

## TPS769xx-Q1 Ultralow-Power 100-mA Low-Dropout Linear Regulators

### 1 Features

- Qualified for Automotive Applications
- 100-mA Low-Dropout Regulator
- Available in 1.2-V, 1.5-V, 1.8-V, 2.5-V, 2.7-V, 2.8-V, 3-V, 3.3-V and 5-V Fixed-Output and Adjustable Versions
- Only 17- $\mu$ A Quiescent Current at 100 mA
- 1- $\mu$ A Quiescent Current in Standby Mode
- Dropout Voltage Typically 71 mV at 100 mA
- Overcurrent Limitation
- $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  Operating Junction Temperature Range
- 5-Pin SOT-23 (DBV) Package

### 2 Applications

- ADAS Modules
- RF Modules
- Wireless Modules
- General Noise-Sensitive Applications

### 3 Description

The TPS769xx-Q1 family of low-dropout (LDO) voltage regulators offers the benefits of low-dropout voltage, ultralow-power operation, and miniaturized packaging. These regulators feature low-dropout voltages and ultralow quiescent current compared to conventional LDO regulators. Offered in a 5-pin small outline integrated-circuit SOT-23 package, the TPS769xx-Q1 series of devices are ideal for micropower operations and where board space is at a premium.

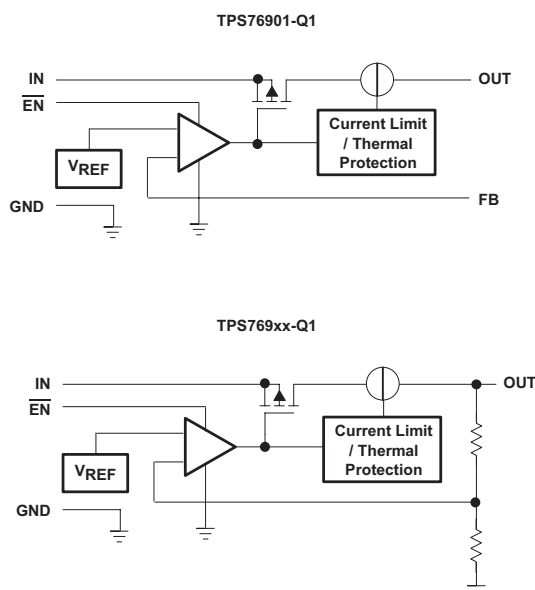
A combination of new circuit design and process innovation has enabled the usual PNP pass transistor to be replaced by a PMOS pass element. Because the PMOS pass element behaves as a low-value resistor, the dropout voltage is very low, typically 71 mV at 100 mA of load current (TPS76950-Q1), and is directly proportional to the load current. Because the PMOS pass element is a voltage-driven device, the quiescent current is ultralow (28  $\mu$ A maximum) and is stable over the entire range of output load current (0 mA to 100 mA). The ultralow-dropout voltage feature and ultralow-power operation result in a significant increase in system battery operating life, making this device suitable for use in automotive applications.

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

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)   |
|-------------|------------|-------------------|
| TPS769xx-Q1 | SOT-23 (5) | 2.90 mm x 1.60 mm |

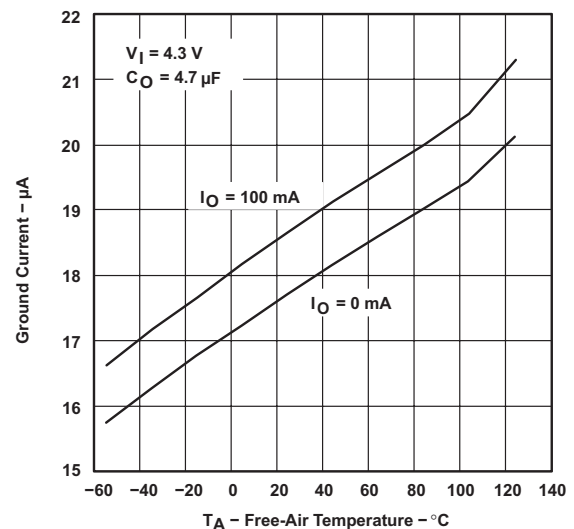
(1) For all available packages, see the orderable addendum at the end of the data sheet.

#### Functional Block Diagrams



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#### TPS76933-Q1 Ground Current vs Free-Air Temperature



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## 4 Revision History

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

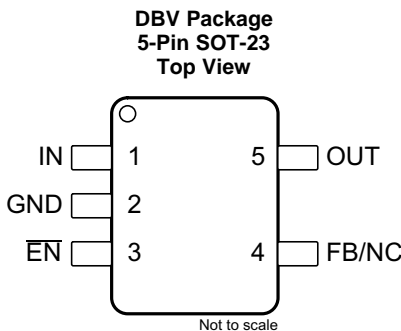
| <b>Changes from Revision C (June 2012) to Revision D</b>  | <b>Page</b> |
|---|-------------|
| • Added <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | <b>1</b>    |
| • Removed <i>Ordering Information</i> table, see POA at the end of the data sheet.....  | <b>1</b>    |

| <b>Changes from Revision B (April 2008) to Revision C</b>                              | <b>Page</b> |
|--|-------------|
| • Changed TPS769xx part names to TPS769xx-Q1 in text and images. ....                  | <b>3</b>    |
| • Updated Figures 17 and 19 to include region of Instability below 0.2 $\Omega$ . .... | <b>9</b>    |

## 5 Description (continued)

The TPS769xx-Q1 devices also feature a logic-enabled sleep mode to shut down the regulator, reducing quiescent current to 1  $\mu$ A (typical) at  $T_J = 25^\circ\text{C}$ . The TPS769xx-Q1 devices are offered in 1.2-V, 1.5-V, 1.8-V, 2.5-V, 2.7-V, 2.8-V, 3-V, 3.3-V, and 5-V fixed-voltage versions and in a variable version (programmable over the range of 1.2 V to 5.5 V).

## 6 Pin Configuration and Functions



### Pin Functions

| PIN |                        | I/O | DESCRIPTION   |
|-----|------------------------|-----|---|
| NO. | NAME                   |     |   |
| 1   | IN                     | I   | Input supply voltage  |
| 2   | GND                    | —   | Ground  |
| 3   | $\overline{\text{EN}}$ | I   | Enable input  |
| 4   | FB/NC                  | I   | Feedback voltage (TPS76901-Q1 only)<br>No connection (Fixed options only) |
| 5   | OUT                    | O   | Regulated output voltage  |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

|  | MIN                                     | MAX         | UNIT             |
|--|---|-------------|------------------|
| Input voltage <sup>(2)</sup>                 | −0.3                                    | 13.5        | V                |
| Voltage range at $\overline{\text{EN}}$      | −0.3                                    | $V_I + 0.3$ | V                |
| Voltage on OUT, FB                           |   | 7           | V                |
| Peak output current                          | Internally Limited                      |             |                  |
| Continuous total power dissipation           | See <a href="#">Dissipation Ratings</a> |             |                  |
| $T_J$ Operating virtual junction temperature | −40                                     | 150         | $^\circ\text{C}$ |
| $T_{\text{stg}}$ Storage temperature         | −65                                     | 150         | $^\circ\text{C}$ |

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

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

### 7.2 ESD Ratings

|  |  | VALUE      | UNIT |
|--|--|------------|------|
| $V_{\text{ESD}}$ Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | $\pm 2000$ | V    |
|  | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | $\pm YYY$  |      |

(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.

### 7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|       |  | MIN | MAX | UNIT |
|-------|--|-----|-----|------|
| $V_I$ | Input voltage <sup>(1)</sup>             | 2.7 | 10  | V    |
| $V_O$ | Output voltage                           | 1.2 | 5.5 | V    |
| $I_O$ | Continuous output current <sup>(2)</sup> | 0   | 100 | mA   |
| $T_J$ | Operating junction temperature           | –40 | 125 | °C   |

- (1) To calculate the minimum input voltage for your maximum output current, use the following formula:  $V_I(\text{min}) = V_O(\text{max}) + V_{DO}(\text{max load})$   
 (2) Continuous output current and operating junction temperature are limited by internal protection circuitry, but it is not recommended that the device operate under conditions beyond those specified in this table for extended periods of time.

### 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | TPS769xx-Q1  | UNIT |
|-------------------------------|--|--------------|------|
|                               |  | DBV (SOT-23) |      |
|                               |  | 5 PINS       |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 204.6        | °C/W |
| $R_{\theta JC(\text{top})}$   | Junction-to-case (top) thermal resistance    | 117.5        | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 34.4         | °C/W |
| $\psi_{JT}$                   | Junction-to-top characterization parameter   | 11.8         | °C/W |
| $\psi_{JB}$                   | Junction-to-board characterization parameter | 33.5         | °C/W |
| $R_{\theta JC(\text{bot})}$   | Junction-to-case (bottom) thermal resistance | —            | °C/W |

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

### 7.5 Electrical Characteristics

over recommended operating free-air temperature range,  $V_I = V_O(\text{typ}) + 1\text{ V}$ ,  $I_O = 100\text{ mA}$ ,  $\overline{EN} = 0\text{ V}$ ,  $C_O = 4.7\text{ }\mu\text{F}$  (unless otherwise noted)

| PARAMETER   |  | TEST CONDITIONS  |      | MIN        | TYP        | MAX | UNIT |
|---|--|--|------|------------|------------|-----|------|
| Output voltage<br>(10 $\mu\text{A}$ to 100 mA<br>load) <sup>(1)</sup> | TPS76901-Q1  | $1.2\text{ V} \leq V_O \leq 5.5\text{ V}$ , $T_J = 25^\circ\text{C}$                         |      | $V_O$      |            |     | V    |
|   |  | $1.2\text{ V} \leq V_O \leq 5.5\text{ V}$ , $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ |      | $0.97 V_O$ | $1.03 V_O$ |     |      |
|   | TPS76912-Q1  | $T_J = 25^\circ\text{C}$ , $2.7\text{ V} < V_{IN} < 10\text{ V}$                             |      | 1.224      |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $2.7\text{ V} < V_{IN} < 10\text{ V}$     |      | 1.187      | 1.261      |     |      |
|   | TPS76915-Q1  | $T_J = 25^\circ\text{C}$ , $2.7\text{ V} < V_{IN} < 10\text{ V}$                             |      | 1.5        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $2.7\text{ V} < V_{IN} < 10\text{ V}$     |      | 1.455      | 1.545      |     |      |
|   | TPS76918-Q1  | $T_J = 25^\circ\text{C}$ , $2.8\text{ V} < V_{IN} < 10\text{ V}$                             |      | 1.8        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $2.8\text{ V} < V_{IN} < 10\text{ V}$     |      | 1.746      | 1.854      |     |      |
|   | TPS76925-Q1  | $T_J = 25^\circ\text{C}$ , $3.5\text{ V} < V_{IN} < 10\text{ V}$                             |      | 2.5        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $3.5\text{ V} < V_{IN} < 10\text{ V}$     |      | 2.425      | 2.575      |     |      |
|   | TPS76927-Q1  | $T_J = 25^\circ\text{C}$ , $3.7\text{ V} < V_{IN} < 10\text{ V}$                             |      | 2.7        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $3.7\text{ V} < V_{IN} < 10\text{ V}$     |      | 2.619      | 2.781      |     |      |
|   | TPS76928-Q1  | $T_J = 25^\circ\text{C}$ , $3.8\text{ V} < V_{IN} < 10\text{ V}$                             |      | 2.8        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $3.8\text{ V} < V_{IN} < 10\text{ V}$     |      | 2.716      | 2.884      |     |      |
|   | TPS76930-Q1  | $T_J = 25^\circ\text{C}$ , $4\text{ V} < V_{IN} < 10\text{ V}$                               |      | 3          |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $4\text{ V} < V_{IN} < 10\text{ V}$       |      | 2.91       | 3.09       |     |      |
|   | TPS76933-Q1  | $T_J = 25^\circ\text{C}$ , $4.3\text{ V} < V_{IN} < 10\text{ V}$                             |      | 3.3        |            |     |      |
|   |  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $4.3\text{ V} < V_{IN} < 10\text{ V}$     |      | 3.201      | 3.399      |     |      |
| TPS76950-Q1   | $T_J = 25^\circ\text{C}$ , $6\text{ V} < V_{IN} < 10\text{ V}$                         |  | 5    |            |            |     |      |
|   | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ , $6\text{ V} < V_{IN} < 10\text{ V}$ |  | 4.85 | 5.15       |            |     |      |

- (1) Minimum IN operating voltage is 2.7 V or  $V_O(\text{typ}) + 1\text{ V}$ , whichever is greater. The maximum IN voltage is 10 V, minimum output current is 10  $\mu\text{A}$ , and maximum output current is 100 mA.

## Electrical Characteristics (continued)

over recommended operating free-air temperature range,  $V_I = V_O$  (typ) + 1 V,  $I_O = 100$  mA,  $\overline{EN} = 0$  V,  $C_O = 4.7$   $\mu$ F (unless otherwise noted)

| PARAMETER  | TEST CONDITIONS  | MIN  | TYP  | MAX | UNIT                   |
|--|--|--|------|-----|------------------------|
| Quiescent current (GND current) <sup>(1)(2)</sup>                  | $\overline{EN} = 0$ V, $0$ mA < $I_O$ < $100$ mA, $T_J = 25^\circ\text{C}$                     |  | 17   |     | $\mu$ A                |
|  | $\overline{EN} = 0$ V, $I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$        |  |      | 28  |                        |
| Load regulation  | $\overline{EN} = 0$ V, $I_O = 0$ to $100$ mA, $T_J = 25^\circ\text{C}$                         |  | 12   |     | mV                     |
| Output voltage line regulation ( $\Delta V_O/V_O$ ) <sup>(2)</sup> | $V_O + 1$ V < $V_I \leq 10$ V, $T_J = 25^\circ\text{C}$ <sup>(1)</sup>                         |  | 0.04 |     | %V                     |
|  | $V_O + 1$ V < $V_I \leq 10$ V, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ <sup>(1)</sup> |  |      | 0.1 |                        |
| Output noise voltage   | BW = $300$ Hz to $50$ kHz, $C_O = 10$ $\mu$ F, $T_J = 25^\circ\text{C}$                        |  | 190  |     | $\mu$ V <sub>rms</sub> |
| Output current limit   | $V_O = 0$ V <sup>(1)</sup>   |  | 350  | 750 | mA                     |
| Standby current  | $\overline{EN} = V_I$ , $2.7$ V < $V_I$ < $10$ V   |  | 1    |     | $\mu$ A                |
|  | $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$   |  |      | 2   |                        |
| FB input current   | FB = $1.224$ V (TPS76901-Q1)   | -1   |      | 1   | $\mu$ A                |
| High level enable input voltage                                    | $2.7$ V < $V_I$ < $10$ V   | 1.7  |      |     | V                      |
| Low level enable input voltage                                     | $2.7$ V < $V_I$ < $10$ V   |  |      | 0.9 | V                      |
| Power supply ripple rejection                                      | f = $1$ kHz, $C_O = 10$ $\mu$ F, $T_J = 25^\circ\text{C}$                                      |  | 60   |     | dB                     |
| Input current ( $\overline{EN}$ )                                  | $\overline{EN} = 0$ V  | -1   | 0    | 1   | $\mu$ A                |
|  | $\overline{EN} = V_I$  | -1   |      | 1   |                        |
| Dropout voltage <sup>(3)</sup>                                     | TPS76928-Q1  | $I_O = 50$ mA, $T_J = 25^\circ\text{C}$                          |      | 60  | mV                     |
|  |  | $I_O = 50$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$  |      | 125 |                        |
|  |  | $I_O = 100$ mA, $T_J = 25^\circ\text{C}$                         |      | 122 |                        |
|  |  | $I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ |      | 245 |                        |
|  | TPS76930-Q1  | $I_O = 50$ mA, $T_J = 25^\circ\text{C}$                          |      | 57  |                        |
|  |  | $I_O = 50$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$  |      | 115 |                        |
|  |  | $I_O = 100$ mA, $T_J = 25^\circ\text{C}$                         |      | 115 |                        |
|  |  | $I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ |      | 230 |                        |
|  | TPS76933-Q1  | $I_O = 50$ mA, $T_J = 25^\circ\text{C}$                          |      | 48  |                        |
|  |  | $I_O = 50$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$  |      | 100 |                        |
|  |  | $I_O = 100$ mA, $T_J = 25^\circ\text{C}$                         |      | 98  |                        |
|  |  | $I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ |      | 200 |                        |
| TPS76950-Q1  | $I_O = 50$ mA, $T_J = 25^\circ\text{C}$  |  | 35   |     |                        |
|  | $I_O = 50$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$                                |  | 85   |     |                        |
|  | $I_O = 100$ mA, $T_J = 25^\circ\text{C}$   |  | 71   |     |                        |
|  | $I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$                               |  | 170  |     |                        |

(2) If  $V_O \leq 1.8$  V then  $V_{Imin} = 2.7$  V,  $V_{Imax} = 10$  V:  
Line Reg. (mV) = (% / V)  $\times \frac{V_O (V_{Imax} - 2.7 \text{ V})}{100} \times 1000$

If  $V_O \geq 2.5$  V then  $V_{Imin} = V_O + 1$  V,  $V_{Imax} = 10$  V:  
Line Reg. (mV) = (% / V)  $\times \frac{V_O (V_{Imax} - (V_O + 1 \text{ V}))}{100} \times 1000$

- (3) The IN voltage equals  $V_O$  (typ) —  $100$  mV; the TPS76901-Q1 output voltage is set to  $3.3$  V nominal with an external resistor divider. TPS76912-Q1, TPS76915-Q1, TPS76918-Q1, TPS76925-Q1, and TPS76927-Q1 dropout voltage is limited by input voltage range limitations.

## 7.6 Dissipation Ratings

| BOARD                 | PACKAGE | $R_{\theta JC}$ | $R_{\theta JA}$ | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A \leq 25^\circ\text{C}$<br>POWER<br>RATING | $T_A = 70^\circ\text{C}$<br>POWER<br>RATING | $T_A = 85^\circ\text{C}$<br>POWER<br>RATING |
|-----------------------|---------|-----------------|-----------------|---|--|---|---|
| Low K <sup>(1)</sup>  | DBV     | 65.8°C/W        | 259°C/W         | 3.9 mW/°C   | 386 mW   | 212 mW                                      | 154 mW                                      |
| High K <sup>(2)</sup> | DBV     | 65.8°C/W        | 180°C/W         | 5.6 mW/°C   | 555 mW   | 305 mW                                      | 222 mW                                      |

- (1) The JEDEC Low K (1s) board design used to derive this data was a 3 inch x 3 inch, two layer board with 2 ounce copper traces on top of the board.
- (2) The JEDEC High K (2s2p) board design used to derive this data was a 3 inch x 3 inch, multilayer board with 1 ounce internal power and ground planes and 2 ounce copper traces on top and bottom of the board.

## 7.7 Typical Characteristics

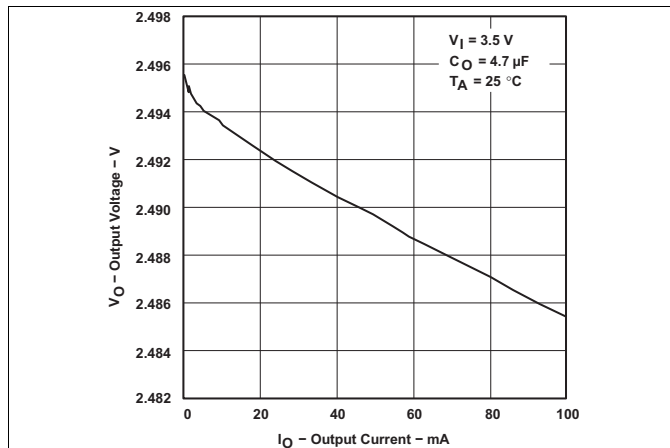


Figure 1. TPS76925-Q1 Output Voltage vs Output Current

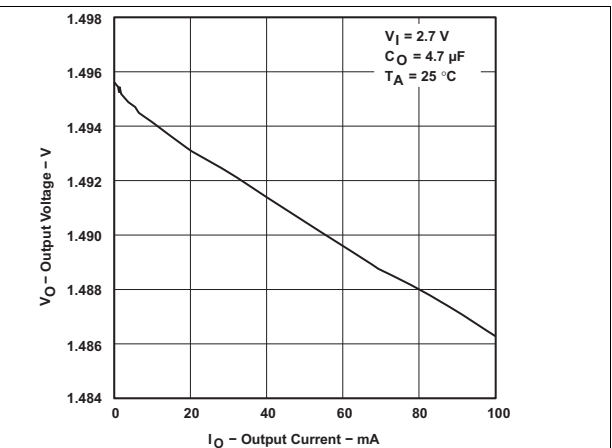


Figure 2. TPS76915-Q1 Output Voltage vs Output Current

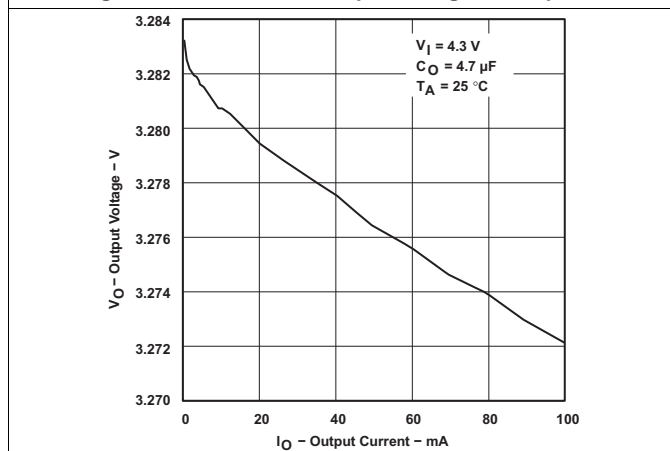


Figure 3. TPS76933-Q1 Output Voltage vs Output Current

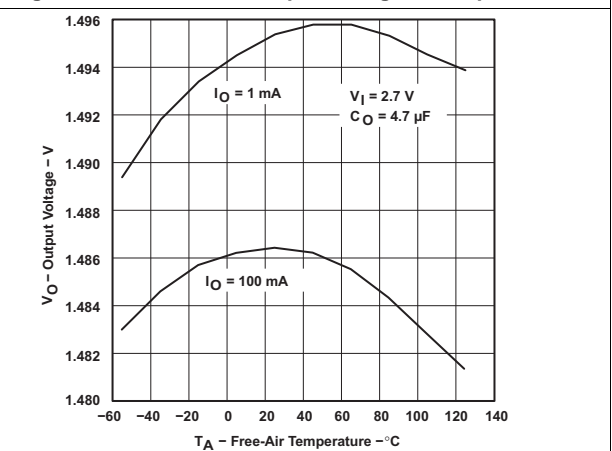


Figure 4. TPS76915-Q1 Output Voltage vs Free-Air Temperature

Typical Characteristics (continued)

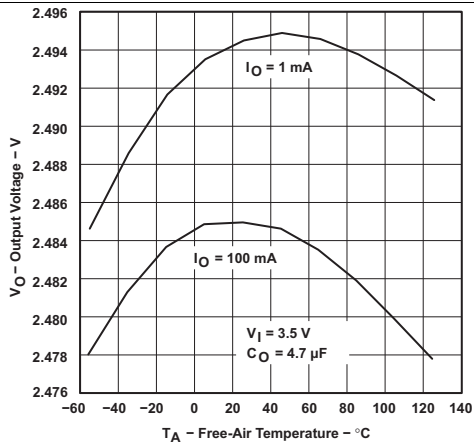


Figure 5. TPS76925-Q1 Output Voltage vs Free-Air Temperature

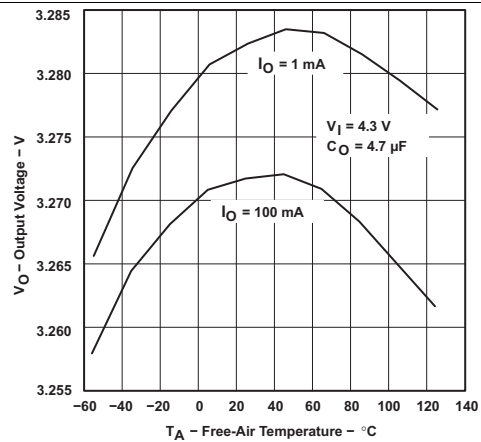


Figure 6. TPS76933-Q1 Output Voltage vs Free-Air Temperature

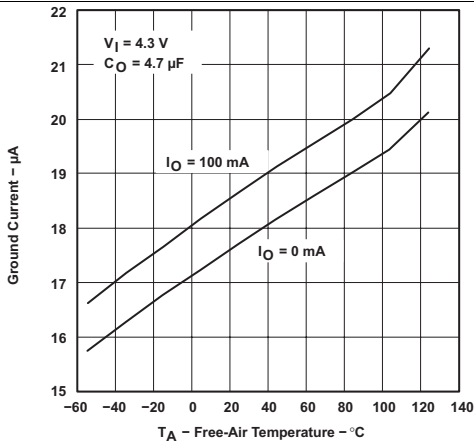


Figure 7. TPS76933-Q1 Ground Current vs Free-Air Temperature

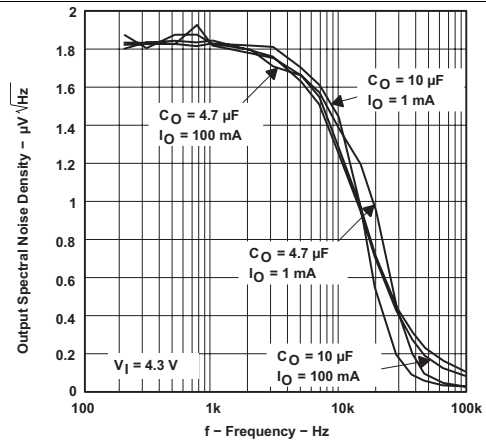


Figure 8. TPS76933-Q1 Output Spectral Noise Density vs Frequency

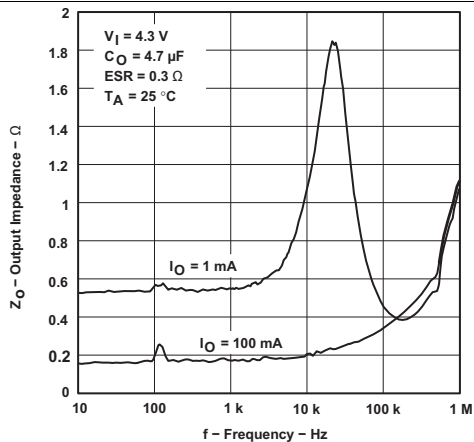


Figure 9. Output Impedance vs Frequency

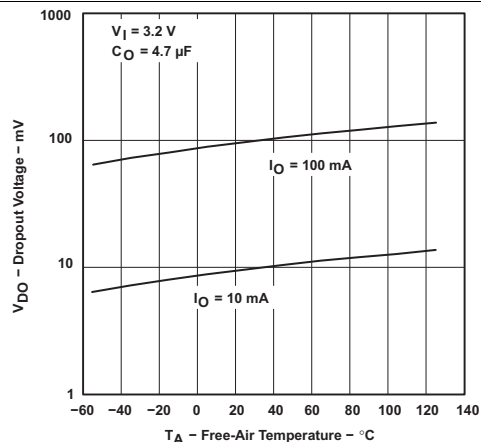
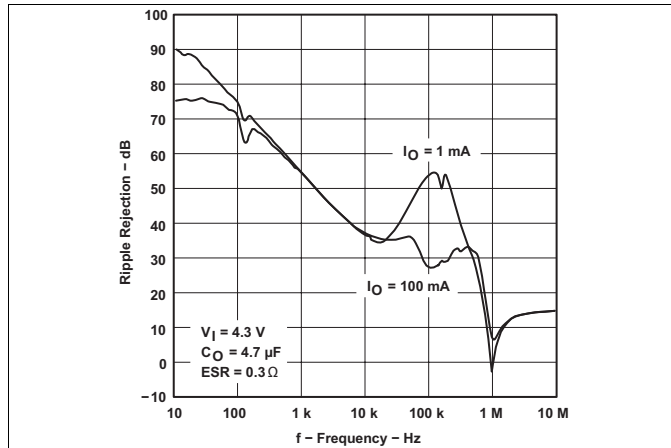
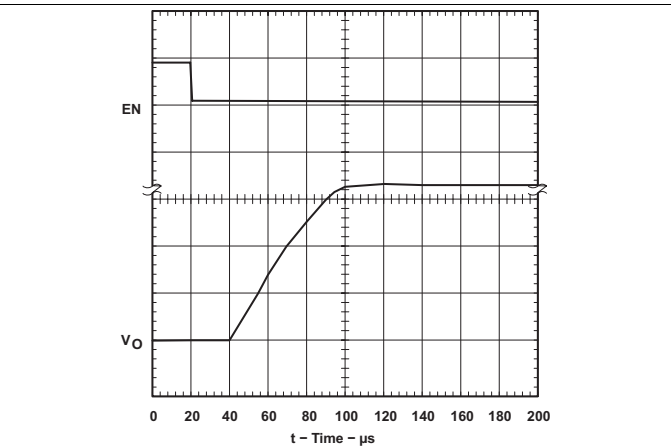


Figure 10. TPS76933-Q1 Dropout Voltage vs Free-Air Temperature

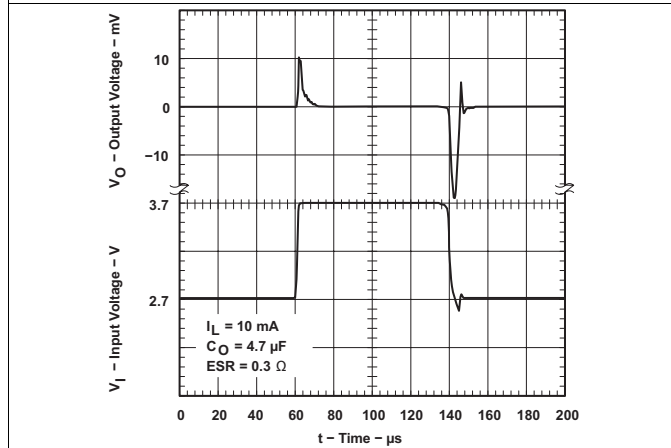
**Typical Characteristics (continued)**



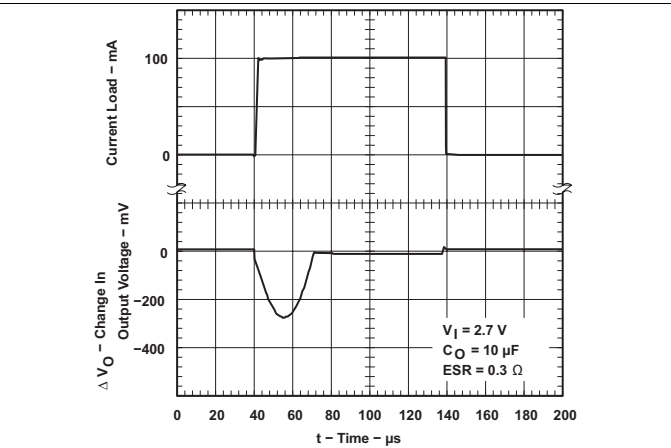
**Figure 11. TPS76933-Q1 Ripple Rejection vs Frequency**



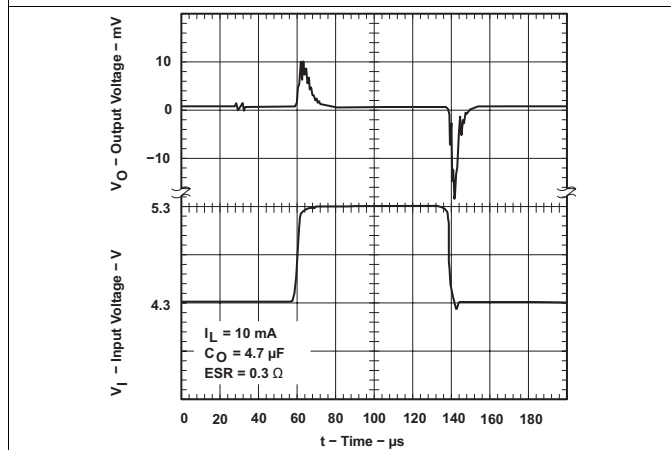
**Figure 12. LDO Start-Up Time**



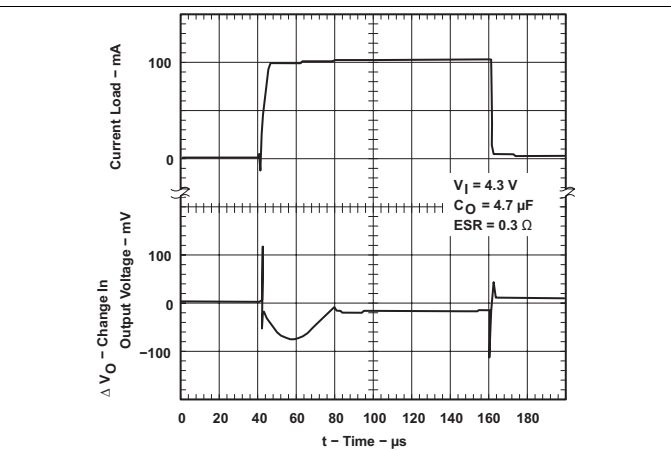
**Figure 13. TPS76915-Q1 Line Transient Response**



**Figure 14. TPS76915-Q1 Load Transient Response**



**Figure 15. TPS76933-Q1 Line Transient Response**



**Figure 16. TPS76933-Q1 Load Transient Response**



Typical Characteristics (continued)

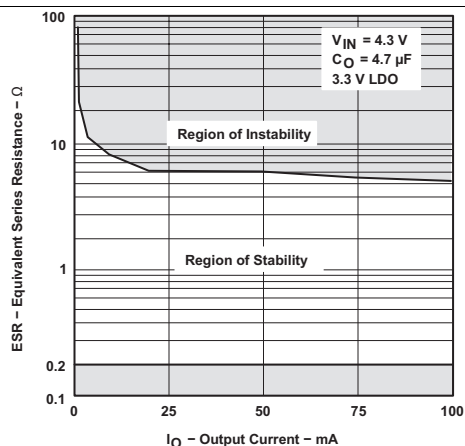


Figure 17. TPS76933-Q1 Typical Regions of Stability Equivalent Series Resistance (ESR) vs Output Current

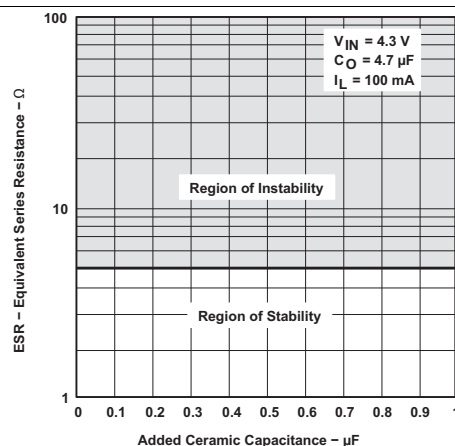


Figure 18. TPS76933-Q1 Typical Regions of Stability Equivalent Series Resistance (ESR) vs Added Ceramic Capacitance

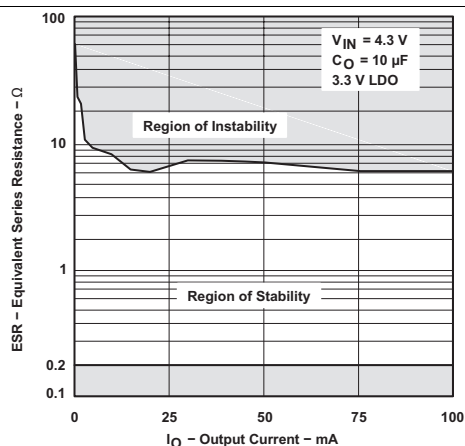


Figure 19. TPS76933-Q1 Typical Regions of Stability Equivalent Series Resistance (ESR) vs Output Current

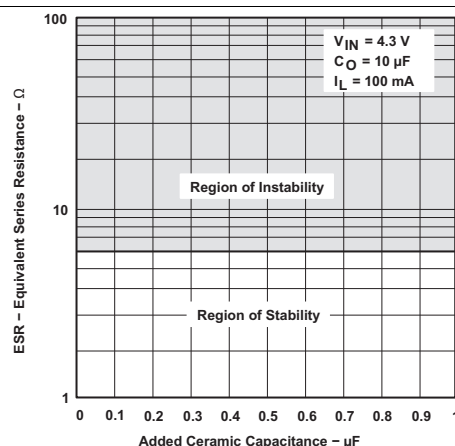


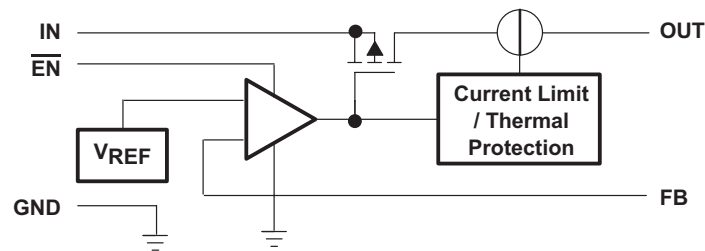
Figure 20. TPS76933-Q1 Typical Regions of Stability Equivalent Series Resistance (ESR) vs Added Ceramic Capacitance

## 8 Detailed Description

### 8.1 Overview

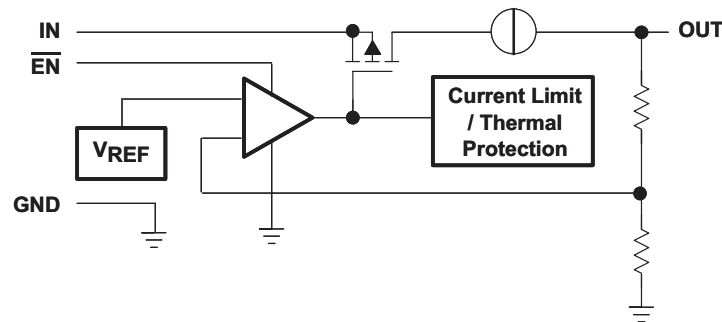
The TPS769xx-Q1 family of low-dropout (LDO) regulators are optimized for use in battery-operated equipment and automotive applications. They feature extremely low dropout voltages, low quiescent current (17  $\mu\text{A}$  nominally), and enable inputs to reduce supply currents to 1  $\mu\text{A}$  when the regulators are turned off.

### 8.2 Functional Block Diagrams



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Figure 21. TPS76901-Q1 Functional Block Diagram



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Figure 22. TPS769xx-Q1 Functional Block Diagram

### 8.3 Feature Description

#### 8.3.1 Regulator Protection

The TPS769xx-Q1 PMOS-pass transistor has a built-in back diode that conducts reverse current when the input voltage drops below the output voltage (for example, during power down). Current is conducted from the output to the input and is not internally limited. If extended reverse voltage operation is anticipated, external limiting might be appropriate.

The TPS769xx-Q1 features internal current limiting and thermal protection. During normal operation, the TPS769xx-Q1 limits output current to approximately 350 mA. When current limiting engages, the output voltage scales back linearly until the overcurrent condition ends. While current limiting is designed to prevent gross device failure, care must be taken not to exceed the power dissipation ratings of the package. If the temperature of the device exceeds approximately 165°C, thermal-protection circuitry shuts it down. Once the device has cooled down to below approximately 140°C, regulator operation resumes.

#### 8.4 Device Functional Modes

At 100-mA loads the device operates in low power mode and the quiescent current consumption is reduced to 28  $\mu\text{A}$  (maximum).

## 9 Application and Implementation

### NOTE

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

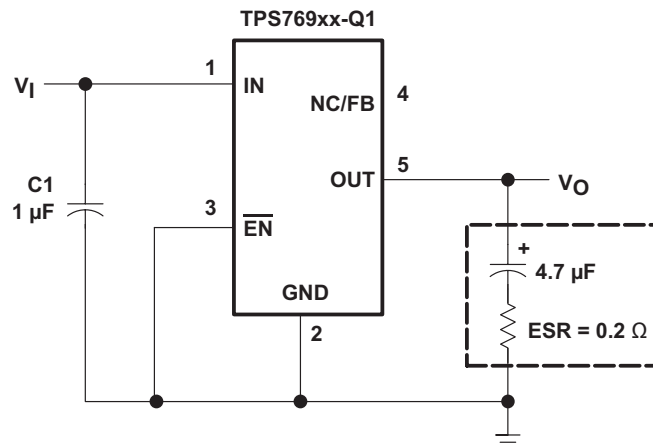
### 9.1 Application Information

The TPS769xx-Q1 uses a PMOS pass element to dramatically reduce both dropout voltage and supply current over more conventional PNP-pass-element LDO designs. The PMOS pass element is a voltage-controlled device and, unlike a PNP transistor, it does not require increased drive current as output current increases. Supply current in the TPS769xx-Q1 is essentially constant from no load to maximum load.

Current limiting and thermal protection prevent damage by excessive output current and/or power dissipation. The device switches into a constant-current mode at approximately 350 mA; further load reduces the output voltage instead of increasing the output current. The thermal protection shuts the regulator off if the junction temperature rises above approximately 165°C. Recovery is automatic when the junction temperature drops approximately 25°C below the high temperature trip point. The PMOS pass element includes a back gate diode that conducts reverse current when the input voltage level drops below the output voltage level.

A voltage of 1.7 V or greater on the  $\overline{\text{EN}}$  input disables the TPS769xx-Q1 internal circuitry, reducing the supply current to 1  $\mu\text{A}$ . A voltage of less than 0.9 V on the  $\overline{\text{EN}}$  input enables the TPS769xx and enables normal operation to resume. The  $\overline{\text{EN}}$  input does not include any deliberate hysteresis, and it exhibits an actual switching threshold of approximately 1.5 V.

### 9.2 Typical Application



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TPS76912-Q1, TPS76915-Q1, TPS76918-Q1, TPS76925-Q1, TPS76927-Q1, TPS76928-Q1, TPS76930-Q1,  
TPS76933-Q1, TPS76950-Q1 (fixed-voltage options).

**Figure 23. Typical Application Circuit**

## Typical Application (continued)

### 9.2.1 Design Requirements

Table 1 lists the design parameters for this example.

Table 1. Design Parameters

| PARAMETER                  | EXAMPLE VALUE                 |
|----------------------------|-------------------------------|
| Input voltage range        | 4 V to 10 V                   |
| Output voltage             | 2.5 V to 5 V                  |
| Output current rating      | 100 mA                        |
| Output capacitor           | 4.7 $\mu$ F to 10 $\mu$ F     |
| Output capacitor ESD range | 200 m $\Omega$ to 10 $\Omega$ |

### 9.2.2 Detailed Design Procedure

#### 9.2.2.1 External Capacitor Requirements

Although not required, TI recommends a 0.047- $\mu$ F or larger ceramic input bypass capacitor, connected between IN and GND and located close to the TPS769xx-Q1, to improve transient response and noise rejection. A higher-value electrolytic input capacitor may be necessary if large, fast-rise-time load transients are anticipated and the device is located several inches from the power source.

Like all low dropout regulators, the TPS769xx-Q1 requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitance is 4.7  $\mu$ F. The ESR (equivalent series resistance) of the capacitor must be between 0.2  $\Omega$  and 10  $\Omega$ . to ensure stability. Capacitor values larger than 4.7  $\mu$ F are acceptable, and allow the use of smaller ESR values. Capacitances less than 4.7  $\mu$ F are not recommended because they require careful selection of ESR to ensure stability. Solid tantalum electrolytic, aluminum electrolytic, and multilayer ceramic capacitors are all suitable, provided they meet the requirements described above. Most of the commercially available 4.7- $\mu$ F surface-mount solid tantalum capacitors, including devices from Sprague, Kemet, and Nichico, meet the ESR requirements stated above. Multilayer ceramic capacitors may have very small equivalent series resistances and may therefore require the addition of a low value series resistor to ensure stability.

Table 2. Capacitor Selection

| PART NO.         | MFR.    | VALUE       | MAX ESR      | SIZE (H x L x W) <sup>(1)</sup> |
|------------------|---------|-------------|--------------|---------------------------------|
| T494B475K016AS   | KEMET   | 4.7 $\mu$ F | 1.5 $\Omega$ | 1.9 x 3.5 x 2.8                 |
| 195D106x0016x2T  | SPRAGUE | 10 $\mu$ F  | 1.5 $\Omega$ | 1.3 x 7 x 2.7                   |
| 695D106x003562T  | SPRAGUE | 10 $\mu$ F  | 1.3 $\Omega$ | 2.5 x 7.6 x 2.5                 |
| TPSC475K035R0600 | AVX     | 4.7 $\mu$ F | 0.6 $\Omega$ | 2.6 x 6 x 3.2                   |

(1) Size is in mm. ESR is maximum resistance in  $\Omega$  at 100 kHz and T<sub>A</sub> = 25°C. Contact manufacturer for minimum ESR values.

#### 9.2.2.2 Output Voltage Programming

The output voltage of the TPS76901-Q1 adjustable regulator is programmed using an external resistor divider as shown in Figure 24. The output voltage is calculated using Equation 1.

$$V_O = V_{ref} \times \left(1 + \frac{R_1}{R_2}\right)$$

where

- The internal reference voltage (V<sub>REF</sub>) = 1.224 V (typical) (1)

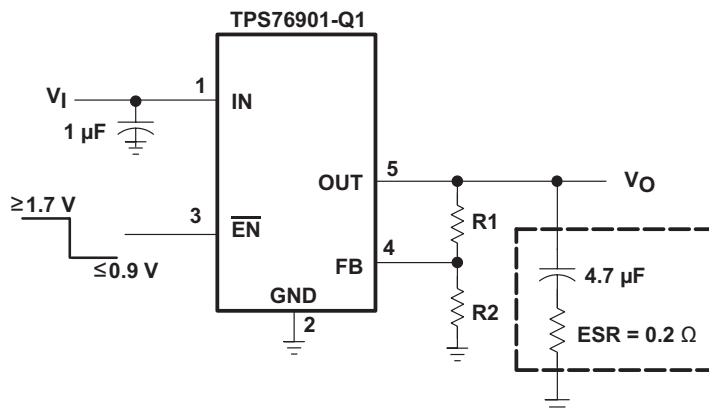
Resistors R1 and R2 must be chosen for approximately 7- $\mu$ A divider current. Lower value resistors can be used but offer no inherent advantage and waste more power. Higher values must be avoided as leakage currents at FB increase the output voltage error. The recommended design procedure is to choose R2 = 169 k $\Omega$  to set the divider current at 7  $\mu$ A and then calculate R1 using Equation 2.

$$R_1 = \left(\frac{V_O}{V_{ref}} - 1\right) \times R_2 \quad (2)$$

Table 3. Output Voltage Programming Guide

| OUTPUT VOLTAGE (V) | DIVIDER RESISTANCE (kΩ) <sup>(1)</sup> |     |
|--------------------|--|-----|
|                    | R1                                     | R2  |
| 2.5                | 174                                    | 169 |
| 3.3                | 287                                    | 169 |
| 3.6                | 324                                    | 169 |
| 4                  | 383                                    | 169 |
| 5                  | 523                                    | 169 |

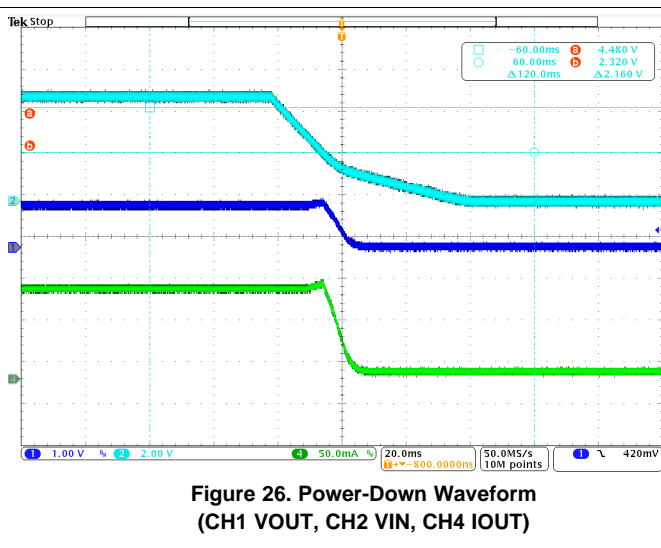
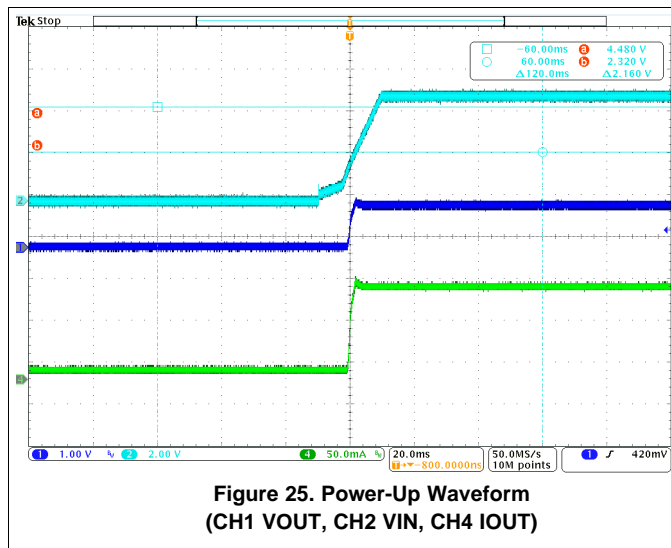
(1) 1% values shown.



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Figure 24. TPS76901-Q1 Adjustable LDO Regulator Programming

### 9.2.3 Application Curves



## 10 Power Supply Recommendations

Design of the device is for operation from an input voltage supply with a range between 2.7 V and 10 V. This input supply must be well regulated. If the input supply is located more than a few inches from the device, TI recommends adding an electrolytic capacitor with a value of 1 μF and a ceramic bypass capacitor at the input.

## 11 Layout

### 11.1 Layout Guidelines

For the LDO power supply, especially these high voltage and large current ones, layout is an important step. If layout is not carefully designed, the regulator could not deliver enough output current because of the thermal limitation. To improve the thermal performance of the device, and maximize the current output at high ambient temperature, it is recommended to spread the GND as large as possible and put enough thermal vias on the thermal pad. [Figure 27](#) shows an example layout.

### 11.2 Layout Example

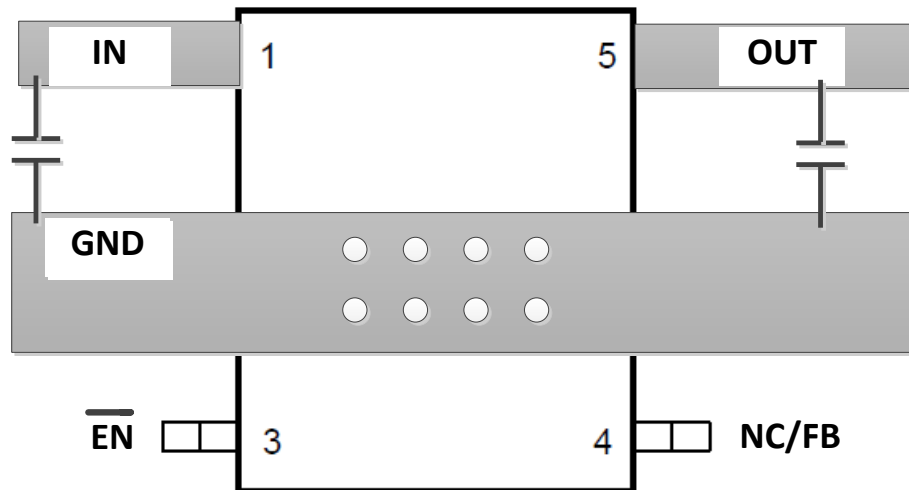


Figure 27. Layout Recommendation

### 11.3 Power Dissipation and Junction Temperature

Specified regulator operation is assured to a junction temperature of 125°C; the maximum junction temperature must be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation the regulator can handle in any given application. To ensure the junction temperature is within acceptable limits, calculate the maximum allowable dissipation,  $P_{D(max)}$ , and the actual dissipation,  $P_D$ , which must be less than or equal to  $P_{D(max)}$ .

The maximum-power-dissipation limit is determined using [Equation 3](#).

$$P_{D(max)} = \frac{T_{Jmax} - T_A}{R_{\theta JA}}$$

where

- $T_{Jmax}$  is the maximum allowable junction temperature
- $R_{\theta JA}$  is the thermal resistance junction-to-ambient for the package, see the dissipation rating table.
- $T_A$  is the ambient temperature.

(3)

The regulator dissipation is calculated using [Equation 4](#).

$$P_D = (V_I - V_O) \times I_O$$

(4)

Power dissipation resulting from quiescent current is negligible. Excessive power dissipation triggers the thermal protection circuit.

## 12 Device and Documentation Support

### 12.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 4. Related Links**

| PARTS       | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|-------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| TPS76901-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76912-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76915-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76918-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76925-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76927-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76928-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76930-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76933-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| TPS76950-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 12.2 Receiving Notification of Documentation Updates

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

### 12.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.4 Trademarks

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

### 12.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.6 Glossary

**SLYZ022** — *TI Glossary*.

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

## 13 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<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|-------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TPS76901QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCFQ                    | <a href="#">Samples</a> |
| TPS76901QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCFQ                    | <a href="#">Samples</a> |
| TPS76912QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCGQ                    | <a href="#">Samples</a> |
| TPS76915QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCHQ                    | <a href="#">Samples</a> |
| TPS76918QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCIQ                    | <a href="#">Samples</a> |
| TPS76918QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCIQ                    | <a href="#">Samples</a> |
| TPS76925QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCJQ                    | <a href="#">Samples</a> |
| TPS76925QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCJQ                    | <a href="#">Samples</a> |
| TPS76927QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCKQ                    | <a href="#">Samples</a> |
| TPS76928QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCLQ                    | <a href="#">Samples</a> |
| TPS76930QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCMQ                    | <a href="#">Samples</a> |
| TPS76930QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCMQ                    | <a href="#">Samples</a> |
| TPS76933QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCNQ                    | <a href="#">Samples</a> |
| TPS76933QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCNQ                    | <a href="#">Samples</a> |
| TPS76950QDBVRG4Q1 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCOQ                    | <a href="#">Samples</a> |
| TPS76950QDBVRQ1   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | PCOQ                    | <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.

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

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

<sup>(5)</sup> 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.

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

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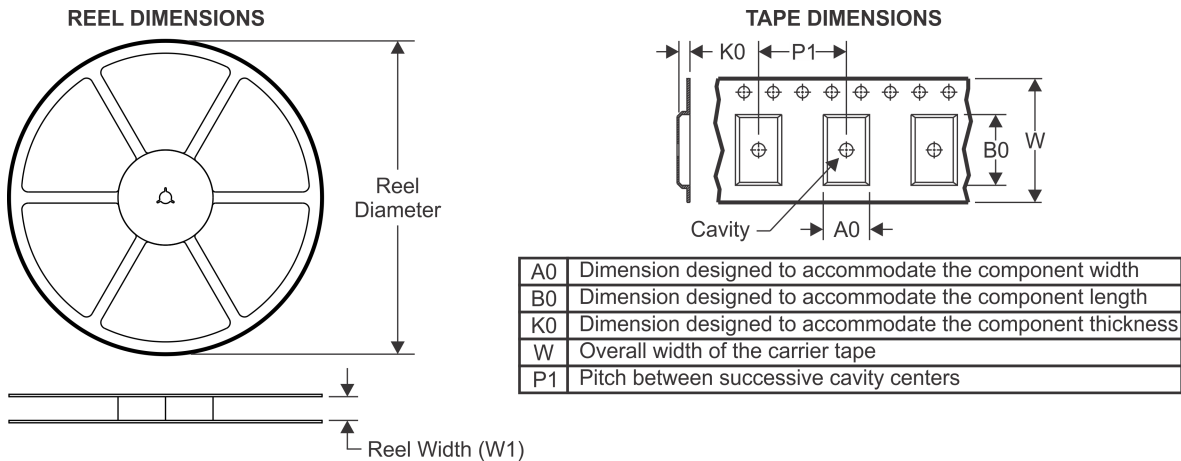
#### **OTHER QUALIFIED VERSIONS OF TPS769-Q1 :**

- Catalog: [TPS769](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

## 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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS76901QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76901QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76912QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76915QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76918QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76918QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76925QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76925QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76927QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76928QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76930QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76930QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76933QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76933QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.0                | 3.15    | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76950QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS76950QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.3     | 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) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS76901QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76901QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76912QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76915QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76918QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76918QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76925QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76925QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76927QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76928QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76930QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76930QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76933QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76933QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS76950QDBVRG4Q1 | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS76950QDBVRQ1   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |

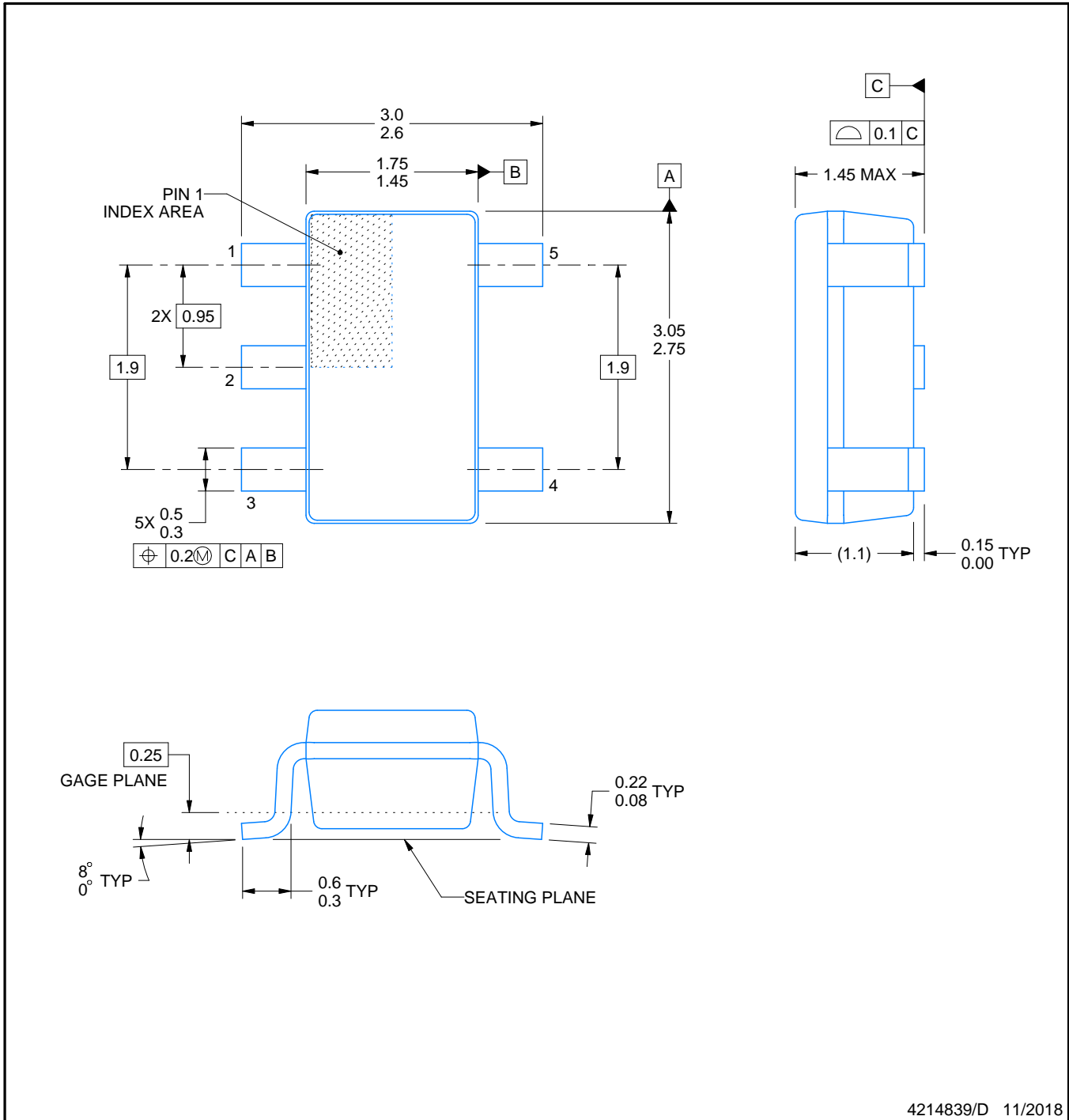
# DBV0005A



## PACKAGE OUTLINE

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



### NOTES:

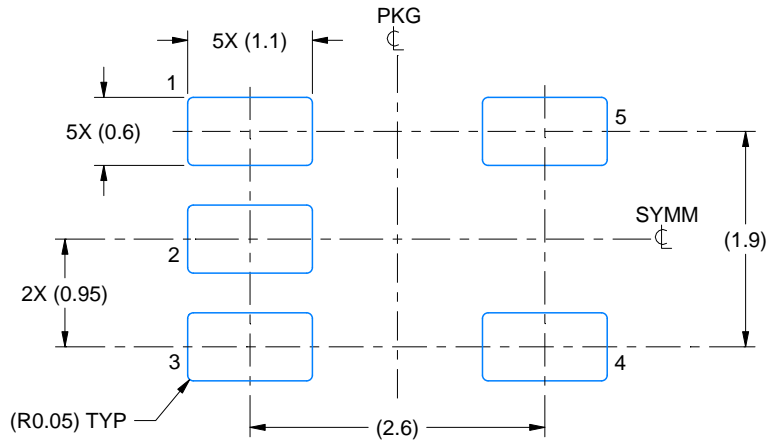
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.

# EXAMPLE BOARD LAYOUT

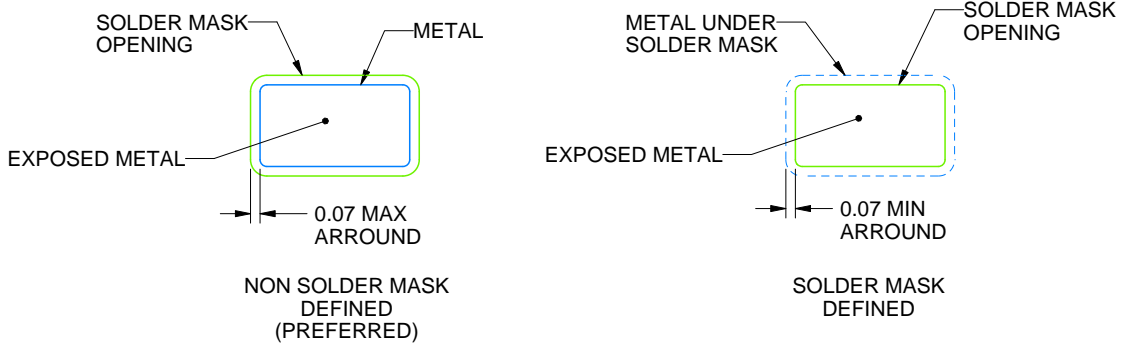
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

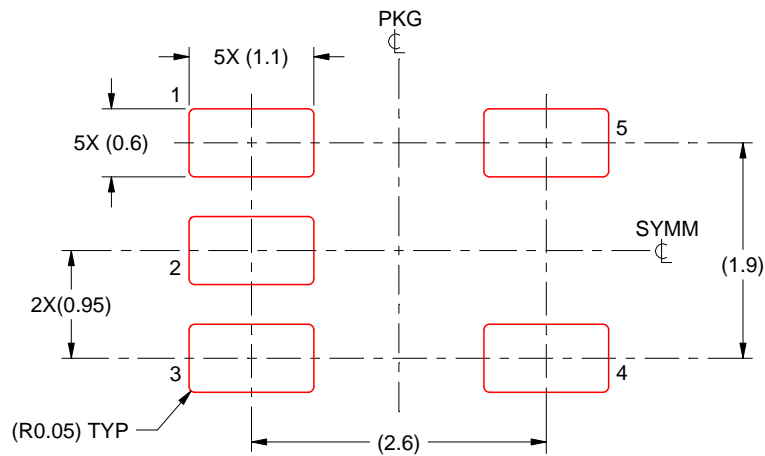
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



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

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NOTES: (continued)

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

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