

# TLV700xx-Q1 車載用 200mA、低 $I_Q$ 、ポータブルデバイス向け低ドロップアウトレギュレータ

## 1 特長

- 車載アプリケーション用に AEC-Q100 認定済み:
  - 温度グレード 1:  $-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$ 、 $T_A$
  - デバイス HBM ESD 分類レベル H2
  - デバイス CDM ESD 分類レベル C4B
- 2% 精度
- 低  $I_Q$ :  $31\mu\text{A}$
- $1.9\text{V} \sim 4.8\text{V}$  の固定出力電圧の組み合わせが可能
- 高 PSRR: 1kHz 時に 68dB
- 実効容量  $0.1\mu\text{F}$  で安定
- サーマル シャットダウン機能と過電流保護機能
- AEC-Q100 レベル I に準拠した  $100\text{mA}$  超のラッチアップ性能
- SOT-23-5、SC70 の各パッケージで提供

## 2 アプリケーション

- 車載用カメラ モジュール
- イメージセンサ電源
- 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
- 車載用ボディエレクトロニクス

## 3 概要

TLV700xx-Q1 ファミリ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、ラインおよび負荷の過渡性能が非常に優れています。これらの LDO は、消費電力の制限が厳しいアプリケーション向け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、総合で 2% 精度を実現しています。低出力ノイズ、非常に高い電源電圧変動除去比 (PSRR)、低ドロップアウト電圧を特長とする本シリーズのデバイスは、バッテリー駆動式の携帯機器向けに設計されています。どのバージョンのデバイスも、安全のためにサーマル シャットダウン機能と電流制限機能を搭載しています。

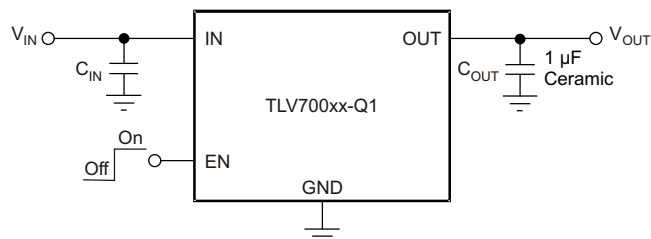
さらに、これらのデバイスはわずか  $0.1\mu\text{F}$  の実効出力容量で安定します。この機能により、バイアス電圧および温度ダイレージングの高い、コスト効率の優れたコンデンサを使用できます。これらのデバイスは、出力負荷なしでも指定の精度へのレギュレーションを行います。

TLV700xx-Q1 LDO は、SOT-23-5 および SC70 パッケージで供給されます。

### パッケージ情報

部品番号	パッケージ <sup>(1)</sup>	パッケージサイズ <sup>(2)</sup>
TLV700xx-Q1	DCK (SC70, 5)	2mm × 2.1mm
	DDC (SOT, 5)	2.9mm × 2.8mm

- 詳細については、[メカニカル](#)、[パッケージ](#)、および[注文情報](#)を参照してください。
- パッケージサイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



代表的なアプリケーションの回路 (固定電圧バージョン)



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## 4 Pin Configuration and Functions

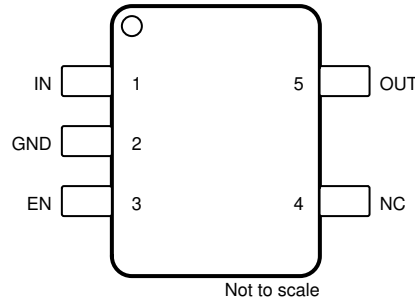


図 4-1. DDC and DCK Packages, 5-Pin SOT (Top View)

表 4-1. Pin Functions

NAME	PIN		I/O	DESCRIPTION
	SC70	SOT		
EN	3	3	I	Enable pin. Driving EN over 0.9V turns on the regulator. Driving EN below 0.4V puts the regulator into shutdown mode and reduces operating current to 1μA, nominal.
GND	2	2	—	Ground pin
IN	1	1	I	Input pin. A small 1μF ceramic capacitor is recommended from this pin to ground to provide stability and good transient performance. See the <a href="#">Input and Output Capacitor Requirements</a> section for more details.
NC	4	4	—	No connection. This pin can be tied to ground to improve thermal dissipation.
OUT	5	5	O	Regulated output voltage pin. A small 1μF ceramic capacitor is needed from this pin to ground to provide stability. See the <a href="#">Input and Output Capacitor Requirements</a> section for more details.

## 5 Specifications

### 5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
$V_{IN}$	Input voltage	-0.3	6	V
$V_{EN}$	Enable voltage	-0.3	$V_{IN} + 0.3$	V
$V_{OUT}$	Output voltage	-0.3	6	V
$I_{OUT}$	Maximum output current	Internally limited		
	Output short-circuit duration	Indefinite		
$T_A$	Operating ambient temperature	-40	150	$^\circ\text{C}$
$T_J$	Operating junction temperature	-40	150	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-55	150	$^\circ\text{C}$

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, 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.

### 5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002 <sup>(1)</sup>	$\pm 2000$	V
		Charged-device model (CDM), per AEC Q100-011	$\pm 750$	

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

### 5.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
$V_{IN}$	Input voltage	2		5.5	V
$V_{EN}$	Enable voltage	0		5.5	V
$I_{OUT}$	Output current		200		mA
$C_{IN}$	Input capacitor	0	1		$\mu\text{F}$
$C_{OUT}$	Output capacitor	0.22	1		$\mu\text{F}$
$T_A$	Operating ambient temperature	-40		125	$^\circ\text{C}$

### 5.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TLV700xx-Q1	UNIT
		DDC (SOT)	
		5 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	262.8	$^\circ\text{C}/\text{W}$
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	68.2	$^\circ\text{C}/\text{W}$
$R_{\theta JB}$	Junction-to-board thermal resistance	81.6	$^\circ\text{C}/\text{W}$
$\Psi_{JT}$	Junction-to-top characterization parameter	1.1	$^\circ\text{C}/\text{W}$
$\Psi_{JB}$	Junction-to-board characterization parameter	80.9	$^\circ\text{C}/\text{W}$
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	n/a	$^\circ\text{C}/\text{W}$

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

## 5.5 Electrical Characteristics

at  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $V_{IN} = V_{OUT(TYP)} + 0.3\text{V}$  or  $2\text{V}$  (whichever is greater),  $I_{OUT} = 10\text{mA}$ ,  $V_{EN} = V_{IN}$ , and  $C_{OUT} = 1\mu\text{F}$  (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		5.5	V
$V_{OUT}$	DC output accuracy	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ , $V_{OUT} \geq 1\text{V}$	-2%		2%	
$\Delta V_O/\Delta V_{IN}$	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
$\Delta V_O/\Delta I_{OUT}$	Load regulation	$0\text{mA} \leq I_{OUT} \leq 200\text{mA}$			15	mV
$V_{DO}$	Dropout voltage <sup>(1)</sup>	$V_{IN} = 0.98 \times V_{OUT(NOM)}$ , $I_{OUT} = 200\text{mA}$		175	250	mV
$I_{CL}$	Output current limit	$V_{OUT} = 0.9 \times V_{OUT(NOM)}$	220	350	860	mA
$I_{GND}$	Ground pin current	$I_{OUT} = 0\text{mA}$		31	55	$\mu\text{A}$
		$I_{OUT} = 200\text{mA}$ , $V_{IN} = V_{OUT} + 0.5\text{V}$		270		
$I_{SHDN}$	Ground pin current (shutdown)	$V_{EN} \leq 0.4\text{V}$ , $2.0\text{V} \leq V_{IN} \leq 4.5\text{V}$		1	2.5	$\mu\text{A}$
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	$BW = 100\text{Hz}$ to $100\text{kHz}$ , $V_{IN} = 2.3\text{V}$ , $V_{OUT} = 1.8\text{V}$ , $I_{OUT} = 10\text{mA}$		48		$\mu\text{V}_{RMS}$
$t_{STR}$	Startup time <sup>(2)</sup>	$C_{OUT} = 1\mu\text{F}$ , $I_{OUT} = 200\text{mA}$		100		$\mu\text{s}$
$V_{EN(HI)}$	Enable pin high (enabled)		0.9		$V_{IN}$	V
$V_{EN(LO)}$	Enable pin low (disabled)		0		0.4	V
$I_{EN}$	Enable pin current	$V_{EN} = 5.5\text{V}$ , $I_{OUT} = 10\mu\text{A}$		0.04	0.5	$\mu\text{A}$
UVLO	Undervoltage lockout	$V_{IN}$ rising		1.9		V
$T_{SD}$	Thermal shutdown temperature	Shutdown, temperature increasing		160		$^\circ\text{C}$
		Reset, temperature decreasing		140		
$T_A$	Operating ambient temperature		-40		125	$^\circ\text{C}$

- (1)  $V_{DO}$  is measured for devices with  $V_{OUT(NOM)} \geq 2.35\text{V}$ .  
 (2) Startup time = time from EN assertion to  $0.98 \times V_{OUT(NOM)}$ .

## 5.6 Typical Characteristics

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

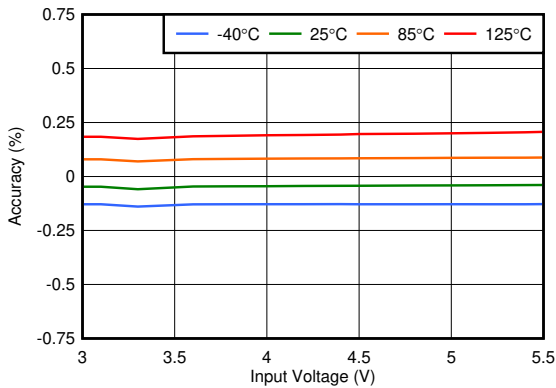


Figure 5-1. TLV70028-Q1 Line Regulation

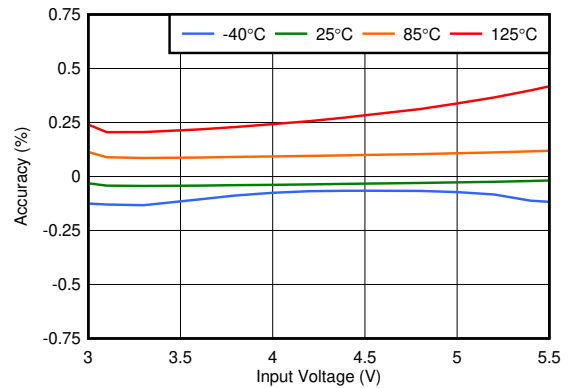


Figure 5-2. TLV70028-Q1 Line Regulation

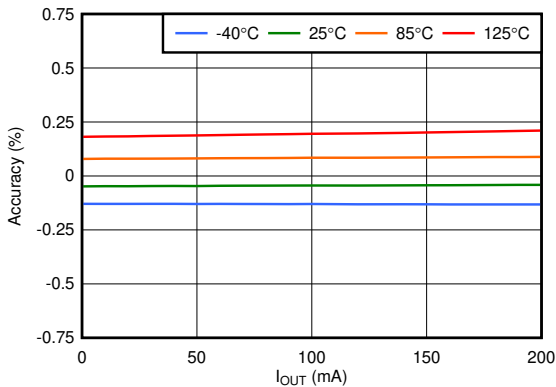


Figure 5-3. TLV70028-Q1 Load Regulation

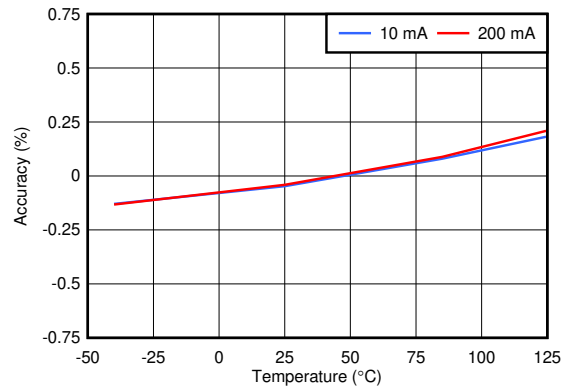


Figure 5-4. TLV70028-Q1 Accuracy vs Temperature

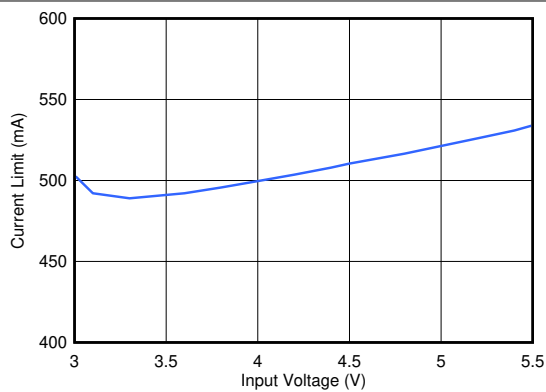


Figure 5-5. TLV70028-Q1 Current Limit vs Input Voltage

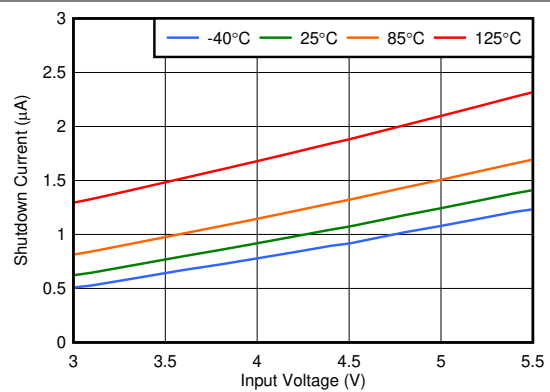
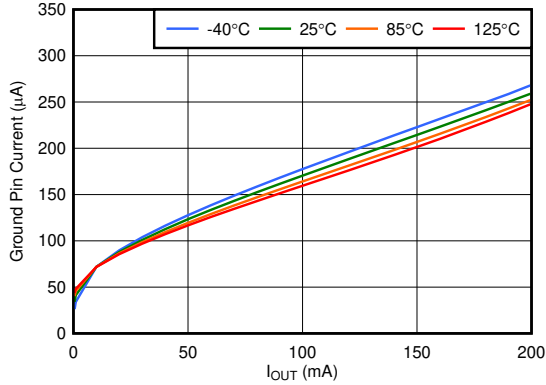


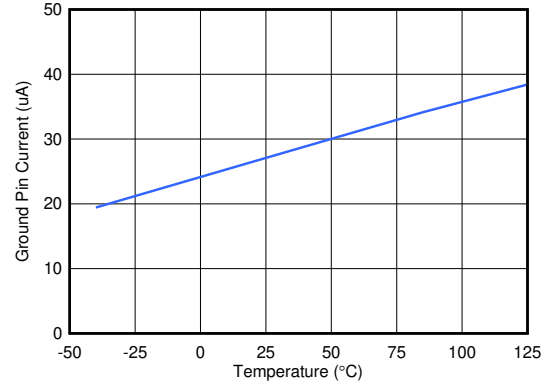
Figure 5-6. TLV70028-Q1 Shutdown Current vs Input Voltage

### 5.6 Typical Characteristics (continued)

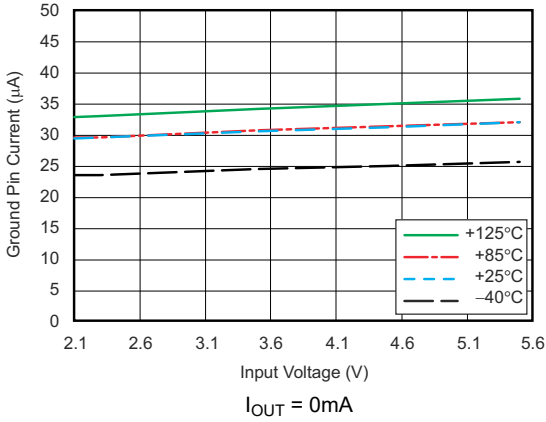
at  $T_J = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $V_{IN} = V_{OUT(TYP)} + 0.5\text{V}$  or  $2\text{V}$  (whichever is greater),  $I_{OUT} = 10\text{mA}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = 1\mu\text{F}$ , and  $C_{OUT} = 1\mu\text{F}$  (unless otherwise noted); typical values are at  $T_J =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



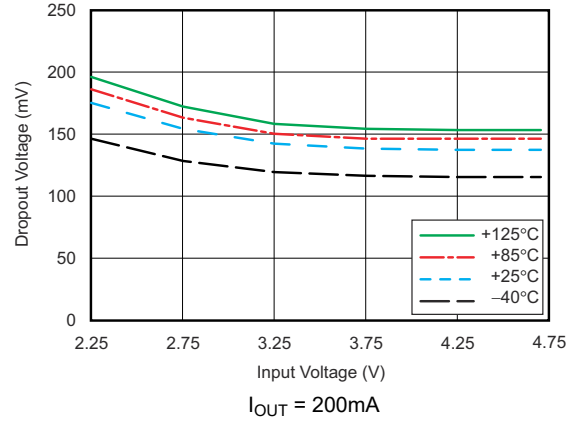
5-7. TLV70028-Q1 Ground Pin Current vs Output Current



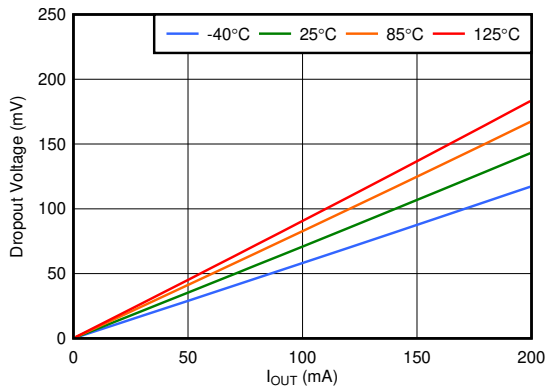
5-8. TLV70028-Q1 Ground Pin Current vs Temperature



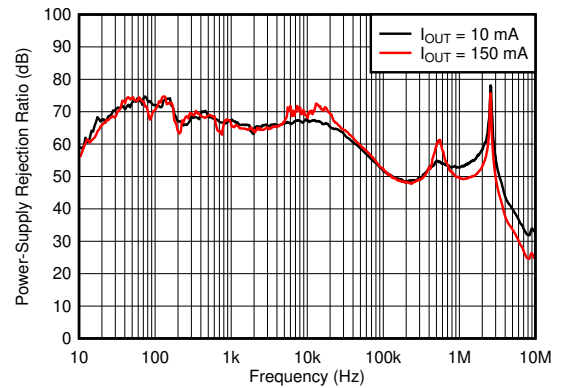
5-9. TLV70048-Q1 Ground Pin Current vs Input Voltage



5-10. TLV70048-Q1 Dropout Voltage vs Input Voltage



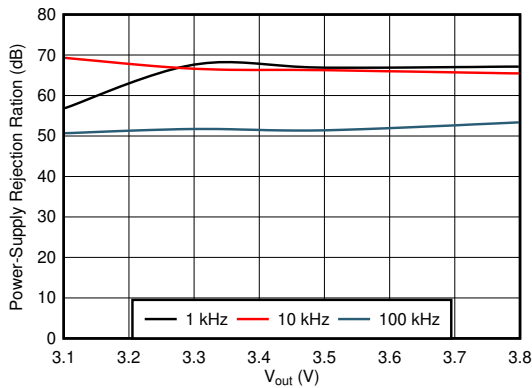
5-11. TLV70028-Q1 Dropout Voltage vs Output Current



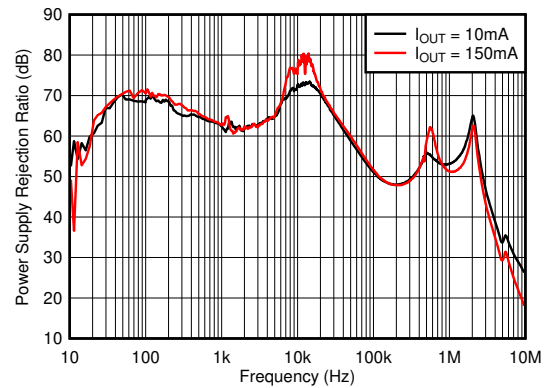
5-12. TLV70028-Q1 Power-Supply Rejection Ratio vs Frequency

### 5.6 Typical Characteristics (continued)

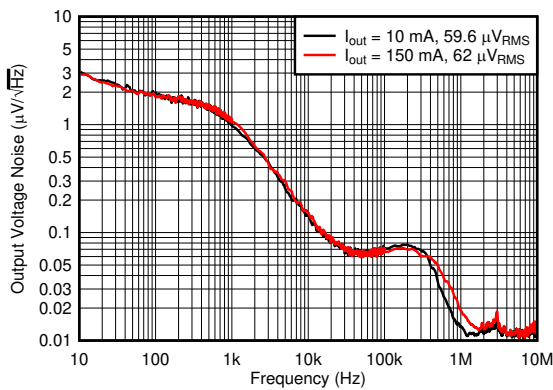
at  $T_J = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $V_{IN} = V_{OUT(TYP)} + 0.5\text{V}$  or  $2\text{V}$  (whichever is greater),  $I_{OUT} = 10\text{mA}$ ,  $V_{EN} = V_{IN}$ ,  $C_{IN} = 1\mu\text{F}$ , and  $C_{OUT} = 1\mu\text{F}$  (unless otherwise noted); typical values are at  $T_J =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



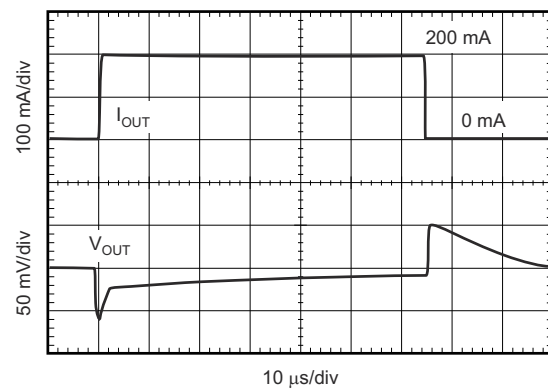
5-13. TLV70028-Q1 Power-Supply Rejection Ratio vs Output Voltage



5-14. TLV70033-Q1 PSRR Ratio

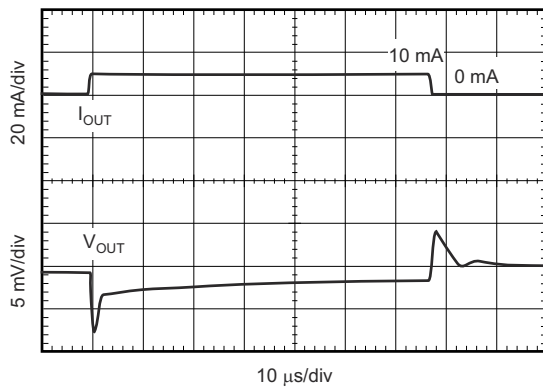


5-15. TLV70028-Q1 Output Spectral Noise Density vs Frequency



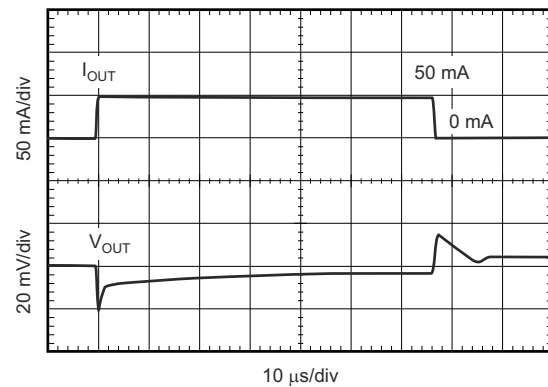
$t_R = t_F = 1\mu\text{s}$ ,  $V_{IN} = 2.1\text{V}$

5-16. Load Transient Response



$t_R = t_F = 1\mu\text{s}$ ,  $V_{IN} = 2.3\text{V}$

5-17. Load Transient Response



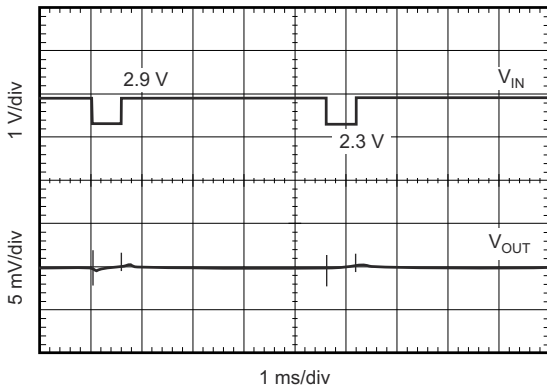
$t_R = t_F = 1\mu\text{s}$ ,  $V_{IN} = 2.3\text{V}$

5-18. Load Transient Response



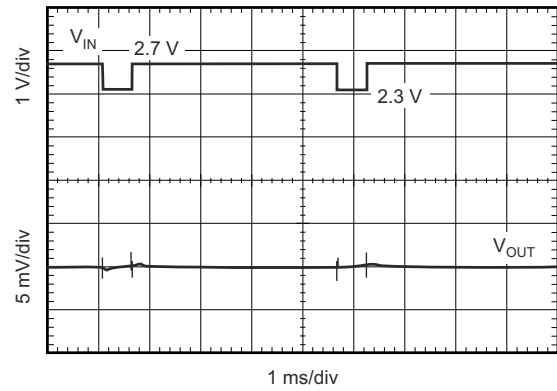
## 5.6 Typical Characteristics (continued)

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



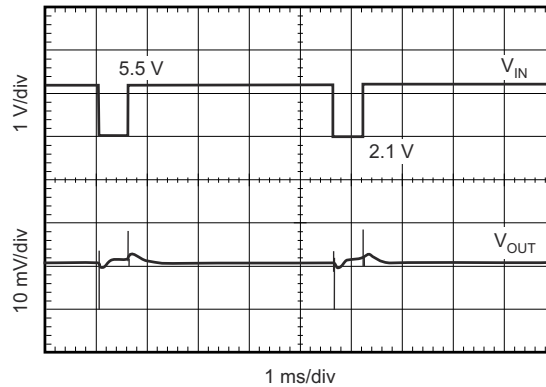
Slew rate =  $1\text{V}/\mu\text{s}$ ,  $I_{OUT} = 200\text{mA}$

5-19. Line Transient Response



Slew rate =  $1\text{V}/\mu\text{s}$ ,  $I_{OUT} = 200\text{mA}$

5-20. Line Transient Response



Slew rate =  $1\text{V}/\mu\text{s}$ ,  $I_{OUT} = 200\text{mA}$

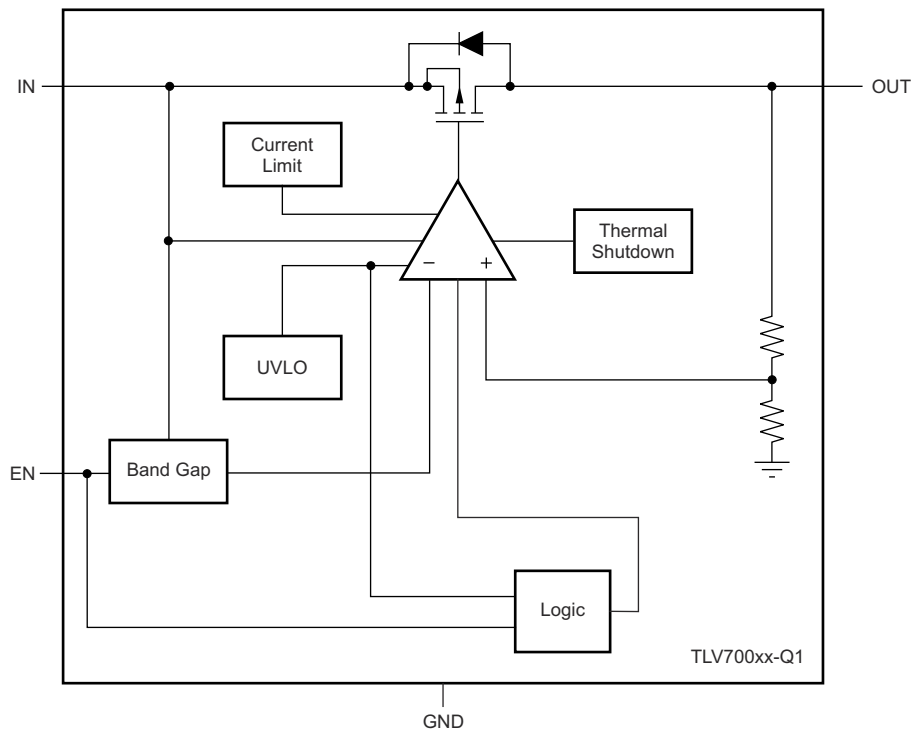
5-21. Line Transient Response

## 6 Detailed Description

### 6.1 Overview

The TLV700xx-Q1 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 band-gap and error amplifier provides overall 2% accuracy together with low output noise, very high power-supply rejection ratio (PSRR), and low dropout voltage.

### 6.2 Functional Block Diagram



### 6.3 Feature Description

#### 6.3.1 Internal Current Limit

The TLV700xx-Q1 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 the output voltage. In such a case, the output voltage is not regulated, and is  $V_{OUT} = I_{LIMIT} \times R_{LOAD}$ . The PMOS pass transistor dissipates  $(V_{IN} - V_{OUT}) \times I_{LIMIT}$  until thermal shutdown is triggered and the device turns off. When the TLV700xx-Q1 cools down, 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 PMOS pass transistor in the TLV700xx-Q1 has a built-in body diode that conducts current when the voltage at OUT exceeds the voltage at IN. This current is not limited, so if extended reverse voltage operation is anticipated, external limiting to 5% of the rated output current is recommended.

#### 6.3.2 Shutdown

The enable pin (EN) is active high and is compatible with standard and low-voltage transistor-transistor logic, complementary metal oxide semiconductor (TTL-CMOS) levels. When shutdown capability is not required, EN can be connected to the IN pin.

#### 6.3.3 Dropout Voltage

The TLV700xx-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 region of operation and the input-to-output

resistance is the  $r_{DS(on)}$  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 when  $(V_{IN} - V_{OUT})$  approaches dropout. This effect is illustrated in [Figure 5-13](#) in the *Typical Characteristics* section.

### 6.3.4 Undervoltage Lockout (UVLO)

The TLV700xx-Q1 uses an undervoltage lockout circuit to keep the output shut off until the internal circuitry is operating properly.

## 6.4 Device Functional Modes

### 6.4.1 Operation with $V_{IN}$ Less Than 2V

The TLV700xx-Q1 family of devices operates with input voltages above 2V. The typical UVLO voltage is 1.9V and the device operates at an input voltage above 2V. When the input voltage falls below the UVLO voltage, the device is shutdown.

### 6.4.2 Operation with $V_{IN}$ Greater Than 2V

When  $V_{IN}$  is greater than 2V, if the input voltage is higher than the desired output voltage plus dropout voltage, the output voltage is equal to the desired value. Otherwise, the output voltage is  $V_{IN}$  minus the dropout voltage.

## 7 Application and Implementation

### 注

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくこととなります。お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

### 7.1 Application Information

The TLV700xx-Q1 devices belong to a family of next-generation-value LDO regulators. The 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 device family designed for RF portable applications. This family of regulators offers sub-band-gap output voltages down to 0.7V, current limit, and thermal protection, and is specified from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

#### 7.1.1 Input and Output Capacitor Requirements

Ceramic, 1.0 $\mu\text{F}$ , X5R- and X7R-type capacitors are recommended because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature.

However, the TLV700xx-Q1 devices are designed to be stable with an effective capacitance of 0.1 $\mu\text{F}$  or larger at the output. Thus, these devices are 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 $\mu\text{F}$ . This effective capacitance refers to the capacitance under the 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 cheaper dielectrics, this capability of being stable with 0.1 $\mu\text{F}$  effective capacitances also enables the use of smaller-footprint capacitors that have higher derating in size- and space-constrained applications.

Note that using a 0.1 $\mu\text{F}$  rated capacitor at the output of the LDO does not provide stability because the effective capacitance under the specified operating conditions is less than 0.1 $\mu\text{F}$ . Maximum ESR must be less than 200m $\Omega$ .

Although an input capacitor is not required for stability, good analog design practice is to connect a 0.1 $\mu\text{F}$  to 1 $\mu\text{F}$ , low-ESR capacitor across the IN pin and the 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 $\Omega$ , a 0.1 $\mu\text{F}$  input capacitor may be necessary to provide stability.

#### 7.1.2 Transient Response

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

#### 7.1.3 Thermal Protection

Thermal protection disables the output when the junction temperature rises to approximately  $160^{\circ}\text{C}$ , allowing the device to cool. When the junction temperature cools to approximately  $140^{\circ}\text{C}$ , 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 the regulator 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  $125^{\circ}\text{C}$  (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. For good reliability, thermal protection must trigger at least  $35^{\circ}\text{C}$  above the maximum expected ambient condition of the particular application. This configuration produces a worst-case junction temperature of  $125^{\circ}\text{C}$  at the highest-expected ambient temperature and worst-case load.

The internal protection circuitry of the TLV700xx-Q1 is designed to protect against overload conditions. This circuitry is not intended to replace proper heatsinking. Continuously running the TLV700xx-Q1 into thermal shutdown degrades device reliability.

## 7.2 Typical Application

The TLV700xx-Q1 devices are 200mA, low quiescent current, low-noise, high-PSRR, fast start-up LDO linear regulators with excellent line and load transient response. The [TLV700xxEVM-503 user's guide](#) evaluation module (EVM) helps designers evaluate the operation and performance of the TLV700xx-Q1 family.

☒ 7-1 shows a typical application for the TLV700xx-Q1 device.

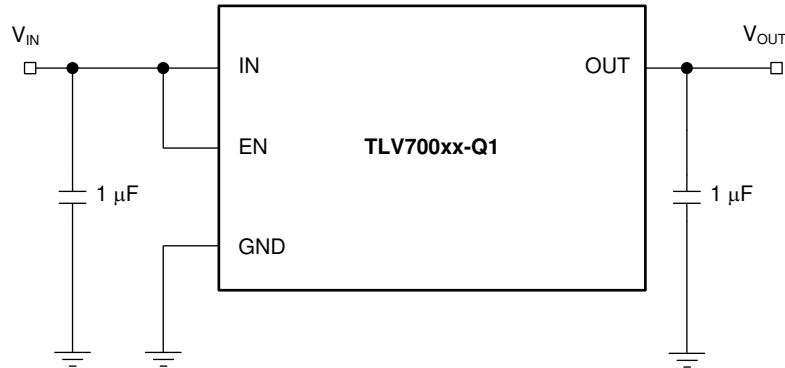


図 7-1. TLV700xx-Q1 Typical Application

### 7.2.1 Design Requirements

表 7-1 shows example design parameters and values for this typical application.

表 7-1. Design Parameters

PARAMETER	VALUE
Input voltage range	2V to 5.5V
Output voltage	2.2V, 2.8V, 3.2V
Output current rating	200mA
Effective output capacitor range	> 0.1µF
Maximum output capacitor ESR range	< 200mΩ

### 7.2.2 Detailed Design Procedure

#### 7.2.2.1 Input Capacitance

Although not required for stability, connecting a 0.1µF to 1µF low-ESR capacitor across the IN pin and GND pin the regulator is good analog design practice.

#### 7.2.2.2 Output Capacitance

Effect capacitance of 0.1µF or larger is required to provide stable operation. The maximum ESR must be less than 200mΩ.

### 7.2.2.3 Thermal Calculation

式 1 shows the thermal calculation.

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

where:

- $P_D$  = Continuous power dissipation
- $I_{OUT}$  = Output current
- $V_{IN}$  = Input voltage
- $V_{OUT}$  = Output voltage
- Because  $I_Q \ll I_{OUT}$ , the term  $I_Q \times V_{IN}$  is always ignored

For a device under operation at a given ambient air temperature ( $T_A$ ), use 式 2 to calculate the junction temperature ( $T_J$ ).

$$T_J = T_A + (R_{\theta JA} \times P_D) \quad (2)$$

where:

- $Z_{\theta JA}$  = Junction-to-ambient air thermal impedance

Use 式 3 to calculate the rise in junction temperature because of power dissipation.

$$\Delta T = T_J - T_A = (R_{\theta JA} \times P_D) \quad (3)$$

For a given maximum junction temperature ( $T_{Jmax}$ ), use 式 4 to calculate the maximum ambient air temperature ( $T_{Amax}$ ) at which the device can operate.

$$T_{Amax} = T_{Jmax} - (R_{\theta JA} \times P_D) \quad (4)$$

### 7.2.3 Application Curve

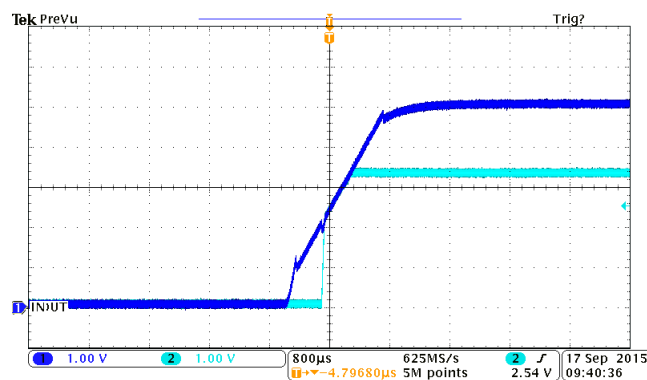


図 7-2. Power-Up

## 7.3 Power Supply Recommendations

The device is designed to operate from an input-voltage supply range between 2V and 5.5V. This input supply must be well regulated. If the input supply is located more than a few inches from the TPS7B69xx-Q1 device, a capacitor with a value of 0.1µF and a ceramic bypass capacitor are recommended to be added at the input.

## 7.4 Layout

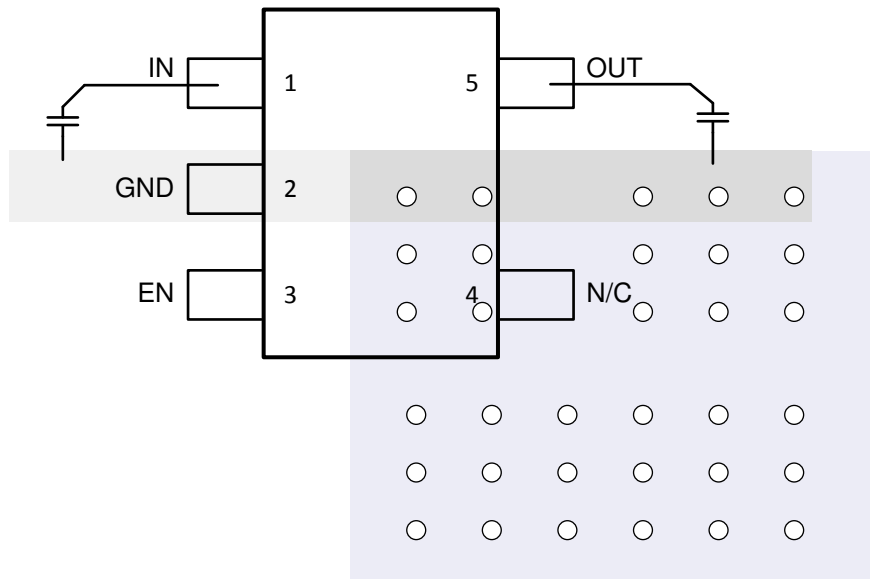
### 7.4.1 Layout Guidelines

When laying out the board for the TLV700xx-Q1, the board is recommended to be designed with separate ground planes for  $V_{IN}$  and  $V_{OUT}$  that are only connected at the GND pin of the device, as shown in [Figure 7-3](#). Also, the ground connection for the bypass capacitor must be connected directly to the GND pin of the device. Improve the PSRR performance of the TLV700xx-Q1 by following these layout guidelines.

### 7.4.2 Board Layout Recommendations to Improve PSRR and Noise Performance

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), the board is recommended to 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, connect the ground connection for the output capacitor directly to the GND pin of the device. High-ESR capacitors can degrade PSRR performance.

### 7.4.3 Layout Example



**Figure 7-3. TLV700xx-Q1 Layout Example**

## 8 Device and Documentation Support

### 8.1 Device Support

#### 8.1.1 Device Nomenclature

表 8-1. Device Nomenclature

PRODUCT <sup>(1)</sup>	DESCRIPTION
TLV700xxQyyyzQ1	<p><b>xx</b> is the nominal output voltage (for example, 28 = 2.8V).</p> <p><b>Q</b> indicates that this device is a grade-1 device in accordance with the AEC-Q100 standard.</p> <p><b>yyy</b> is the package designator.</p> <p><b>z</b> is the tape and reel quantity (R = 3000, T = 250).</p> <p><b>Q1</b> indicates that this device is an automotive grade (AEC-Q100) device.</p>

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or see the device product folder at [www.ti.com](http://www.ti.com).

### 8.2 Documentation Support

#### 8.2.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [TLV700xxEVM-503 user's guide](#)

### 8.3 ドキュメントの更新通知を受け取る方法

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### 8.7 用語集

[テキサス・インスツルメンツ用語集](#) この用語集には、用語や略語の一覧および定義が記載されています。

## 9 Revision History

### Changes from Revision C (June 2018) to Revision D (January 2025)

Page

- ドキュメント全体にわたって表、図、相互参照の採番方法を更新..... 1



• Added <i>Device Nomenclature</i> table.....	16
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<b>Changes from Revision B (October 2016) to Revision C (June 2018)</b>	<b>Page</b>
• ドキュメントに DCK (SC70) パッケージを追加。TLV70025-Q1 および TLV70033-Q1 は従来は SLVSA61 に記載...	1
• 「 <i>特長</i> 」セクションの「 <i>固定出力電圧</i> 」の箇条書き項目を、「 <i>固定出力電圧の組み合わせ</i> 」に変更.....	1
• 「 <i>概要</i> 」セクションの最後の段落に SC70 パッケージを含めるよう変更.....	1
• 「 <i>デバイス情報</i> 」表に RGR の行を追加した.....	1
• Added T <sub>J</sub> parameter to <i>Absolute Maximum Ratings</i> table.....	4
• Changed T <sub>J</sub> parameter to T <sub>A</sub> in <i>Recommended Operating Conditions</i> table and changed <i>junction</i> to <i>ambient</i> in parameter name.....	4
• Added <i>TLV70033-Q1 PSRR Ratio</i> figure.....	6

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## 10 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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV70025QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	QVC	<a href="#">Samples</a>
TLV70028QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SJU	<a href="#">Samples</a>
TLV70032QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SKA	<a href="#">Samples</a>
TLV70033QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	OFL	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

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**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

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

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

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

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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**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
TLV70025QDDCRQ1	SOT-23-THIN	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70028QDDCRQ1	SOT-23-THIN	DDC	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70032QDDCRQ1	SOT-23-THIN	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70033QDDCRQ1	SOT-23-THIN	DDC	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70025QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70028QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70032QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70033QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0

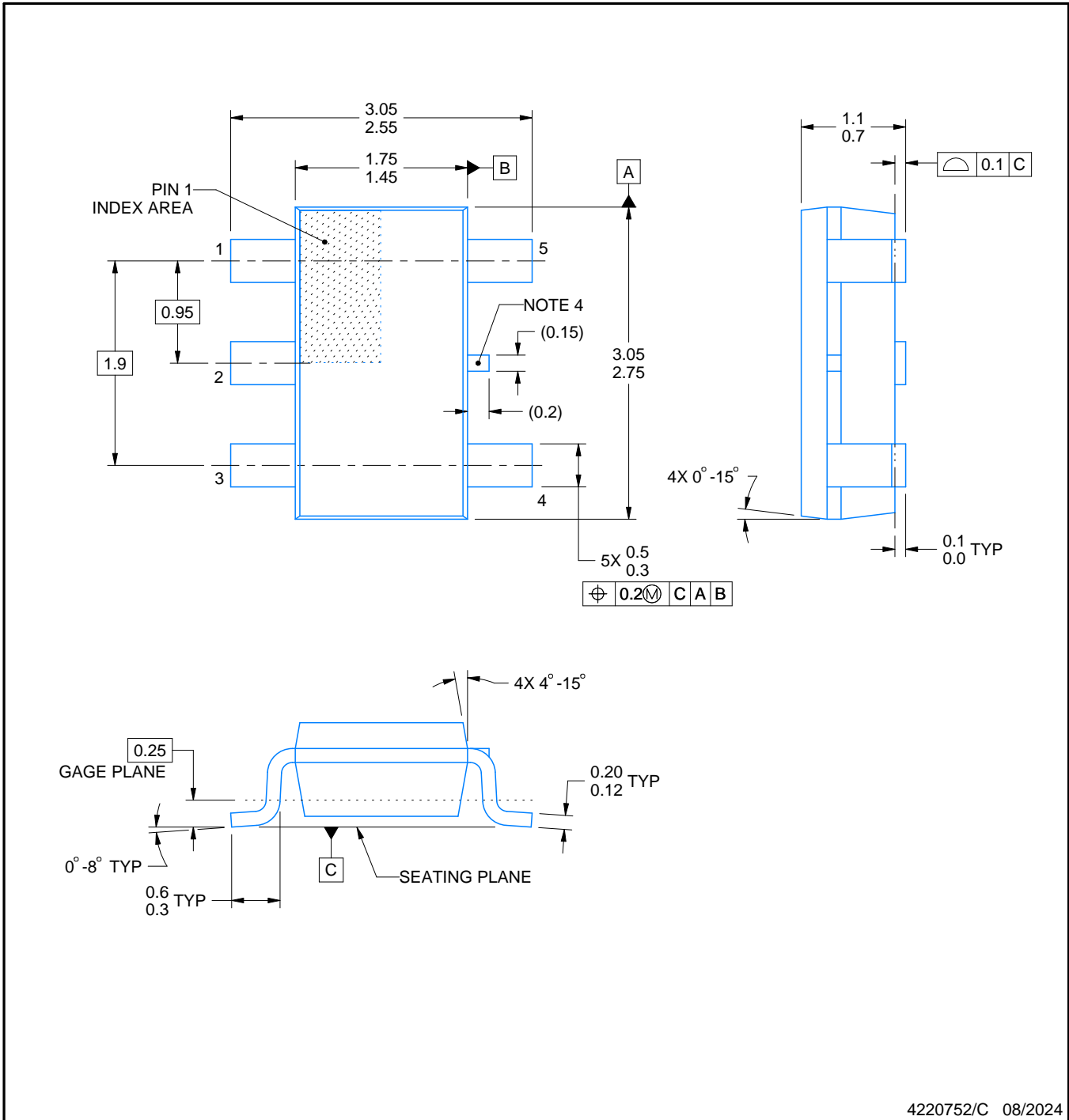
# DDC0005A



# PACKAGE OUTLINE

## SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR



### NOTES:

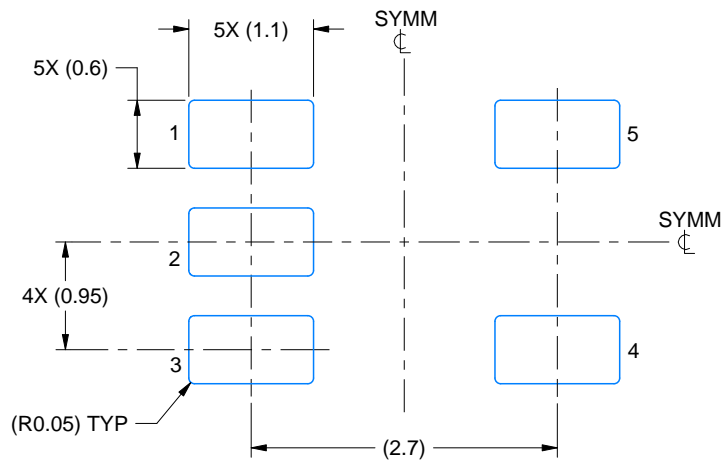
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-193.
4. Support pin may differ or may not be present.

# EXAMPLE BOARD LAYOUT

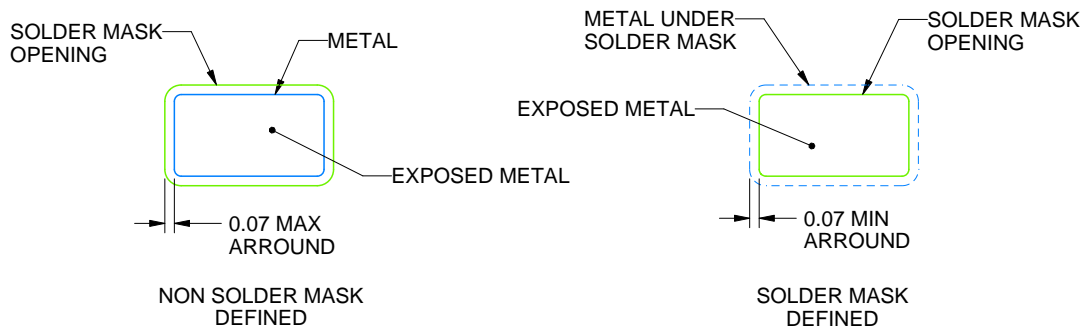
DDC0005A

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.

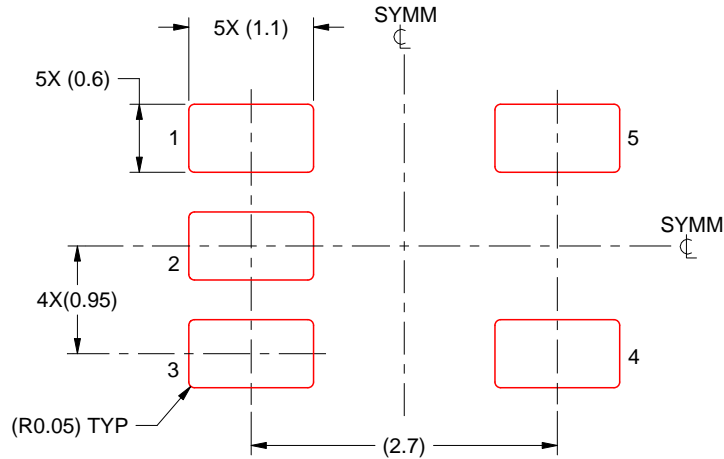


# EXAMPLE STENCIL DESIGN

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.

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