

TLV702-Q1 300mA、低 I_Q 、低ドロップアウトのレギュレータ

1 特長

- 車載アプリケーション用に認定済み
- 下記内容でAEC-Q100認定済み
 - デバイス温度グレード1: 動作時周囲温度範囲 $-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$
 - デバイスHBM ESD分類レベルH2
 - デバイスCDM ESD分類レベルC4B
- 非常に低いドロップアウト
 - $I_{\text{OUT}} = 50\text{mA}$, $V_{\text{OUT}} = 2.8\text{V}$ で37mV
 - $I_{\text{OUT}} = 100\text{mA}$, $V_{\text{OUT}} = 2.8\text{V}$ で75mV
 - $I_{\text{OUT}} = 300\text{mA}$, $V_{\text{OUT}} = 2.8\text{V}$ で220mV
- 温度範囲全体にわたって2%の精度
- 低い I_Q : 35 μA
- 1.2V~4.8Vの固定出力電圧の組み合わせが可能
- 高いPSRR: 1kHzにおいて68dB
- 実効容量 0.1 μF で安定⁽¹⁾
- サーマル・シャットダウンおよび過電流保護機能
- パッケージ: 5ピンSOT (DBVおよびDDC)および1.5mm \times 1.5mm、6ピンWSON

(1) 「アプリケーション情報」の「入力および出力コンデンサの要件」を参照してください。

2 アプリケーション

- 車載用カメラ・モジュール
- 画像センサ用電源
- マイクロプロセッサ用レール
- 車載用インフォテインメントのヘッド・ユニット
- 車体用電子機器

3 概要

TLV702-Q1シリーズの低ドロップアウト(LDO)リニア・レギュレータは、低静止電流のデバイスで、ラインおよび負荷過渡性能が非常に優れています。これらのLDOは、電力の制約が厳しいアプリケーション用に設計されています。

高精度のバンドギャップおよびエラー・アンプにより、2%の総合精度を実現しています。低い出力ノイズ、非常に高い電源除去率(PSRR)、低いドロップアウト電圧から、このシリーズのデバイスは広範なバッテリー動作機器に理想的です。デバイスのすべてのバージョンには、安全のためサーマル・シャットダウンと電流制限保護が組み込まれています。

さらに、これらのデバイスはわずか0.1 μF の実効出力容量で安定します。この特長により、バイアス電圧が高く温度ダイレーティングが大きい、コスト効率の高いコンデンサを使用できます。これらのデバイスは、出力負荷なしでも指定の精度へのレギュレーションを行います。

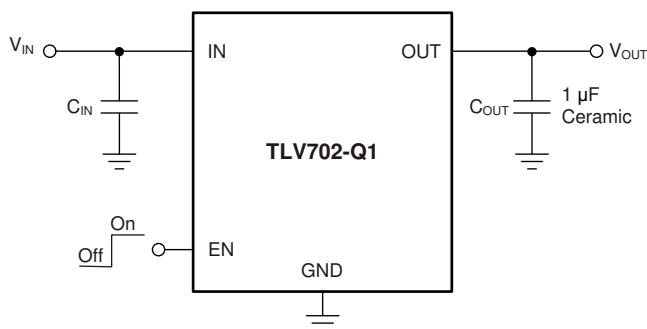
TLV702-Q1シリーズのLDOリニア・レギュレータは、SOTおよびWSONパッケージで供給されます。

製品情報⁽¹⁾

| 型番 | パッケージ | 本体サイズ(公称) |
|-----------|----------|------------------------|
| TLV702-Q1 | SOT (5) | 2.90mm \times 1.60mm |
| | WSON (6) | 1.50mm \times 1.50mm |

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にあるパッケージ・オプションについての付録を参照してください。

代表的なアプリケーション



目次

| | | | | | |
|-----|----------------------------------|----|------|--------------------------------|----|
| 1 | 特長 | 1 | 8 | Application and Implementation | 13 |
| 2 | アプリケーション | 1 | 8.1 | Application Information | 13 |
| 3 | 概要 | 1 | 8.2 | Typical Application | 13 |
| 4 | 改訂履歴 | 2 | 9 | Power Supply Recommendations | 15 |
| 5 | Pin Configuration and Functions | 4 | 9.1 | Power Dissipation | 15 |
| 6 | Specifications | 5 | 10 | Layout | 15 |
| 6.1 | Absolute Maximum Ratings | 5 | 10.1 | Layout Guidelines | 15 |
| 6.2 | ESD Ratings | 5 | 10.2 | Layout Examples | 16 |
| 6.3 | Recommended Operating Conditions | 5 | 11 | デバイスおよびドキュメントのサポート | 17 |
| 6.4 | Thermal Information | 5 | 11.1 | デバイス・サポート | 17 |
| 6.5 | Electrical Characteristics | 6 | 11.2 | ドキュメントのサポート | 17 |
| 6.6 | Typical Characteristics | 7 | 11.3 | ドキュメントの更新通知を受け取る方法 | 17 |
| 7 | Detailed Description | 11 | 11.4 | コミュニティ・リソース | 17 |
| 7.1 | Overview | 11 | 11.5 | 商標 | 17 |
| 7.2 | Functional Block Diagrams | 11 | 11.6 | 静電気放電に関する注意事項 | 17 |
| 7.3 | Feature Description | 11 | 11.7 | Glossary | 18 |
| 7.4 | Device Functional Modes | 12 | 12 | メカニカル、パッケージ、および注文情報 | 18 |

4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision C (January 2018) から Revision D に変更

Page

| | | |
|---|--|---|
| • | Changed OUT pin number from 5 to 3 in DSE column of <i>Pin Functions</i> table | 4 |
| • | Added footnote to maximum EN voltage specification | 5 |
| • | Added parameter names to <i>Recommended Operating Conditions</i> table | 5 |

Revision B (June 2015) から Revision C に変更

Page

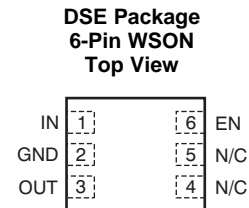
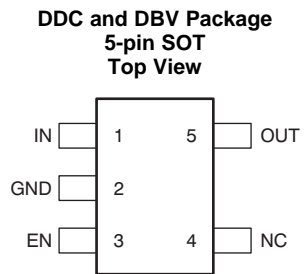
| | | |
|---|---|----|
| • | ドキュメントにDBVパッケージを追加 | 1 |
| • | DBVパッケージを追加して特長の「パッケージ」箇条書きを変更 | 1 |
| • | Added DBV package to <i>Pin Configuration and Functions</i> section | 4 |
| • | Added DBV column to <i>Thermal Information</i> table | 5 |
| • | Changed title of <i>Layout Example for the DDC and DBV Packages</i> figure to include DBV package | 16 |

Revision A (August 2013) から Revision B に変更

Page

| | | |
|---|---|---|
| • | データシートにDSE (6ピンWSON)パッケージを追加 | 1 |
| • | 「製品情報」表、「ESD定格」表、「推奨動作条件」表、「詳細説明」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクションをデータシートに追加 | 1 |
| • | データシート全体を通して、デバイスのPバージョンへの参照をすべて削除 | 1 |
| • | 「特長」の箇条書きで、「2%の精度」項目に「温度範囲全体にわたって」を追加 | 1 |
| • | データシート全体で、DDCパッケージ名をTSOT23からSOTに変更 | 1 |
| • | 「アプリケーション」の箇条書きを変更 | 1 |
| • | 「概要」セクションのテキストを変更 | 1 |
| • | 「代表的なアプリケーション」回路のセラミック・コンデンサの単位をmFからμFに変更(誤植) | 1 |
| • | Changed "free-air temperature" to "junction temperature" in <i>Absolute Maximum Ratings</i> condition statement | 5 |
| • | Added T _J to T _A condition in <i>Electrical Characteristics</i> condition statement | 6 |
| • | Changed T _A to T _J for typical values in <i>Electrical Characteristics</i> condition statement | 6 |

5 Pin Configuration and Functions



Pin Functions

| NAME | PIN | | I/O | DESCRIPTION |
|------|----------------|------------|-----|---|
| | DDC, DBV (SOT) | DSE (WSON) | | |
| IN | 1 | 1 | I | Input pin. A small, 1- μ F ceramic capacitor is recommended from this pin to ground to assure stability and good transient performance. See Input and Output Capacitor Requirements in the <i>Application Information</i> section for more details. |
| GND | 2 | 2 | — | Ground pin |
| EN | 3 | 6 | I | Enable pin. Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode and reduces operating current to 1 μ A, nominal. |
| NC | 4 | 4, 5 | — | No connection. Tie this pin to ground to improve thermal dissipation. |
| OUT | 5 | 3 | O | Regulated output voltage pin. A small, 1- μ F ceramic capacitor is needed from this pin to ground for stability. See Input and Output Capacitor Requirements in the <i>Application Information</i> section for more details. |

6 Specifications

6.1 Absolute Maximum Ratings

over operating junction temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|-------------------------------|--|--------------------|------------------|------|
| Voltage ⁽²⁾ | IN | −0.3 | 6 | V |
| | EN | −0.3 | 6 ⁽³⁾ | V |
| | OUT | −0.3 | 6 | V |
| Current (source) | OUT | Internally limited | | A |
| Output short-circuit duration | | Indefinite | | |
| Temperature | Operating virtual junction, T _J | −55 | 150 | °C |
| | Storage, T _{stg} | −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.
- (2) All voltages are with respect to network ground terminal.
- (3) The absolute maximum rating is V_{IN} + 0.3 V or 6.0 V, whichever is smaller.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|---|-------|
| V _(ESD) | Electrostatic discharge | Human-body model (HBM), per AEC Q100-002 ⁽¹⁾ | ±2000 |
| | | Charged-device model (CDM), per AEC Q100-011 | ±750 |

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

6.3 Recommended Operating Conditions

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

| | | MIN | NOM | MAX | UNIT |
|------------------|--|-----|-----|-----|------|
| V _{IN} | Input voltage | 2 | | 5.5 | V |
| V _{OUT} | Output voltage | 1.2 | | 4.8 | V |
| I _{OUT} | Output current | 0 | | 300 | mA |
| T _A | Ambient temperature | −40 | | 125 | °C |
| T _J | Operating virtual junction temperature | −40 | | 125 | °C |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TLV702-Q1 | | | UNIT |
|-------------------------------|--|-----------|-----------|------------|------|
| | | DDC (SOT) | DBV (SOT) | DSE (WSON) | |
| | | 5 PINS | 5 PINS | 6 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 262.8 | 249.2 | 321.3 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 68.2 | 136.4 | 207.9 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 81.6 | 85.9 | 281.5 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 1.1 | 19.5 | 42.4 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 80.9 | 85.3 | 284.8 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | N/A | N/A | 142.3 | °C/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 $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V (whichever is greater); $I_{OUT} = 10\text{ mA}$, $V_{EN} = 0.9\text{ V}$, $C_{OUT} = 1\text{ }\mu\text{F}$, and $T_J, T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$.

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------|--------------------------------|--|-----|------|----------|---------------------|
| | DC output accuracy | | -2% | 0.5% | 2% | |
| $\Delta V_{O(\Delta V)}$ | Line regulation | $V_{OUT(nom)} + 0.5\text{ V} \leq V_{IN} \leq 5.5\text{ V}$, $I_{OUT} = 10\text{ mA}$ | | 1 | 5 | mV |
| $\Delta V_{O(\Delta I)}$ | Load regulation | $0\text{ mA} \leq I_{OUT} \leq 300\text{ mA}$ | | 1 | 15 | mV |
| V_{DO} | Dropout voltage ⁽¹⁾ | $V_{IN} = 0.98 \times V_{OUT(nom)}$, $I_{OUT} = 300\text{ mA}$ | | 260 | 375 | mV |
| I_{CL} | Output current limit | $V_{OUT} = 0.9 \times V_{OUT(nom)}$ | 320 | 500 | 860 | mA |
| I_{GND} | Ground pin current | $I_{OUT} = 0\text{ mA}$ | | 35 | 55 | μA |
| | | $I_{OUT} = 300\text{ mA}$, $V_{IN} = V_{OUT} + 0.5\text{ V}$ | | 370 | | μA |
| I_{SHDN} | Ground pin current (shutdown) | $V_{EN} \leq 0.4\text{ V}$, $V_{IN} = 2\text{ V}$ | | 400 | | nA |
| | | $V_{EN} \leq 0.4\text{ V}$, $2\text{ V} \leq V_{IN} \leq 4.5\text{ V}$ | | 1 | 2.5 | μA |
| PSRR | Power-supply rejection ratio | $V_{IN} = 2.3\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 10\text{ mA}$, $f = 1\text{ kHz}$ | | 68 | | dB |
| V_n | Output noise voltage | BW = 100 Hz to 100 kHz, $V_{IN} = 2.3\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 10\text{ mA}$ | | 48 | | μV_{RMS} |
| t_{STR} | Start-up time ⁽²⁾ | $C_{OUT} = 1\text{ }\mu\text{F}$, $I_{OUT} = 300\text{ mA}$ | | 100 | | μs |
| $V_{EN(high)}$ | Enable pin high (enabled) | | 0.9 | | V_{IN} | V |
| $V_{EN(low)}$ | Enable pin low (disabled) | | 0 | | 0.4 | V |
| I_{EN} | Enable pin current | $V_{IN} = V_{EN} = 5.5\text{ V}$ | | 0.04 | | μA |
| UVLO | Undervoltage lockout | V_{IN} rising | | 1.9 | | V |
| T_{sd} | Thermal shutdown temperature | Shutdown, temperature increasing | | 165 | | $^\circ\text{C}$ |
| | | Reset, temperature decreasing | | 145 | | $^\circ\text{C}$ |

(1) V_{DO} is measured for devices with $V_{OUT(nom)} \geq 2.35\text{ V}$.

(2) Start-up time = time from EN assertion to $0.98 \times V_{OUT(nom)}$.

6.6 Typical Characteristics

Over operating temperature range ($T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$), $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V , whichever is greater; $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$.

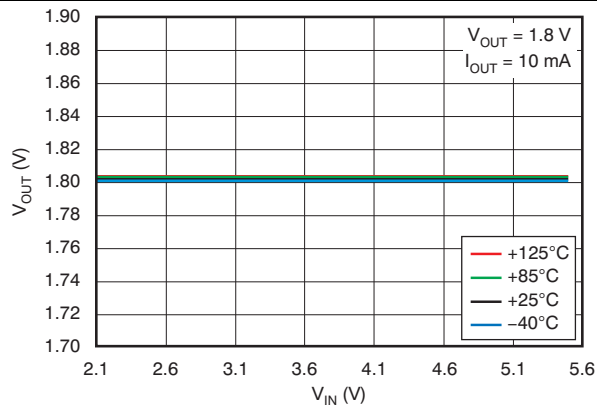


Figure 1. Line Regulation

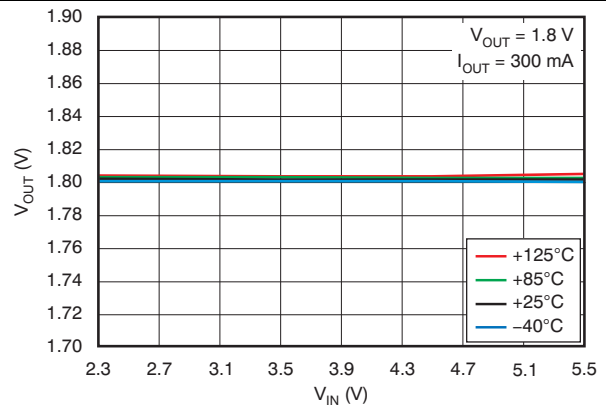


Figure 2. Line Regulation

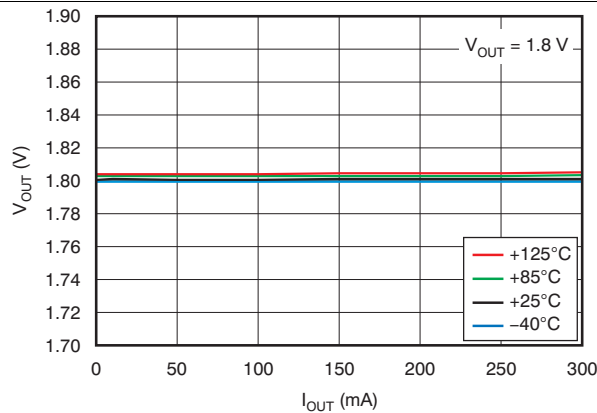


Figure 3. Load Regulation

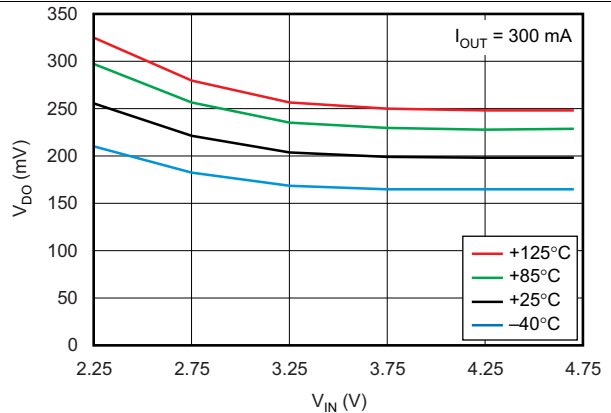


Figure 4. Dropout Voltage vs Input Voltage

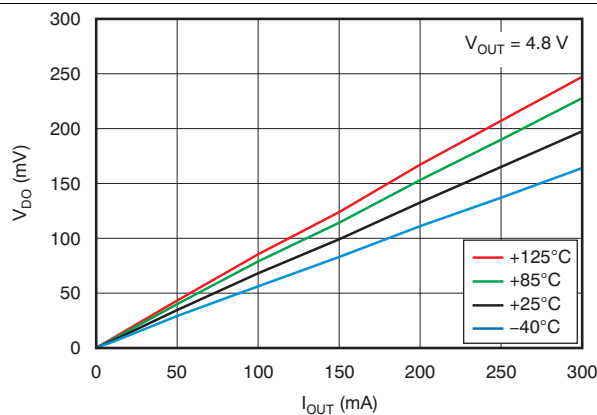


Figure 5. Dropout Voltage vs Output Current

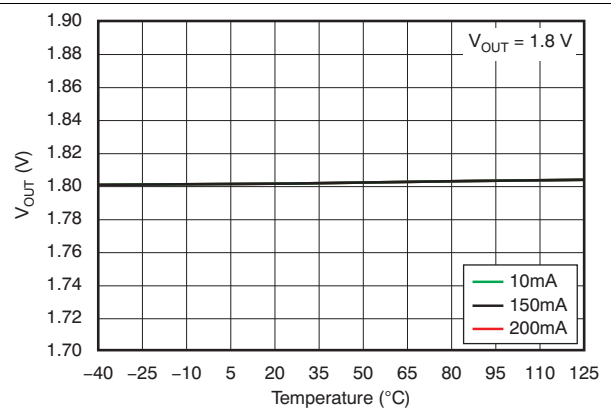


Figure 6. Output Voltage vs Temperature

Typical Characteristics (continued)

Over operating temperature range ($T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$), $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V , whichever is greater; $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\ \mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$.

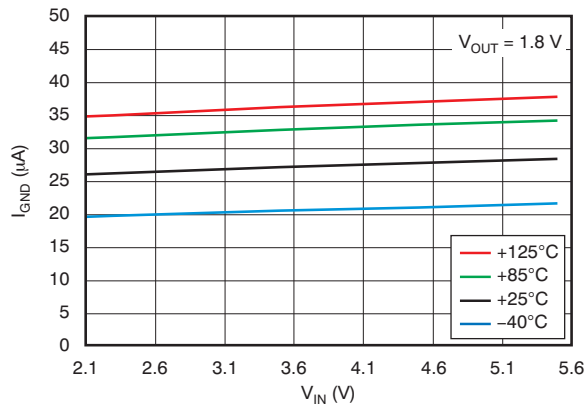


Figure 7. Ground Pin Current vs Input Voltage

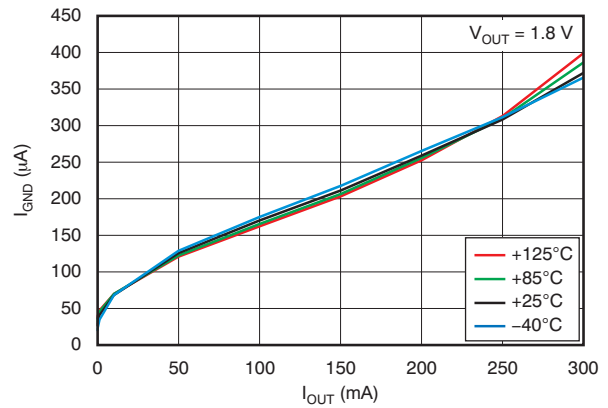


Figure 8. Ground Pin Current vs Load

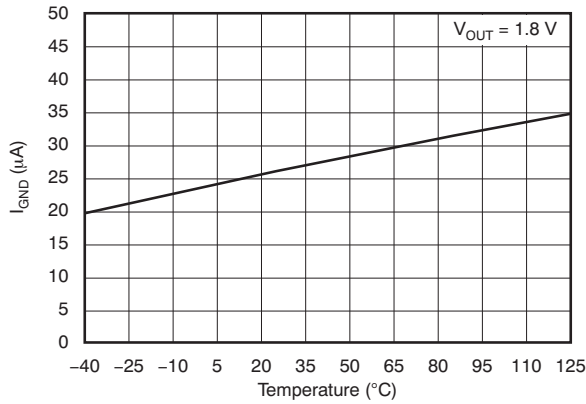


Figure 9. Ground Pin Current vs Temperature

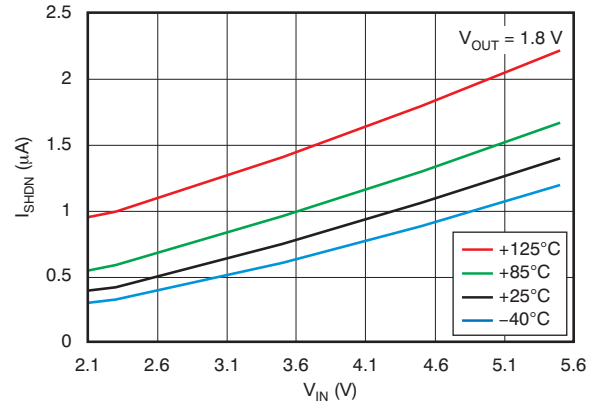


Figure 10. Shutdown Current vs Input Voltage

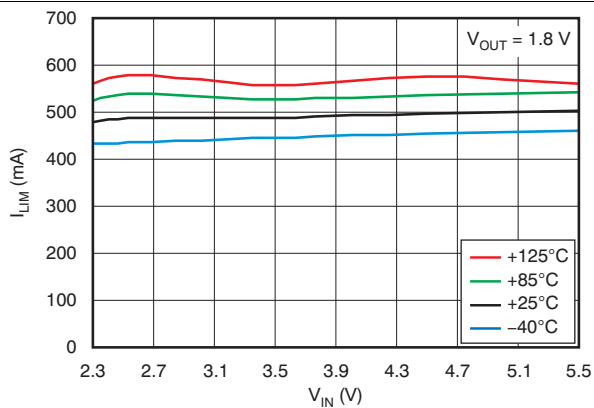


Figure 11. Current Limit vs Input Voltage

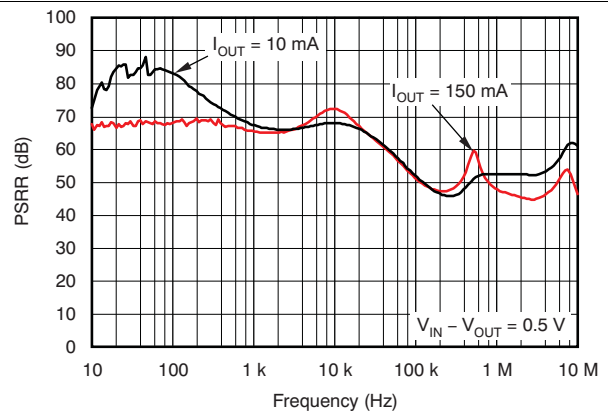


Figure 12. Power-Supply Ripple Rejection vs Frequency

Typical Characteristics (continued)

Over operating temperature range ($T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$), $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V , whichever is greater; $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\text{ }\mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$.



Figure 13. Power-Supply Ripple Rejection vs Input Voltage

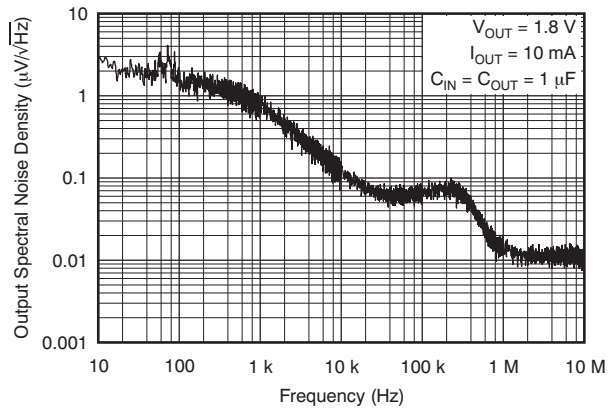


Figure 14. Output Spectral Noise Density vs Frequency



Figure 15. Load Transient Response



Figure 16. Load Transient Response



Figure 17. Load Transient Response

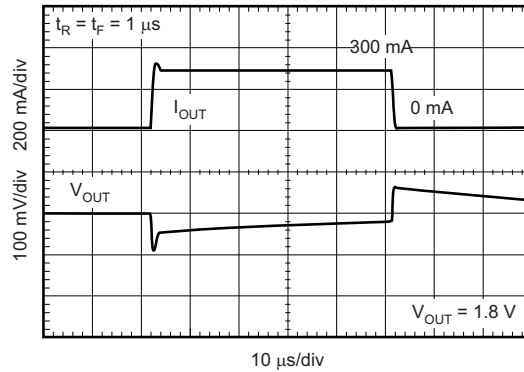
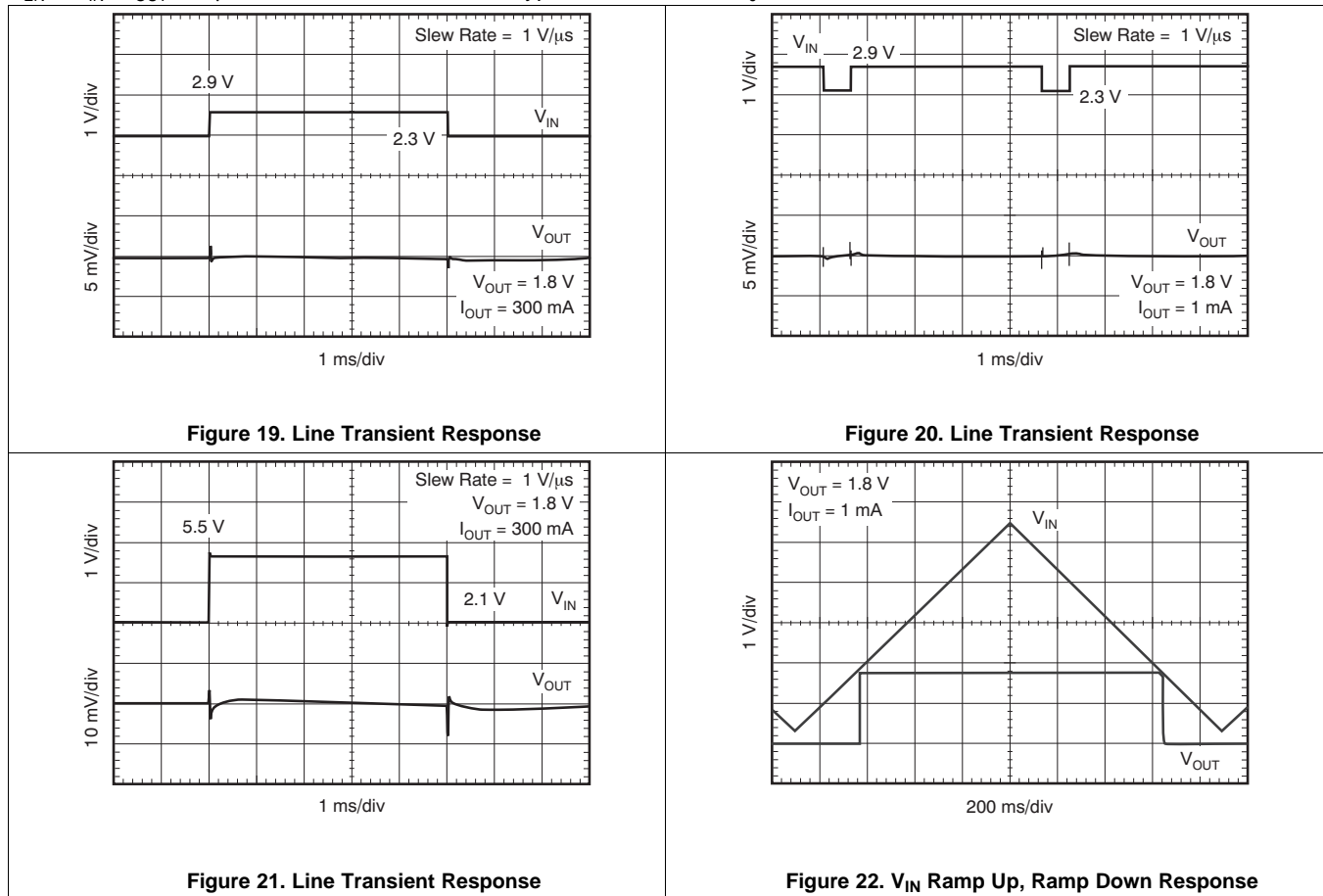


Figure 18. Load Transient Response

Typical Characteristics (continued)

Over operating temperature range ($T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$), $V_{IN} = V_{OUT(nom)} + 0.5\text{ V}$ or 2 V , whichever is greater; $I_{OUT} = 10\text{ mA}$, $V_{EN} = V_{IN}$, $C_{OUT} = 1\ \mu\text{F}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$.



7 Detailed Description

7.1 Overview

The TLV702-Q1 series of low-dropout (LDO) linear regulators are low quiescent current devices with excellent line and load transient performance. These LDOs are designed for power-sensitive applications. A precision bandgap and error amplifier provides overall 2% accuracy. Low output noise, very high power-supply rejection ratio (PSRR), and low dropout voltage make this series of devices ideal for most battery-operated handheld equipment. All device versions have integrated thermal shutdown, current limit, and undervoltage lockout (UVLO) protections.

7.2 Functional Block Diagrams

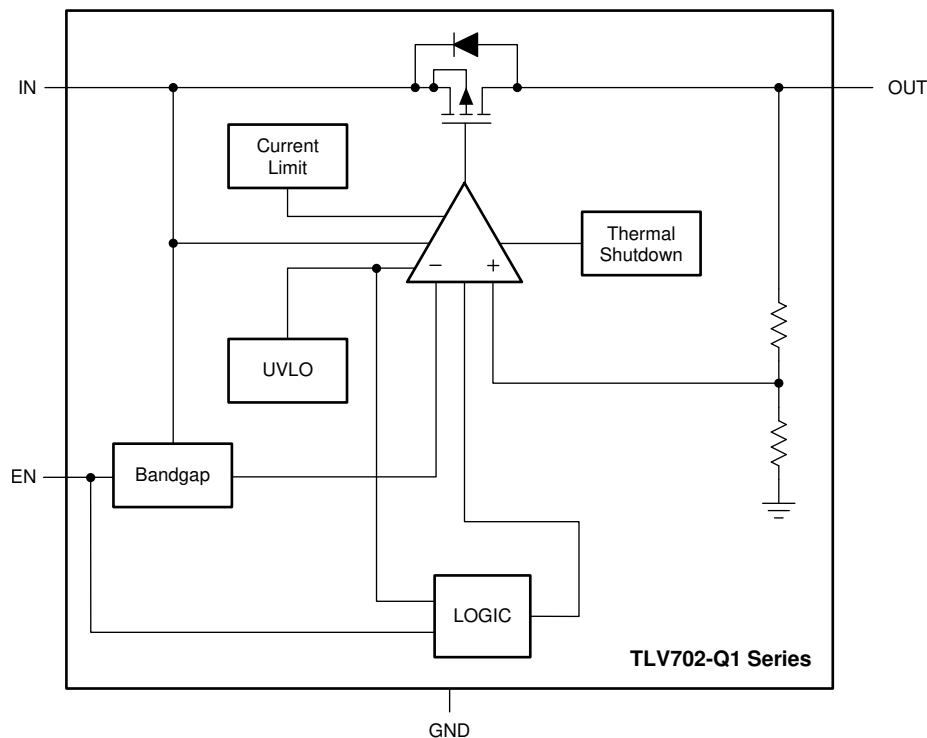


Figure 23. TLV702-Q1 Block Diagram

7.3 Feature Description

7.3.1 Internal Current Limit

The TLV702-Q1 internal current limit protection helps to protect the regulator during fault conditions. During current limit operation, the output sources a fixed amount of current that is largely independent of the output voltage. In such a case, the output voltage is not regulated, and is $V_{OUT} = I_{CL} \times R_{LOAD}$. The PMOS pass transistor dissipates $(V_{IN} - V_{OUT}) \times I_{CL}$ until thermal shutdown is triggered and the device turns off. As the device cools, the device is turned on by the internal thermal shutdown circuit. If the fault condition continues, the device cycles between current limit operation and thermal shutdown. See [Thermal Consideration](#) for more details.

The PMOS pass element in the TLV702-Q1 has a built-in body diode that conducts current when the voltage at the OUT pin exceeds the voltage at IN. This current is not limited; if extended reverse-voltage operation is anticipated, externally limit the output current to 5% of the rated I_{OUT} specification.

Feature Description (continued)

7.3.2 Shutdown

The enable pin (EN) is active high. The device is enabled when voltage at EN pin exceeds 0.9 V. The device is turned off when the EN pin is held at less than 0.4 V. When shutdown capability is not required, connect the EN pin to the IN pin.

7.3.3 Dropout Voltage

The TLV702-Q1 uses a PMOS pass transistor to achieve low dropout. When $(V_{IN} - V_{OUT})$ is less than the dropout voltage (V_{DO}), the PMOS pass device is in the linear (triode) region of operation. The input-to-output resistance is equal to the drain-source on-state resistance ($R_{DS(on)}$) of the PMOS pass element. V_{DO} scales approximately with output current because the PMOS device behaves as a resistor in dropout.

As with any linear regulator, PSRR and transient response are degraded as $(V_{IN} - V_{OUT})$ approaches dropout. This effect is shown in [Figure 13](#).

7.3.4 Undervoltage Lockout

The TLV702-Q1 uses a UVLO circuit to keep the output shut off until internal circuitry is operating properly.

7.4 Device Functional Modes

7.4.1 Normal Operation

The device regulates to the nominal output voltage under the following conditions:

- The input voltage is greater than the nominal output voltage added to the dropout voltage.
- The output current is less than the current limit.
- The input voltage is greater than the UVLO voltage.

7.4.2 Dropout Operation

If the input voltage is less than the nominal output voltage plus the specified dropout voltage, but all other conditions are met for normal operation, the device operates in dropout mode. In this condition, the output voltage is the same as the input voltage minus the dropout voltage. The transient performance of the device is significantly degraded because the pass device is in a triode state and no longer regulates the output voltage of the LDO. Line or load transients in dropout may result in large output voltage deviations.

[Table 1](#) lists the conditions that lead to the different modes of operation.

Table 1. Device Functional Mode Comparison

| OPERATING MODE | PARAMETER | |
|----------------|----------------------------------|--------------------|
| | V_{IN} | I_{OUT} |
| Normal mode | $V_{IN} > V_{OUT(nom)} + V_{DO}$ | $I_{OUT} < I_{CL}$ |
| Dropout mode | $V_{IN} < V_{OUT(nom)} + V_{DO}$ | $I_{OUT} < I_{CL}$ |
| Current limit | $V_{IN} > UVLO$ | $I_{OUT} > I_{CL}$ |

8 Application and Implementation

NOTE

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

8.1 Application Information

The TLV702-Q1 belongs to a new family of next-generation value LDO regulators. These devices consume low quiescent current and deliver excellent line and load transient performance. These characteristics, combined with low noise and very good PSRR with little ($V_{IN} - V_{OUT}$) headroom, make this family of devices ideal for portable RF applications. This family of regulators offers current limit and thermal protection, and is specified from -40°C to $+125^{\circ}\text{C}$.

8.2 Typical Application

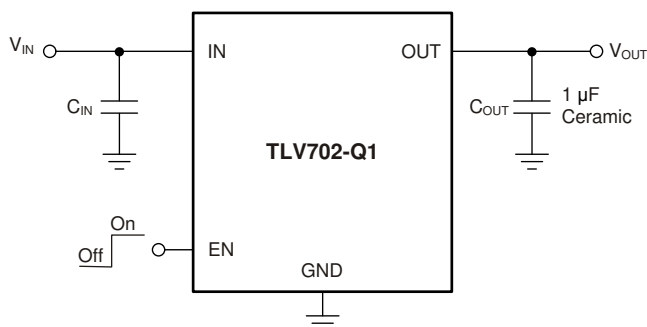


Figure 24. Typical Application Circuit

8.2.1 Design Requirements

Table 2 lists the design parameters.

Table 2. Design Parameters

| PARAMETER | DESIGN REQUIREMENT |
|----------------|--------------------|
| Input voltage | 2.5 V to 3.3 V |
| Output voltage | 1.8 V |
| Output current | 100 mA |

8.2.2 Detailed Design Procedure

8.2.2.1 Input and Output Capacitor Requirements

1- μ F X5R- and X7R-type ceramic capacitors are recommended because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature.

However, the TLV702-Q1 is designed to be stable with an *effective capacitance* of 0.1 μ F or larger at the output. Thus, the device is stable with capacitors of other dielectric types as well, as long as the effective capacitance under operating bias voltage and temperature is greater than 0.1 μ F. This effective capacitance refers to the capacitance that the LDO sees under operating bias voltage and temperature conditions; that is, the capacitance after taking both bias voltage and temperature derating into consideration. In addition to allowing the use of lower-cost dielectrics, this capability of being stable with 0.1- μ F effective capacitance also enables the use of smaller footprint capacitors that have higher derating in size- and space-constrained applications.

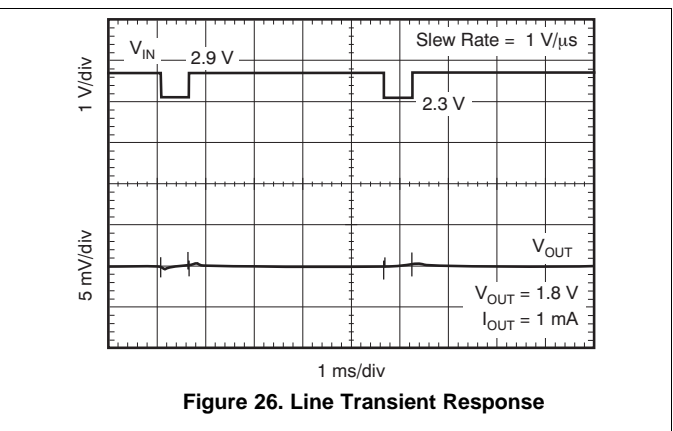
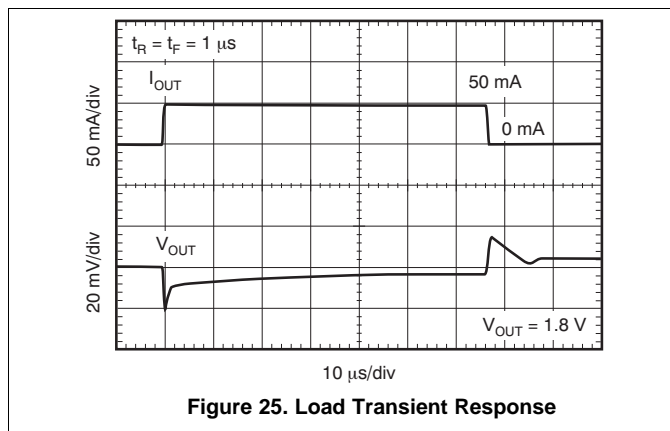
Using a 0.1- μ F rated capacitor at the output of the LDO does not ensure stability because the effective capacitance under the specified operating conditions must not be less than 0.1 μ F. Maximum ESR should be less than 200 m Ω .

Although an input capacitor is not required for stability, it is good analog design practice to connect a 0.1- μ F to 1- μ F, low ESR capacitor across the IN pin and GND pin of the regulator. This capacitor counteracts reactive input sources and improves transient response, noise rejection, and ripple rejection. A higher-value capacitor may be necessary if large, fast rise-time load transients are anticipated, or if the device is not located close to the power source. If source impedance is more than 2 Ω , a 0.1- μ F input capacitor may be necessary for stability.

8.2.2.2 Transient Response

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

8.2.3 Application Curves



9 Power Supply Recommendations

Connect a low output impedance power supply directly to the IN pin of the TLV702-Q1. Inductive impedances between the input supply and the IN pin can create significant voltage excursions at the IN pin during start-up or load transient events.

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 the ambient air.

Refer to [Thermal Information](#) for thermal performance on the TLV702-Q1 evaluation module (EVM). The EVM is a two-layer board with two ounces of copper per side.

Power dissipation depends on input voltage and load conditions. Power dissipation (P_D) is equal to the product of the output current and the voltage drop across the output pass element, as shown in [Equation 1](#).

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

10 Layout

10.1 Layout Guidelines

Place the input and output capacitors as close to the device pins as possible. To improve ac performance such as PSRR, output noise, and transient response, design the board 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, connect the ground connection for the output capacitor directly to the GND pin of the device. High-ESR capacitors may degrade PSRR performance.

10.1.1 Thermal Consideration

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 may 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 heatsink. For reliable operation, limit junction temperature to 125°C maximum.

To estimate the margin of safety in a complete design (including heatsink), increase the ambient temperature until the thermal protection is triggered; use worst-case loads and signal conditions.

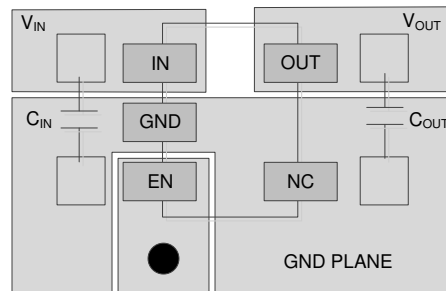
The internal protection circuitry of the TLV702-Q1 is designed to protect against overload conditions but is not intended to replace proper heatsinking. Continuously running the TLV702-Q1 into thermal shutdown degrades device reliability.

Layout Guidelines (continued)

10.1.2 Package Mounting

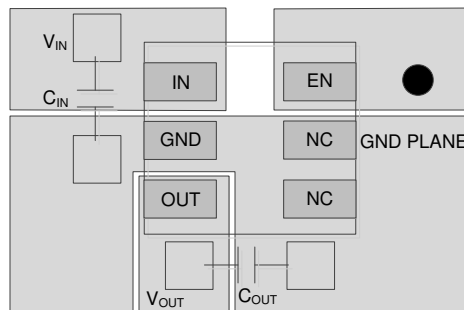
Solder pad footprint recommendations for the TLV702-Q1 are available from the TI website at www.ti.com. The recommended layout examples for the DDC and DSE packages are shown in [Figure 27](#) and [Figure 28](#), respectively.

10.2 Layout Examples



● Represents via used for application specific connections

Figure 27. Layout Example for the DDC and DBV Packages



● Represents via used for application specific connections

Figure 28. Layout Example for the DSE Package

11 デバイスおよびドキュメントのサポート

11.1 デバイス・サポート

11.1.1 開発サポート

11.1.1.1 SPICEモデル

SPICEを使用した回路パフォーマンスのコンピュータによるシミュレーションは、アナログ回路やシステムのパフォーマンスを分析するため多くの場合に有用です。TLV702用のSPICEモデルは、製品フォルダの「ツールとソフトウェア」から入手できます。

11.1.2 デバイスの項目表記

表 3. 製品情報⁽¹⁾

| 製品名 | V _{OUT} ⁽²⁾ |
|---------------|--|
| TLV702xx yyyz | XXは公称出力電圧です(例: 28 = 2.8V)。 YYYはパッケージ指定子です。 Zはテープ・アンド・リール数量です(R = 3,000、T = 250)。 |

- (1) 最新のパッケージおよび注文情報については、このドキュメントの最後にあるパッケージ・オプションの付録を参照するか、www.ti.comのデバイス製品フォルダをご覧ください。
- (2) 出力電圧は、1.2Vから4.8Vまで、50mV刻みで利用できます。詳細と在庫については、工場にお問い合わせください。

11.2 ドキュメントのサポート

11.2.1 関連資料

関連資料については、以下を参照してください。

テキサス・インスツルメンツ、『[Using the TLV700xxEVM-503](#)』ユーザー・ガイド (英語)

11.3 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、ti.comのデバイス製品フォルダを開いてください。右上の「アラートを受け取る」をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取れます。変更の詳細については、修正されたドキュメントに含まれている改訂履歴をご覧ください。

11.4 コミュニティ・リソース

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

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

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

11.5 商標

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

11.6 静電気放電に関する注意事項



すべての集積回路は、適切なESD保護方法を用いて、取扱いと保存を行うようにして下さい。

静電気放電はわずかな性能の低下から完全なデバイスの故障に至るまで、様々な損傷を与えます。高精度の集積回路は、損傷に対して敏感であり、極めてわずかなパラメータの変化により、デバイスに規定された仕様に適合しなくなる場合があります。

11.7 Glossary

[SLYZ022](#) — *TI Glossary*.

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

12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|----------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV702125QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU SN NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1M57 |
| TLV702125QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1M57 |
| TLV702125QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1M57 |
| TLV70212QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1B5H |
| TLV70212QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B5H |
| TLV70212QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B5H |
| TLV70212QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H9 |
| TLV70212QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H9 |
| TLV70212QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H9 |
| TLV70213QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H8 |
| TLV70213QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H8 |
| TLV70213QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H8 |
| TLV70215QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1B6H |
| TLV70215QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B6H |
| TLV70215QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B6H |
| TLV70215QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HB |
| TLV70215QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HB |
| TLV70215QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HB |
| TLV70218QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU SN NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1B7H |
| TLV70218QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B7H |
| TLV70218QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B7H |
| TLV70218QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HC |
| TLV70218QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HC |
| TLV70218QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HC |
| TLV70225QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | G7 |
| TLV70225QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | G7 |
| TLV70225QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | G7 |
| TLV70227QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1B8H |

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---------------------------------|---------------|----------------------|---------------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV70227QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B8H |
| TLV70227QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B8H |
| TLV70227QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H7 |
| TLV70227QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H7 |
| TLV70227QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H7 |
| TLV70228QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1B9H |
| TLV70228QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B9H |
| TLV70228QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1B9H |
| TLV70228QDDCRQ1 | Active | Production | SOT-23- THIN (DDC) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | SJV |
| TLV70228QDDCRQ1.A | Active | Production | SOT-23- THIN (DDC) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | SJV |
| TLV70228QDDCRQ1.B | Active | Production | SOT-23- THIN (DDC) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | SJV |
| TLV70228QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HD |
| TLV70228QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HD |
| TLV70228QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HD |
| TLV70229QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1BAH |
| TLV70229QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1BAH |
| TLV70229QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1BAH |
| TLV70229QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H1 |
| TLV70229QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H1 |
| TLV70229QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H1 |
| TLV70230QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1MQ7 |
| TLV70230QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1MQ7 |
| TLV70230QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1MQ7 |
| TLV70230QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HE |
| TLV70230QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HE |
| TLV70230QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HE |
| TLV70231QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HF |
| TLV70231QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HF |

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TLV70231QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HF |
| TLV70232QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HG |
| TLV70232QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HG |
| TLV70232QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HG |
| TLV70233QDBVRQ1 | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU SN NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | 1BBH |
| TLV70233QDBVRQ1.A | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1BBH |
| TLV70233QDBVRQ1.B | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 1BBH |
| TLV70233QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H2 |
| TLV70233QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H2 |
| TLV70233QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H2 |
| TLV70236QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H3 |
| TLV70236QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H3 |
| TLV70236QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | H3 |
| TLV70245QDSERQ1 | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HH |
| TLV70245QDSERQ1.A | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HH |
| TLV70245QDSERQ1.B | Active | Production | WSON (DSE) 6 | 3000 LARGE T&R | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HH |

(1) **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 TLV702-Q1 :

- Catalog : [TLV702](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV702125QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV702125QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70212QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70212QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70212QDSEQRQ1 | WSON | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70213QDSEQRQ1 | WSON | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70215QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70215QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70215QDSEQRQ1 | WSON | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70218QDSEQRQ1 | WSON | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70225QDSEQRQ1 | WSON | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70227QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70227QDBVRQ1 | 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV70227QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70228QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70228QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70228QDDCRQ1 | SOT-23-THIN | DDC | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TLV70228QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70229QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70229QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70230QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70230QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70231QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70232QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70233QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TLV70233QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70236QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |
| TLV70245QDSERQ1 | WSO | DSE | 6 | 3000 | 179.0 | 8.4 | 1.8 | 1.8 | 1.0 | 4.0 | 8.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV702125QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV702125QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70212QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70212QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70212QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70213QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70215QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70215QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70215QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70218QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70218QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70225QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70227QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70227QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70227QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70228QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV70228QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| TLV70228QDDCRQ1 | SOT-23-THIN | DDC | 5 | 3000 | 213.0 | 191.0 | 35.0 |
| TLV70228QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70229QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70229QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70230QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70230QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70231QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70232QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70233QDBVRQ1 | SOT-23 | DBV | 5 | 3000 | 183.0 | 183.0 | 20.0 |
| TLV70233QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70236QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |
| TLV70245QDSERQ1 | WSON | DSE | 6 | 3000 | 200.0 | 183.0 | 25.0 |

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)

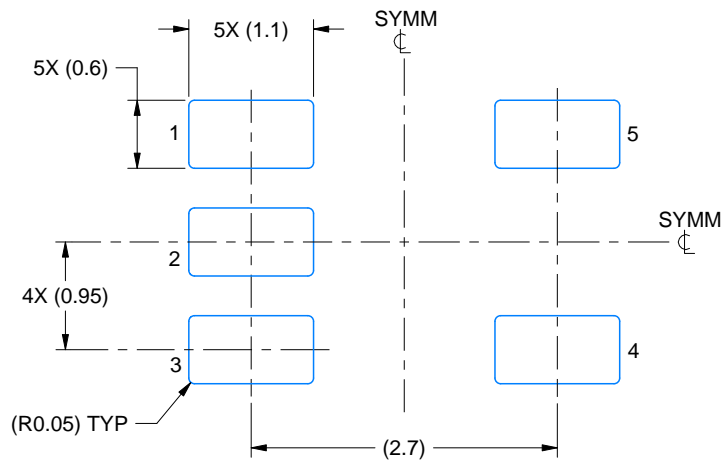
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

EXAMPLE BOARD LAYOUT

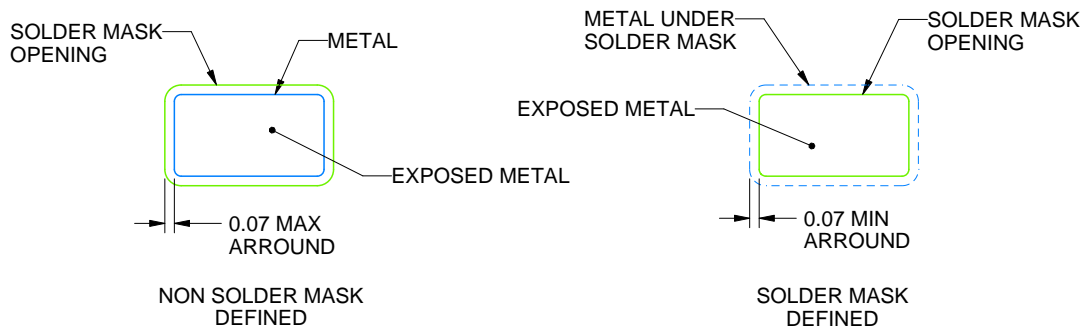
DDC0005A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPLODED METAL SHOWN
SCALE:15X



SOLDERMASK DETAILS

4220752/C 08/2024

NOTES: (continued)

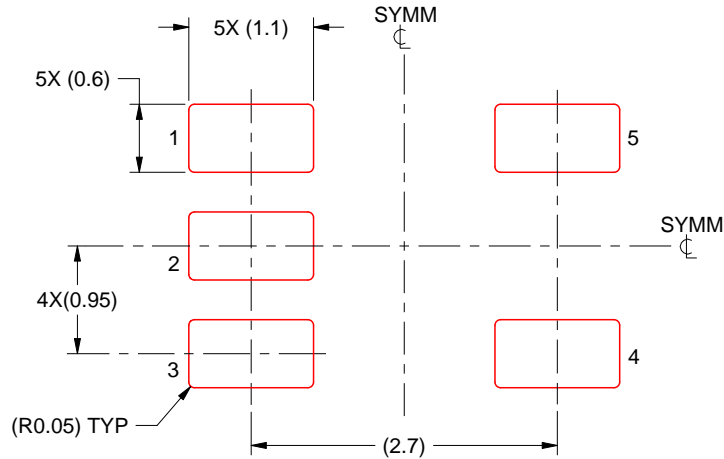
- 4. Publication IPC-7351 may have alternate designs.
- 5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DDC0005A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR

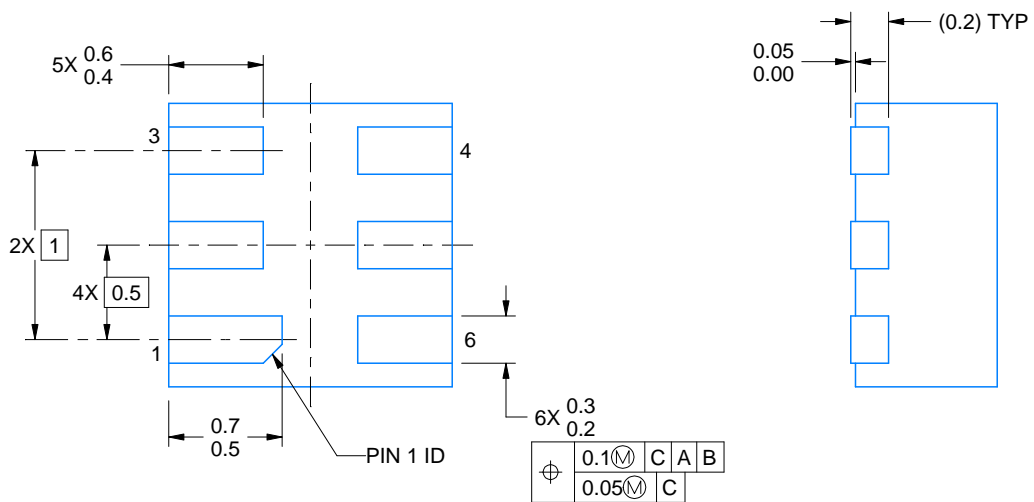
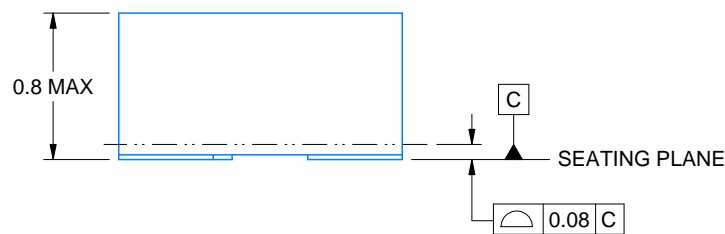
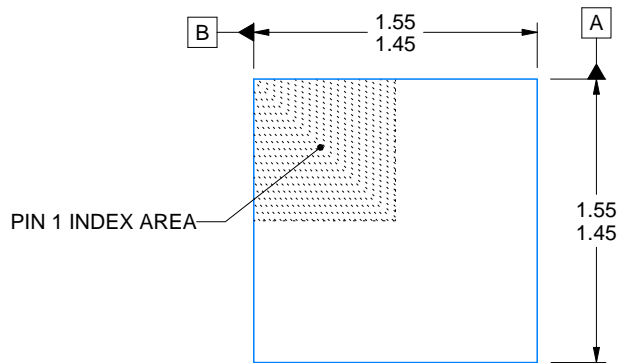
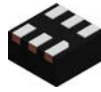


SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

4220752/C 08/2024

NOTES: (continued)

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



4220552/B 01/2024

NOTES:

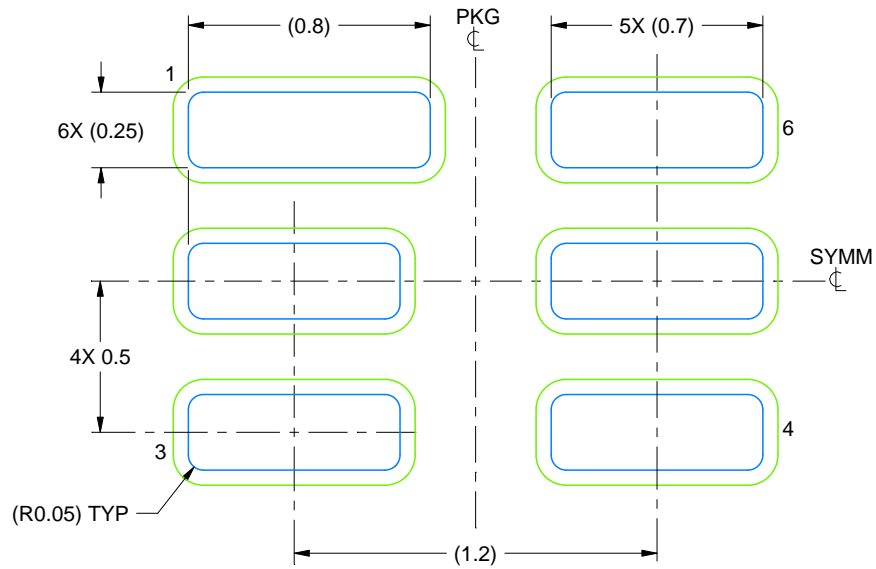
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

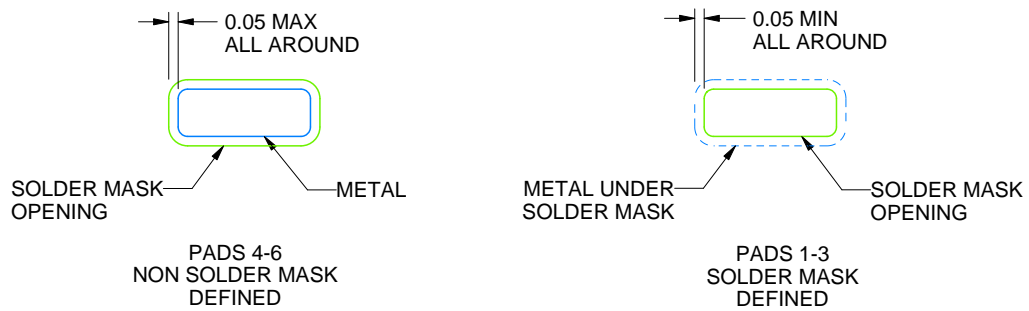
DSE0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
SCALE:40X



SOLDER MASK DETAILS

4220552/B 01/2024

NOTES: (continued)

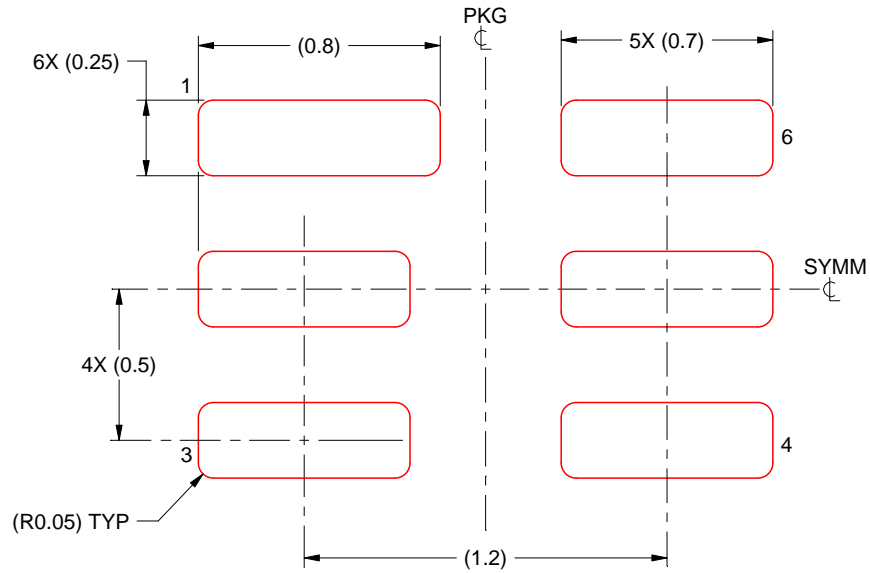
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

DSE0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:40X

NOTES: (continued)

4. 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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