

## 具有使能功能的 TPS709 150mA、30V、1 $\mu$ A $I_Q$ 稳压器

### 1 特性

- 超低  $I_Q$  : 1  $\mu$ A
- 反向电流保护
- 低  $I_{\text{关断}}$  : 150nA
- 输入电压范围 : 2.7 V 至 30 V
- 支持 200mA 峰值输出
- 在工作温度范围内的精度为 2%
- 可提供固定输出电压 : 1.2 V 至 6.5 V
- 热关断保护和过流保护
- 封装 : SOT-23-5、WSO-6

### 2 应用

- 烟雾和热量探测器
- 恒温器
- 运动检测器 (PIR、uWave 等)
- 无线电动工具
- 电器电池组
- 电表
- 水表

### 3 说明

TPS709 系列线性稳压器是设计用于功耗敏感类应用的超低静态电流器件。一个精密带隙和误差放大器在温度范围内的精度为 2%。只有 1 $\mu$ A 的静态电流使得此器件成为由电池供电、要求非常小闲置状态功率耗散的常开系统的理想解决方案。为了增加安全性，这些器件还具有热关断、电流限制和反向电流保护功能。

关断模式通过将 EN 引脚拉为低电平进行使能。该模式的关断电流低至 150nA (典型值)。

TPS709 系列采用 WSON-6 和 SOT-23-5 封装。

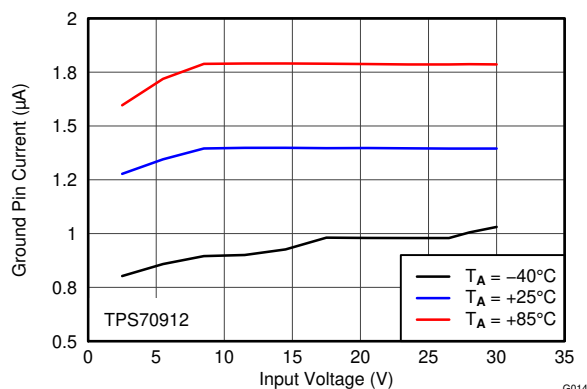
#### 器件信息<sup>(1)</sup>

| 器件型号   | 封装         | 封装尺寸 (标称值)      |
|--------|------------|-----------------|
| TPS709 | SOT-23 (5) | 2.90mm × 1.60mm |
|        | WSON (6)   | 2.00mm × 2.00mm |

(1) 如需了解所有可用封装，请参阅产品说明书末尾的封装选项附录。



典型应用电路



接地电流与  $V_{IN}$  和温度间的关系



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## 4 Revision History

注：以前版本的页码可能与当前版本的页码不同

| <b>Changes from Revision G (November 2015) to Revision H (July 2021)</b>                                                            | <b>Page</b> |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------|
| • 更新了整个文档中的表格、图和交叉参考的编号格式.....                                                                                                      | 1           |
| • 更改了 <i>应用</i> 部分.....                                                                                                             | 1           |
| • Changed $V_{EN(HI)}$ row (changed parameter description and added test condition) in <i>Electrical Characteristics</i> table..... | 5           |
| • Added $V_{EN(LOW)}$ row to <i>Electrical Characteristics</i> table.....                                                           | 5           |
| • Added M3 suffix information to <i>Device Nomenclature</i> table.....                                                              | 17          |
| <b>Changes from Revision F (December 2014) to Revision G (November 2015)</b>                                                        | <b>Page</b> |
| • Added DBV package for TPS709A to <i>Pin Configurations and Functions</i> section.....                                             | 3           |
| • Added DBV package for TPS709B to <i>Pin Configurations and Functions</i> section.....                                             | 3           |
| • Added TPS709A and TPS709B to Pin Functions table.....                                                                             | 3           |
| • Moved operating junction temperature from <i>Electrical Characteristics</i> to <i>Recommended Operating Conditions</i> .....      | 4           |

## 5 Pin Configuration and Functions

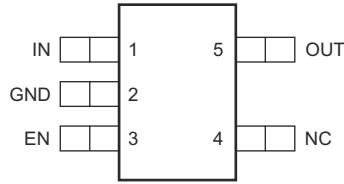


图 5-1. TPS709: DBV Package, 5-Pin SOT-23, Top View

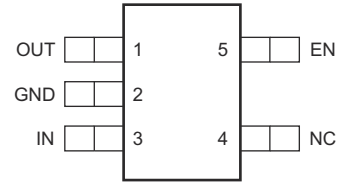


图 5-2. TPS709A: DBV Package, 5-Pin SOT-23, Top View

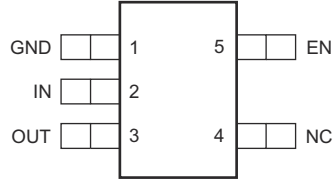


图 5-3. TPS709B: DBV Package, 5-Pin SOT-23, Top View

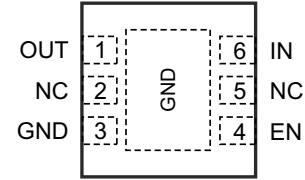


图 5-4. DRV Package, 6-Pin WSON, Top View

表 5-1. Pin Functions

| PIN         |        |        |         |         | I/O | DESCRIPTION                                                                                                                                                                                                            |
|-------------|--------|--------|---------|---------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NAME        | DRV    | DBV    |         |         |     |                                                                                                                                                                                                                        |
|             | TPS709 | TPS709 | TPS709A | TPS709B |     |                                                                                                                                                                                                                        |
| EN          | 4      | 3      | 5       | 5       | I   | Enable pin. Drive this pin high to enable the device. Drive this pin low to put the device into low current shutdown. This pin can be left floating to enable the device. The maximum voltage must remain below 6.5 V. |
| GND         | 3      | 2      | 2       | 1       | —   | Ground                                                                                                                                                                                                                 |
| IN          | 6      | 1      | 3       | 2       | I   | Unregulated input to the device                                                                                                                                                                                        |
| NC          | 2, 5   | 4      | 4       | 4       | —   | No internal connection                                                                                                                                                                                                 |
| OUT         | 1      | 5      | 1       | 3       | O   | Regulated output voltage. Connect a small 2.2-μF or greater ceramic capacitor from this pin to ground to assure stability.                                                                                             |
| Thermal pad |        | —      | —       | —       | —   | The thermal pad is electrically connected to the GND node. Connect this pad to the GND plane for improved thermal performance.                                                                                         |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

specified at  $T_J = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  (unless otherwise noted); all voltages are with respect to GND<sup>(1)</sup>

|                                                |                   | MIN                                     | MAX | UNIT |
|------------------------------------------------|-------------------|-----------------------------------------|-----|------|
| Voltage                                        | V <sub>IN</sub>   | - 0.3                                   | 32  | V    |
|                                                | V <sub>EN</sub>   | - 0.3                                   | 7   |      |
|                                                | V <sub>OUT</sub>  | - 0.3                                   | 7   |      |
| Maximum output current                         | I <sub>OUT</sub>  | Internally limited                      |     |      |
| Output short-circuit duration                  |                   | Indefinite                              |     |      |
| Continuous total power dissipation             | P <sub>DISS</sub> | See <a href="#">Thermal Information</a> |     |      |
| Operating junction temperature, T <sub>J</sub> |                   | - 55                                    | 150 | °C   |
| Storage temperature, T <sub>stg</sub>          |                   | - 55                                    | 150 | °C   |

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

### 6.2 ESD Ratings

|             |                         |                                                                                | VALUE      | UNIT |
|-------------|-------------------------|--------------------------------------------------------------------------------|------------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | $\pm 2000$ | V    |
|             |                         | Charged device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | $\pm 500$  |      |

- (1) JEDEC document JEP155 states that 2-kV HBM allows safe manufacturing with a standard ESD control process.  
 (2) JEDEC document JEP157 states that 500-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 voltage                  | 2.7  |     | 30  | V                  |
| $V_{OUT}$ | Output voltage                 | 1.2  |     | 6.5 | V                  |
| $V_{EN}$  | Enable voltage                 | 0    |     | 6.5 | V                  |
| $T_J$     | Operating junction temperature | - 40 |     | 125 | $^{\circ}\text{C}$ |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | TPS709 |        | UNIT                        |
|-------------------------------|----------------------------------------------|--------|--------|-----------------------------|
|                               |                                              | DBV    | DRV    |                             |
|                               |                                              | 5 PINS | 6 PINS |                             |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 212.1  | 73.1   | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 78.5   | 97.0   | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 39.5   | 42.6   | $^{\circ}\text{C}/\text{W}$ |
| $\psi_{JT}$                   | Junction-to-top characterization parameter   | 2.86   | 2.9    | $^{\circ}\text{C}/\text{W}$ |
| $\psi_{JB}$                   | Junction-to-board characterization parameter | 38.7   | 42.9   | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | N/A    | 12.8   | $^{\circ}\text{C}/\text{W}$ |

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

## 6.5 Electrical Characteristics

at ambient temperature ( $T_A$ ) =  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{IN} = V_{OUT(\text{typ})} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater),  $I_{OUT} = 1\text{ mA}$ ,  $V_{EN} = 2\text{ V}$ , and  $C_{IN} = C_{OUT} = 2.2\text{-}\mu\text{F}$  ceramic (unless otherwise noted); typical values are at  $T_A = 25^{\circ}\text{C}$

| PARAMETER        |                                         | TEST CONDITIONS                                                                                                                                | MIN  | TYP | MAX  | UNIT                       |
|------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|------|----------------------------|
| $V_{IN}$         | Input voltage range                     |                                                                                                                                                | 2.7  |     | 30   | V                          |
| $V_{OUT}$        | Output voltage range                    |                                                                                                                                                | 1.2  |     | 6.5  | V                          |
| $V_{OUT}$        | DC output accuracy                      | $V_{OUT} < 3.3\text{ V}$                                                                                                                       | - 2% |     | 2%   |                            |
|                  |                                         | $V_{OUT} \geq 3.3\text{ V}$                                                                                                                    | - 1% |     | 1%   |                            |
| $\Delta V_{OUT}$ | Line regulation                         | $(V_{OUT(\text{nom})} + 1\text{ V}, 2.7\text{ V}) \leq V_{IN} \leq 30\text{ V}$                                                                |      | 3   | 10   | mV                         |
|                  | Load regulation                         | $V_{IN} = V_{OUT(\text{typ})} + 1.5\text{ V}$ or $3\text{ V}$ (whichever is greater), $100\text{ }\mu\text{A} \leq I_{OUT} \leq 150\text{ mA}$ |      | 20  | 50   |                            |
| $V_{DO}$         | Dropout voltage <sup>(1) (3)</sup>      | TPS70933, $I_{OUT} = 50\text{ mA}$                                                                                                             |      | 295 | 650  | mV                         |
|                  |                                         | TPS70933, $I_{OUT} = 150\text{ mA}$                                                                                                            |      | 960 | 1400 |                            |
|                  |                                         | TPS70950, $I_{OUT} = 50\text{ mA}$                                                                                                             |      | 245 | 500  |                            |
|                  |                                         | TPS70950, $I_{OUT} = 150\text{ mA}$                                                                                                            |      | 690 | 1200 |                            |
|                  |                                         | TPS70965, $I_{OUT} = 50\text{ mA}$                                                                                                             |      | 180 | 500  |                            |
|                  |                                         | TPS70965, $I_{OUT} = 150\text{ mA}$                                                                                                            |      | 460 | 1000 |                            |
| $I_{(CL)}$       | Output current limit <sup>(4)</sup>     | $V_{OUT} = 0.9 \times V_{OUT(\text{nom})}$                                                                                                     | 200  | 320 | 500  | mA                         |
| $I_{GND}$        | Ground pin current                      | $I_{OUT} = 0\text{ mA}$ , $V_{OUT} \leq 3.3\text{ V}$                                                                                          |      | 1.3 | 2.05 | $\mu\text{A}$              |
|                  |                                         | $I_{OUT} = 0\text{ mA}$ , $V_{OUT} > 3.3\text{ V}$                                                                                             |      | 1.4 | 2.25 |                            |
|                  |                                         | $I_{OUT} = 150\text{ mA}$                                                                                                                      |      | 350 |      |                            |
| $I_{SHUTDOWN}$   | Shutdown current                        | $V_{EN} \leq 0.4\text{ V}$ , $V_{IN} = 2.7\text{ V}$                                                                                           |      | 150 |      | nA                         |
| PSRR             | Power-supply rejection ratio            | $f = 10\text{ Hz}$                                                                                                                             |      | 80  |      | dB                         |
|                  |                                         | $f = 100\text{ Hz}$                                                                                                                            |      | 62  |      |                            |
|                  |                                         | $f = 1\text{ kHz}$                                                                                                                             |      | 52  |      |                            |
| $V_n$            | Output noise voltage                    | $\text{BW} = 10\text{ Hz to } 100\text{ kHz}$ , $I_{OUT} = 10\text{ mA}$ , $V_{IN} = 2.7\text{ V}$ , $V_{OUT} = 1.2\text{ V}$                  |      | 190 |      | $\mu\text{V}_{\text{RMS}}$ |
| $t_{STR}$        | Start-up time <sup>(2)</sup>            | $V_{OUT(\text{nom})} \leq 3.3\text{ V}$                                                                                                        |      | 200 | 600  | $\mu\text{s}$              |
|                  |                                         | $V_{OUT(\text{nom})} > 3.3\text{ V}$                                                                                                           |      | 500 | 1500 |                            |
| $V_{EN(HI)}$     | Enable pin high-level input voltage     | Device enabled                                                                                                                                 | 0.9  |     |      | V                          |
| $V_{EN(LOW)}$    | Enable pin low-level input voltage      | Device disabled                                                                                                                                | 0    |     | 0.4  | V                          |
| $I_{EN}$         | EN pin current                          | $EN = 1.0\text{ V}$ , $V_{IN} = 5.5\text{ V}$                                                                                                  |      | 300 |      | nA                         |
| $I_{(REV)}$      | Reverse current (flowing out of IN pin) | $V_{OUT} = 3\text{ V}$ , $V_{IN} = V_{EN} = 0\text{ V}$                                                                                        |      | 10  |      | nA                         |
|                  | Reverse current (flowing into OUT pin)  | $V_{OUT} = 3\text{ V}$ , $V_{IN} = V_{EN} = 0\text{ V}$                                                                                        |      | 100 |      |                            |
| $t_{SD}$         | Thermal shutdown temperature            | Shutdown, temperature increasing                                                                                                               |      | 158 |      | $^{\circ}\text{C}$         |
|                  |                                         | Reset, temperature decreasing                                                                                                                  |      | 140 |      |                            |

(1)  $V_{DO}$  is measured with  $V_{IN} = 0.98 \times V_{OUT(\text{nom})}$ .

(2) Start-up time = time from EN assertion to  $0.95 \times V_{OUT(\text{nom})}$  and load =  $47\text{ }\Omega$ .

(3) Dropout is only valid when  $V_{OUT} \geq 2.8\text{ V}$  because of the minimum input voltage limits.

(4) Measured with  $V_{IN} = V_{OUT} + 3\text{ V}$  for  $V_{OUT} \leq 2.5\text{ V}$ . Measured with  $V_{IN} = V_{OUT} + 2.5\text{ V}$  for  $V_{OUT} > 2.5\text{ V}$ .

## 6.6 Typical Characteristics

over operating temperature range ( $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ ),  $I_{\text{OUT}} = 10\text{ mA}$ ,  $V_{\text{EN}} = 2\text{ V}$ ,  $C_{\text{OUT}} = 2.2\text{ }\mu\text{F}$ , and  $V_{\text{IN}} = V_{\text{OUT(typ)}} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^\circ\text{C}$

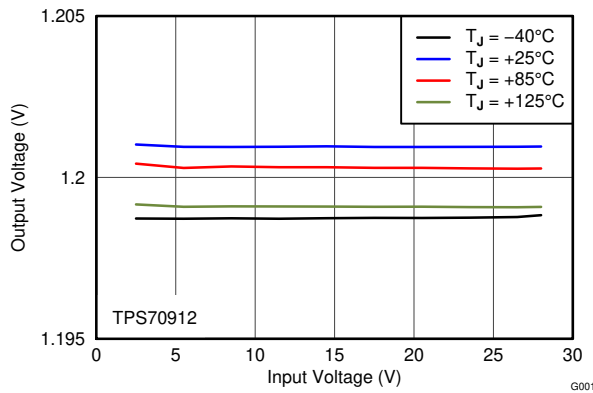


图 6-1. 1.2-V Line Regulation vs  $V_{\text{IN}}$  and Temperature

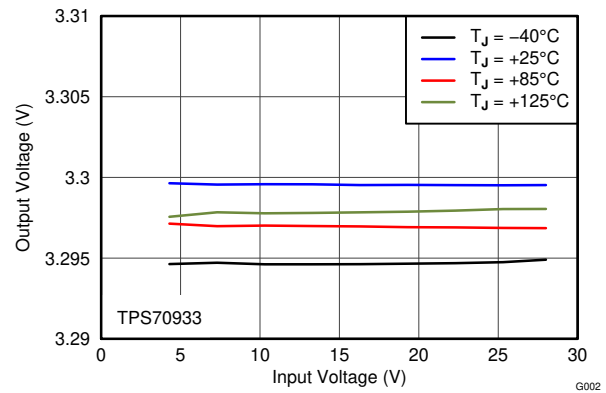


图 6-2. 3.3-V Line Regulation vs  $V_{\text{IN}}$  and Temperature

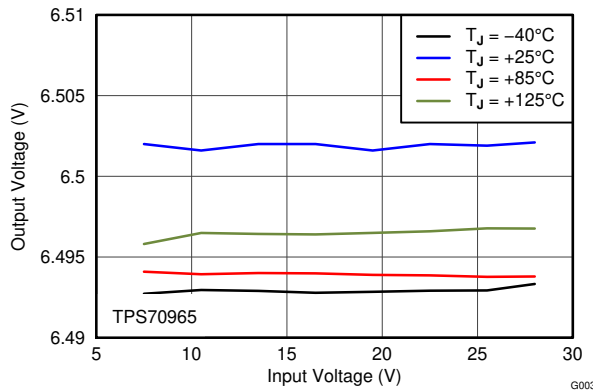


图 6-3. 6.5-V Line Regulation vs  $V_{\text{IN}}$  and Temperature

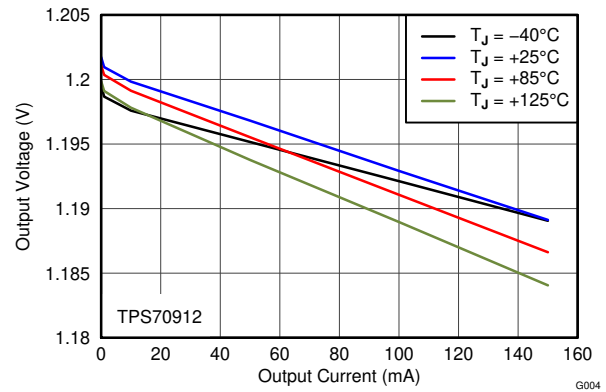


图 6-4. 1.2-V Load Regulation vs  $I_{\text{OUT}}$  and Temperature

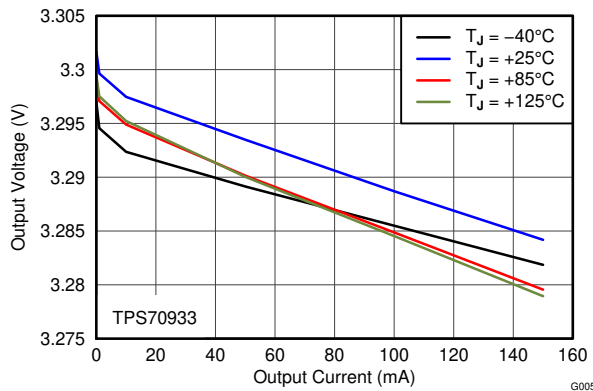


图 6-5. 3.3-V Load Regulation vs  $I_{\text{OUT}}$  and Temperature

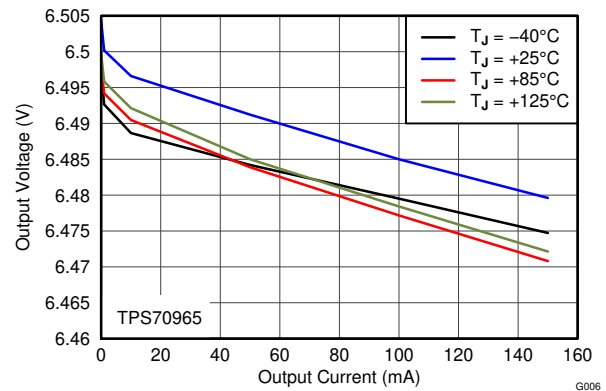


图 6-6. 6.5-V Load Regulation vs  $I_{\text{OUT}}$  and Temperature

## 6.6 Typical Characteristics (continued)

over operating temperature range ( $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ ),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = 2\text{ V}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , and  $V_{IN} = V_{OUT(\text{typ})} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^\circ\text{C}$

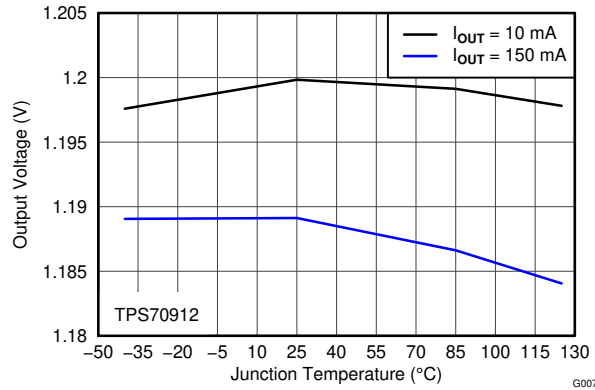


图 6-7.  $V_{OUT}$  vs Temperature

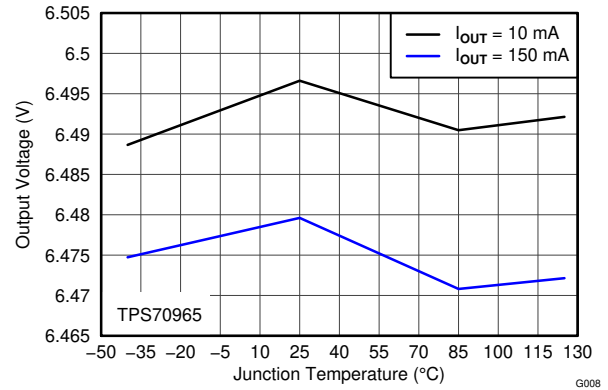


图 6-8.  $V_{OUT}$  vs Temperature

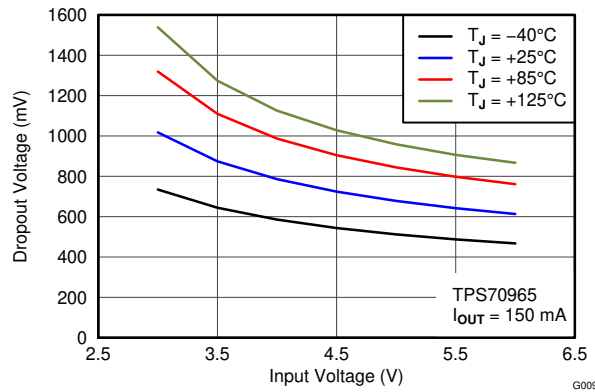


图 6-9. Dropout Voltage vs  $V_{IN}$  and Temperature

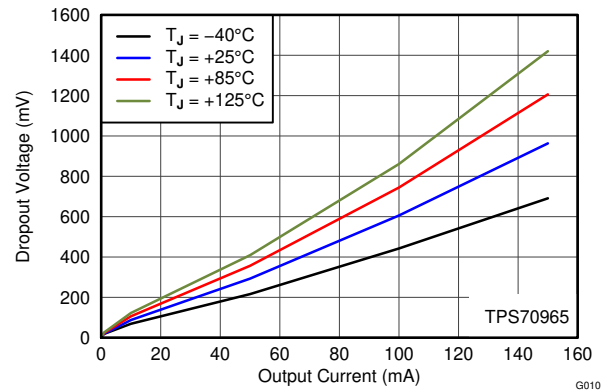


图 6-10. Dropout Voltage vs  $I_{OUT}$  and Temperature

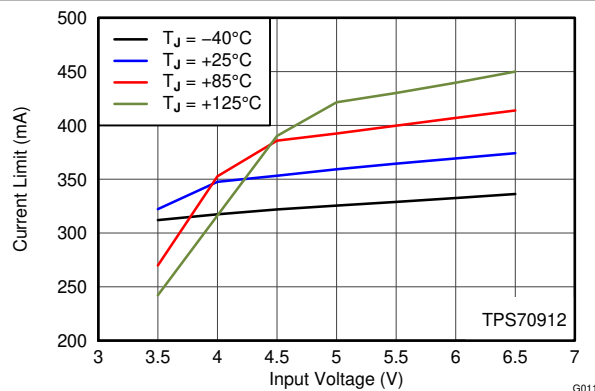


图 6-11. 1.2-V Current Limit vs  $V_{IN}$  and Temperature

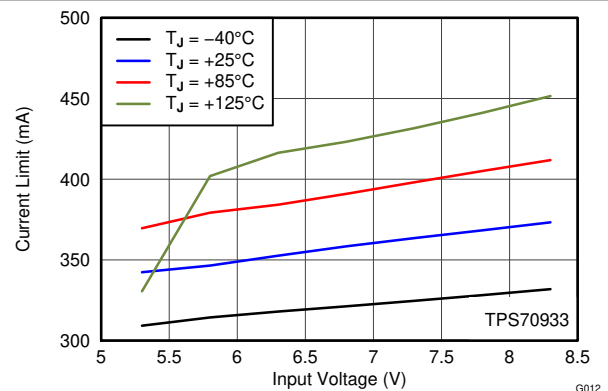


图 6-12. 3.3-V Current Limit vs  $V_{IN}$  and Temperature

## 6.6 Typical Characteristics (continued)

over operating temperature range ( $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ ),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = 2\text{ V}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , and  $V_{IN} = V_{OUT(\text{typ})} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^\circ\text{C}$

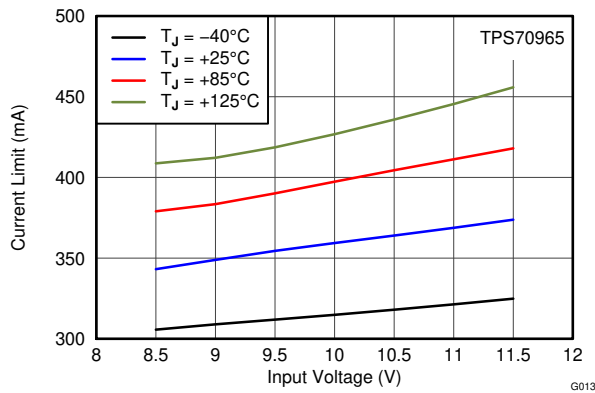


图 6-13. 6.5-V Current Limit vs  $V_{IN}$  and Temperature

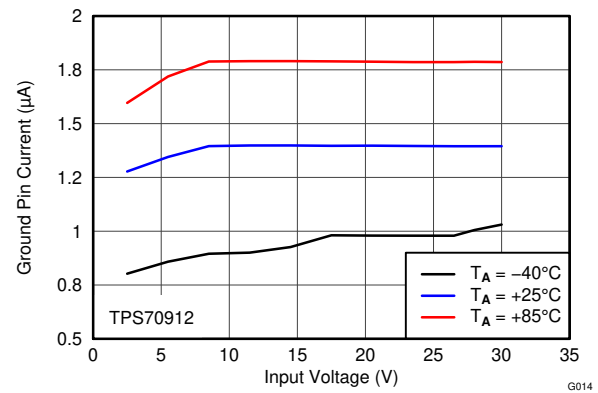


图 6-14. GND Current vs  $V_{IN}$  and Temperature

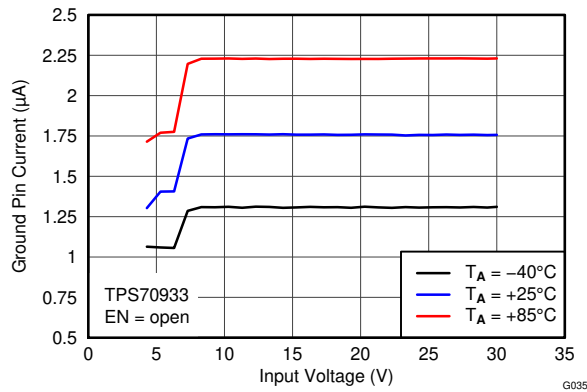


图 6-15. GND Current vs  $V_{IN}$  and Temperature

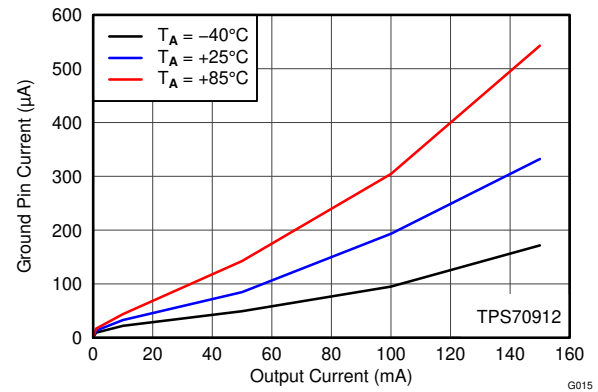


图 6-16. GND Current vs  $I_{OUT}$  and Temperature

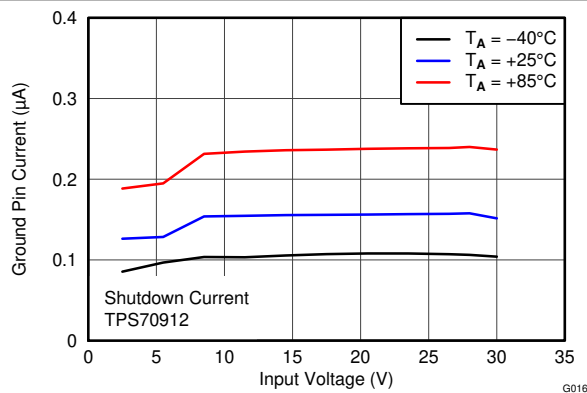


图 6-17. Shutdown Current vs  $V_{IN}$  and Temperature

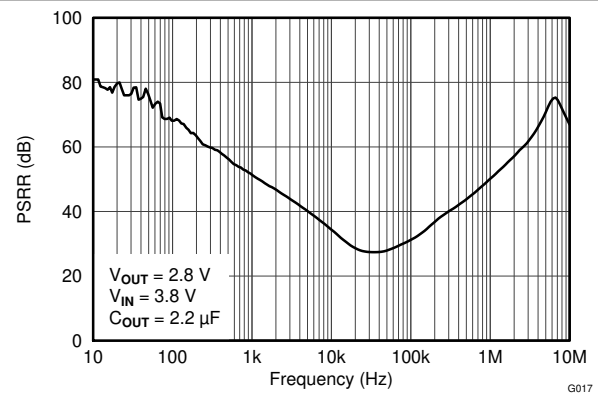


图 6-18. Power-Supply Rejection Ratio vs Frequency

## 6.6 Typical Characteristics (continued)

over operating temperature range ( $T_J = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ),  $I_{\text{OUT}} = 10\text{ mA}$ ,  $V_{\text{EN}} = 2\text{ V}$ ,  $C_{\text{OUT}} = 2.2\text{ }\mu\text{F}$ , and  $V_{\text{IN}} = V_{\text{OUT(typ)}} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^{\circ}\text{C}$

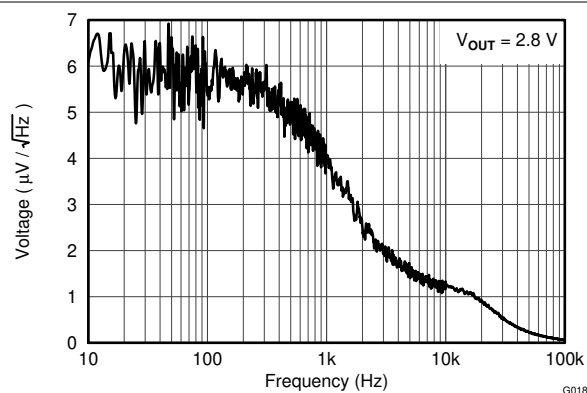


图 6-19. Noise

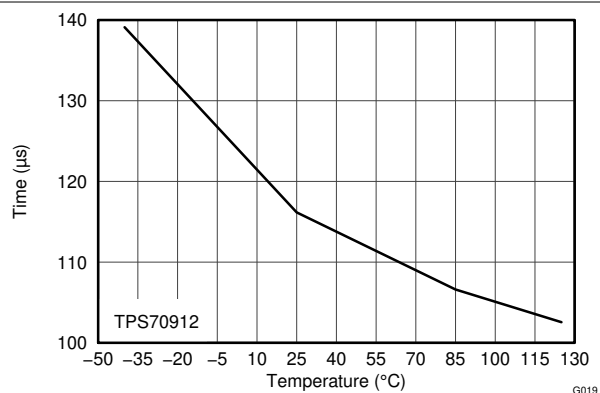


图 6-20. Start-Up Time vs Temperature

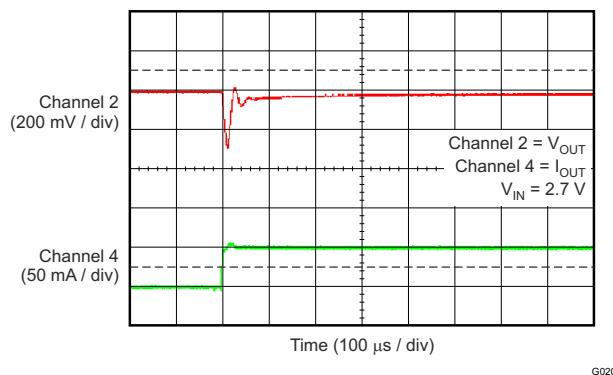


图 6-21. TPS70912 Load Transient  
(0 mA to 50 mA)

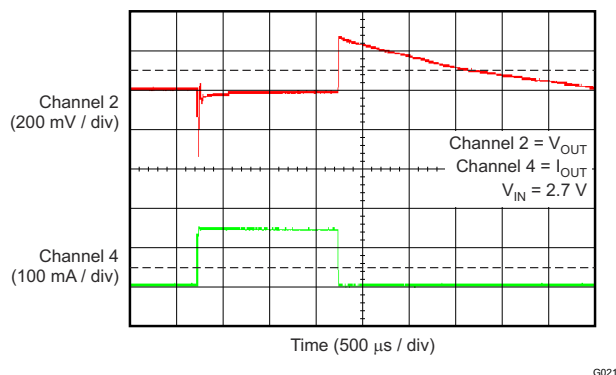


图 6-22. TPS70912 Load Transient  
(1 mA to 150 mA)

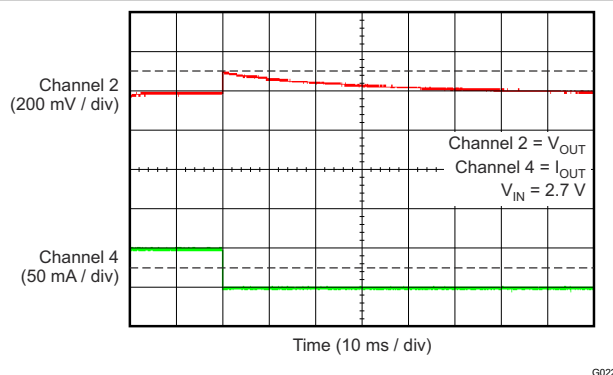


图 6-23. TPS70912 Load Transient  
(50 mA to 0 mA)

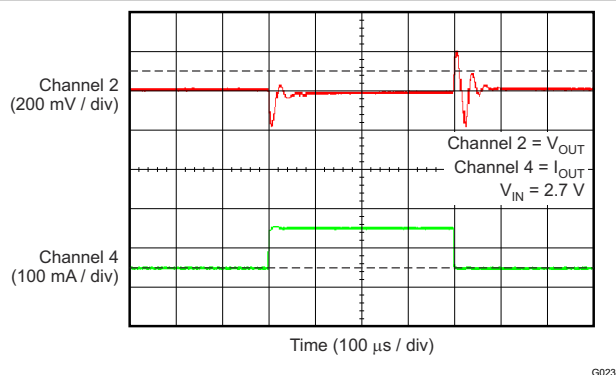


图 6-24. TPS70912 Load Transient  
(50 mA to 150 mA)

## 6.6 Typical Characteristics (continued)

over operating temperature range ( $T_J = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = 2\text{ V}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , and  $V_{IN} = V_{OUT(\text{typ})} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^{\circ}\text{C}$

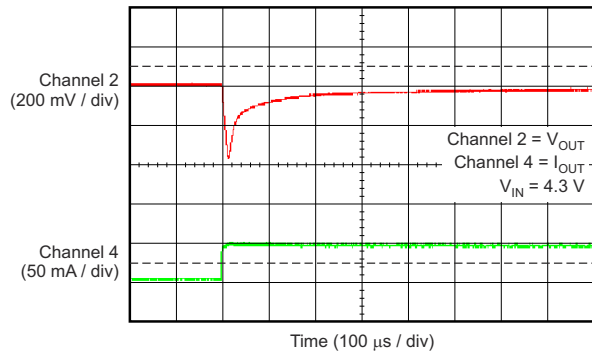


图 6-25. TPS70933 Load Transient  
(0 mA to 50 mA)

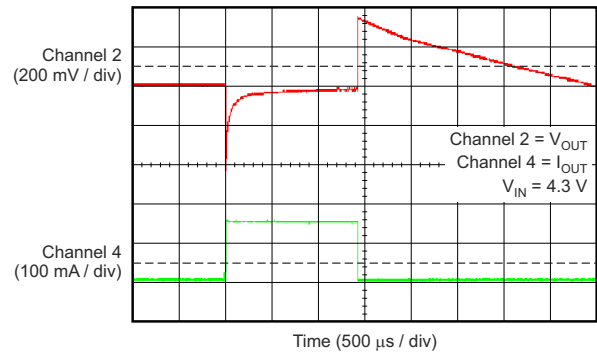


图 6-26. TPS70933 Load Transient  
(1 mA to 150 mA)

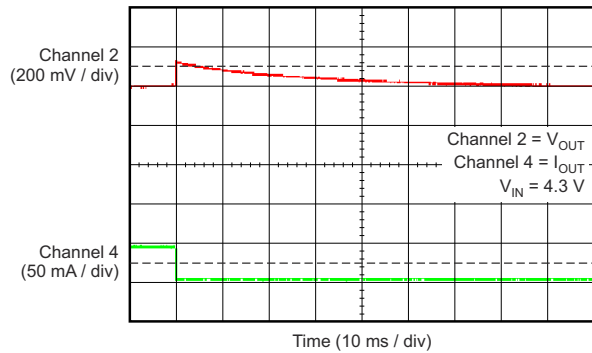


图 6-27. TPS70933 Load Transient  
(50 mA to 0 mA)

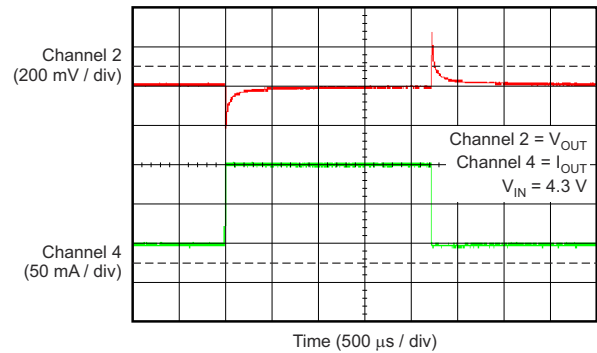


图 6-28. TPS70933 Load Transient  
(50 mA to 150 mA)

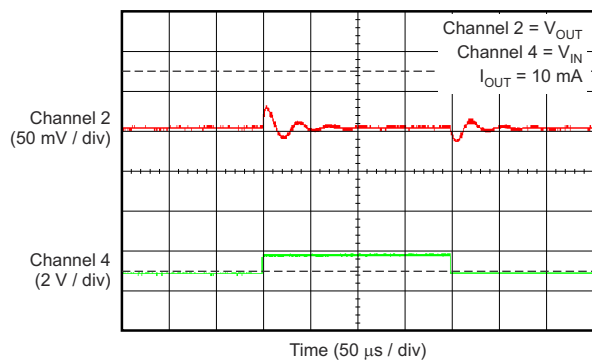


图 6-29. TPS70912 Line Transient  
(2.7 V to 3.7 V)

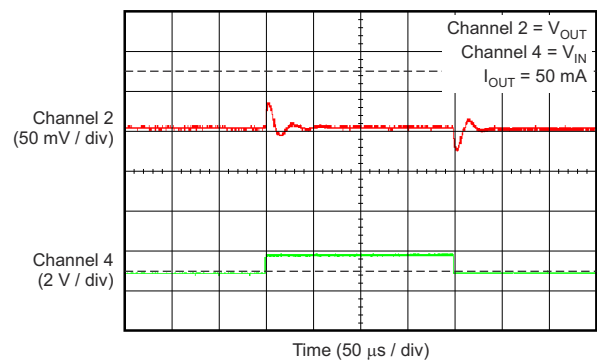


图 6-30. TPS70912 Line Transient  
(2.7 V to 3.7 V)

## 6.6 Typical Characteristics (continued)

over operating temperature range ( $T_J = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = 2\text{ V}$ ,  $C_{OUT} = 2.2\text{ }\mu\text{F}$ , and  $V_{IN} = V_{OUT(\text{typ})} + 1\text{ V}$  or  $2.7\text{ V}$  (whichever is greater), unless otherwise noted; typical values are at  $T_J = 25^{\circ}\text{C}$

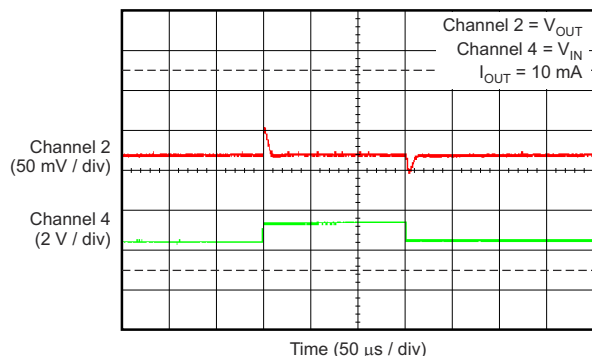


图 6-31. TPS70933 Line Transient  
(4.3 V to 5.3 V)

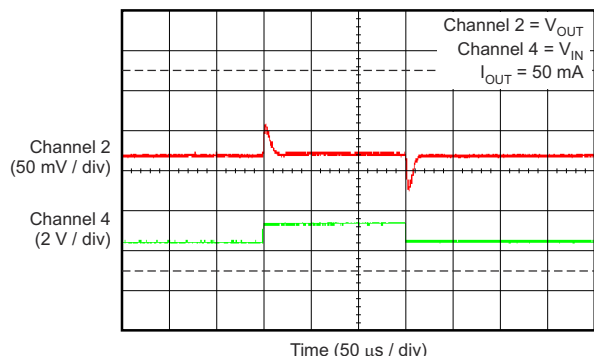


图 6-32. TPS70933 Line Transient  
(4.3 V to 5.3 V)

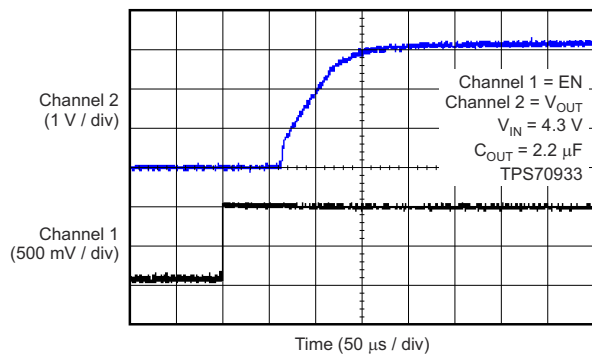


图 6-33. Power-Up With Enable

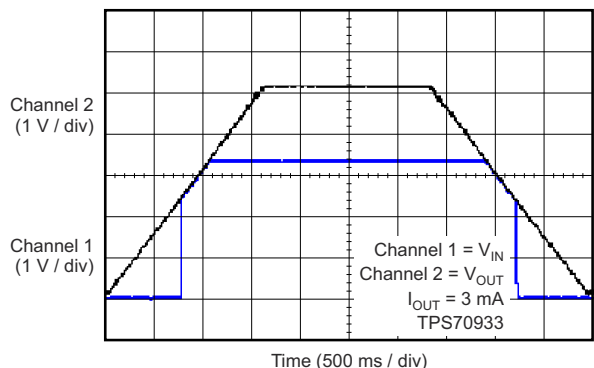


图 6-34. Power-Up and Power-Down Response

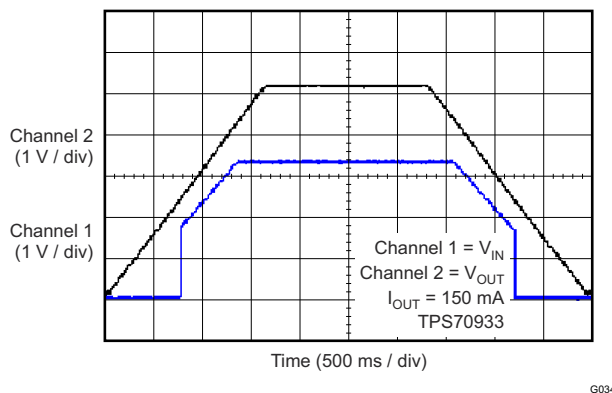


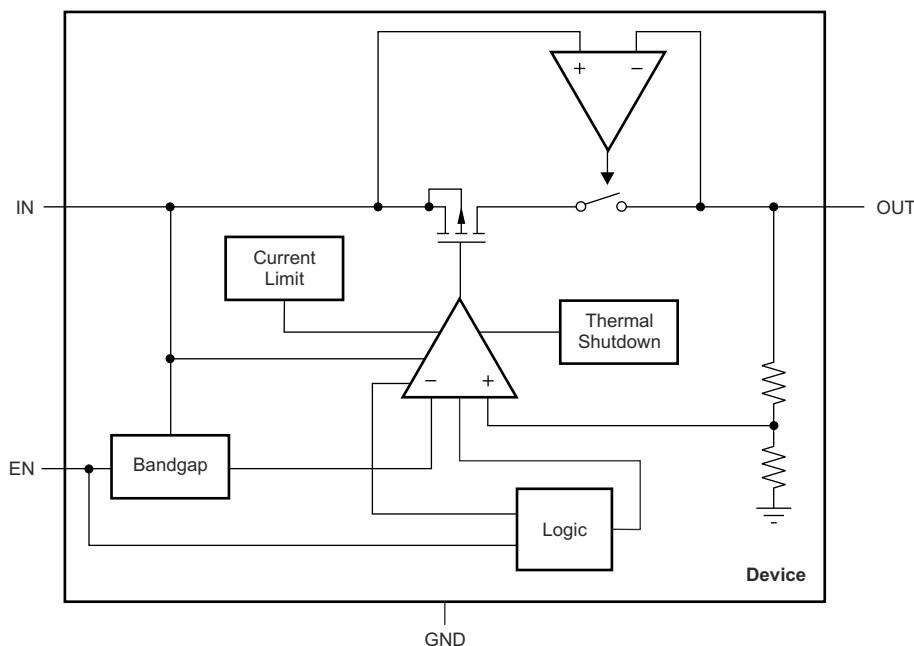
图 6-35. Power-Up and Power-Down Response

## 7 Detailed Description

### 7.1 Overview

The TPS709 series of devices are ultra-low quiescent current, low-dropout (LDO) linear regulators. The TPS709 offers reverse current protection to block any discharge current from the output into the input. The TPS709 also features current limit and thermal shutdown for reliable operation.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Internal Current Limit

The TPS709 internal current limit helps protect the regulator during fault conditions. During current limit, the output sources a fixed amount of current that is largely independent of output voltage. In such a case, the output voltage is not regulated, and can be measured as  $(V_{OUT} = I_{LIMIT} \times R_{LOAD})$ . The PMOS pass transistor dissipates  $[(V_{IN} - V_{OUT}) \times I_{LIMIT}]$  until a thermal shutdown is triggered and the device turns off. When cool, the device is turned on by the internal thermal shutdown circuit. If the fault condition continues, the device cycles between current limit and thermal shutdown; see the [Thermal Protection](#) section for more details.

The TPS709 is characterized over the recommended operating output current range up to 150 mA. The internal current limit begins to limit the output current at a minimum of 200 mA of output current. The TPS709 continues to operate for output currents between 150 mA and 200 mA but some data sheet parameters may not be met.

#### 7.3.2 Dropout Voltage

The TPS709 use a PMOS pass transistor to achieve low dropout voltage. When  $(V_{IN} - V_{OUT})$  is less than the dropout voltage ( $V_{DO}$ ), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the  $R_{DS(ON)}$  of the PMOS pass element.  $V_{DO}$  approximately scales with the output current because the PMOS device functions like a resistor in dropout.

The ground pin current of many linear voltage regulators increases substantially when the device is operated in dropout. This increase in ground pin current while operating in dropout can be several orders of magnitude larger than when the device is not in dropout. The TPS709 employs a special control loop that limits the increase in ground pin current while operating in dropout. This functionality allows for the most efficient operation while in dropout conditions that can greatly increase battery run times.

### 7.3.3 Undervoltage Lockout (UVLO)

The TPS709 uses an undervoltage lockout (UVLO) circuit to keep the output shut off until the internal circuitry operates properly.

### 7.3.4 Reverse-Current Protection

The TPS709 has integrated reverse-current protection. Reverse-current protection prevents the flow of current from the OUT pin to the IN pin when output voltage is higher than input voltage. The reverse-current protection circuitry places the power path in high impedance when the output voltage is higher than the input voltage. This setting reduces leakage current from the output to the input to 10 nA, typical. The reverse current protection is always active regardless of the enable pin logic state or if the OUT pin voltage is greater than 1.8 V. Reverse current can flow if the output voltage is less than 1.8 V and if input voltage is less than the output voltage.

If voltage is applied to the input pin, then the maximum voltage that can be applied to the OUT pin is the lower of three times the nominal output voltage or 6.5 V. For example, if the 1.2-V output voltage version is used, then the maximum reverse bias voltage that can be applied to the OUT pin is 3.6 V. If the 5.0-V output voltage version is used, then the maximum reverse bias voltage that can be applied to the OUT pin is 6.5 V.

## 7.4 Device Functional Modes

The TPS709 has the following functional modes:

1. **Enabled:** When the enable pin (EN) goes above 0.9 V, the device is enabled. EN is pulled high by a 300-nA current source; therefore, EN can be left floating to enable the device. Do not connect EN to VIN. The EN pin is clamped by a 6.5-V Zener diode. Do not exceed the 7-V absolute maximum rating on the enable pin or excessive current flowing into the Zener clamp will destroy the device.
2. **Disabled:** When EN goes below 0.4 V, the device is disabled. During this time, OUT is high impedance and the current into IN ( $I_{\text{SHUTDOWN}}$ ) is typically 150 nA.

## 8 Application and Implementation

### Note

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

### 8.1 Application Information

The TPS709 is a series of devices that consume low quiescent current and deliver excellent line and load transient performance. This performance, combined with low noise and very good PSRR with little ( $V_{IN} - V_{OUT}$ ) headroom, makes this device ideal for RF portable applications, current limit, and thermal protection. The TPS709 is specified from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

#### 8.1.1 Input and Output Capacitor

The TPS709 devices are stable with output capacitors with an effective capacitance of  $2.0\ \mu\text{F}$  or greater for output voltages below 1.5 V. For output voltages equal or greater than 1.5 V, the minimum effective capacitance for stability is  $1.5\ \mu\text{F}$ . The maximum capacitance for stability is  $47\ \mu\text{F}$ . The equivalent series resistance (ESR) of the output capacitor must be between  $0\ \Omega$  and  $0.2\ \Omega$  for stability.

The effective capacitance is the minimum capacitance value of a capacitor after taking into account variations resulting from tolerances, temperature, and dc bias effects. X5R- and X7R-type ceramic capacitors are recommended because these capacitors have minimal variation in value and ESR over temperature.

Although an input capacitor is not required for stability, good analog design practice is to connect a  $0.1\text{-}\mu\text{F}$  to  $2.2\text{-}\mu\text{F}$  capacitor from IN to GND. This capacitor counteracts reactive input sources and improves transient response, input ripple, and PSRR. An input capacitor is necessary if line transients greater than 10 V in magnitude are anticipated.

#### 8.1.2 Transient Response

As with any regulator, increasing the output capacitor size reduces over- and undershoot magnitude, but increases transient response duration.

### 8.2 Typical Application

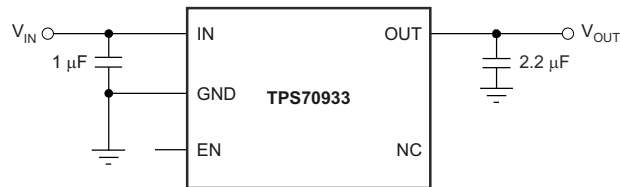


图 8-1. Wide Input, 3.3-V, Low- $I_Q$  Rail

#### 8.2.1 Design Requirements

表 8-1 summarizes the design requirements for 图 8-1.

表 8-1. Design Requirements for a Wide Input, 3.3-V, Low- $I_Q$  Rail Application

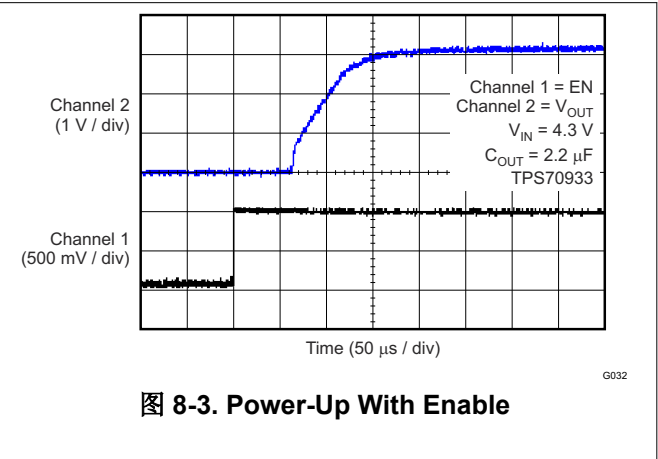
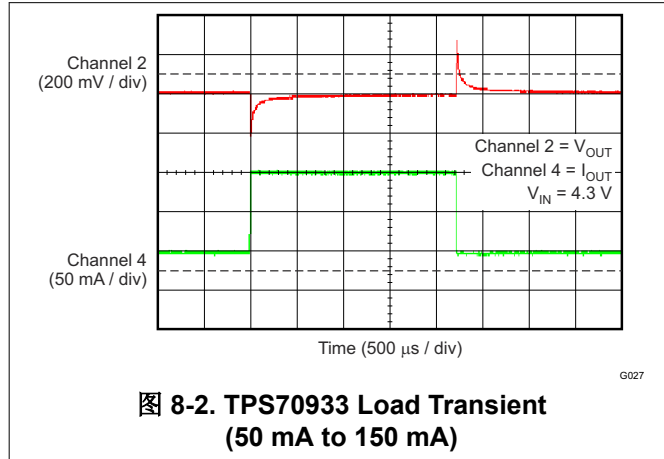
| PARAMETER            | DESIGN SPECIFICATION |
|----------------------|----------------------|
| $V_{IN}$             | 5 V to 20 V          |
| $V_{OUT}$            | 3.3 V                |
| $I_{(IN)}$ (no load) | $< 5\ \mu\text{A}$   |
| $I_{OUT}$ (max)      | 150 mA               |

### 8.2.2 Detailed Design Procedure

Select a 2.2-μF, 10-V X7R output capacitor to satisfy the minimum output capacitance requirement with a 3.3-V dc bias.

Select a 1.0-μF, 25-V X7R input capacitor to provide input noise filtering and eliminate high-frequency voltage transients.

### 8.2.3 Application Curves



## 9 Power Supply Recommendations

This device is designed to operate with an input supply range of 2.7 V to 30 V. If the input supply is noisy, additional input capacitors with low ESR can help improve output noise performance.

### 9.1 Power Dissipation

The ability to remove heat from the die is different for each package type, presenting different considerations in the printed circuit board (PCB) layout. The PCB area around the device that is free of other components moves the heat from the device to ambient air. Performance data for JEDEC low and high-K boards are given in the [Thermal Information](#) table. Using heavier copper increases the effectiveness in removing heat from the device. The addition of plated through-holes to heat-dissipating layers also improves the heat sink effectiveness.

Power dissipation depends on input voltage and load conditions. Power dissipation (P<sub>DISS</sub>) is equal to the product of the output current and the voltage drop across the output pass element, as shown in [方程式 1](#):

$$P_{DISS} = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (1)$$

## 10 Layout

### 10.1 Layout Guidelines

Place input and output capacitors as close to the device pins as possible. To improve ac performance (such as PSRR, output noise, and transient response), TI recommends that the board be designed with separate ground planes for  $V_{IN}$  and  $V_{OUT}$ , with the ground plane connected only at the GND pin of the device. In addition, the ground connection for the output capacitor must be connected directly to the device GND pin.

#### 10.1.1 Thermal Protection

Thermal protection disables the output when the junction temperature rises to approximately 165°C, allowing the device to cool. When the junction temperature cools to approximately 145°C, the output circuitry is again enabled. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit can cycle on and off. This cycling limits the dissipation of the regulator, protecting it from damage as a result of overheating.

Any tendency to activate the thermal protection circuit indicates excessive power dissipation or an inadequate heat sink. For reliable operation, limit junction temperature to 125°C, maximum. To estimate the margin of safety in a complete design (including heat sink), increase the ambient temperature until the thermal protection is triggered; use worst-case loads and signal conditions. For good reliability, thermal protection must trigger at least 35°C above the maximum expected ambient condition of the particular application. This configuration produces a worst-case junction temperature of 125°C at the highest expected ambient temperature and worst-case load.

The TPS709 internal protection circuitry is designed to protect against overload conditions. This circuitry is not intended to replace proper heat sinking. Continuously running the TPS709 into thermal shutdown degrades device reliability.

### 10.2 Layout Example

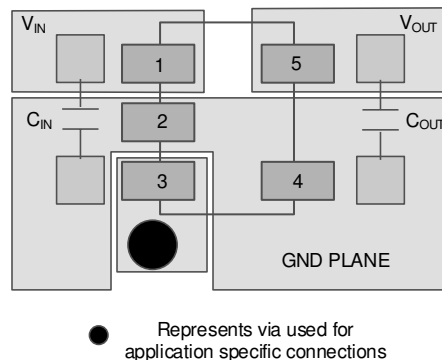


图 10-1. Layout Example for DBV Package

## 11 Device and Documentation Support

### 11.1 Device Support

#### 11.1.1 Development Support

##### 11.1.1.1 Evaluation Modules

An evaluation module (EVM) is available to assist in the initial circuit performance evaluation using the TPS709xx. The [TPS70933EVM-110 evaluation module](#) (and [related user guide](#)) can be requested at the Texas Instruments website through the product folders or purchased directly from the [TI eStore](#).

##### 11.1.1.2 Spice Models

Computer simulation of circuit performance using SPICE is often useful when analyzing the performance of analog circuits and systems. A SPICE model for the TPS709 is available through the product folders under *Simulation Models*.

#### 11.1.2 Device Nomenclature

表 11-1. Device Nomenclature<sup>(1)</sup>

| PRODUCT                                        | V <sub>OUT</sub>                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TPS709xx(x) yyy z<br>or<br>TPS709xx(x) yyy zM3 | <b>XX(X)</b> is the nominal output voltage. For output voltages with a resolution of 100 mV, two digits are used in the ordering number; otherwise, three digits are used (for example, 28 = 2.8 V; 125 = 1.25 V).<br><b>YYY</b> is the package designator.<br><b>Z</b> is the tape and reel quantity (R = 3000, T = 250).<br><b>M3</b> suffix device has same electrical specs as other devices and shares same design. |

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](#).

### 11.2 Documentation Support

#### 11.2.1 Related Documentation

For related documentation see the following:

Texas Instruments, [TPS70933EVM-110 Evaluation Module user guide](#)

### 11.3 支持资源

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

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

### 11.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

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### 11.5 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.

### 11.6 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

## 12 Mechanical, Packaging, and Orderable Information

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

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**PACKAGING INFORMATION**

| Orderable part number         | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TPS70912DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| <a href="#">TPS70912DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| <a href="#">TPS70912DRVR</a>  | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DRVR.A                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DRVR.B                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| <a href="#">TPS70912DRVT</a>  | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DRVT.A                | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| TPS70912DRVT.B                | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCX                 |
| <a href="#">TPS709135DBVR</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| TPS709135DBVR.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| TPS709135DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| <a href="#">TPS709135DBVT</a> | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| TPS709135DBVT.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| TPS709135DBVT.B               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCY                 |
| <a href="#">TPS70915DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| <a href="#">TPS70915DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| <a href="#">TPS70915DRVR</a>  | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVR.A                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVR.B                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| <a href="#">TPS70915DRVT</a>  | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVT.A                | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TPS70915DRVT.B                 | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVTG4                 | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVTG4.A               | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| TPS70915DRVTG4.B               | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIM                 |
| <a href="#">TPS70916DBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| TPS70916DBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| TPS70916DBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| <a href="#">TPS70916DBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| TPS70916DBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| TPS70916DBVT.B                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SCZ                 |
| <a href="#">TPS70918DBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| <a href="#">TPS70918DBVT</a>   | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVT.A                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVT.B                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVTG4                 | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVTG4.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DBVTG4.B               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| <a href="#">TPS70918DRVR</a>   | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVR.A                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVR.B                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVRG4                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVRG4.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVRG4.B               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| <a href="#">TPS70918DRVRM3</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVRM3.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| <a href="#">TPS70918DRVT</a>   | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| TPS70918DRVT.B                 | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDA                 |
| <a href="#">TPS70919DBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |
| TPS70919DBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TPS70919DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |
| TPS70919DBVRG4.A             | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| TPS70919DBVRG4.B             | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| <a href="#">TPS70919DBVT</a> | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |
| TPS70919DBVT.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |
| TPS70919DBVT.B               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDB                 |
| <a href="#">TPS70925DBVR</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DBVR.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DBVRG4.A             | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| TPS70925DBVRG4.B             | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| <a href="#">TPS70925DBVT</a> | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DBVT.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DBVT.B               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| <a href="#">TPS70925DRVR</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DRVR.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DRVR.B               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| <a href="#">TPS70925DRVT</a> | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DRVT.A               | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| TPS70925DRVT.B               | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDC                 |
| <a href="#">TPS70927DBVR</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| TPS70927DBVR.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| TPS70927DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| <a href="#">TPS70927DBVT</a> | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| TPS70927DBVT.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| TPS70927DBVT.B               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDD                 |
| <a href="#">TPS70928DBVR</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |
| TPS70928DBVR.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |
| TPS70928DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |
| <a href="#">TPS70928DBVT</a> | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |
| TPS70928DBVT.A               | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |

| Orderable part number         | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TPS70928DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDE                 |
| <a href="#">TPS70930DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DBVRG4.A              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| TPS70930DBVRG4.B              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| <a href="#">TPS70930DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| <a href="#">TPS70930DRV.R</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.R.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.R.B               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.RG4               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.RG4.A             | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.RG4.B             | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| <a href="#">TPS70930DRV.T</a> | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| TPS70930DRV.T.B               | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDF                 |
| <a href="#">TPS70933DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVRG4                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVRG4.A              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVRG4.B              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| <a href="#">TPS70933DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| <a href="#">TPS70933DRV.R</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRV.R.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRV.R.B               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRV.RG4               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRV.RG4.A             | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TPS70933DRVRG4.B                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| <a href="#">TPS70933DRVRM3</a>  | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRVRM3.A                | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| <a href="#">TPS70933DRVVT</a>   | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| TPS70933DRVVT.B                 | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDG                 |
| <a href="#">TPS70936DBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| TPS70936DBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| TPS70936DBVR.B                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| <a href="#">TPS70936DBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| TPS70936DBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| TPS70936DBVT.B                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SEJ                 |
| <a href="#">TPS70936DRVVR</a>   | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1FV                 |
| TPS70936DRVVR.A                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1FV                 |
| TPS70936DRVVR.B                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1FV                 |
| <a href="#">TPS70936DRVVRM3</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 1FV                 |
| TPS70936DRVVRM3.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 1FV                 |
| <a href="#">TPS70938DBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVR.B                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| <a href="#">TPS70938DBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVT.B                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVTG4                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVTG4.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| TPS70938DBVTG4.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIC                 |
| <a href="#">TPS70939DBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |
| TPS70939DBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |
| TPS70939DBVR.B                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |
| <a href="#">TPS70939DBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |
| TPS70939DBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |
| TPS70939DBVT.B                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SID                 |

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TPS70950DBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVR.B                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVRG4                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVRG4.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVRG4.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| <a href="#">TPS70950DBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU   SN   NIPDAU                 | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DBVT.B                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| <a href="#">TPS70950DRVVR</a>   | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVR.A                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVR.B                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVRG4                 | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVRG4.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVRG4.B               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| <a href="#">TPS70950DRVVRM3</a> | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVRM3.A               | Active        | Production           | WSON (DRV)   6   | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| <a href="#">TPS70950DRVVT</a>   | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| TPS70950DRVVT.B                 | Active        | Production           | WSON (DRV)   6   | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SDH                 |
| <a href="#">TPS70960DBVR</a>    | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVR.A                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVR.B                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVRG4                  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVRG4.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVRG4.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| <a href="#">TPS70960DBVT</a>    | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVT.A                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| TPS70960DBVT.B                  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | SIT                 |
| <a href="#">TPS709A30DBVR</a>   | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |
| TPS709A30DBVR.A                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |
| TPS709A30DBVR.B                 | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TPS709A30DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |
| TPS709A30DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |
| TPS709A30DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11RF                |
| <a href="#">TPS709A33DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| TPS709A33DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| TPS709A33DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| TPS709A33DBVRG4.A              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| TPS709A33DBVRG4.B              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | -           | Call TI                              | Call TI                           | -40 to 125   |                     |
| <a href="#">TPS709A33DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| TPS709A33DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| TPS709A33DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 11SF                |
| <a href="#">TPS709B33DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| TPS709B33DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| TPS709B33DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| <a href="#">TPS709B33DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| TPS709B33DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| TPS709B33DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13C7                |
| <a href="#">TPS709B345DBVR</a> | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 1XSW                |
| TPS709B345DBVR.A               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 1XSW                |
| TPS709B345DBVR.B               | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 1XSW                |
| <a href="#">TPS709B50DBVR</a>  | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVR.A                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVR.B                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVRG4                | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVRG4.A              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVRG4.B              | Active        | Production           | SOT-23 (DBV)   5 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| <a href="#">TPS709B50DBVT</a>  | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVT.A                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |
| TPS709B50DBVT.B                | Active        | Production           | SOT-23 (DBV)   5 | 250   SMALL T&R       | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | 13D7                |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

**(2) Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

**(3) RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

**(4) Lead finish/Ball material:** Parts 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.

**(5) MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

**(6) Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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#### **OTHER QUALIFIED VERSIONS OF TPS709 :**

- Automotive : [TPS709-Q1](#)

NOTE: Qualified Version Definitions:

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

## TAPE AND REEL INFORMATION



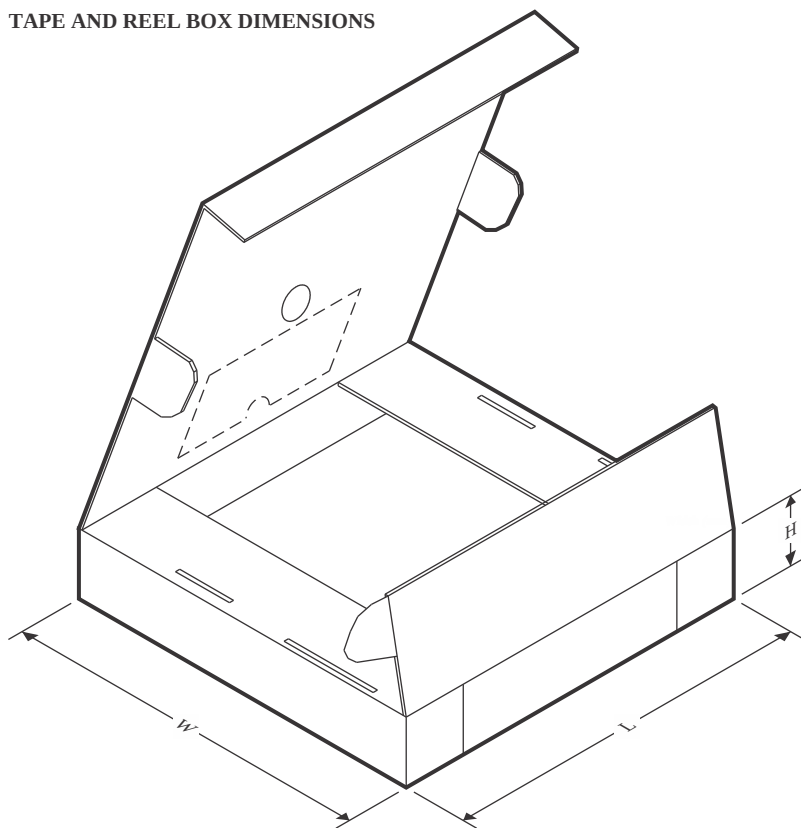
\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS70912DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70912DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70912DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70912DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS709135DBVR  | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709135DBVT  | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70915DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70915DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70915DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70915DRVR   | WSO          | DRV             | 6    | 3000 | 179.0              | 8.4                | 2.2     | 2.2     | 1.2     | 4.0     | 8.0    | Q2            |
| TPS70915DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70915DRVT   | WSO          | DRV             | 6    | 250  | 179.0              | 8.4                | 2.2     | 2.2     | 1.2     | 4.0     | 8.0    | Q2            |
| TPS70915DRVTG4 | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70916DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70916DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70918DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |

| 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS70918DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70918DBVTG4 | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70918DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70918DRVRG4 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70918DRVRM3 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70918DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70919DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70919DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70925DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70925DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70925DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70925DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70927DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70927DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70928DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70928DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70930DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70930DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70930DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70930DRVRG4 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70930DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70933DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70933DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70933DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70933DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70933DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70933DRVRG4 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70933DRVRM3 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70933DRVT   | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70936DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70936DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70936DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70936DRVR   | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70936DRVRM3 | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70938DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70938DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70938DBVTG4 | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70939DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70939DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70950DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70950DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |

| 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS70950DBVT    | SOT-23       | DBV             | 5    | 250  | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS70950DRV     | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70950DRVRG4  | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70950DRVRM3  | WSO          | DRV             | 6    | 3000 | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70950DRVT    | WSO          | DRV             | 6    | 250  | 180.0              | 8.4                | 2.3     | 2.3     | 1.15    | 4.0     | 8.0    | Q2            |
| TPS70960DBVR    | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70960DBVRG4  | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS70960DBVT    | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709A30DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709A30DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709A33DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.2     | 3.2     | 1.4     | 4.0     | 8.0    | Q3            |
| TPS709A33DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B33DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B33DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B345DBVR  | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B50DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B50DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| TPS709B50DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS70912DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70912DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70912DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70912DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS709135DBVR  | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709135DBVT  | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70915DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70915DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70915DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70915DRVR   | WSON         | DRV             | 6    | 3000 | 200.0       | 183.0      | 25.0        |
| TPS70915DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70915DRVT   | WSON         | DRV             | 6    | 250  | 200.0       | 183.0      | 25.0        |
| TPS70915DRVTG4 | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70916DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70916DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70918DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70918DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70918DBVTG4 | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS70918DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70918DRVRG4 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70918DRVRM3 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70918DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70919DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70919DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70925DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70925DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70925DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70925DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70927DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70927DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70928DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70928DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70930DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70930DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70930DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70930DRVRG4 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70930DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70933DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70933DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70933DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70933DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70933DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70933DRVRG4 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70933DRVRM3 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70933DRVT   | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70936DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70936DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70936DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70936DRVR   | WSON         | DRV             | 6    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70936DRVRM3 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70938DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70938DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70938DBVTG4 | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70939DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70939DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS70950DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70950DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS70950DBVT   | SOT-23       | DBV             | 5    | 250  | 210.0       | 185.0      | 35.0        |
| TPS70950DRVR   | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70950DRVRG4 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |
| TPS70950DRVRM3 | WSON         | DRV             | 6    | 3000 | 182.0       | 182.0      | 20.0        |

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS70950DRV     | WSON         | DRV             | 6    | 250  | 182.0       | 182.0      | 20.0        |
| TPS70960DBVR    | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70960DBVRG4  | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS70960DBVT    | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS709A30DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709A30DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS709A33DBVR   | SOT-23       | DBV             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| TPS709A33DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS709B33DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709B33DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| TPS709B345DBVR  | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709B50DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709B50DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS709B50DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |

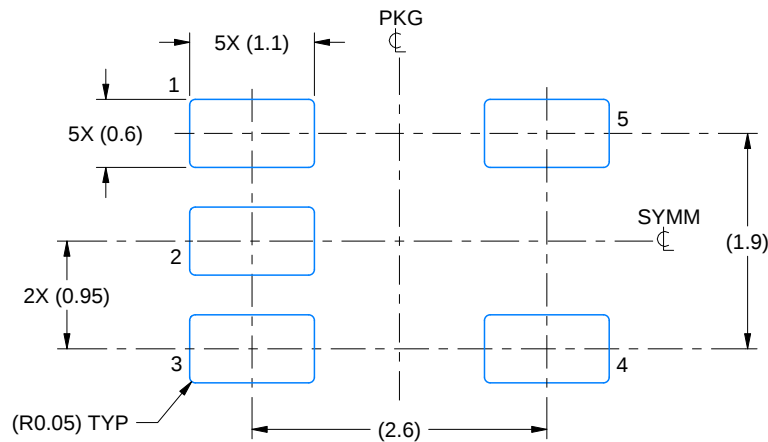


# EXAMPLE BOARD LAYOUT

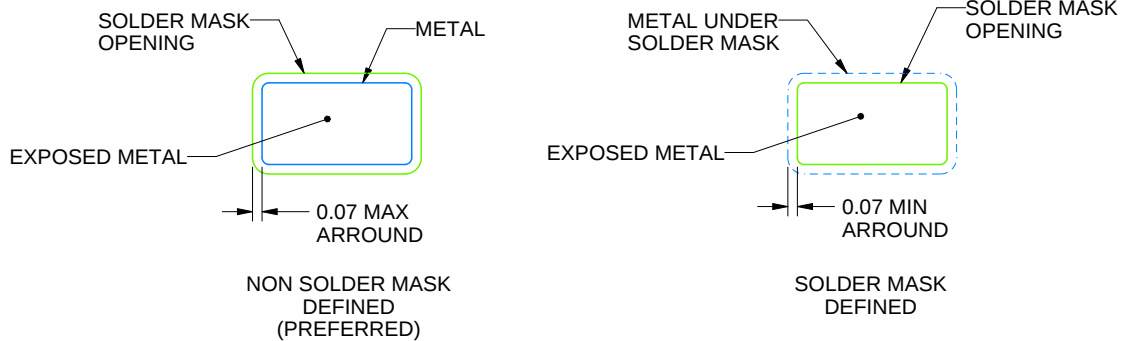
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

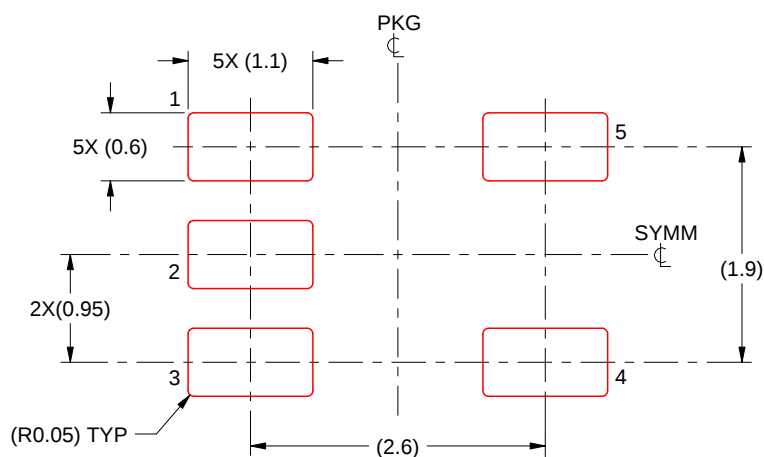
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR

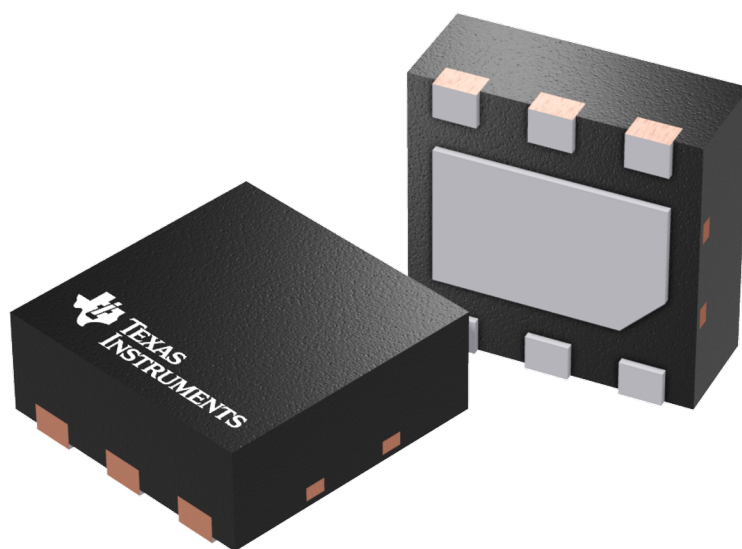


SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

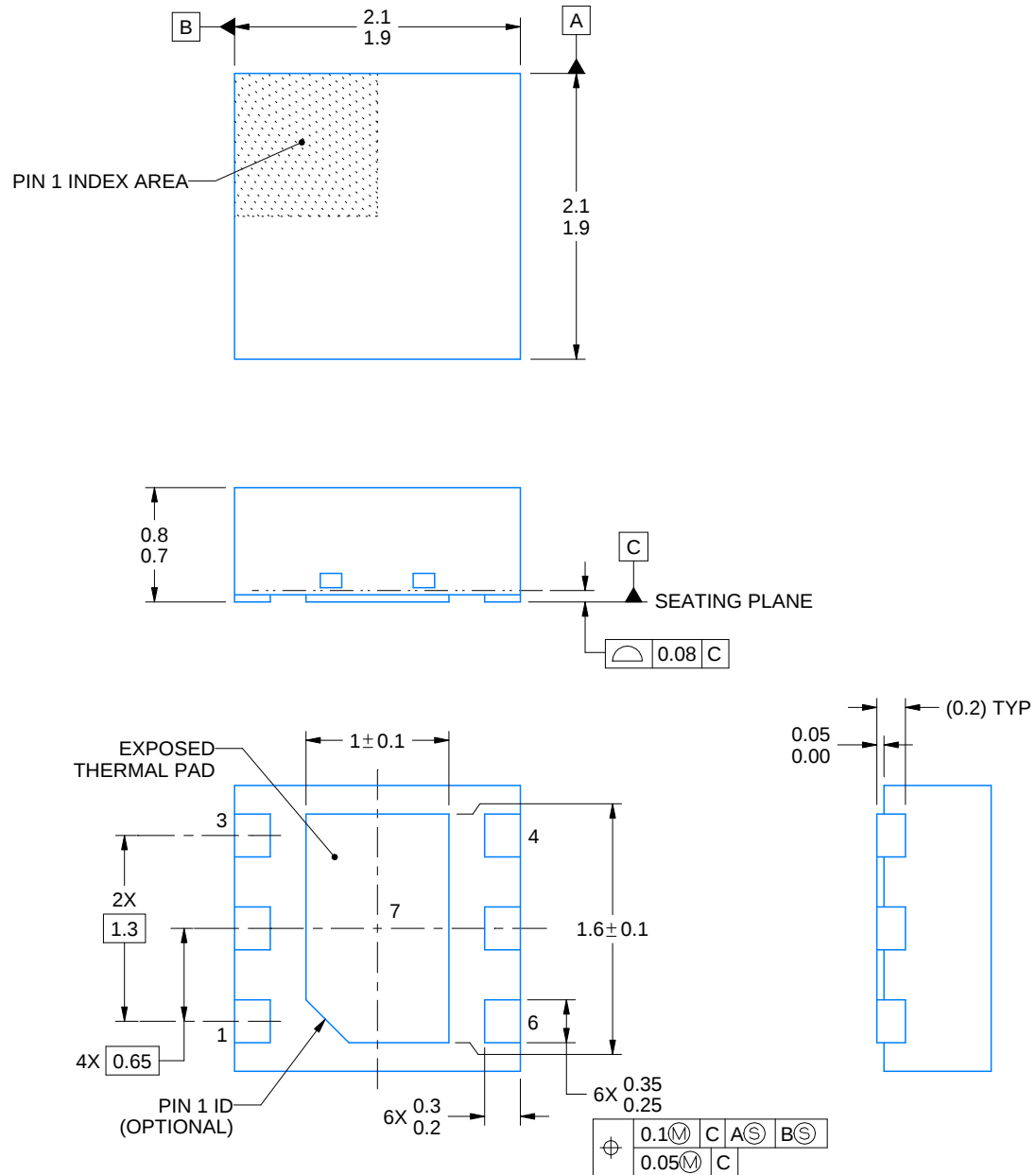
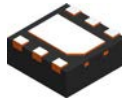
4214839/K 08/2024

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.



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4222173/B 04/2018

## NOTES:

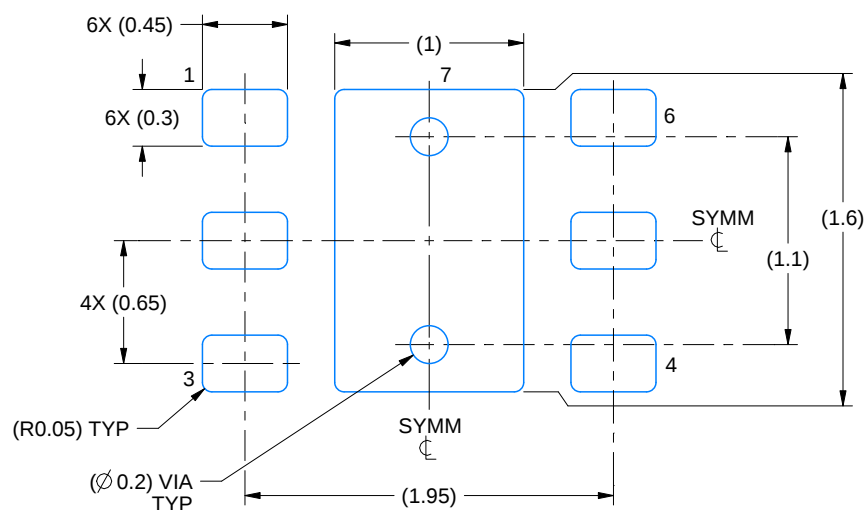
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# EXAMPLE BOARD LAYOUT

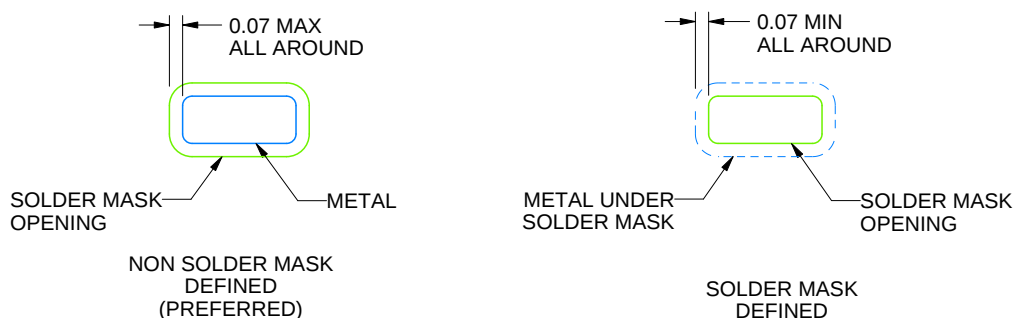
DRV0006A

WSN - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE  
SCALE:25X



SOLDER MASK DETAILS

4222173/B 04/2018

NOTES: (continued)

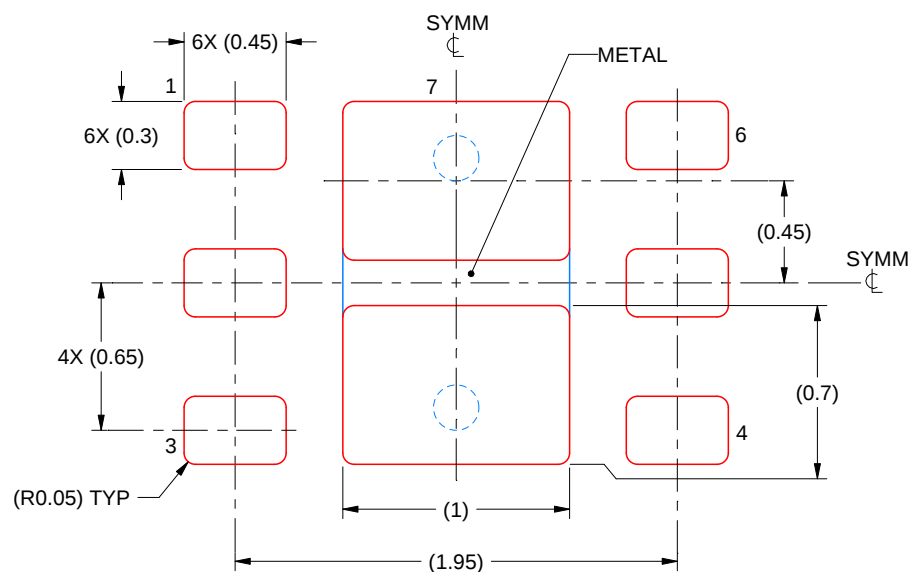
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

## EXAMPLE STENCIL DESIGN

DRV0006A

WSO - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



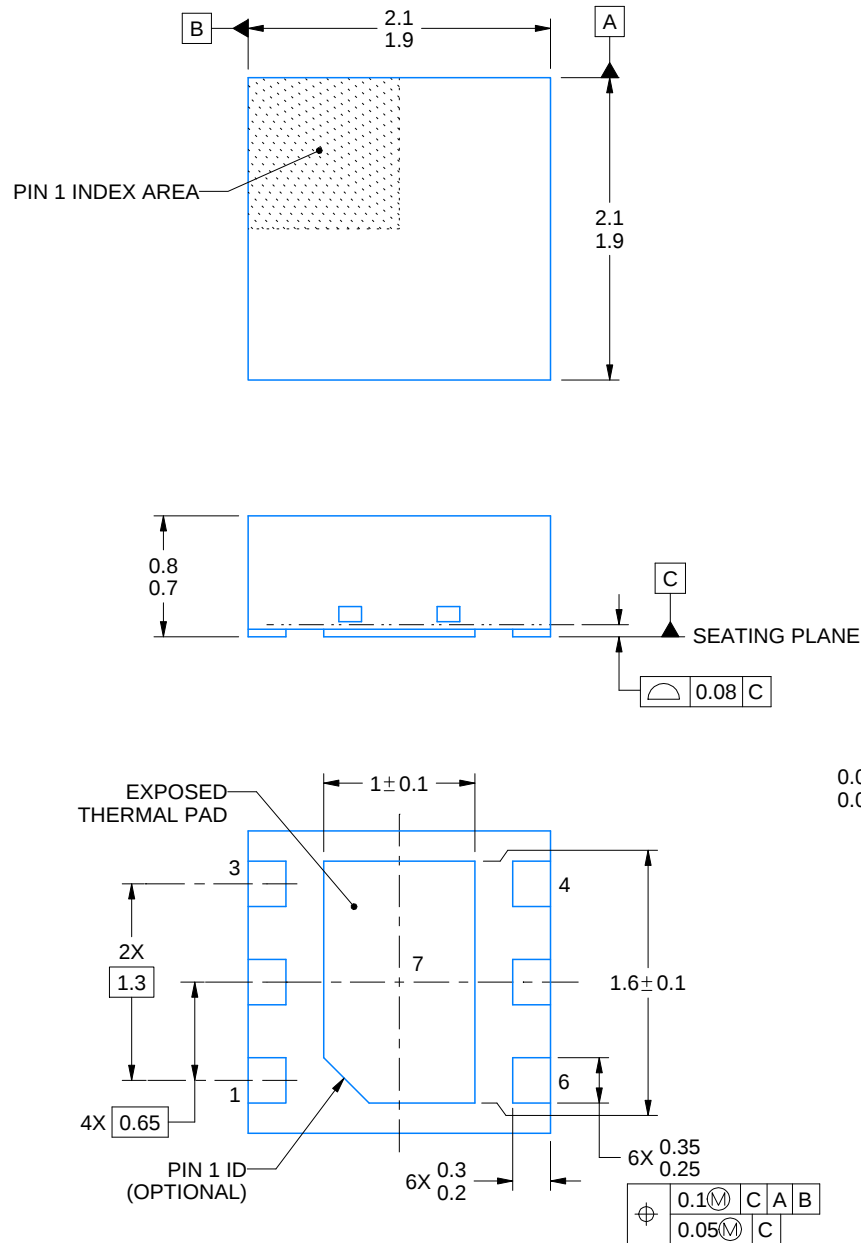
SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD #7  
88% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE  
SCALE:30X

4222173/B 04/2018

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



4225563/A 12/2019

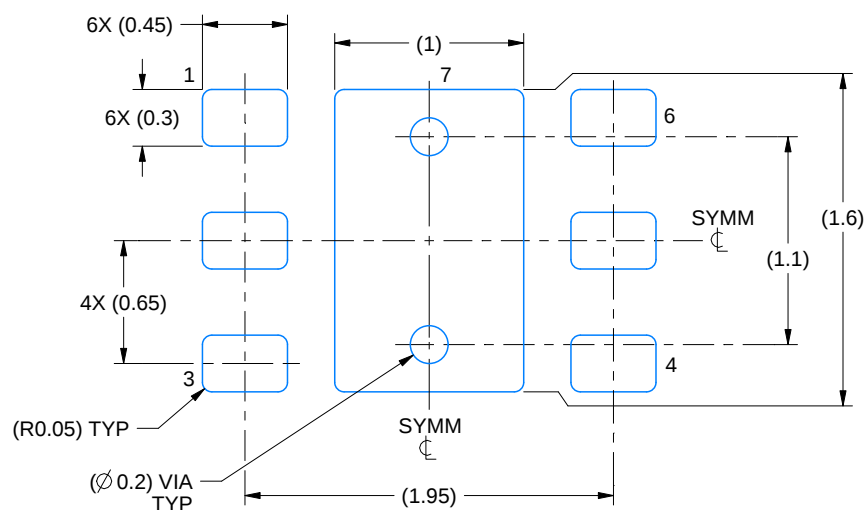
## NOTES:

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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

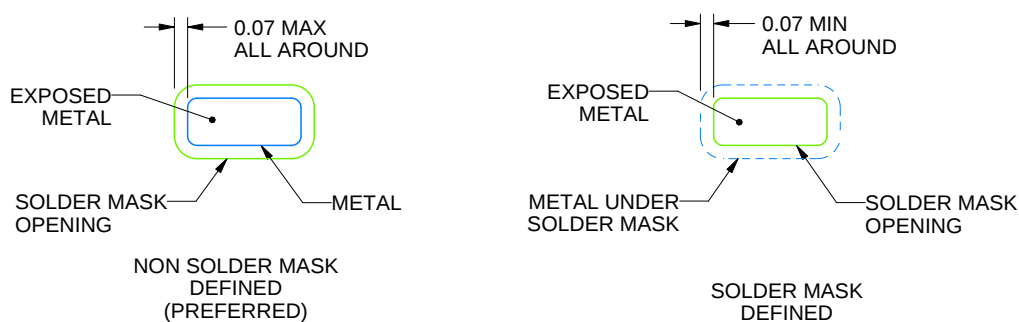
**DRV0006D**

**WSN - 0.8 mm max height**

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:25X



## SOLDER MASK DETAILS

4225563/A 12/2019

NOTES: (continued)

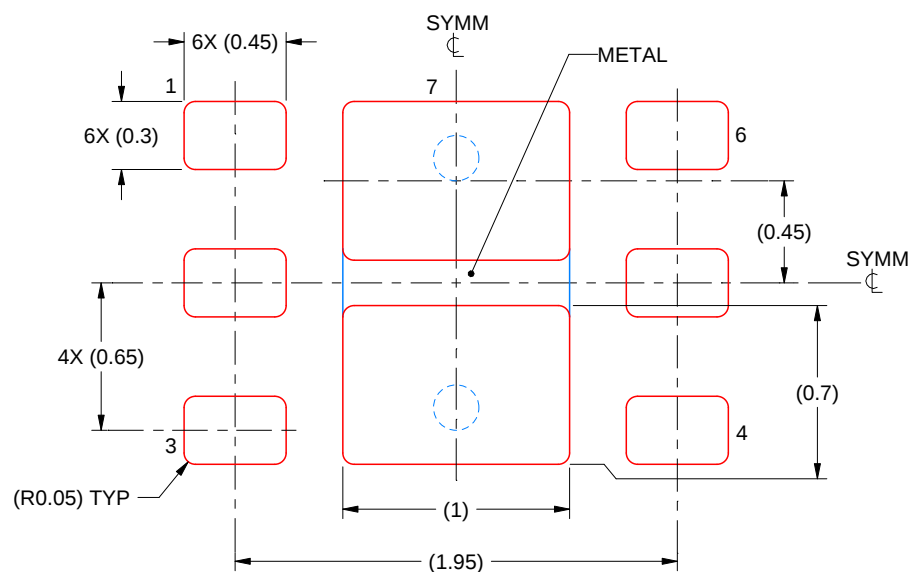
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

# EXAMPLE STENCIL DESIGN

DRV0006D

WSO - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD #7  
88% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE  
SCALE:30X

4225563/A 12/2019

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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