 | V             |
| $V_{EN(LKG)}$                 | EN input leakage current                              | $V_{EN} = 5\text{ V}$                                                                     |     |      | 100 | nA            |
| <b>REFERENCE VOLTAGE</b>      |                                                       |                                                                                           |     |      |     |               |
| $V_{FB}$                      | FB voltage                                            | $T_J = 0^{\circ}\text{C}$ to $125^{\circ}\text{C}$ , PWM mode                             | 594 | 600  | 606 | mV            |
| $V_{FB}$                      | FB voltage                                            | PWM mode                                                                                  | 591 | 600  | 609 | mV            |
| $I_{FB(LKG)}$                 | FB input leakage current                              | $V_{FB} = 0.6\text{ V}$                                                                   |     |      | 100 | nA            |
| <b>SWITCHING FREQUENCY</b>    |                                                       |                                                                                           |     |      |     |               |
| $f_{SW(FCCM)}$                | Switching frequency, FPWM operation                   | $V_{IN} = 5\text{ V}$ ; $V_{OUT} = 1.8\text{ V}$                                          |     | 2400 |     | kHz           |
| <b>STARTUP</b>                |                                                       |                                                                                           |     |      |     |               |
|                               | Internal fixed soft-start time                        | From EN = High to $V_{FB} = 0.56\text{ V}$                                                |     |      | 1   | ms            |
| <b>POWER STAGE</b>            |                                                       |                                                                                           |     |      |     |               |
| $R_{DS(ON)(HS)}$              | High-side MOSFET on-resistance                        | TPS62A01xDRL; $V_{IN} = 5\text{ V}$                                                       |     | 180  |     | m $\Omega$    |
| $R_{DS(ON)(LS)}$              | Low-side MOSFET on-resistance                         | TPS62A01xDRL; $V_{IN} = 5\text{ V}$                                                       |     | 120  |     | m $\Omega$    |
| $R_{DS(ON)(HS)}$              | High-side MOSFET on-resistance                        | $V_{IN} = 5\text{ V}$ ; TPS62A01xDDC; TPS62A02                                            |     | 100  |     | m $\Omega$    |
| $R_{DS(ON)(LS)}$              | Low-side MOSFET on-resistance                         | $V_{IN} = 5\text{ V}$ ; TPS62A01xDDC; TPS62A02                                            |     | 67   |     | m $\Omega$    |
| <b>OVERCURRENT PROTECTION</b> |                                                       |                                                                                           |     |      |     |               |
| $I_{HS(OC)}$                  | High-side peak current limit                          | TPS62A01                                                                                  | 1.3 | 1.8  |     | A             |
| $I_{LS(OC)}$                  | Low-side valley current limit                         | TPS62A01                                                                                  |     | 1.8  |     | A             |
| $I_{HS(OC)}$                  | High-side peak current limit                          | TPS62A02                                                                                  | 2.7 | 3.4  |     | A             |
| $I_{LS(OC)}$                  | Low-side valley current limit                         | TPS62A02xDRL                                                                              |     | 4.2  |     | A             |
| $I_{LS(OC)}$                  | Low-side valley current limit                         | TPS62A02xDDC                                                                              |     | 3.15 |     | A             |
| <b>POWER GOOD</b>             |                                                       |                                                                                           |     |      |     |               |
| $V_{PGTH}$                    | Power Good threshold                                  | PG low, FB falling                                                                        |     | 93.5 |     | %             |
| $V_{PGTH}$                    | Power Good threshold                                  | PG high, FB rising                                                                        |     | 96   |     | %             |
|                               | PG delay falling                                      |                                                                                           |     | 35   |     | $\mu\text{s}$ |
|                               | PG delay rising                                       |                                                                                           |     | 10   |     | $\mu\text{s}$ |
| $I_{PG(LKG)}$                 | PG pin Leakage current when open drain output is high | $V_{PG} = 5\text{ V}$                                                                     |     |      | 100 | nA            |
|                               | PG pin output low-level voltage                       | $I_{PG} = 1\text{ mA}$                                                                    |     |      | 400 | mV            |

## 6.5 Electrical Characteristics (续)

$T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{IN} = 2.5\text{ V}$  to  $5.5\text{ V}$ . Typical values are at  $T_J = 25^{\circ}\text{C}$  and  $V_{IN} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER               |                                    | TEST CONDITIONS                                                              | MIN | TYP | MAX | UNIT               |
|-------------------------|------------------------------------|------------------------------------------------------------------------------|-----|-----|-----|--------------------|
| <b>OUTPUT DISCHARGE</b> |                                    |                                                                              |     |     |     |                    |
|                         | Output discharge current on SW pin | $V_{IN} = 3\text{ V}$ , $V_{OUT} = 2.0\text{ V}$ ; TPS62A01xDRL              |     | 60  |     | mA                 |
|                         | Output discharge current on SW pin | $V_{IN} = 3\text{ V}$ , $V_{OUT} = 2.0\text{ V}$ ; TPS62A01xDDC;<br>TPS62A02 |     | 76  |     | mA                 |
| <b>THERMAL SHUTDOWN</b> |                                    |                                                                              |     |     |     |                    |
| $T_{J(SD)}$             | Thermal shutdown threshold         | Temperature rising                                                           |     | 170 |     | $^{\circ}\text{C}$ |
| $T_{J(HYS)}$            | Thermal shutdown hysteresis        |                                                                              |     | 20  |     | $^{\circ}\text{C}$ |

## 6.6 Typical Characteristics

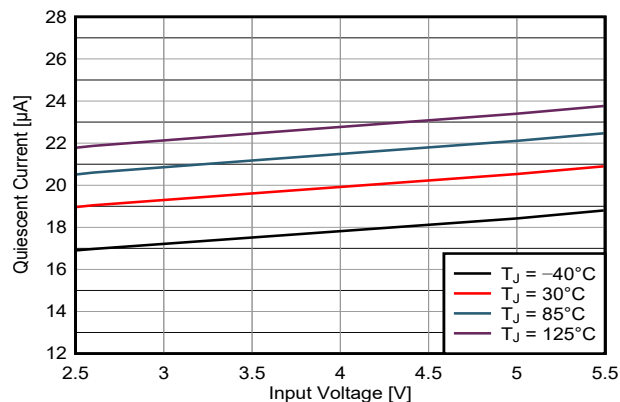


图 6-1. Quiescent Current vs Input Voltage (TPS62A01)

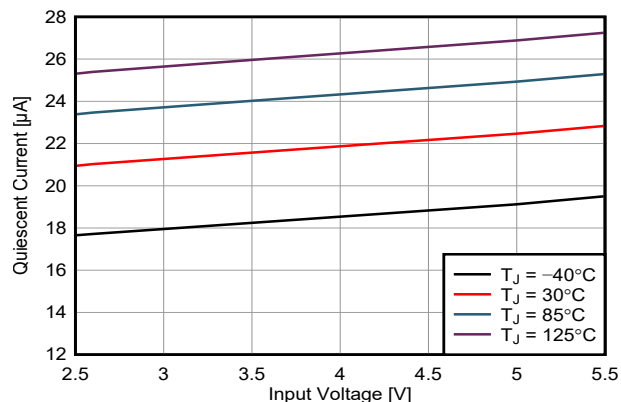


图 6-2. Quiescent Current vs Input Voltage (TPS62A02)

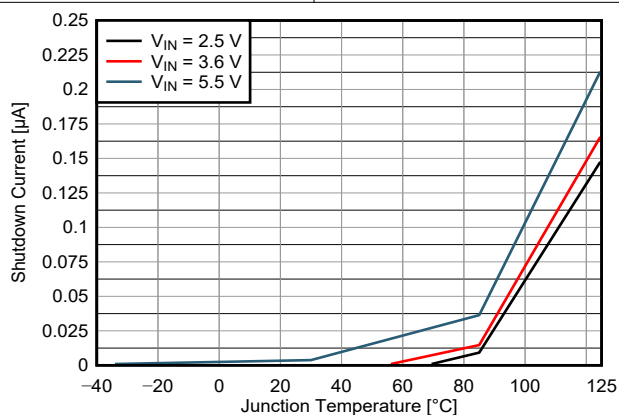


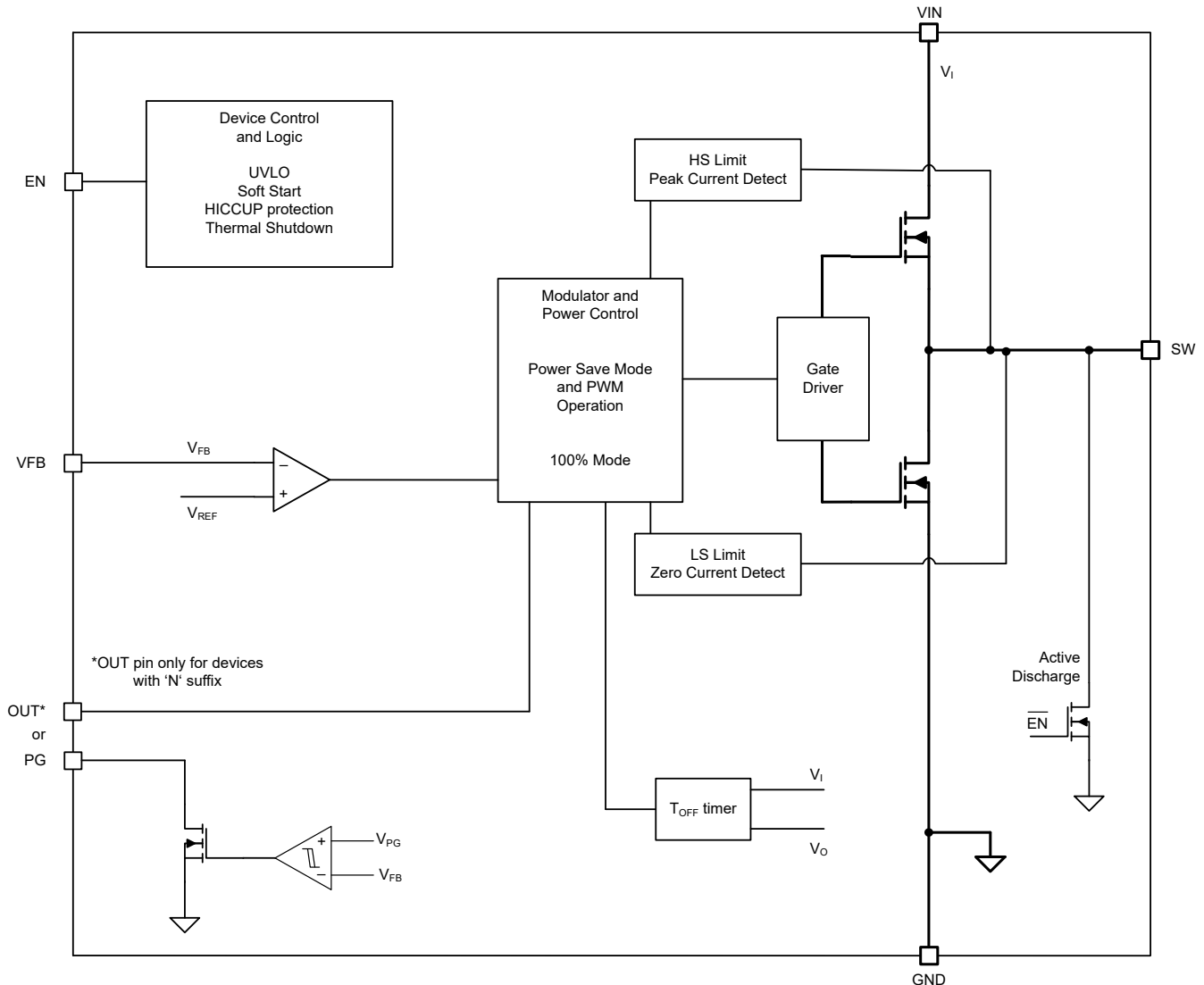
图 6-3. Shutdown Current vs Junction Temperature

## 7 Detailed Description

### 7.1 Overview

The TPS62A0x is a high-efficiency synchronous step-down converter. The device operates with an adaptive off time with a peak current control scheme. The device operates typically at 2.4MHz frequency pulse width modulation (PWM) at moderate to heavy load currents. Based on the  $V_{IN}/V_{OUT}$  ratio, a simple circuit sets the required off time for the low-side MOSFET, making the switching frequency relatively constant regardless of the variation of the input voltage, output voltage, and load current.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Power Save Mode

The device automatically enters power save mode to improve efficiency at light load when the inductor current becomes discontinuous. In power save mode, the converter reduces the switching frequency and minimizes current consumption. In power save mode, the output voltage rises slightly above the nominal output voltage. This effect is minimized by increasing the output capacitor or adding a feedforward capacitor.

### 7.3.2 100% Duty Cycle Low Dropout Operation

The device offers low input-to-output voltage difference by entering 100% duty cycle mode. In this mode, the high-side MOSFET switch is constantly turned on and the low-side MOSFET is switched off. The minimum input voltage to maintain output regulation, depending on the load current and output voltage, is calculated as:

$$V_{IN(MIN)} = V_{OUT} + I_{OUT} \times (R_{DS(ON)} + R_L) \quad (1)$$

where

- $R_{DS(ON)}$  = High-side FET on-resistance
- $R_L$  = Inductor ohmic resistance (DCR)

### 7.3.3 Soft Start

After enabling the device, internal soft-start circuitry ramps up the output voltage, which reaches the nominal output voltage during start-up time, avoiding excessive inrush current and creating a smooth voltage rise slope. Internal soft-start circuitry also prevents excessive voltage drops of primary cells and rechargeable batteries with high internal impedance.

The TPS62A0x is able to start into a prebiased output capacitor. The converter starts with the applied bias voltage and ramps the output voltage to the nominal value.

### 7.3.4 Switch Current Limit and Short-Circuit Protection (HICCUP)

The switch current limit prevents the device from high inductor current and drawing excessive current from the battery or input rail. Due to internal propagation delay, the AC peak current can exceed the static current limit during that time. Excessive current can occur with a shorted or saturated inductor, an overload or shorted output circuit condition. If the inductor current reaches the threshold  $I_{LIM}$ , the high-side MOSFET is turned off and the low-side MOSFET is turned on to ramp down the inductor current with an adaptive off time.

When this switch current limit is triggered 32 times, the device stops switching to protect the output. The device then automatically starts a new start-up after a typical delay time of 100µs has passed. This is named HICCUP short-circuit protection. The device repeats this mode until the high load condition disappears. HICCUP protection is also enabled during the start-up.

### 7.3.5 Undervoltage Lockout

To avoid misoperation of the device at low input voltages, an undervoltage lockout (UVLO) is implemented, which shuts down the device at voltages lower than  $V_{UVLO}$ .

### 7.3.6 Thermal Shutdown

The device goes into thermal shutdown and stops switching when the junction temperature exceeds  $T_{JSD}$ . When the device temperature falls below the threshold by 20°C, the device returns to normal operation automatically.

## 7.4 Device Functional Modes

### 7.4.1 Enable and Disable

The device is enabled by setting the EN input to a logic High. Accordingly, a logic Low disables the device. If the device is enabled, the internal power stage starts switching and regulates the output voltage to the set point voltage. The EN input must be terminated and not be left floating.

### 7.4.2 Power Good

The TPS62A0x (except devices with 'N' suffix) has a built-in power-good (PG) feature to indicate whether the output voltage has reached the target and the device is ready. The PG signal can be used for start-up sequencing of multiple rails. The PG pin is an open-drain output that requires a pullup resistor to any voltage up to the recommended input voltage level. PG is low when the device is turned off due to EN, UVLO (undervoltage lockout), or thermal shutdown. VIN must remain present for the PG pin to stay low. If not used, the power-good

can be tie to GND or left open. The PG indicator has a de-glitch to avoid the signal indicating glitches or transient responses from the loop.

**表 7-1. Power-Good indicator Functional Table**

| Logic Signals |        |                  |                 | PG Status      |
|---------------|--------|------------------|-----------------|----------------|
| $V_I$         | EN Pin | Thermal Shutdown | $V_O$           |                |
| $V_I > UVLO$  | HIGH   | NO               | $V_O$ on target | High Impedance |
|               |        |                  | $V_O < target$  | LOW            |
|               |        |                  | YES             | LOW            |
|               |        | YES              | x               | LOW            |
|               | LOW    | x                | x               | LOW            |
| $V_I < 1.8V$  | x      | x                | x               | Undefined      |

## 8 Application and Implementation

### 备注

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, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

The following section discusses the design of the external components to complete the power supply design for several input and output voltage options by using typical applications as a reference.

### 8.2 Typical Application

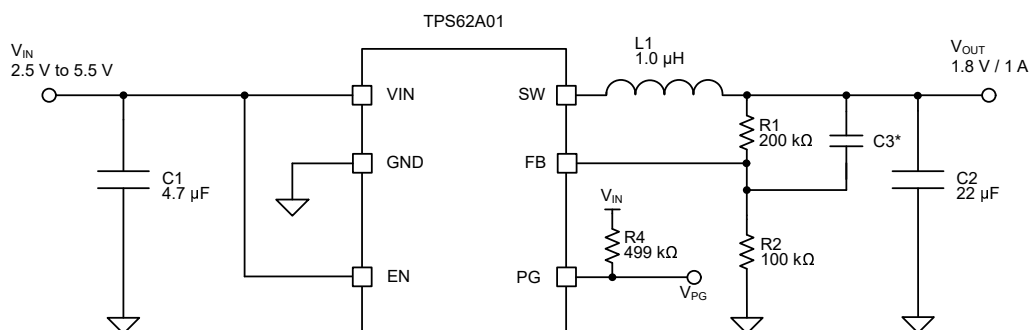


图 8-1. TPS62A01 Typical Application Circuit

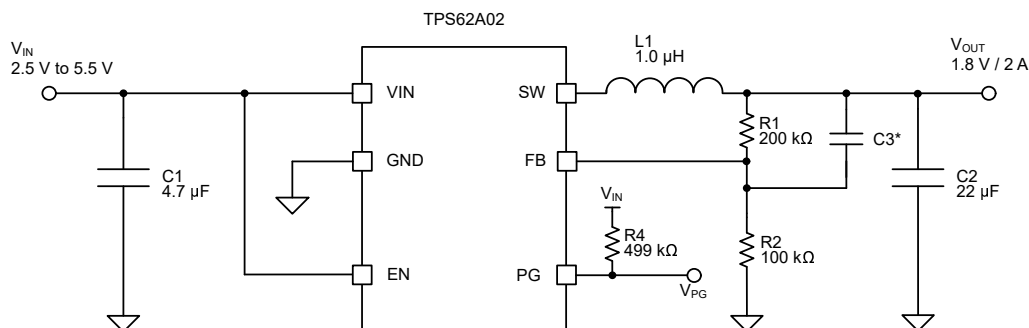


图 8-2. TPS62A02 Typical Application Circuit

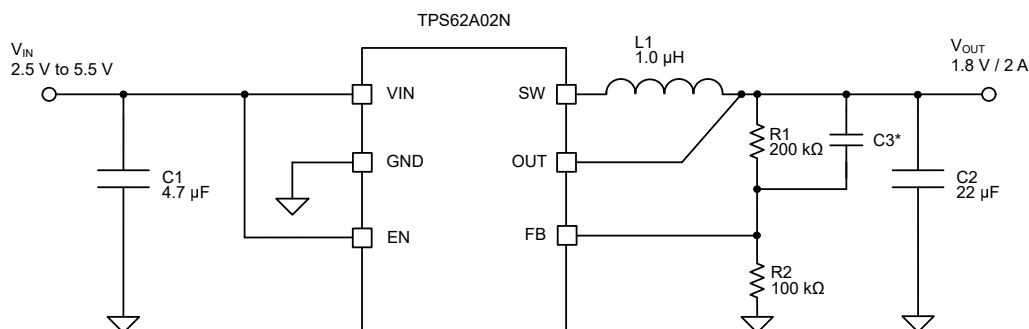


图 8-3. TPS62A02N Typical Application Circuit

\*C3 is optional

## 8.2.1 Design Requirements

For this design example, use the parameters listed in 表 8-1 as the input parameters

**表 8-1. Design Parameters**

| Design Parameter       | Example Value |
|------------------------|---------------|
| Input voltage          | 2.5V to 5.5V  |
| Output voltage         | 1.8V          |
| Maximum output current | 1.0A, 2.0A    |

表 8-2 lists the components used for the example.

**表 8-2. List of Components**

| Reference | Description                                                       | Manufacturer <sup>(1)</sup> |
|-----------|-------------------------------------------------------------------|-----------------------------|
| C1        | 4.7μF, Ceramic Capacitor, 10V, X7R, size 0805, GRM21BR71A475KA73L | Murata                      |
| C2        | 22μF, Ceramic Capacitor, 10V, X7R, size 0805, GRM21BZ71A226KE15L  | Murata                      |
| L1        | 1μH, Power Inductor, DFE252012F-1R0M (1A) / XGL3520-102MEC (2A)   | Murata / Coilcraft          |
| R1, R2    | Chip resistor, 1%, size 0603                                      | Std.                        |
| C3        | Optional, 120pF if needed                                         | Std.                        |

(1) See the [Third-Party Products Disclaimer](#).

## 8.2.2 Detailed Design Procedure

### 8.2.2.1 Setting the Output Voltage

The output voltage is set by an external resistor divider according to 方程式 2.

$$R1 = R2 \times \left( \frac{V_{OUT}}{V_{FB}} - 1 \right) = R2 \times \left( \frac{V_{OUT}}{0.6V} - 1 \right) \quad (2)$$

R2 must not be higher than 100k Ω to provide acceptable noise sensitivity.

### 8.2.2.2 Output Filter Design

The inductor and output capacitor together provide a low-pass filter. To simplify this process, 表 8-3 outlines possible inductor and capacitor value combinations. Checked cells represent combinations that are proven for stability by simulation and lab test. Check further combinations for each individual application.

**表 8-3. Matrix of Output Capacitor and Inductor Combinations for TPS62A01 and TPS62A02**

| V <sub>OUT</sub> [V]         | L [μH] <sup>(1)</sup> | C <sub>OUT</sub> [μF] <sup>(2)</sup> |                   |                   |
|------------------------------|-----------------------|--------------------------------------|-------------------|-------------------|
|                              |                       | 10                                   | 22                | 2 × 22            |
| 0.6 ≤ V <sub>OUT</sub> < 1.2 | 1                     |                                      | +                 | ++ <sup>(3)</sup> |
| 1.2 ≤ V <sub>OUT</sub> < 1.8 |                       |                                      | ++ <sup>(3)</sup> | +                 |
| 1.8 ≤ V <sub>OUT</sub>       |                       | + <sup>(4)</sup>                     | ++ <sup>(3)</sup> | +                 |

(1) Inductor tolerance and current de-rating is anticipated. The effective inductance can vary by +20% and – 30%.

(2) Capacitance tolerance and bias voltage de-rating is anticipated. The effective capacitance can vary by +20% and – 50%.

(3) This LC combination is the standard value and recommended for most applications.

(4) The minimum C<sub>OUT</sub> of 10μF does not support an additional feedforward capacitor.

A 0.47μH inductor can also be used with the same recommended output capacitors for the TPS62A02x. In case a lower output ripple is desired, higher output capacitance can help reduce the ripple.

### 8.2.2.3 Input and Output Capacitor Selection

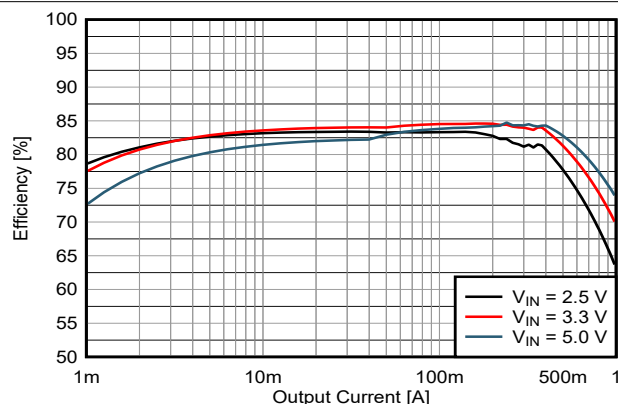
The architecture of the TPS62A0x allows use of tiny ceramic-type output capacitors with low equivalent series resistance (ESR). These capacitors provide low output voltage ripple and are thus recommended. To keep resistance up to high frequencies and to achieve narrow capacitance variation with temperature, TI recommends to use X7R or X5R dielectric.

The input capacitor is the low impedance energy source for the converter that helps provide stable operation. TI recommends a low-ESR multilayer ceramic capacitor for best filtering. For most applications, a 4.7  $\mu$ F input capacitor is sufficient; a larger value reduces input voltage ripple.

The TPS62A0x is designed to operate with an output capacitor of 10  $\mu$ F to 47  $\mu$ F, depending on the selected output voltage, as outlined in [表 8-3](#).

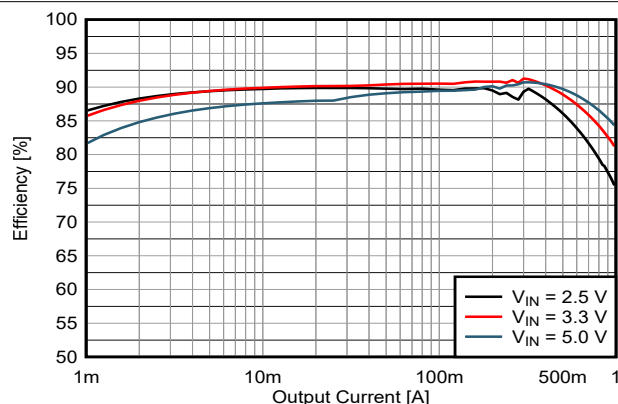
A feedforward capacitor reduces the output ripple in PSM and improves the load transient response. A 120pF capacitor is good for the 1.8V output typical application.

## 8.2.3 Application Curves



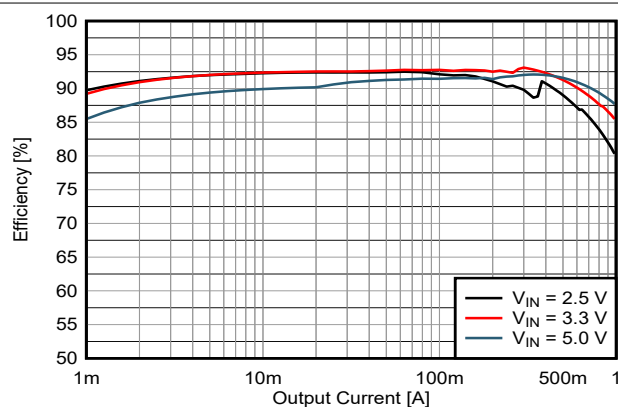
TPS62A01 (PSM/PWM) SOT-563 (DRL)

图 8-4. 0.6V Output Efficiency



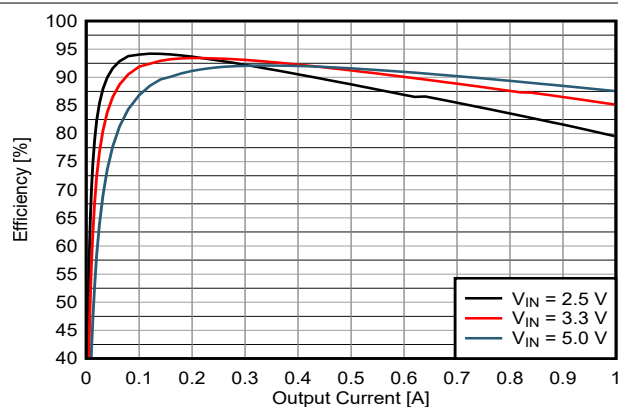
TPS62A01 (PSM/PWM) SOT-563 (DRL)

图 8-5. 1.2V Output Efficiency



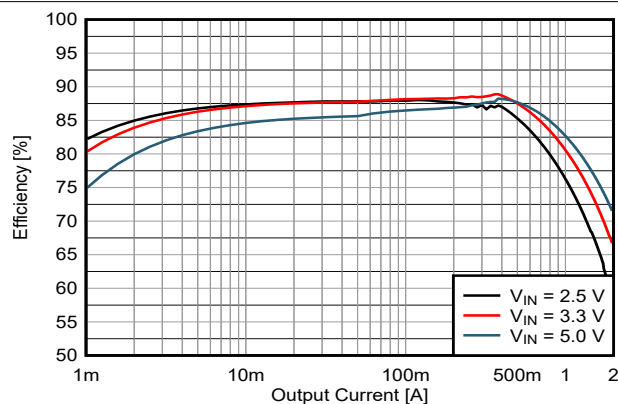
TPS62A01 (PSM/PWM) SOT-563 (DRL)

图 8-6. 1.8V Output Efficiency



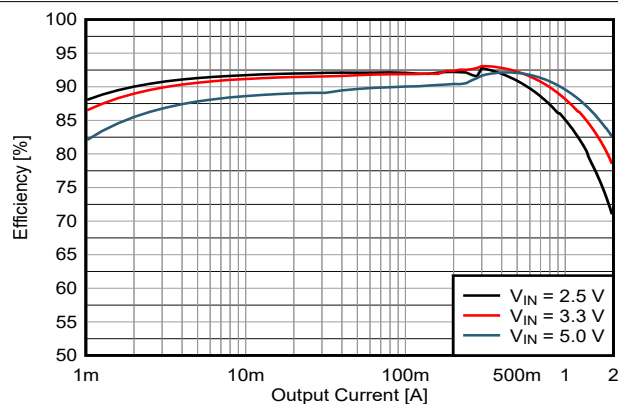
TPS62A01A (FPWM) SOT-563 (DRL)

图 8-7. 1.8V Output Efficiency



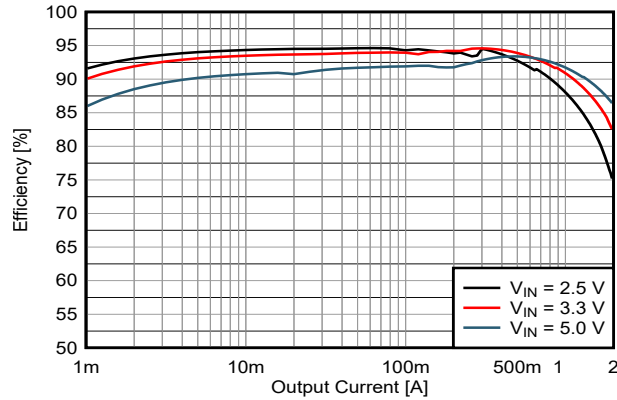
TPS62A02 (PSM/PWM) SOT-563 (DRL)

图 8-8. 0.6V Output Efficiency



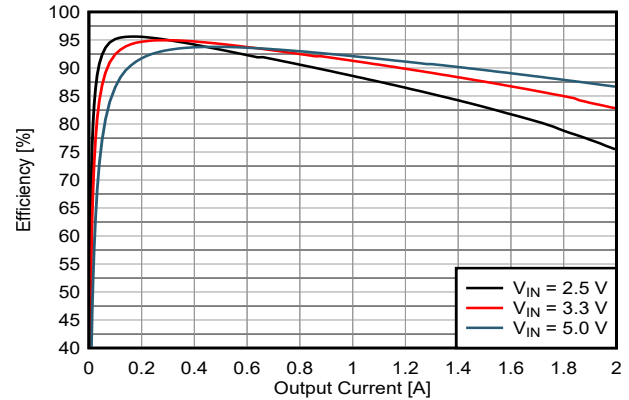
TPS62A02 (PSM/PWM) SOT-563 (DRL)

图 8-9. 1.2V Output Efficiency



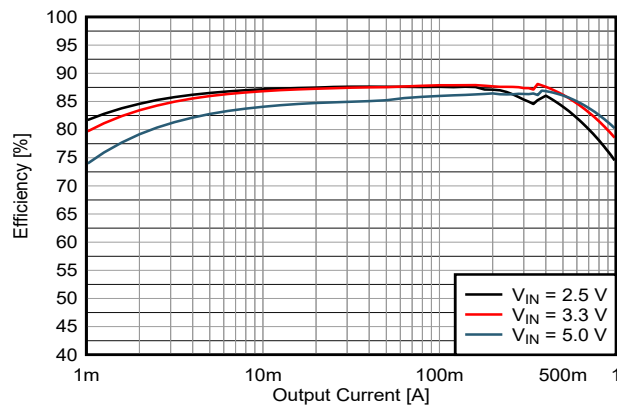
TPS62A02 (PSM/PWM) SOT-563 (DRL)

**图 8-10. 1.8V Output Efficiency**



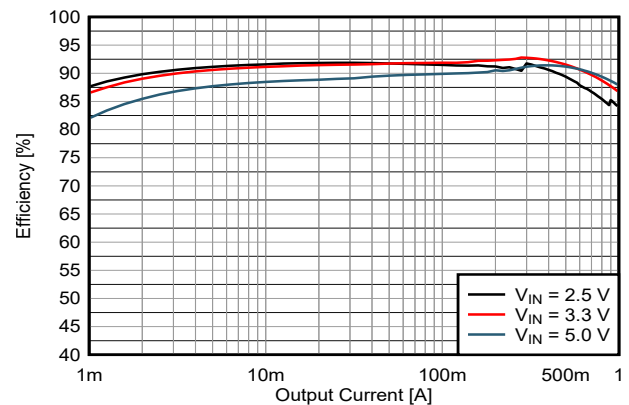
TPS62A02A (FPWM) SOT-563 (DRL)

**图 8-11. 1.8V Output Efficiency**



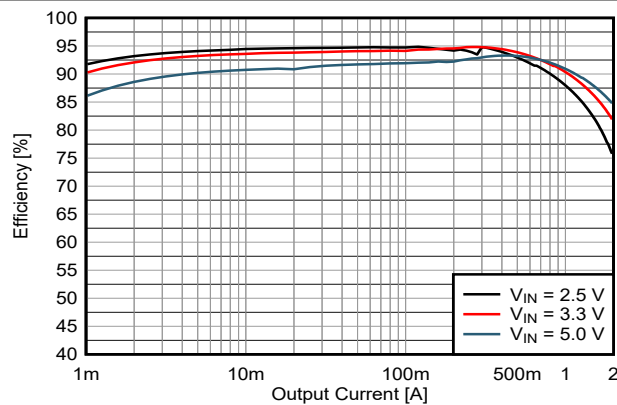
TPS62A01 (PSM/PWM) SOT-23 (DDC)

**图 8-12. 0.6V Output Efficiency**



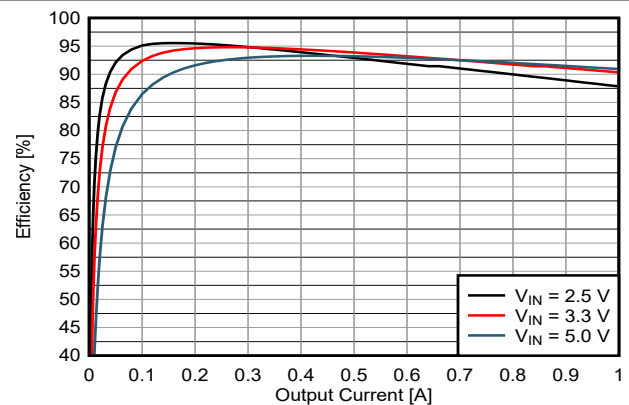
TPS62A01 (PSM/PWM) SOT-23 (DDC)

**图 8-13. 1.2V Output Efficiency**



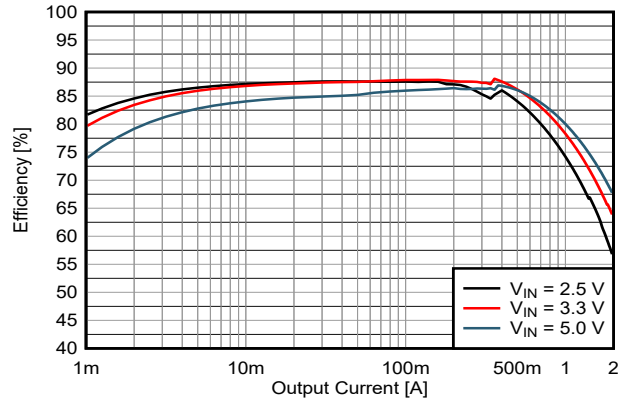
TPS62A01 (PSM/PWM) SOT-23 (DDC)

**图 8-14. 1.8V Output Efficiency**



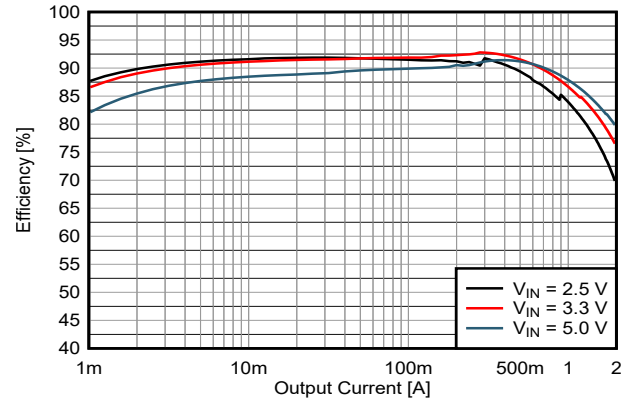
TPS62A01A (FPWM) SOT-23 (DDC)

**图 8-15. 1.8V Output Efficiency**



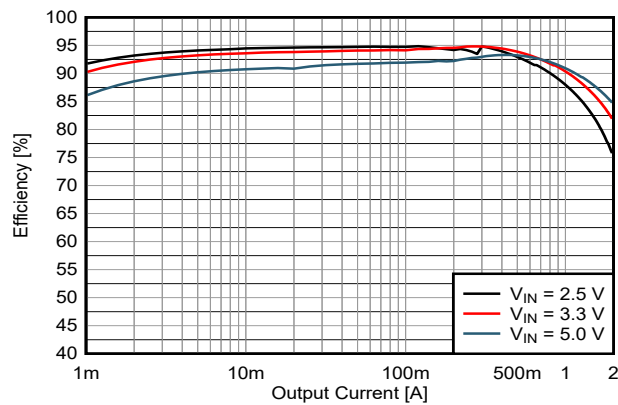
TPS62A02 (PSM/PWM) SOT-23 (DDC)

图 8-16. 0.6V Output Efficiency



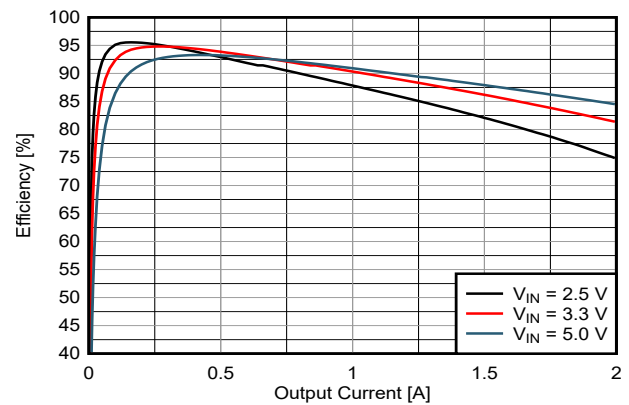
TPS62A02 (PSM/PWM) SOT-23 (DDC)

图 8-17. 1.2V Output Efficiency



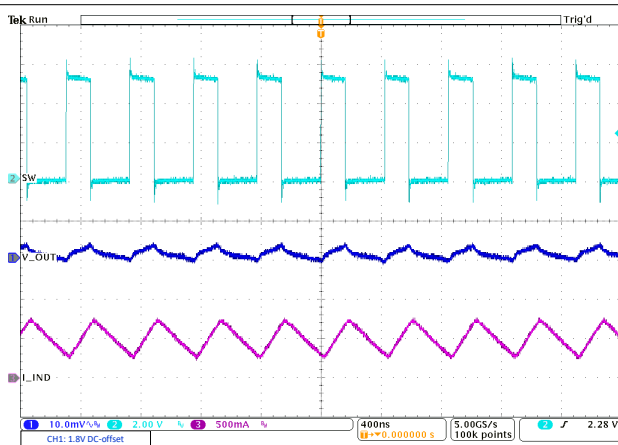
TPS62A02 (PSM/PWM) SOT-23 (DDC)

图 8-18. 1.8V Output Efficiency



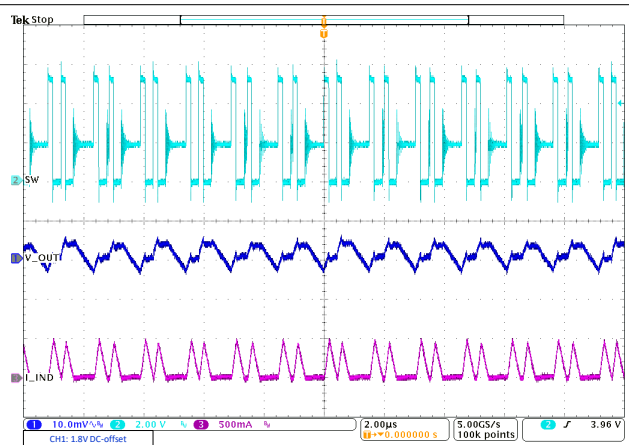
TPS62A02A (FPWM) SOT-23 (DDC)

图 8-19. 1.8V Output Efficiency



$I_{OUT} = 500 \text{ mA}$

图 8-20. PWM Operation



$I_{OUT} = 100 \text{ mA}$

图 8-21. Power Save Mode Operation

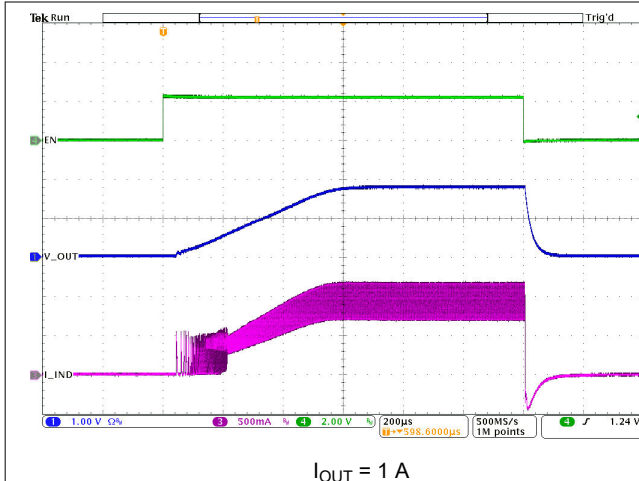


图 8-22. Start-Up with Load

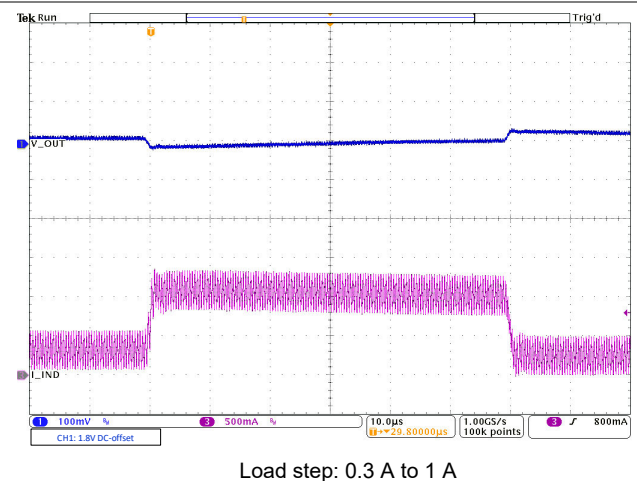


图 8-23. Load Transient

### 8.3 Power Supply Recommendations

The device is designed to operate from an input voltage supply range from 2.5V to 5.5V. Make sure that the input power supply has a sufficient current rating for the application.

### 8.4 Layout

#### 8.4.1 Layout Guidelines

The printed-circuit-board (PCB) layout is an important step to maintain the high performance of the TPS62A01x and TPS62A02x devices.

- Place the input and output capacitors and the inductor as close as possible to the IC. This action keeps the power traces short. Routing these power traces direct and wide results in low trace resistance and low parasitic inductance.
- Connect the low side of the input and output capacitors properly to the GND pin to avoid a ground potential shift.
- The sense traces connected to FB is a signal trace. Take special care to avoid noise being induced. Keep these traces away from SW nodes.
- Use a common ground. GND layers can be used for shielding.

See 图 8-24 and 图 8-25 for the recommended PCB layout.

#### 8.4.2 Layout Example

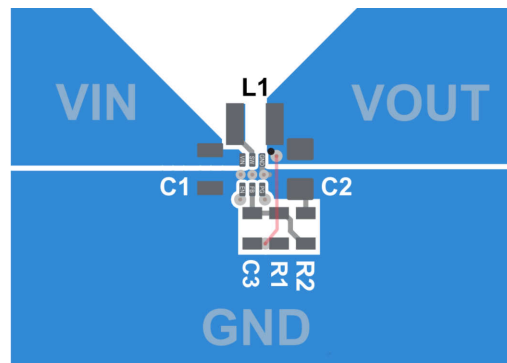


图 8-24. TPS62A0x (SOT563) PCB Layout Recommendation

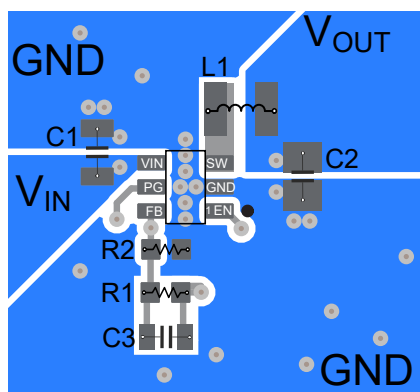


图 8-25. TPS62A0x (SOT23-6) PCB Layout Recommendation

## 9 Device and Documentation Support

### 9.1 Device Support

#### 9.1.1 第三方产品免责声明

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### 9.3 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [使用条款](#)。

### 9.4 Trademarks

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### 9.5 静电放电警告



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ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 9.6 术语表

#### TI 术语表

本术语表列出并解释了术语、首字母缩略词和定义。

## 10 Revision History

注：以前版本的页码可能与当前版本的页码不同

| <b>Changes from Revision C (December 2023) to Revision D (April 2024)</b>           | <b>Page</b>       |
|-------------------------------------------------------------------------------------|-------------------|
| • 在整个数据表中添加了带有“N”后缀的器件.....                                                         | <a href="#">1</a> |
| • Changed absolute maximum voltage of VIN, EN and PG from 6V to 6.5V.....           | <a href="#">4</a> |
| • Updated block diagram to include devices with 'N' suffix (OUT instead of PG)..... | <a href="#">8</a> |

| <b>Changes from Revision B (July 2022) to Revision C (December 2023)</b>                                        | <b>Page</b>       |
|-----------------------------------------------------------------------------------------------------------------|-------------------|
| • Added DDC package option throughout the data sheet.....                                                       | <a href="#">3</a> |
| • Changed ESD Ratings CDM row from showing testing was per JESD22-C101 to show that testing was per JS-002..... | <a href="#">4</a> |
| • Changed block diagram PG circuit by swapping $V_{PG}$ and $V_{FB}$ .....                                      | <a href="#">8</a> |

| <b>Changes from Revision A (March 2022) to Revision B (July 2022)</b> | <b>Page</b>       |
|-----------------------------------------------------------------------|-------------------|
| • Added TPS62A02 and TPS62A02A.....                                   | <a href="#">3</a> |

## 11 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<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| TPS62A01ADRLR    | ACTIVE        | SOT-5X3      | DRL             | 6    | 4000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | 1J8                     | <a href="#">Samples</a> |
| TPS62A01DRLR     | ACTIVE        | SOT-5X3      | DRL             | 6    | 4000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | 1J7                     | <a href="#">Samples</a> |
| TPS62A02ADRLR    | ACTIVE        | SOT-5X3      | DRL             | 6    | 4000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | 1JM                     | <a href="#">Samples</a> |
| TPS62A02APDDCR   | ACTIVE        | SOT-23-THIN  | DDC             | 6    | 3000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | A02AP                   | <a href="#">Samples</a> |
| TPS62A02DRLR     | ACTIVE        | SOT-5X3      | DRL             | 6    | 4000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | 1JL                     | <a href="#">Samples</a> |
| TPS62A02PDDCR    | ACTIVE        | SOT-23-THIN  | DDC             | 6    | 3000        | RoHS & Green    | Call TI   SN                         | Level-1-260C-UNLIM   | -40 to 125   | A02P                    | <a href="#">Samples</a> |

(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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 TPS62A01, TPS62A01A :**

- Automotive : [TPS62A01-Q1](#), [TPS62A01A-Q1](#)

NOTE: Qualified Version Definitions:

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

## TAPE AND REEL INFORMATION



\*All dimensions are nominal

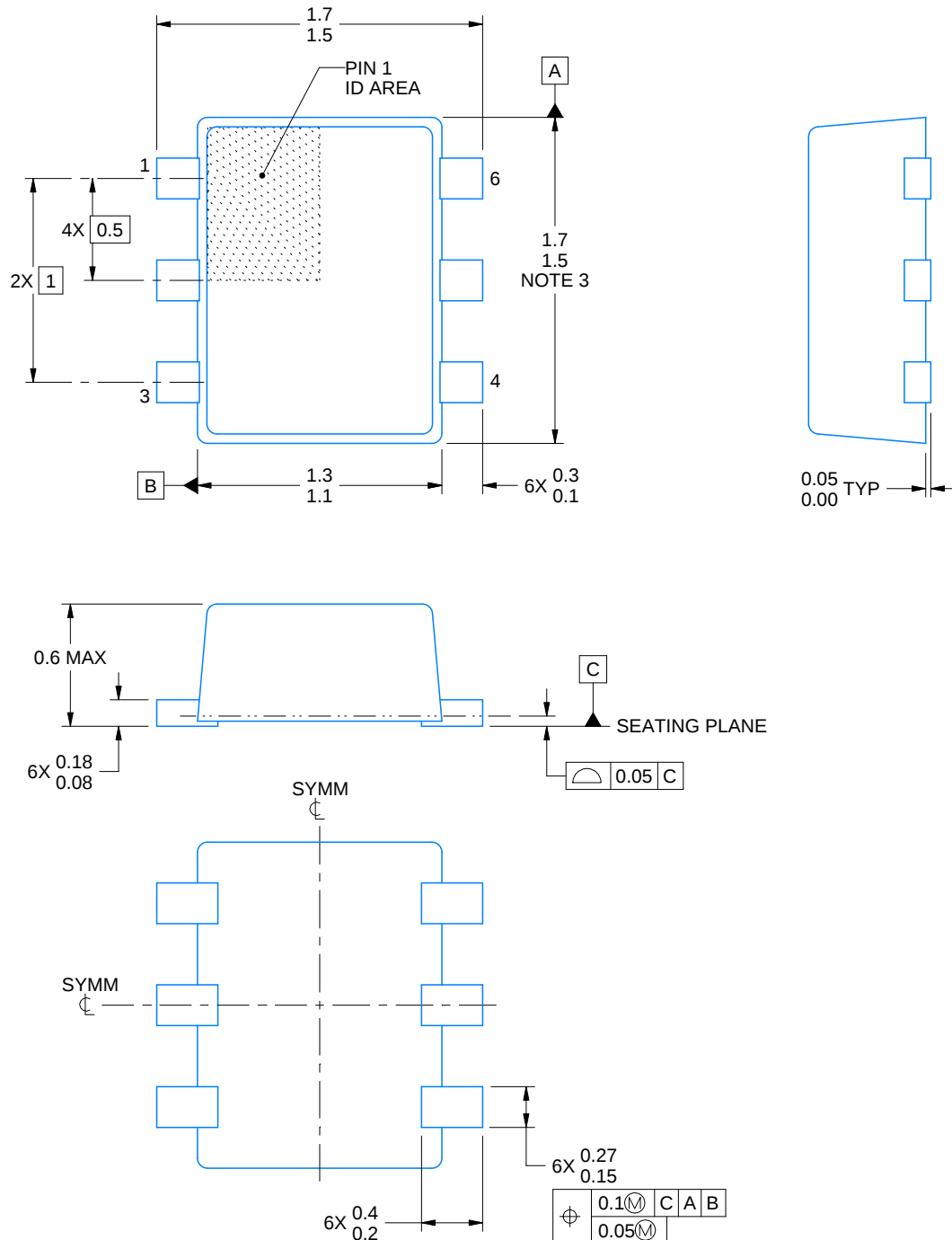
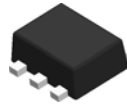
| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS62A01ADRLR  | SOT-5X3      | DRL             | 6    | 4000 | 180.0              | 8.4                | 2.0     | 1.8     | 0.75    | 4.0     | 8.0    | Q3            |
| TPS62A01DRLR   | SOT-5X3      | DRL             | 6    | 4000 | 180.0              | 8.4                | 2.0     | 1.8     | 0.75    | 4.0     | 8.0    | Q3            |
| TPS62A02ADRLR  | SOT-5X3      | DRL             | 6    | 4000 | 180.0              | 8.4                | 2.0     | 1.8     | 0.75    | 4.0     | 8.0    | Q3            |
| TPS62A02APDDCR | SOT-23-THIN  | DDC             | 6    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS62A02DRLR   | SOT-5X3      | DRL             | 6    | 4000 | 180.0              | 8.4                | 2.0     | 1.8     | 0.75    | 4.0     | 8.0    | Q3            |
| TPS62A02PDDCR  | SOT-23-THIN  | DDC             | 6    | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS62A01ADRLR  | SOT-5X3      | DRL             | 6    | 4000 | 210.0       | 185.0      | 35.0        |
| TPS62A01DRLR   | SOT-5X3      | DRL             | 6    | 4000 | 210.0       | 185.0      | 35.0        |
| TPS62A02ADRLR  | SOT-5X3      | DRL             | 6    | 4000 | 210.0       | 185.0      | 35.0        |
| TPS62A02APDDCR | SOT-23-THIN  | DDC             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS62A02DRLR   | SOT-5X3      | DRL             | 6    | 4000 | 210.0       | 185.0      | 35.0        |
| TPS62A02PDDCR  | SOT-23-THIN  | DDC             | 6    | 3000 | 210.0       | 185.0      | 35.0        |



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## NOTES:

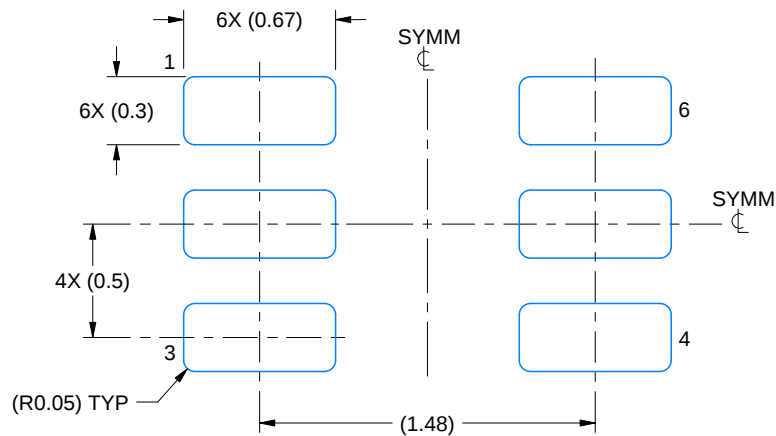
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-293 Variation UAAD

# EXAMPLE BOARD LAYOUT

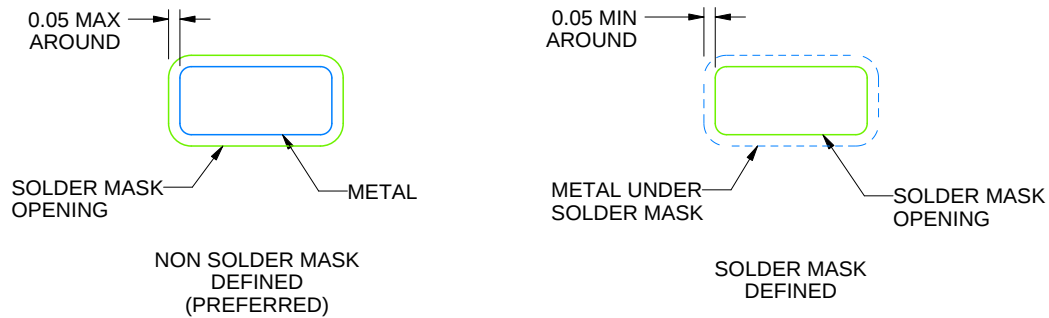
DRL0006A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE  
SCALE:30X



SOLDERMASK DETAILS

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NOTES: (continued)

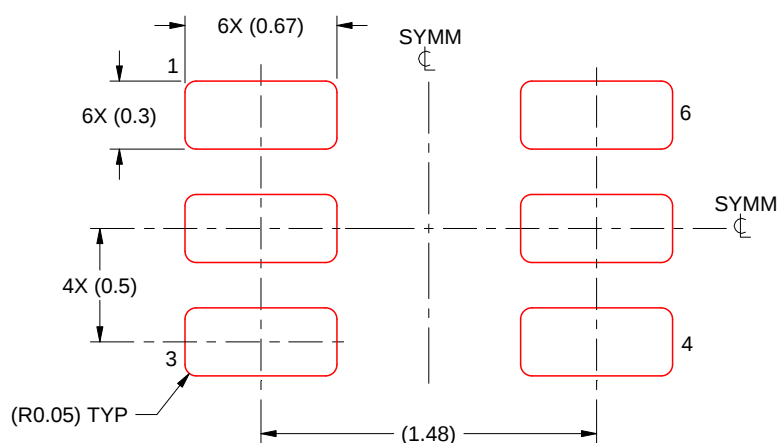
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
7. Land pattern design aligns to IPC-610, Bottom Termination Component (BTC) solder joint inspection criteria.

## EXAMPLE STENCIL DESIGN

DRL0006A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE

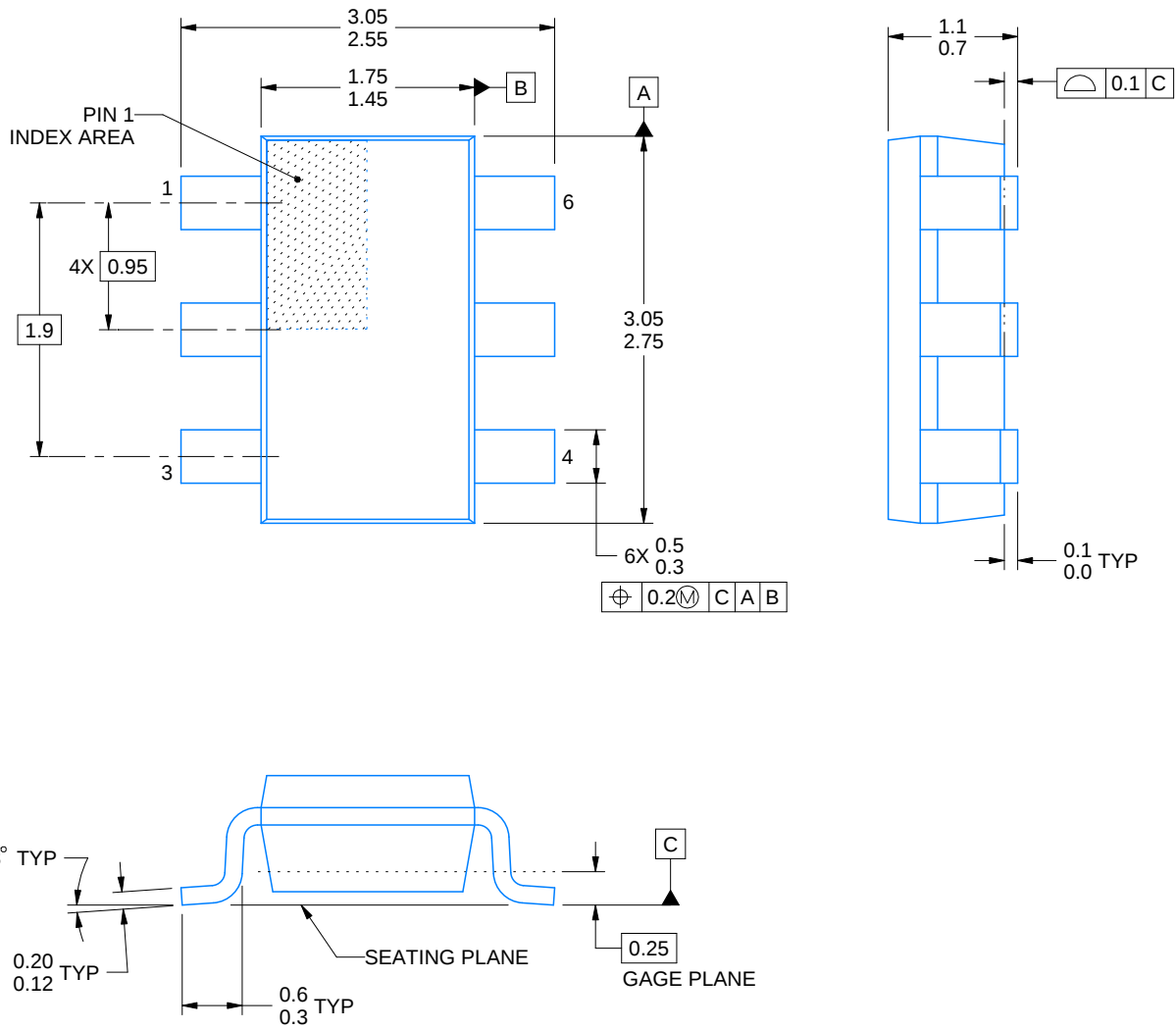


SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE:30X

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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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## NOTES:

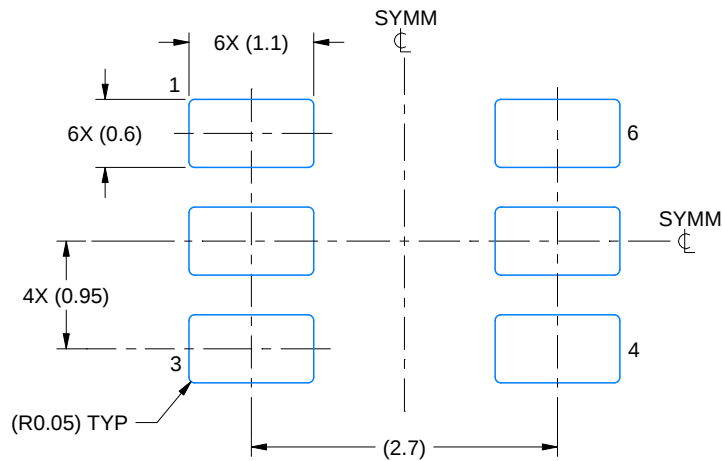
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-193.

# EXAMPLE BOARD LAYOUT

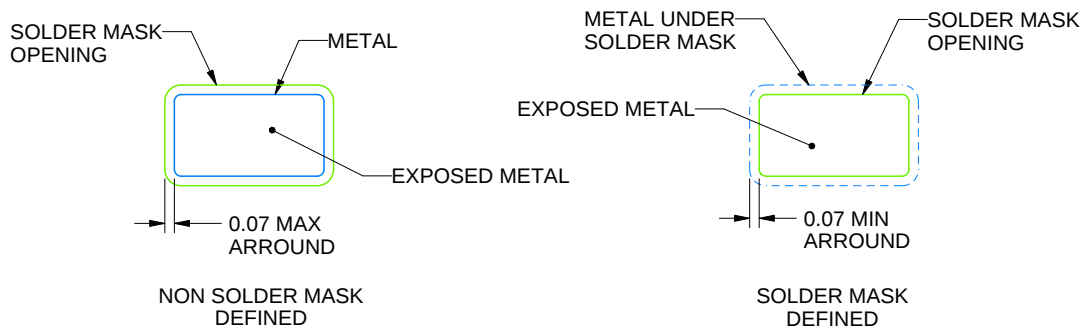
DDC0006A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPLODED METAL SHOWN  
SCALE:15X

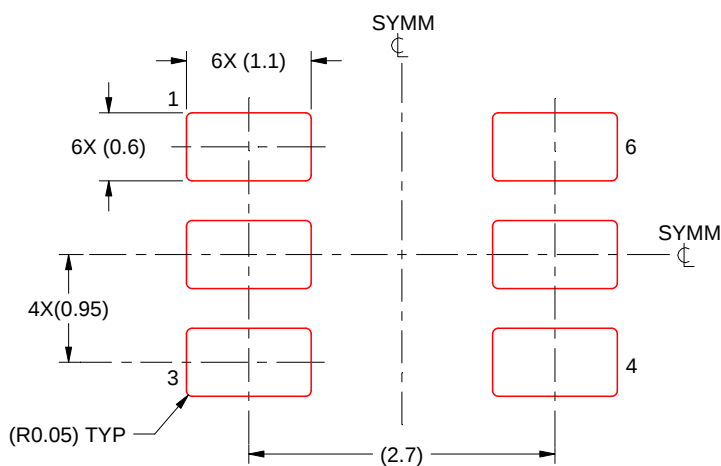


SOLDERMASK DETAILS

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NOTES: (continued)

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



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

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NOTES: (continued)

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

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