

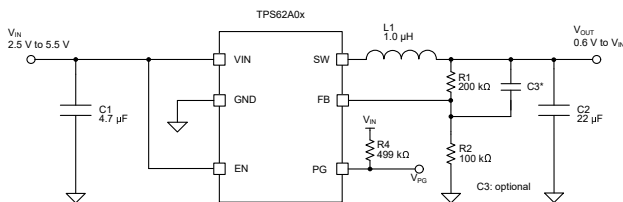
TPS62A0x, TPS62A0xA, and TPS62A02Nx 1A, 2A, High-Efficiency, Synchronous Buck Converters in a SOT-563 and a SOT-23 Package

1 Features

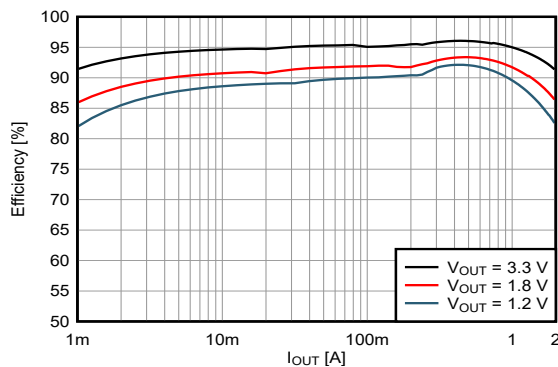
- 2.5V to 5.5V input voltage range
- 0.6V to V_{IN} adjustable output voltage range
- 180mΩ/120mΩ low $R_{DS(ON)}$ switches (1A DRL)
- 100mΩ/67mΩ low $R_{DS(ON)}$ switches (1A DDC, 2A)
- < 23μA quiescent current
- 1% feedback accuracy (0°C to 125°C)
- 100% mode operation
- 2.4MHz switching frequency
- Power save mode or PWM option available
- Power-good output pin (optional)
- Short-circuit protection (HICCUP)
- Internal soft start-up
- Active output discharge
- Thermal shutdown protection
- Pin-to-pin compatible with the [TLV62585 \(DRL\)](#)
- Pin-to-pin compatible with the [TLV62569 \(DDC\)](#)

2 Applications

- [Set top box, TV applications](#)
- [IP network camera, Multi-function printer](#)
- [Wireless router, solid state drive](#)
- [Battery-powered applications](#)
- General purpose point-of-load supply



Typical Application



Efficiency vs Output Current at 5V_{IN} (TPS62A02x)

3 Description

The TPS62A0x family of devices are synchronous step-down buck DC/DC converters optimized for high efficiency and compact design size. The devices integrate switches capable of delivering an output current up to 2A. At medium to heavy loads, the devices operate in pulse width modulation (PWM) mode with 2.4MHz switching frequency. At light load, the devices automatically enter power save mode (PSM) to maintain high efficiency over the entire load current range. In shutdown, the current consumption is minimal as well. The TPS62A0xA variants of this device family operate in forced PWM across the whole load current range.

The TPS62A0x devices provide an adjustable output voltage through an external resistor divider. An internal soft-start circuit limits the inrush current during start-up. Other features like overcurrent protection, thermal shutdown protection, and power good (optional) are built-in. The devices are available in a SOT563 and SOT23-6 package.

Package Information

| PART NUMBER | PACKAGE ⁽¹⁾ | PACKAGE SIZE ⁽²⁾ |
|-------------|------------------------|-----------------------------|
| TPS62A01x | DRL (SOT-563, 6) | 1.60mm × 1.60mm |
| | DDC (SOT-23, 6) | 2.90mm × 2.80mm |
| TPS62A02x | DRL (SOT-563, 6) | 1.60mm × 1.60mm |
| | DDC (SOT-23, 6) | 2.90mm × 2.80mm |
| TPS62A02Nx | DRL (SOT-563, 6) | 1.60mm × 1.60mm |

(1) For more information, see [Section 11](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.

Device Information

| PART NUMBER ⁽¹⁾ | OPERATION MODE | OUTPUT CURRENT | PIN 6 |
|----------------------------|----------------|----------------|-------|
| TPS62A01 | PSM, PWM | 1A | PG |
| TPS62A01A | FPWM | | |
| TPS62A02 | PSM, PWM | 2A | OUT |
| TPS62A02A | FPWM | | |
| TPS62A02N | PSM, PWM | | |
| TPS62A02NA | FPWM | | |

(1) See the [Device Comparison Table](#).



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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 | PSM, PWM | | OUT | | |
| TPS62A02ADRLR | FPWM | | | | |
| TPS62A02NDRLR | 2A | | PSM, PWM | PG | |
| TPS62A02NADRLR | | | FPWM | | |
| TPS62A01PDDCR | 1A | SOT-23, 6 | PSM, PWM | | PG |
| TPS62A01APDDCR | | | FPWM | | |
| TPS62A02PDDCR | 2A | | PSM, PWM | PG | |
| TPS62A02APDDCR | | | FPWM | | |

5 Pin Configuration and Functions

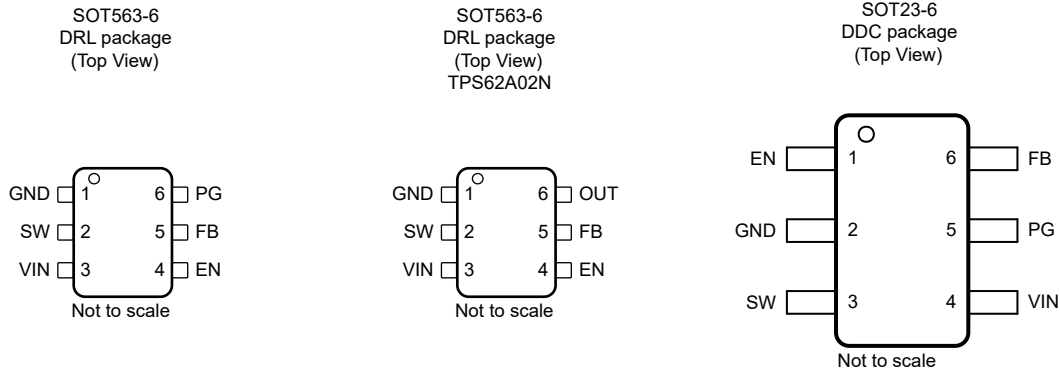


Figure 5-1. 6-Pin DRL SOT-563 Package (Top View), 6-Pin DDC SOT-23 Package (Top View)

Table 5-1. Pin Functions

| Name | Pin Number | | Type ⁽¹⁾ | Description |
|--------------------|------------|---------|---------------------|---|
| | 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 ⁽²⁾ | | / | 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 _{IN} 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) ⁽¹⁾

| | | MIN | MAX | UNIT |
|----------------------------|--------------------------------|------|-----------------------|------|
| Pin voltage ⁽²⁾ | VIN, EN, PG | -0.3 | 6.5 | V |
| | SW, DC | -0.3 | V _{IN} + 0.3 | V |
| | SW, transient < 10 ns | -3.0 | 10 | V |
| | FB | -0.3 | 3 | V |
| T _J | Operating junction temperature | -40 | 150 | °C |
| T _{stg} | 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 ⁽¹⁾ | ±2000 | V |
| | | Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002 ⁽²⁾ | ±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 |
|------------------|-------------------------------------|----------------------------------|-----|-----------------|------|
| V _{IN} | Input supply voltage range | 2.5 | | 5.5 | V |
| V _{OUT} | Output voltage range | 0.6 | | V _{IN} | V |
| I _{OUT} | Output current range | 0 | | 1 | A |
| I _{OUT} | Output current range ⁽¹⁾ | 0 | | 2 | A |
| L | Effective inductance | | 1.0 | | μH |
| C _{OUT} | Output capacitance | V _{OUT} < 1.2 V | 44 | | μF |
| C _{OUT} | Output capacitance | 1.2 V ≤ V _{OUT} < 1.8 V | 22 | | μF |
| C _{OUT} | Output capacitance | V _{OUT} ≥ 1.8 V | 10 | | μF |
| I _{PG} | Power Good input current capability | 0 | | 1 | mA |
| T _J | 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 ⁽¹⁾ | | TPS62A0x | TPS62A0x | UNIT |
|-------------------------------|--|----------|----------|------|
| | | DRL | DDC | |
| | | 6 PINS | 6 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 157.3 | 132.1 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 92.2 | 74.9 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 45.6 | 45.5 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 4.0 | 25.5 | °C/W |

6.4 Thermal Information (continued)

| THERMAL METRIC ⁽¹⁾ | | TPS62A0x | TPS62A0x | UNIT |
|-------------------------------|--|----------|----------|------|
| | | DRL | DDC | |
| | | 6 PINS | 6 PINS | |
| Ψ_{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 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 |
|-------------------------------|---|---|-----|------|-----|---------------|
| SUPPLY | | | | | | |
| $I_{Q(VIN)}$ | VIN quiescent current | Non-switching; $V_{EN} = \text{High}$; $V_{FB} = 610\text{ mV}$; TPS62A01xDRL | | 20 | | μA |
| $I_{Q(VIN)}$ | VIN quiescent current | Non-switching; $V_{EN} = \text{High}$; $V_{FB} = 610\text{ mV}$; TPS62A01xDDC; TPS62A02 | | 23 | | μA |
| $I_{SD(VIN)}$ | VIN shutdown supply current | $V_{EN} = \text{Low}$ | | 0.01 | 2 | μA |
| UVLO | | | | | | |
| $V_{UVLO(R)}$ | 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 |
| ENABLE | | | | | | |
| $V_{EN(R)}$ | 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 |
| REFERENCE VOLTAGE | | | | | | |
| V_{FB} | FB voltage | $T_J = 0^{\circ}\text{C}$ to 125°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 |
| SWITCHING FREQUENCY | | | | | | |
| $f_{SW(FCCM)}$ | Switching frequency, FPWM operation | $V_{IN} = 5\text{ V}$; $V_{OUT} = 1.8\text{ V}$ | | 2400 | | kHz |
| STARTUP | | | | | | |
| | Internal fixed soft-start time | From EN = High to $V_{FB} = 0.56\text{ V}$ | | | 1 | ms |
| POWER STAGE | | | | | | |
| $R_{DS(ON)(HS)}$ | High-side MOSFET on-resistance | TPS62A01xDRL; $V_{IN} = 5\text{ V}$ | | 180 | | m Ω |
| $R_{DS(ON)(LS)}$ | Low-side MOSFET on-resistance | TPS62A01xDRL; $V_{IN} = 5\text{ V}$ | | 120 | | m Ω |
| $R_{DS(ON)(HS)}$ | High-side MOSFET on-resistance | $V_{IN} = 5\text{ V}$; TPS62A01xDDC; TPS62A02 | | 100 | | m Ω |
| $R_{DS(ON)(LS)}$ | Low-side MOSFET on-resistance | $V_{IN} = 5\text{ V}$; TPS62A01xDDC; TPS62A02 | | 67 | | m Ω |
| OVERCURRENT PROTECTION | | | | | | |
| $I_{HS(OC)}$ | 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 |
| POWER GOOD | | | | | | |
| 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 | | μs |
| | PG delay rising | | | 10 | | μs |
| $I_{PG(LKG)}$ | 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 |
| OUTPUT DISCHARGE | | | | | | |

6.5 Electrical Characteristics (continued)

$T_J = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = 2.5\text{ V}$ to 5.5 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 |
|-------------------------|------------------------------------|---|-----|-----|-----|--------------------|
| | 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; TPS62A02 | | 76 | | mA |
| THERMAL SHUTDOWN | | | | | | |
| $T_{J(SD)}$ | Thermal shutdown threshold | Temperature rising | | 170 | | $^{\circ}\text{C}$ |
| $T_{J(HYS)}$ | Thermal shutdown hysteresis | | | 20 | | $^{\circ}\text{C}$ |

6.6 Typical Characteristics

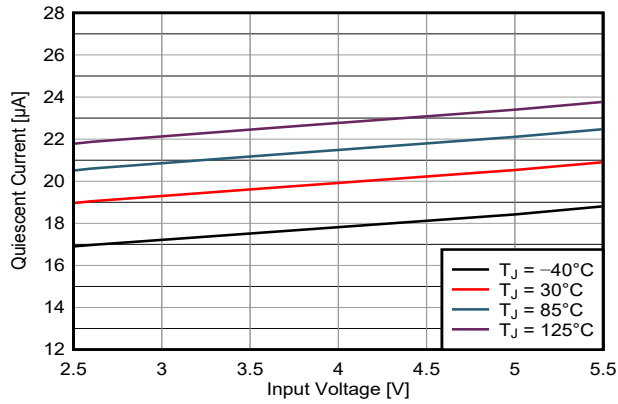


Figure 6-1. Quiescent Current vs Input Voltage (TPS62A01)

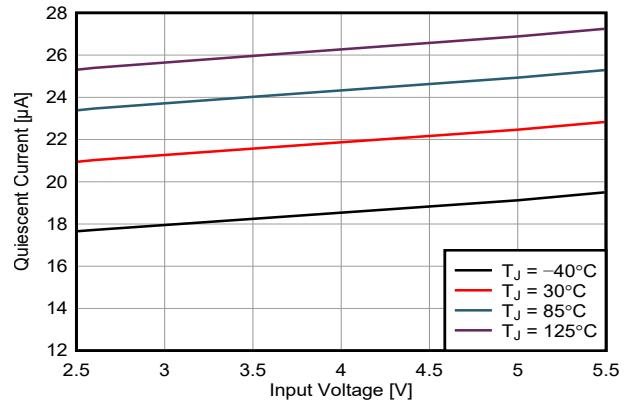


Figure 6-2. Quiescent Current vs Input Voltage (TPS62A02)

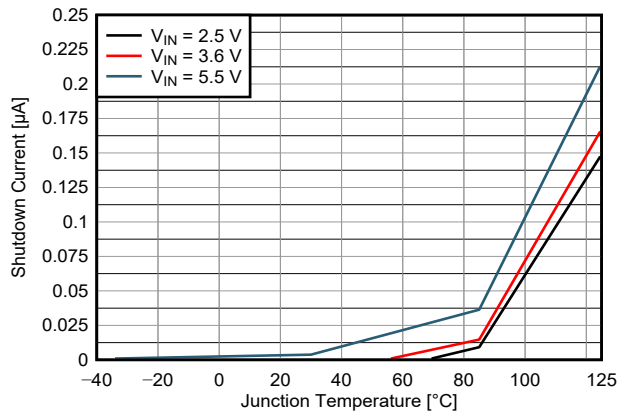


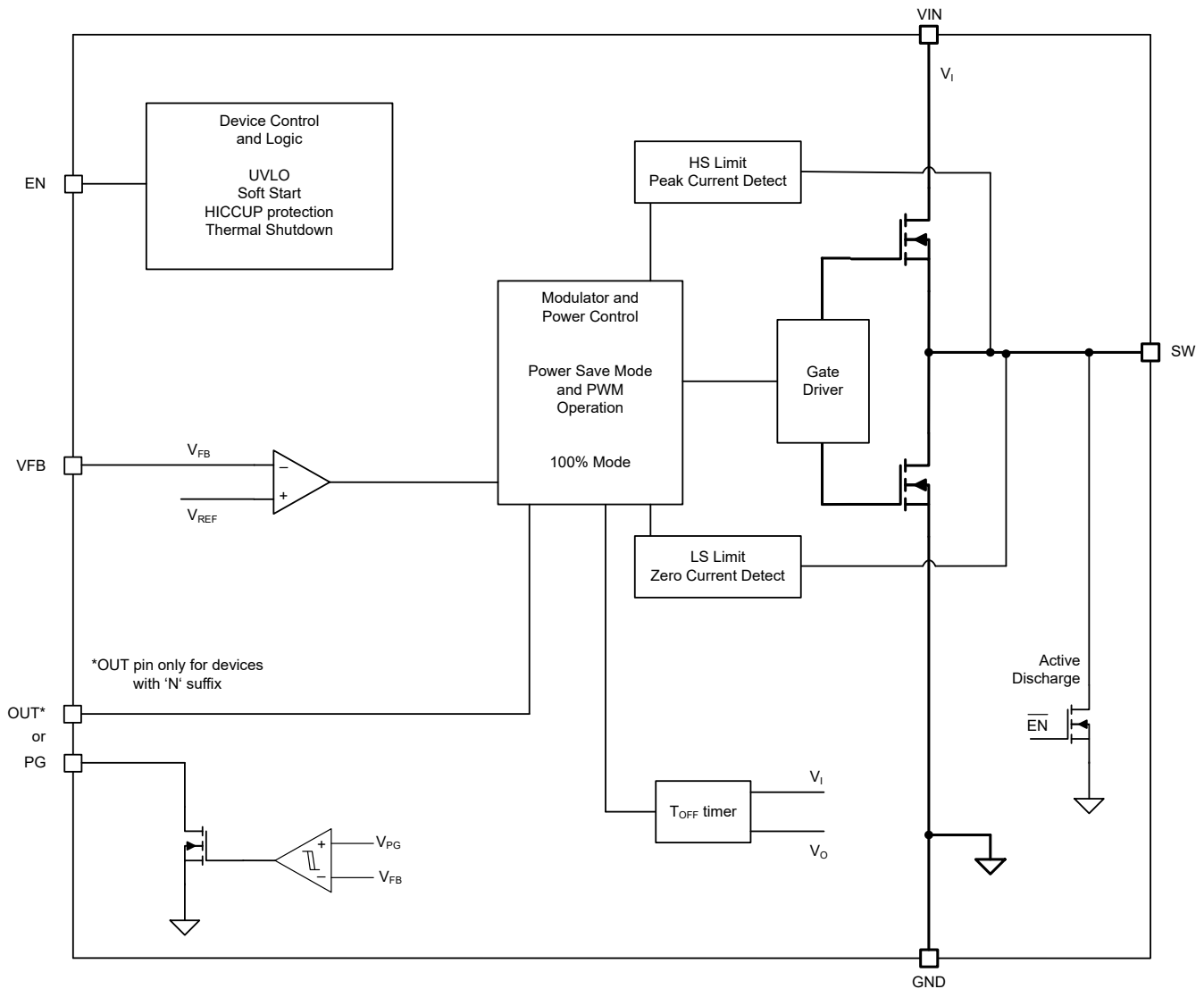
Figure 6-3. Shutdown Current vs Junction Temperature

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 100 μ s 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. V_{IN} 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.

Table 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 | |
| | LOW | YES | x | LOW |
| | LOW | x | x | LOW |
| $V_I < 1.8V$ | x | x | x | Undefined |

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, 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

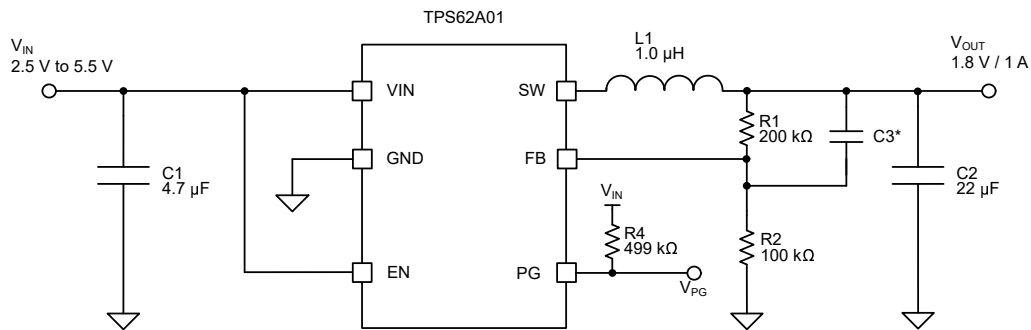


Figure 8-1. TPS62A01 Typical Application Circuit

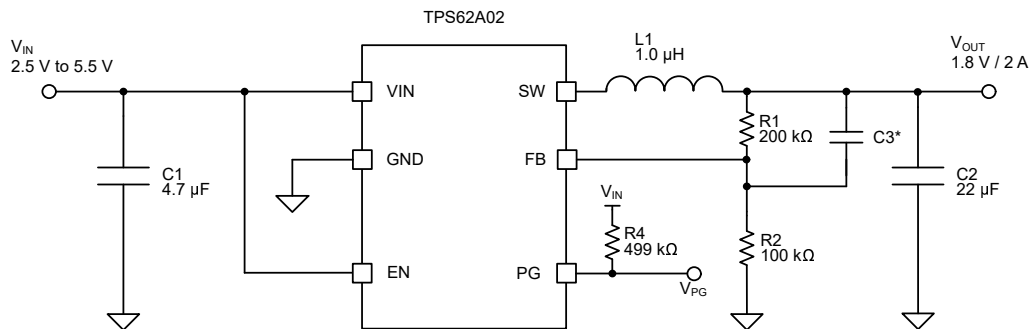


Figure 8-2. TPS62A02 Typical Application Circuit

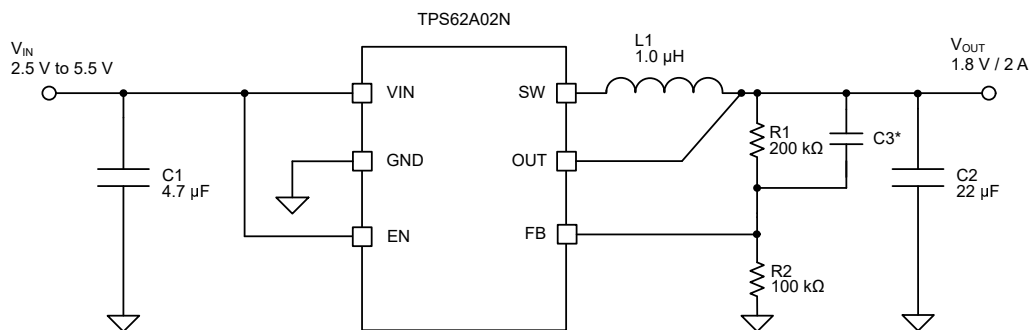


Figure 8-3. TPS62A02N Typical Application Circuit

*C3 is optional

8.2.1 Design Requirements

For this design example, use the parameters listed in [Table 8-1](#) as the input parameters

Table 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 |

[Table 8-2](#) lists the components used for the example.

Table 8-2. List of Components

| Reference | Description | Manufacturer ⁽¹⁾ |
|-----------|---|-----------------------------|
| 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 [Equation 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 100kΩ 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, [Table 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.

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

| V _{OUT} [V] | L [µH] ⁽¹⁾ | C _{OUT} [µF] ⁽²⁾ | | |
|------------------------------|-----------------------|--------------------------------------|-------------------|-------------------|
| | | 10 | 22 | 2 × 22 |
| 0.6 ≤ V _{OUT} < 1.2 | 1 | | + | ++ ⁽³⁾ |
| 1.2 ≤ V _{OUT} < 1.8 | | | ++ ⁽³⁾ | + |
| 1.8 ≤ V _{OUT} | | + ⁽⁴⁾ | ++ ⁽³⁾ | + |

- (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_{OUT} 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

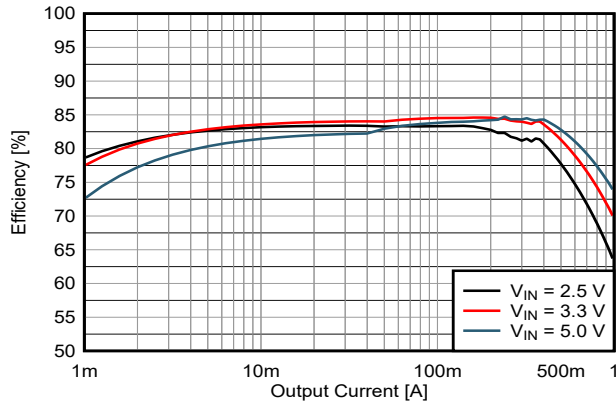
resistance up to high frequencies and to achieve narrow capacitance variation with temperature, TI recommends to use X7R or X5R dielectric.

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 μ F input capacitor is sufficient; a larger value reduces input voltage ripple.

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

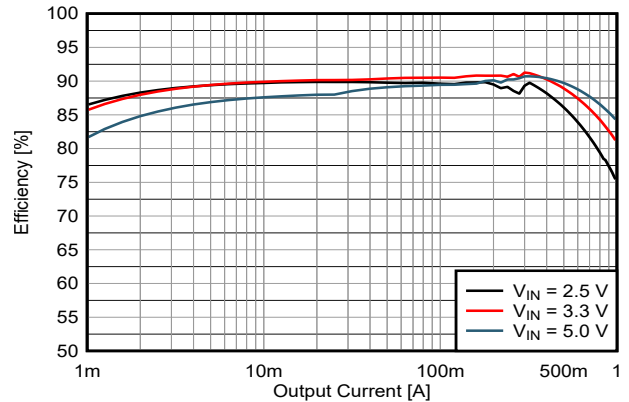
A feedforward capacitor reduces the output ripple in PSM and improves the load transient response. A 120pF capacitor is good for the 1.8V output typical application.

8.2.3 Application Curves



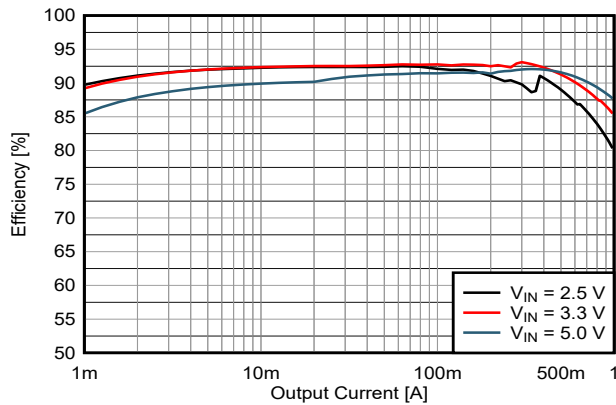
TPS62A01 (PSM/PWM) SOT-563 (DRL)

Figure 8-4. 0.6V Output Efficiency



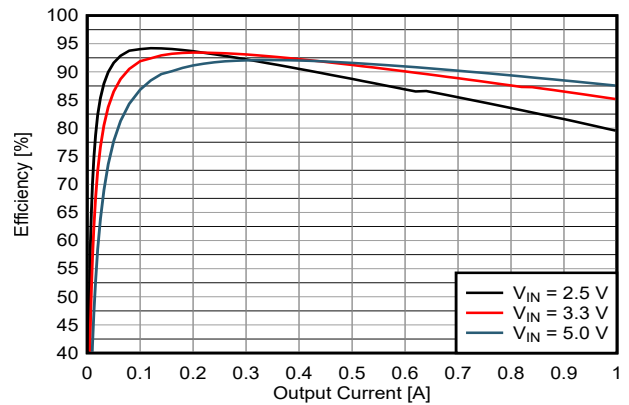
TPS62A01 (PSM/PWM) SOT-563 (DRL)

Figure 8-5. 1.2V Output Efficiency



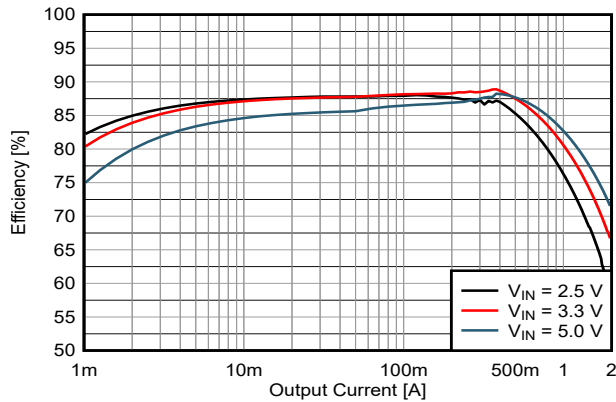
TPS62A01 (PSM/PWM) SOT-563 (DRL)

Figure 8-6. 1.8V Output Efficiency



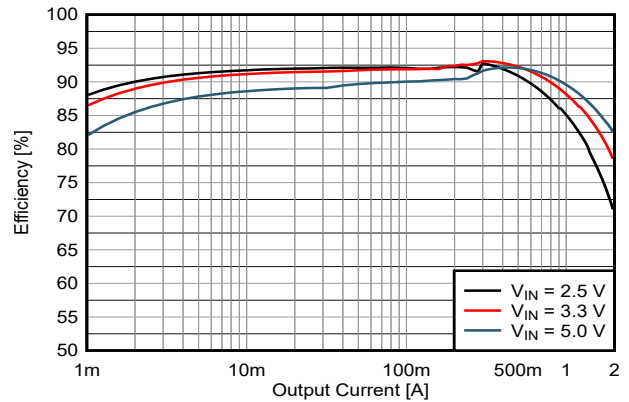
TPS62A01A (FPWM) SOT-563 (DRL)

Figure 8-7. 1.8V Output Efficiency



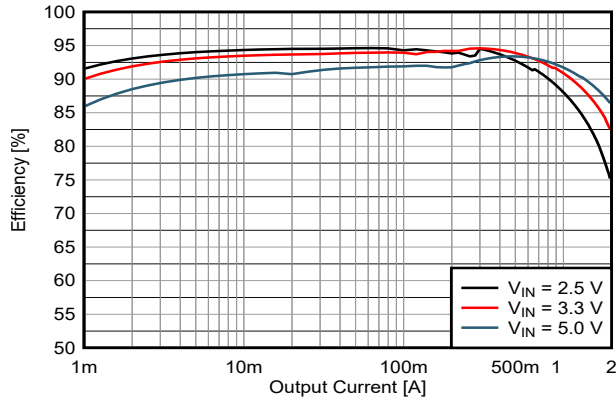
TPS62A02 (PSM/PWM) SOT-563 (DRL)

Figure 8-8. 0.6V Output Efficiency



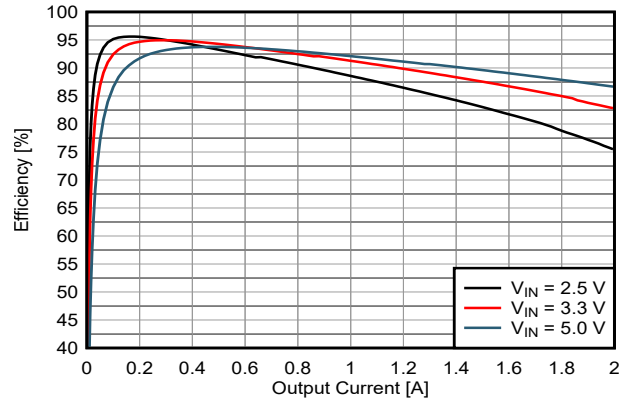
TPS62A02 (PSM/PWM) SOT-563 (DRL)

Figure 8-9. 1.2V Output Efficiency



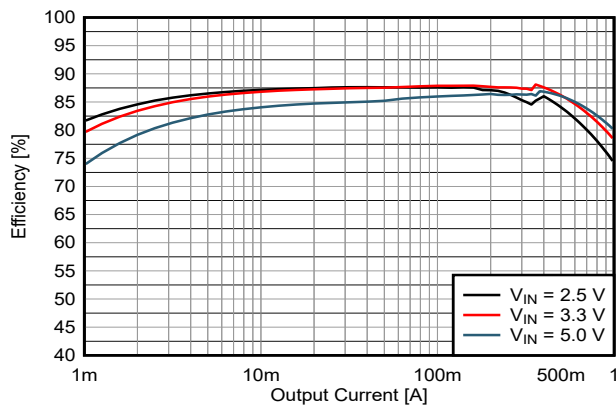
TPS62A02 (PSM/PWM) SOT-563 (DRL)

Figure 8-10. 1.8V Output Efficiency



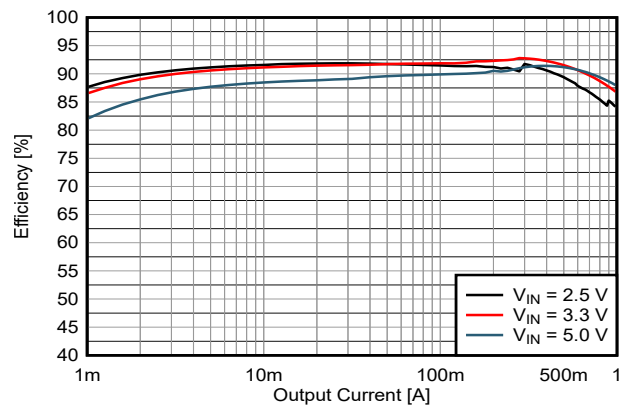
TPS62A02A (FPWM) SOT-563 (DRL)

Figure 8-11. 1.8V Output Efficiency



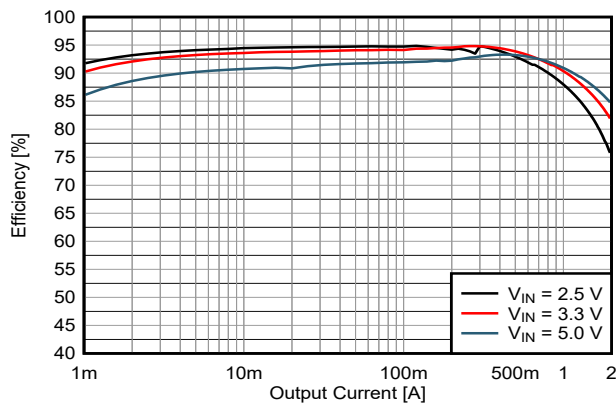
TPS62A01 (PSM/PWM) SOT-23 (DDC)

Figure 8-12. 0.6V Output Efficiency



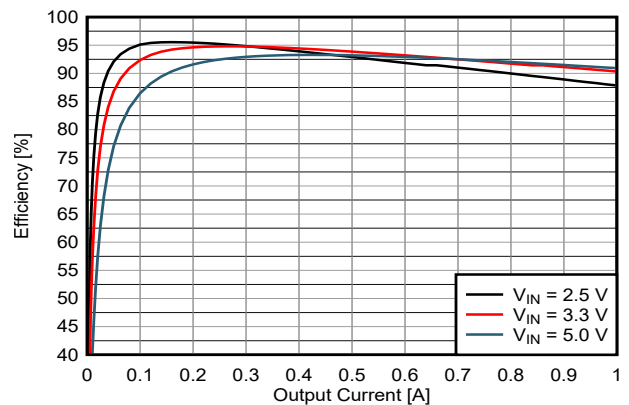
TPS62A01 (PSM/PWM) SOT-23 (DDC)

Figure 8-13. 1.2V Output Efficiency



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

Figure 8-14. 1.8V Output Efficiency



TPS62A01A (FPWM) SOT-23 (DDC)

Figure 8-15. 1.8V Output Efficiency

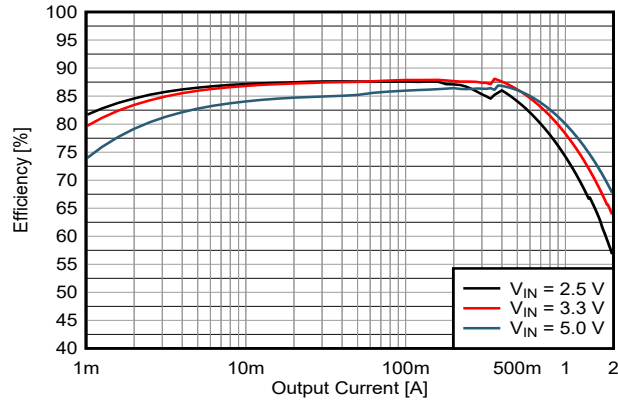


Figure 8-16. 0.6V Output Efficiency

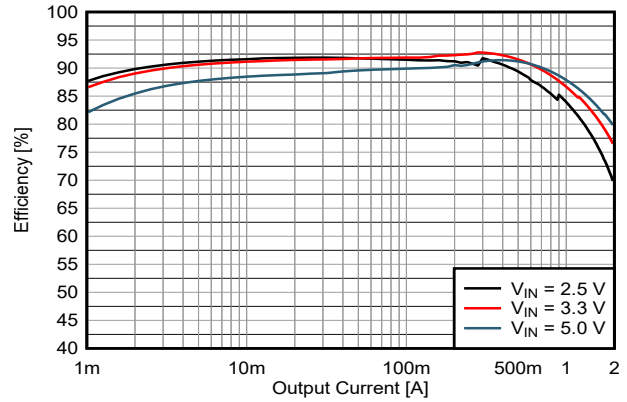


Figure 8-17. 1.2V Output Efficiency

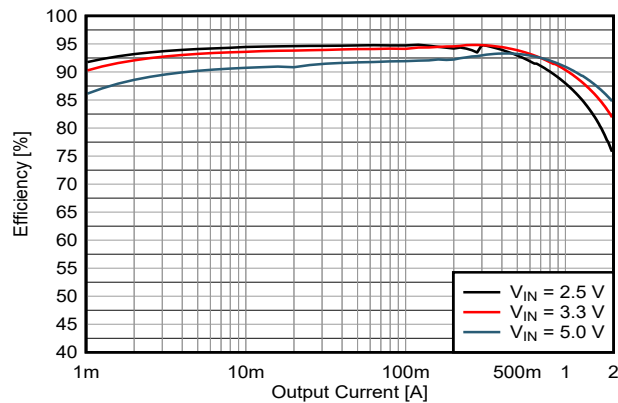


Figure 8-18. 1.8V Output Efficiency

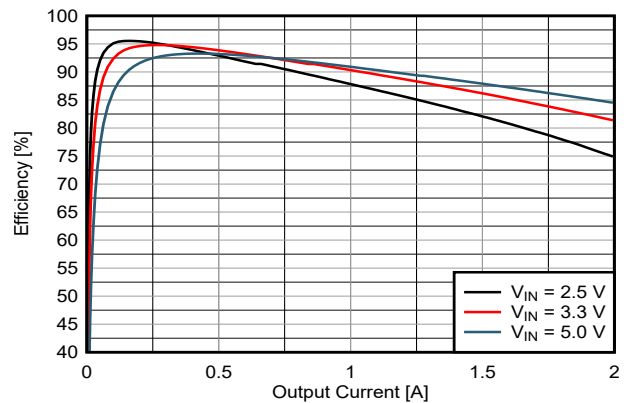


Figure 8-19. 1.8V Output Efficiency

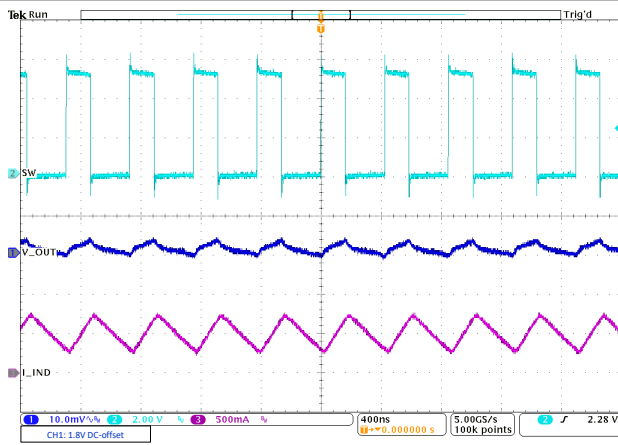


Figure 8-20. PWM Operation

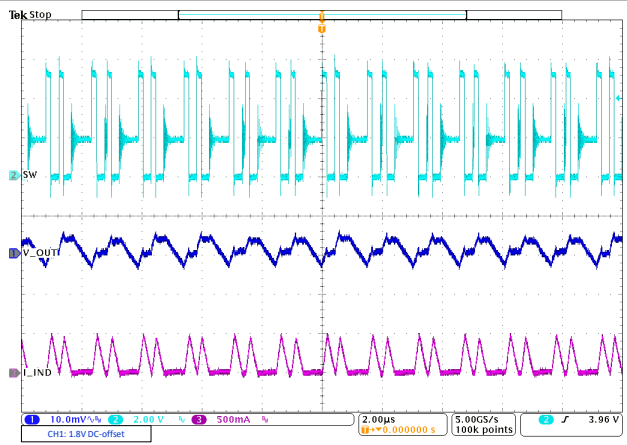
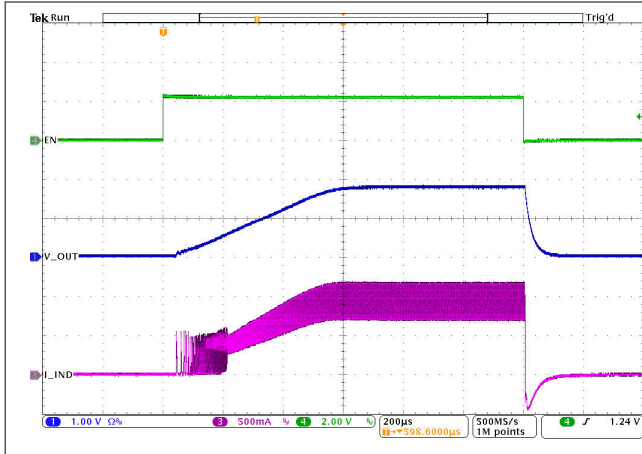
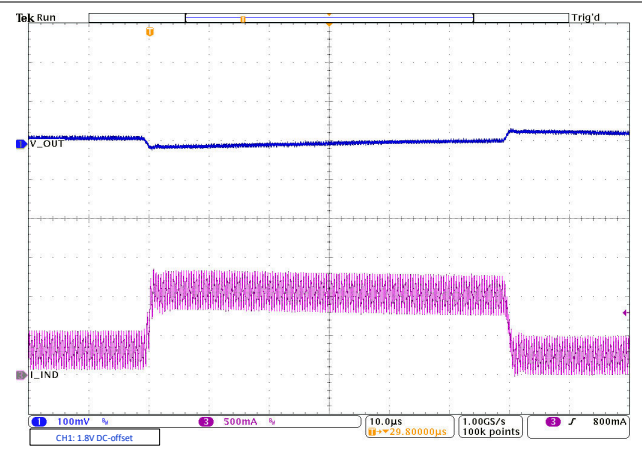


Figure 8-21. Power Save Mode Operation



$I_{OUT} = 1\text{ A}$

Figure 8-22. Start-Up with Load



Load step: 0.3 A to 1 A

Figure 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 [Figure 8-24](#) and [Figure 8-25](#) for the recommended PCB layout.

8.4.2 Layout Example

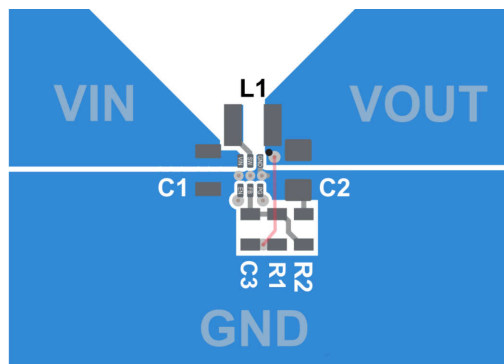


Figure 8-24. TPS62A0x (SOT563) PCB Layout Recommendation

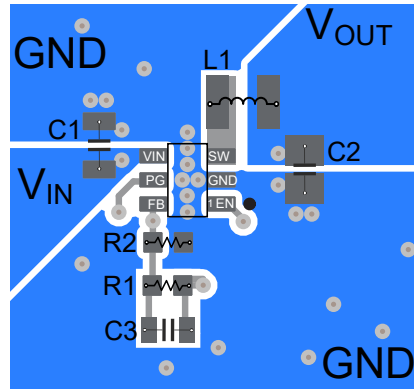


Figure 8-25. TPS62A0x (SOT23-6) PCB Layout Recommendation

9 Device and Documentation Support

9.1 Device Support

9.1.1 Third-Party Products Disclaimer

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9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* 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.

9.3 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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9.5 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.

9.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (April 2024) to Revision E (June 2024) Page

- Changed device status of TPS62A02Nx versions and devices in DDC package from preview to production throughout the data sheet.....3

Changes from Revision C (December 2023) to Revision D (April 2024) Page

- Added devices with 'N' suffix throughout the data sheet..... 1
- Changed absolute maximum voltage of VIN, EN and PG from 6V to 6.5V.....4
- Updated block diagram to include devices with 'N' suffix (OUT instead of PG)..... 8

Changes from Revision B (July 2022) to Revision C (December 2023) Page

- Added DDC package option throughout the data sheet..... 3
- Changed ESD Ratings CDM row from showing testing was per JESD22-C101 to show that testing was per JS-002..... 4
- Changed block diagram PG circuit by swapping V_{PG} and V_{FB} 8

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 (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 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| TPS62A01ADRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | 1J8 | Samples |
| TPS62A01APDDCR | ACTIVE | SOT-23-THIN | DDC | 6 | 3000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | A01AP | Samples |
| TPS62A01DRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | 1J7 | Samples |
| TPS62A01PDDCR | ACTIVE | SOT-23-THIN | DDC | 6 | 3000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | A01P | Samples |
| TPS62A02ADRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | 1JM | Samples |
| TPS62A02APDDCR | ACTIVE | SOT-23-THIN | DDC | 6 | 3000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | A02AP | Samples |
| TPS62A02DRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | 1JL | Samples |
| TPS62A02NADRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | 1SC | Samples |
| TPS62A02NDRLR | ACTIVE | SOT-5X3 | DRL | 6 | 4000 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 125 | 1SB | Samples |
| TPS62A02PDDCR | ACTIVE | SOT-23-THIN | DDC | 6 | 3000 | RoHS & Green | Call TI SN | Level-1-260C-UNLIM | -40 to 125 | A02P | 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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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

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

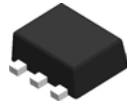
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 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 |

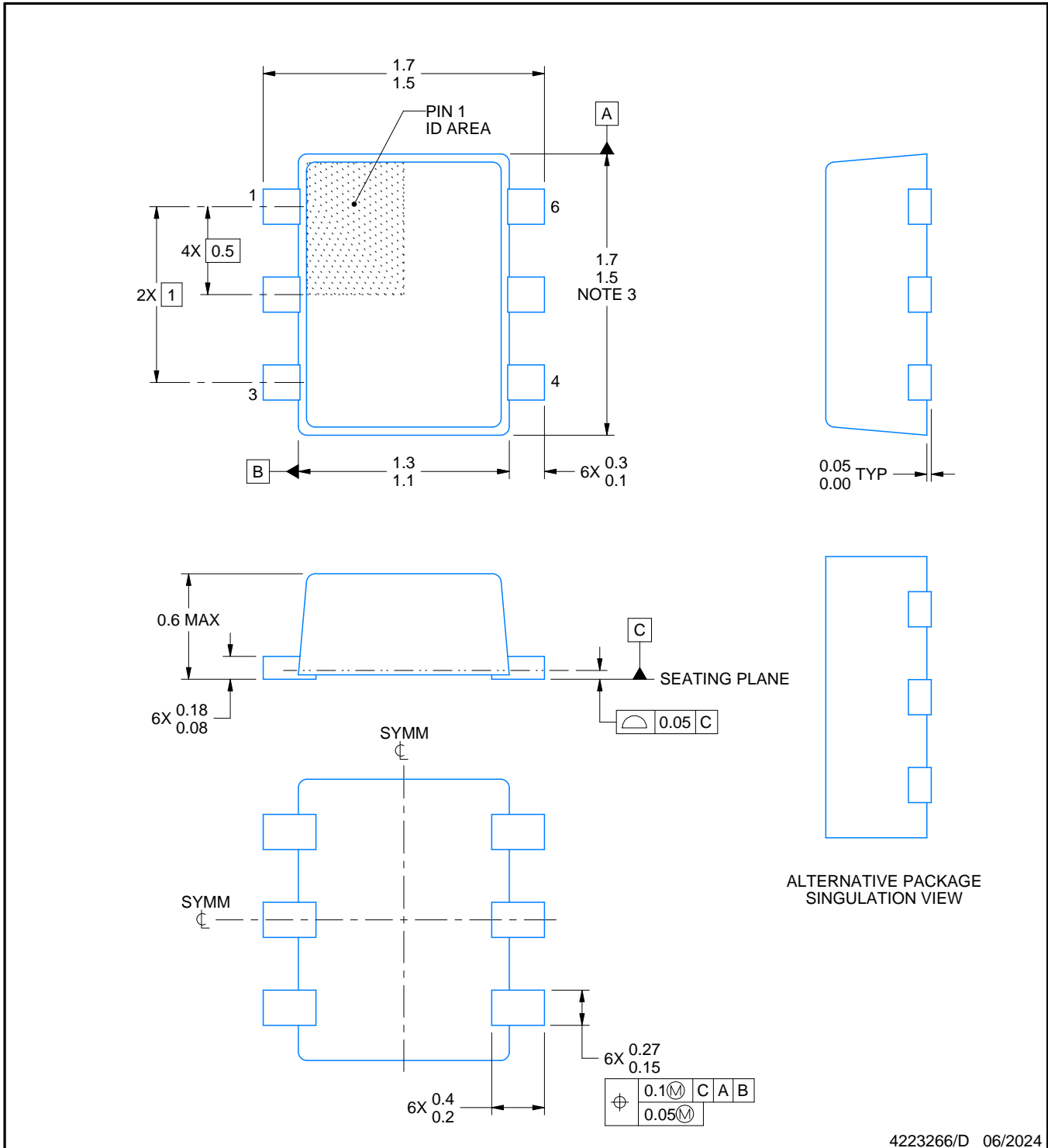
DRL0006A



PACKAGE OUTLINE

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



4223266/D 06/2024

NOTES:

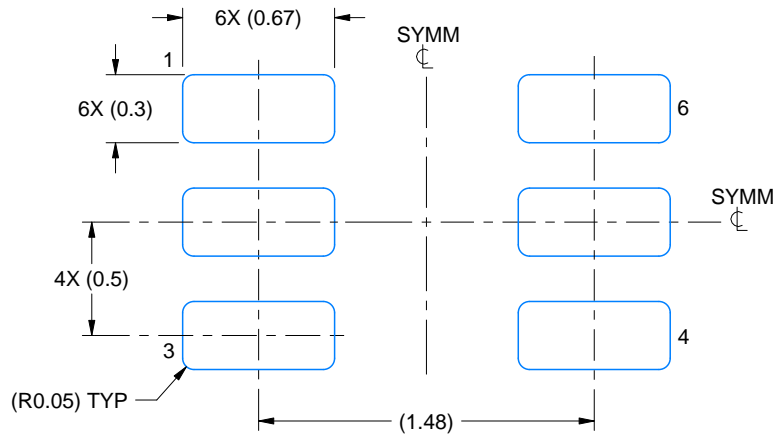
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

EXAMPLE BOARD LAYOUT

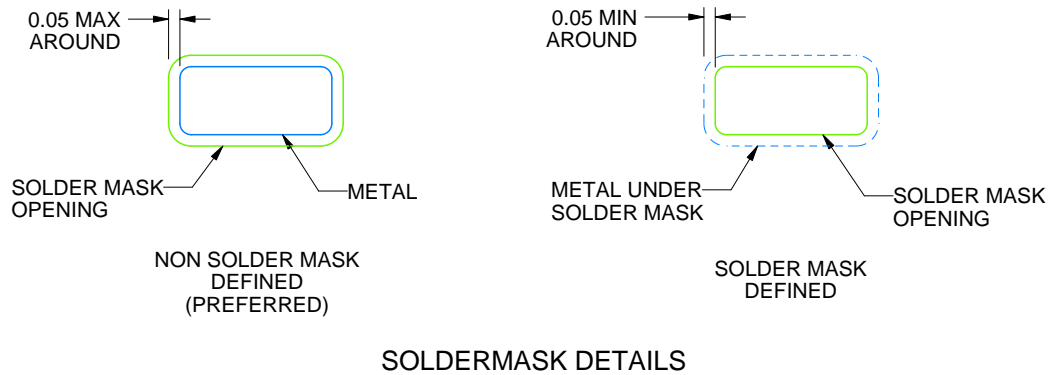
DRL0006A

SOT - 0.6 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE
SCALE:30X



SOLDERMASK DETAILS

4223266/D 06/2024

NOTES: (continued)

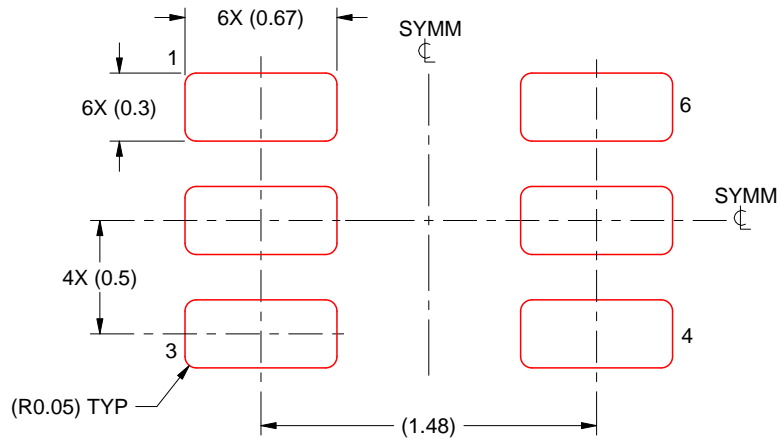
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
7. Land pattern design aligns to IPC-610, Bottom Termination Component (BTC) solder joint inspection criteria.

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

4223266/D 06/2024

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.

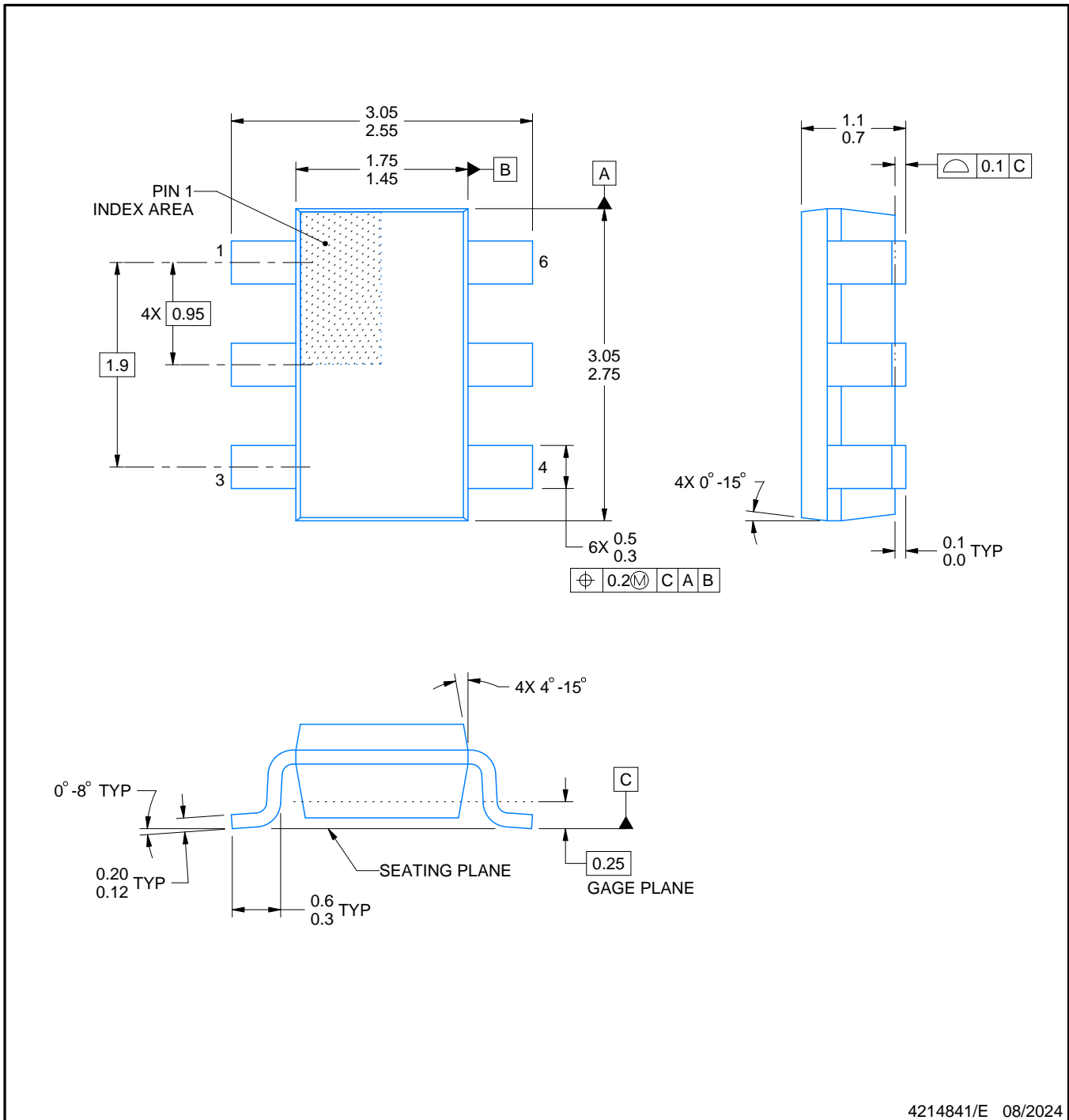
DDC0006A



PACKAGE OUTLINE

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



4214841/E 08/2024

NOTES:

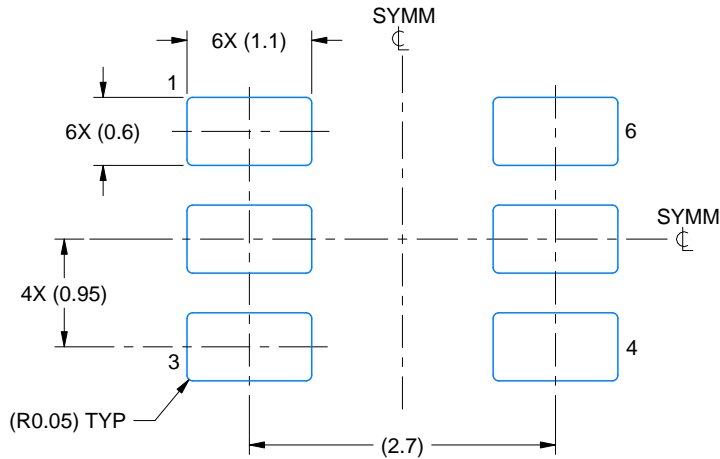
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-193.

EXAMPLE BOARD LAYOUT

DDC0006A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPLODED METAL SHOWN
SCALE:15X



SOLDEMASK DETAILS

4214841/E 08/2024

NOTES: (continued)

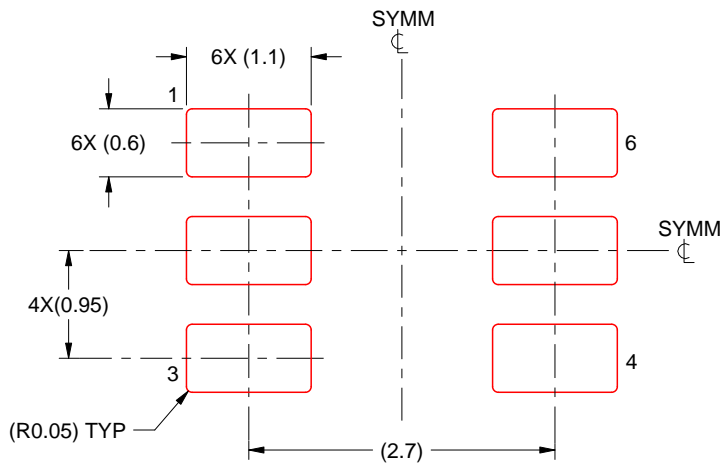
- 4. Publication IPC-7351 may have alternate designs.
- 5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DDC0006A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



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

4214841/E 08/2024

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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