适用于便携式器件的 TLV700xx-Q1 汽车类，200mA，低 I_Q 低压降稳压器 (LDO)

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
  - 温度等级 1：–40°C 至 125°C，T_A
  - 器件 HBM ESD 分类等级 H2
  - 器件 CDM ESD 分类等级 C4B
- 2% 的精度
- 低 I_Q：31μA
- 可提供 1.9V 至 4.8V 范围内的固定输出电压组合
- 高 PSRR：1kHz 时为 68dB
- 可在采用 0.1 μ F 的有效电容时保持稳定
- 热关断和过流保护
- 闩锁效应性能达到 100mA，符合 AEC-Q100 1 级规范
- 采用 SOT-23-5 和 SC70 封装

2 应用

- 汽车摄像头模块
- 图像传感器电源
- 微处理器导轨
- 汽车信息娱乐主体单元
- 汽车车身电子设备

3 说明

TLV700xx-Q1 系列低压降 (LDO) 线性稳压器是具有出色线路和负载瞬态性能的低静态电流器件。这些 LDO 旨在用于功耗敏感型应用。高精度带隙与误差放大器支持 2% 的总精度。低输出噪声、极高电源抑制比 (PSRR) 和低压降电压使得这个器件系列成为大多数电池供电手持设备的理想选择。所有器件版本具有热关断和电流限值以保证安全。

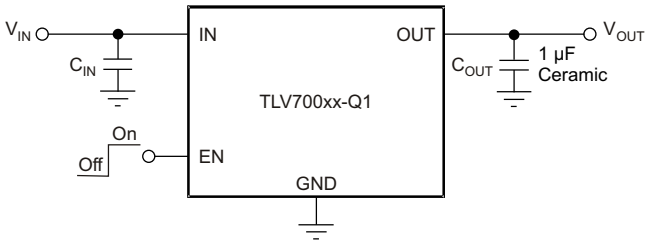
此外，即使有效输出电容仅为 0.1 μ F，这些器件也可稳定运行。凭借这一特性，可以使用具有更高偏置电压和温度降额的经济实惠的电容器。这些器件在没有负载的情况下可调节至指定的精度。

TLV700xx-Q1 LDO 采用 SOT-23-5 和 SC70 封装。

封装信息

器件型号	封装(1)	封装尺寸(2)
TLV700xx-Q1	DCK（SC70，5）	2mm × 2.1mm
	DDC（SOT，5）	2.9mm × 2.8mm

(1) 如需更多信息，请参阅*机械、封装和可订购信息*。
(2) 封装尺寸（长 × 宽）为标称值，并包括引脚（如适用）。



典型应用电路（固定电压版本）

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4 Pin Configuration and Functions

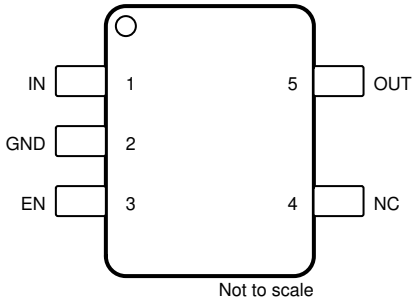


图 4-1. DDC and DCK Packages, 5-Pin SOT (Top View)

表 4-1. Pin Functions

PIN			I/O	DESCRIPTION
NAME	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 *Input and Output Capacitor Requirements* 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 *Input and Output Capacitor Requirements* section for more details.

5 Specifications

5.1 Absolute Maximum Ratings

at T_A = –40°C to +125°C (unless otherwise noted); all voltages are with respect to GND(1)

		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	°C
T_J	Operating junction temperature	–40	150	°C
T_{stg}	Storage temperature	–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.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002(1)	±2000	V
		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.

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		µF
C_{OUT}	Output capacitor	0.22	1		µF
T_A	Operating ambient temperature	–40		125	°C

5.4 Thermal Information

THERMAL METRIC(1)		TLV700xx-Q1 DDC (SOT) 5 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	262.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	68.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	81.6	°C/W
ψ_{JT}	Junction-to-top characterization parameter	1.1	°C/W
ψ_{JB}	Junction-to-board characterization parameter	80.9	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	n/a	°C/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°C to +125°C, V_{IN} = $V_{OUT(TYP)}$ + 0.3V or 2V (whichever is greater), I_{OUT} = 10mA, V_{EN} = V_{IN}, and C_{OUT} = 1µF (unless otherwise noted); typical values are at T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range		2		5.5	V
V_{OUT}	DC output accuracy	–40°C ≤ T_A ≤ +125°C, V_{OUT} ≥ 1V	–2%		2%	
$\Delta V_O/\Delta V_{IN}$	Line regulation	$V_{OUT(NOM)}$ + 0.5V ≤ V_{IN} ≤ 5.5V, I_{OUT} = 10mA		1	5	mV
$\Delta V_O/\Delta I_{OUT}$	Load regulation	0mA ≤ I_{OUT} ≤ 200mA			15	mV
V_{DO}	Dropout voltage(1)	V_{IN} = 0.98 × $V_{OUT(NOM)}$, I_{OUT} = 200mA		175	250	mV
I_{CL}	Output current limit	V_{OUT} = 0.9 × $V_{OUT(NOM)}$	220	350	860	mA
I_{GND}	Ground pin current	I_{OUT} = 0mA		31	55	µA
		I_{OUT} = 200mA, V_{IN} = V_{OUT} + 0.5V		270		
I_{SHDN}	Ground pin current (shutdown)	V_{EN} ≤ 0.4V, 2.0V ≤ V_{IN} ≤ 4.5V		1	2.5	µA
PSRR	Power-supply rejection ratio	V_{IN} = 2.3V, V_{OUT} = 1.8V, I_{OUT} = 10mA, f = 1kHz		68		dB
V_N	Output noise voltage	BW = 100Hz to 100kHz, V_{IN} = 2.3V, V_{OUT} = 1.8V, I_{OUT} = 10mA		48		μV_{RMS}
t_{STR}	Startup time(2)	C_{OUT} = 1µF, I_{OUT} = 200mA		100		µs
$V_{EN(HI)}$	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} = 5.5V , I_{OUT} = 10µA		0.04	0.5	µA
UVLO	Undervoltage lockout	V_{IN} rising		1.9		V
T_{SD}	Thermal shutdown temperature	Shutdown, temperature increasing		160		°C
		Reset, temperature decreasing		140		
T_A	Operating ambient temperature		–40		125	°C

(1) V_{DO} is measured for devices with $V_{OUT(NOM)}$ ≥ 2.35V.
(2) Startup time = time from EN assertion to 0.98 × $V_{OUT(NOM)}$.

5.6 Typical Characteristics

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

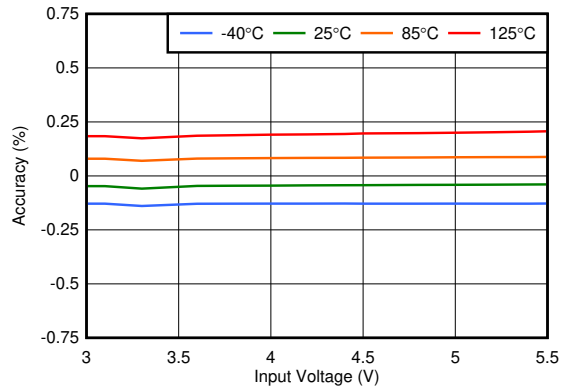


图 5-1. TLV70028-Q1 Line Regulation

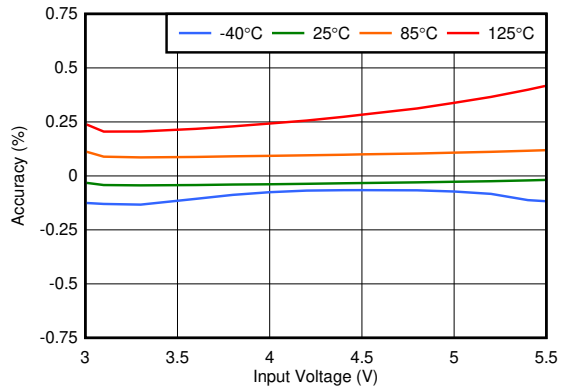


图 5-2. TLV70028-Q1 Line Regulation

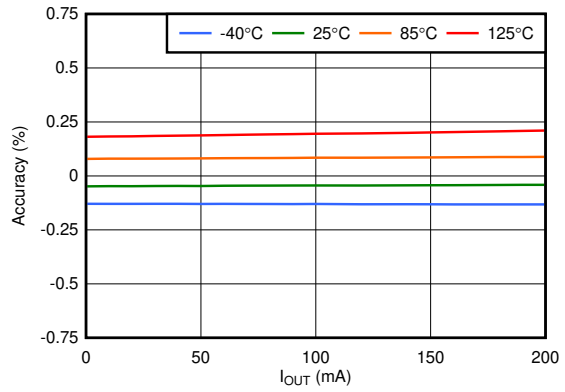


图 5-3. TLV70028-Q1 Load Regulation

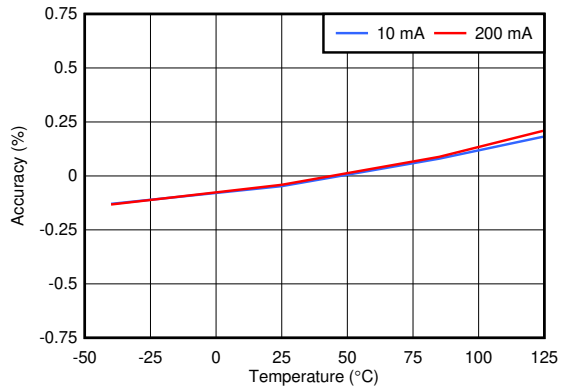


图 5-4. TLV70028-Q1 Accuracy vs Temperature

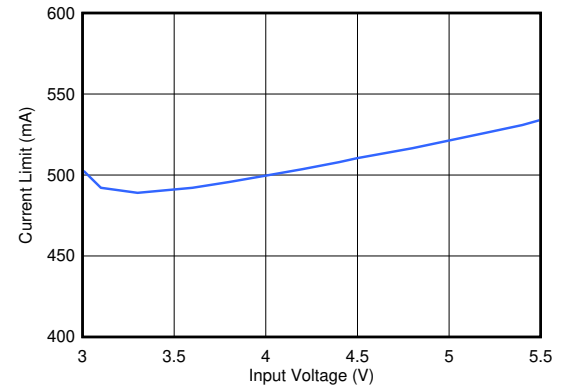


图 5-5. TLV70028-Q1 Current Limit vs Input Voltage

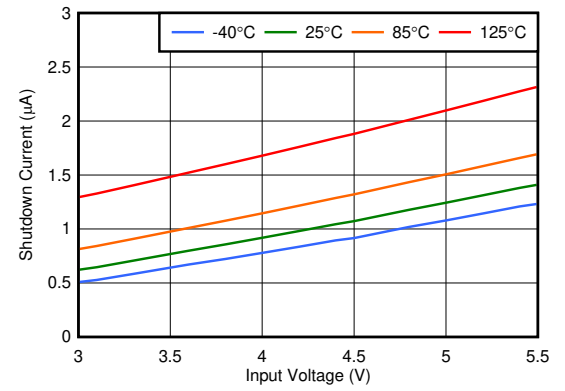


图 5-6. TLV70028-Q1 Shutdown Current vs Input Voltage

5.6 Typical Characteristics (continued)

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

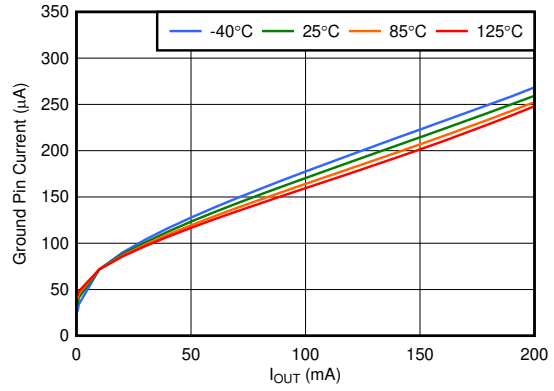


图 5-7. TLV70028-Q1 Ground Pin Current vs Output Current

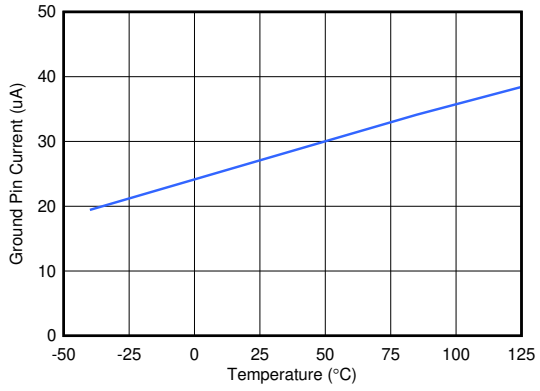
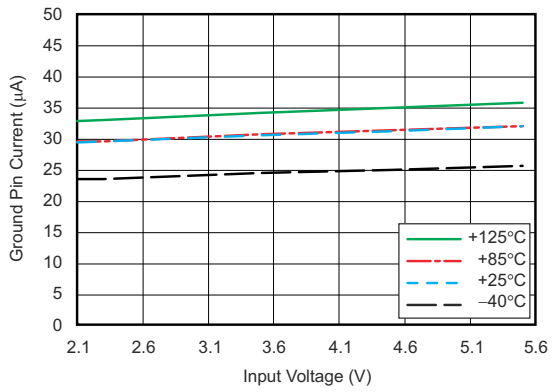
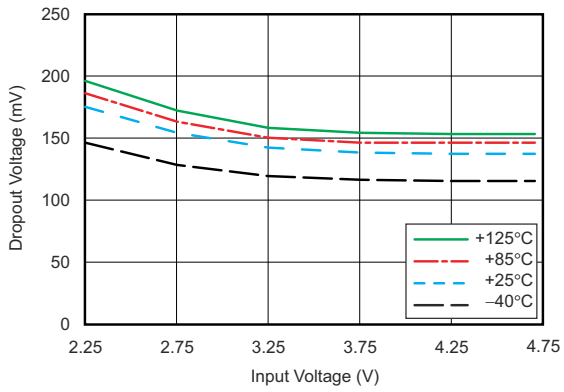


图 5-8. TLV70028-Q1 Ground Pin Current vs Temperature



I_{OUT} = 0mA

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



I_{OUT} = 200mA

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

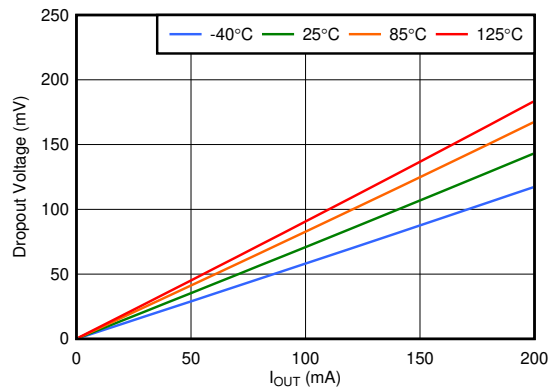


图 5-11. TLV70028-Q1 Dropout Voltage vs Output Current

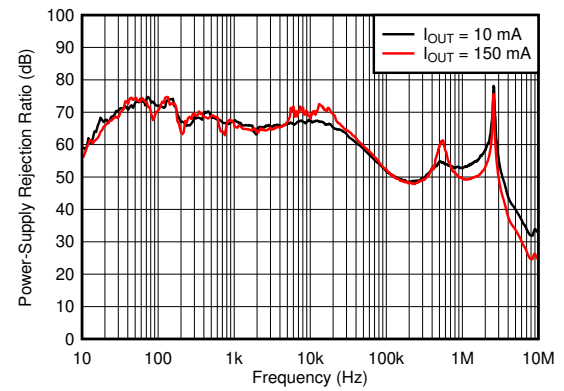


图 5-12. TLV70028-Q1 Power-Supply Rejection Ratio vs Frequency

5.6 Typical Characteristics (continued)

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

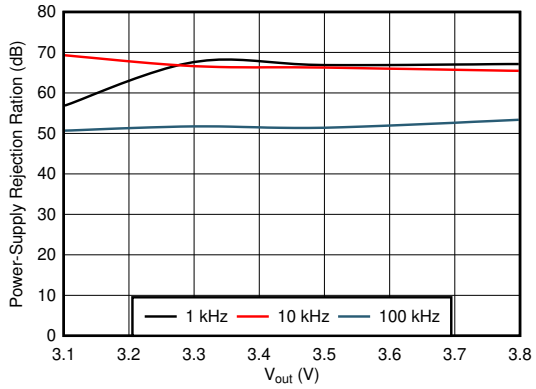


图 5-13. TLV70028-Q1 Power-Supply Rejection Ratio vs Output Voltage

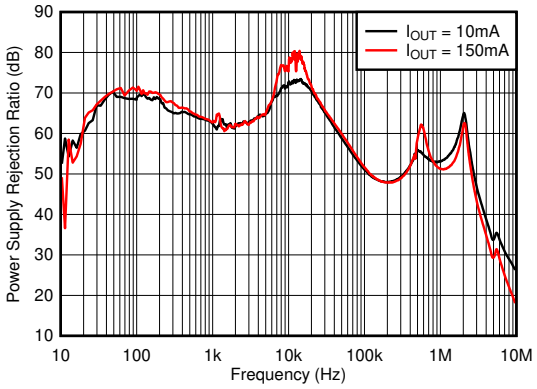


图 5-14. TLV70033-Q1 PSRR Ratio

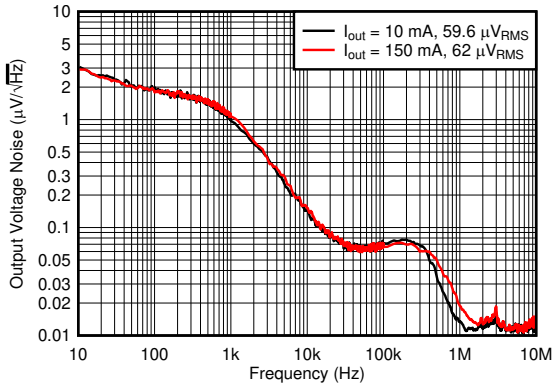
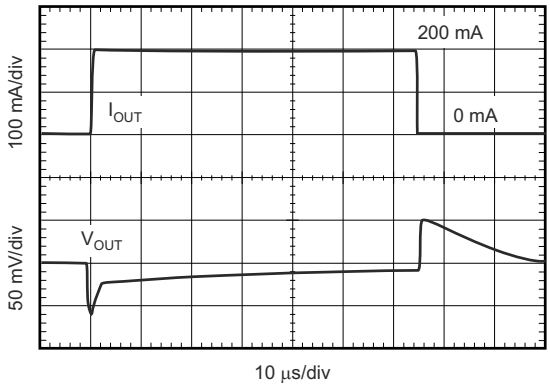
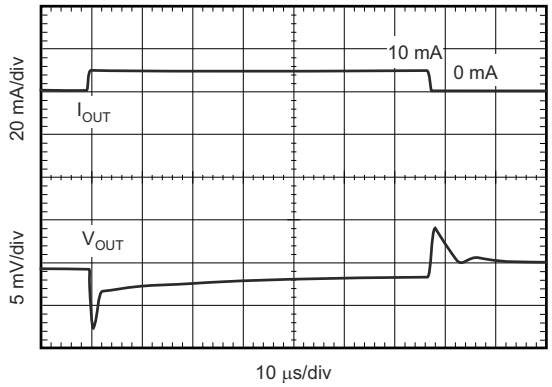


图 5-15. TLV70028-Q1 Output Spectral Noise Density vs Frequency



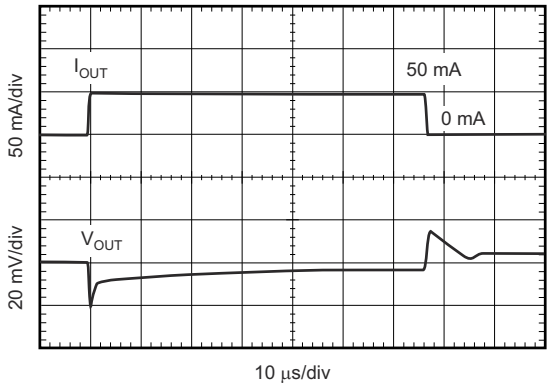
t_R = t_F = 1µs, V_{IN} = 2.1V

图 5-16. Load Transient Response



t_R = t_F = 1µs, V_{IN} = 2.3V

图 5-17. Load Transient Response

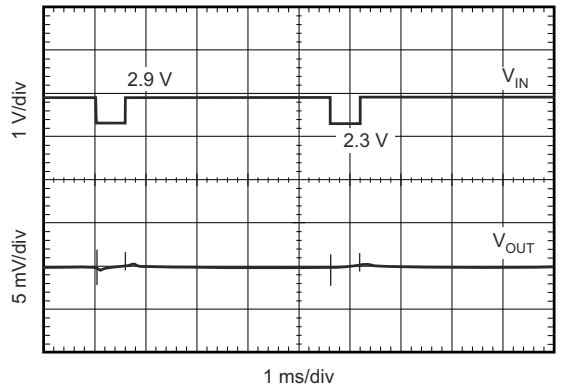


t_R = t_F = 1µs, V_{IN} = 2.3V

图 5-18. Load Transient Response

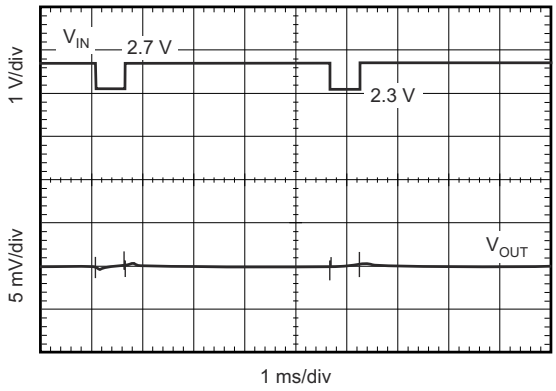
5.6 Typical Characteristics (continued)

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



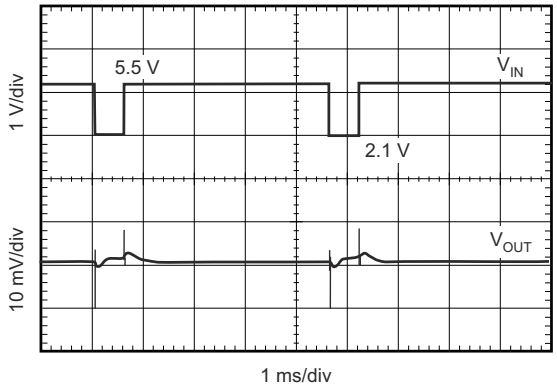
Slew rate = 1V/µs, I_{OUT} = 200mA

图 5-19. Line Transient Response



Slew rate = 1V/µs, I_{OUT} = 200mA

图 5-20. Line Transient Response



Slew rate = 1V/µs, I_{OUT} = 200mA

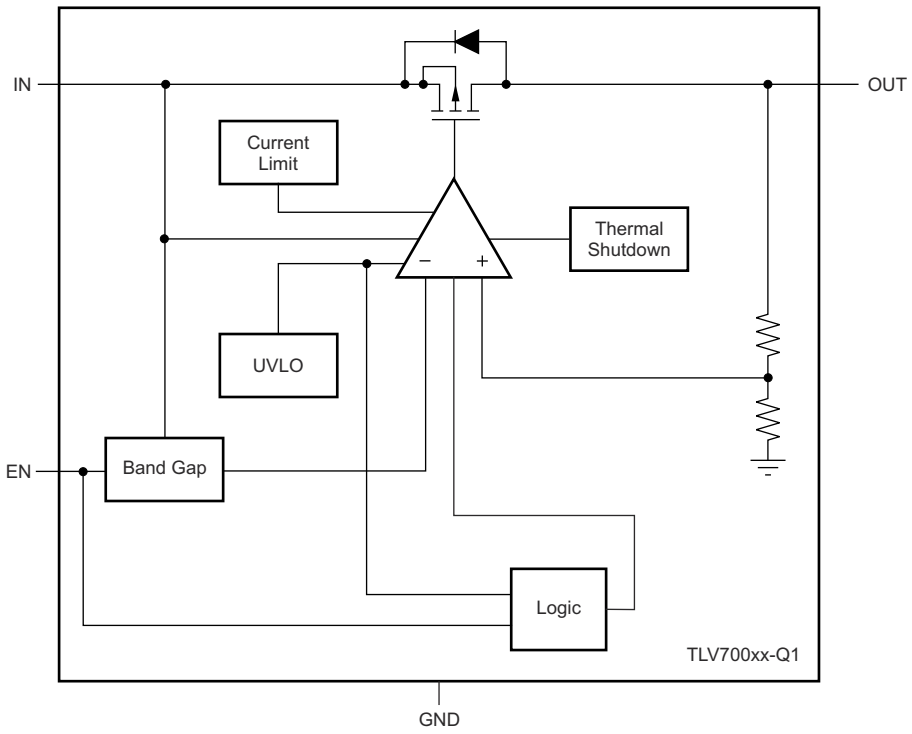
图 5-21. Line Transient Response

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}) × 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 图 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

备注

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。

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 snd very good PSRR with little (V_{IN} – V_{OUT}) headroom, make this device family designed for 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°C to +125°C.

7.1.1 Input and Output Capacitor Requirements

Ceramic, 1.0µF, 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 0.1µF 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 0.1µF. 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 0.1µF effective capacitances also enables the use of smaller-footprint capacitors that have higher derating in size- and space-constrained applications.

Note that using a 0.1µF rated capacitor at the output of the LDO does not provide stability because the effective capacitance under the specified operating conditions is less than 0.1µF. Maximum ESR must be less than 200mΩ.

Although an input capacitor is not required for stability, good analog design practice is to connect a 0.1µF to 1µF, 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 2Ω, a 0.1µF 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°C, allowing the device to cool. When the junction temperature cools to approximately 140°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°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°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 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 guideevaluation module (EVM) helps designers evaluate the operation and performance of the TLV700xx-Q1 family.

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

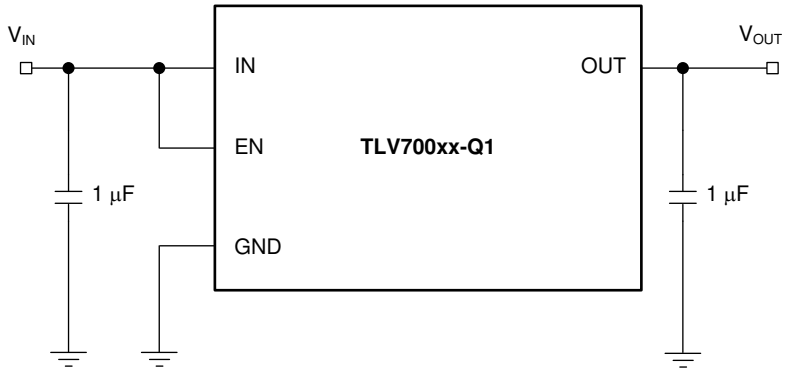


图 7-1. TLV700xx-Q1 Typical Application

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

方程式 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 << I_{OUT}, the term I_Q × V_{IN} is always ignored

For a device under operation at a given ambient air temperature (T_A), use 方程式 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 方程式 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 方程式 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

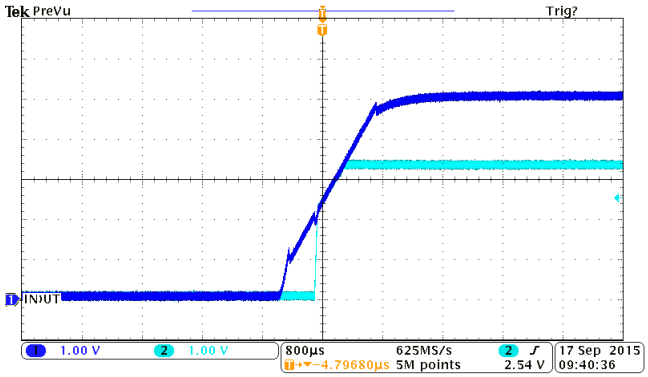


图 7-2. Power-Up

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 图 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

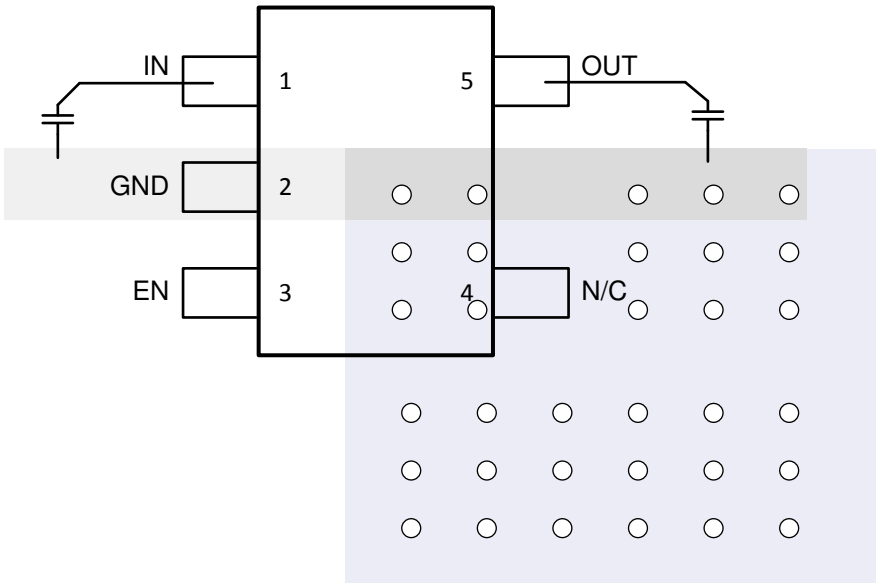


图 7-3. TLV700xx-Q1 Layout Example

8 Device and Documentation Support

8.1 Device Support

8.1.1 Device Nomenclature

表 8-1. Device Nomenclature

PRODUCT(1)	DESCRIPTION
TLV700**xxQyyyzQ1**	**xx** is the nominal output voltage (for example, 28 = 2.8V). **Q** indicates that this device is a grade-1 device in accordance with the AEC-Q100 standard. **yyy** is the package designator. **z** is the tape and reel quantity (R = 3000, T = 250). **Q1** indicates that this device is an automotive grade (AEC-Q100) device.

(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.

8.2 Documentation Support

8.2.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *TLV700xxEVM-503* user's guide

8.3 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击*通知* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

8.4 支持资源

TI E2E™ 中文支持论坛是工程师的重要参考资料，可直接从专家处获得快速、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，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。

8.5 Trademarks

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8.6 静电放电警告

静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

8.7 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。

9 Revision History

Changes from Revision C (June 2018) to Revision D (January 2025)	Page
• 更新了整个文档中的表格、图和交叉参考的编号格式	1
• Added *Device Nomenclature* table	16

Changes from Revision B (October 2016) to Revision C (June 2018)	Page
• 已将 DCK (SC70) 封装添加到文档；请注意，TLV70025-Q1 和 TLV70033-Q1 之前已在 SLVSA61 中列出	1
• 将“*特性*”部分中的“*固定输出电压*”要点更改为“*固定输出电压组合*”	1
• 更改了“描述”部分的最后一段以加入 SC70 封装	1
• 向*器件信息*表中添加了 SC70 行	1
• Added T_J parameter to *Absolute Maximum Ratings* table	4
• Changed T_J parameter to T_A in *Recommended Operating Conditions* table and changed *junction* to *ambient* in parameter name	4
• Added *TLV70033-Q1 PSRR Ratio* figure	6

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.

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	Samples
TLV70028QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SJU	Samples
TLV70032QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SKA	Samples
TLV70033QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	OFL	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

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

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals.
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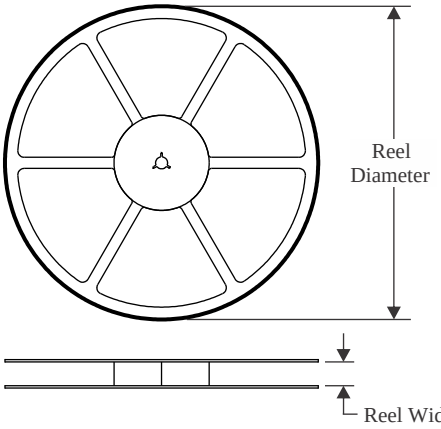
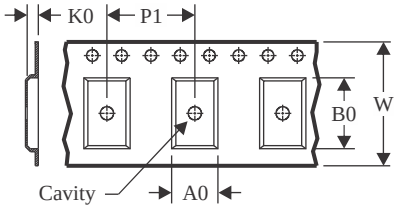
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

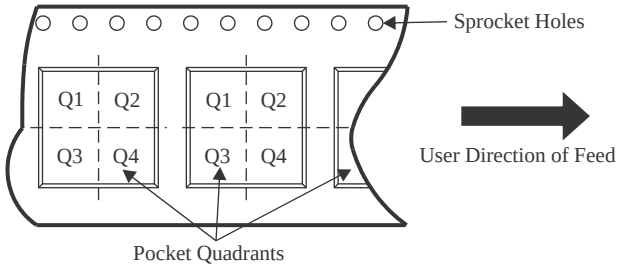


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

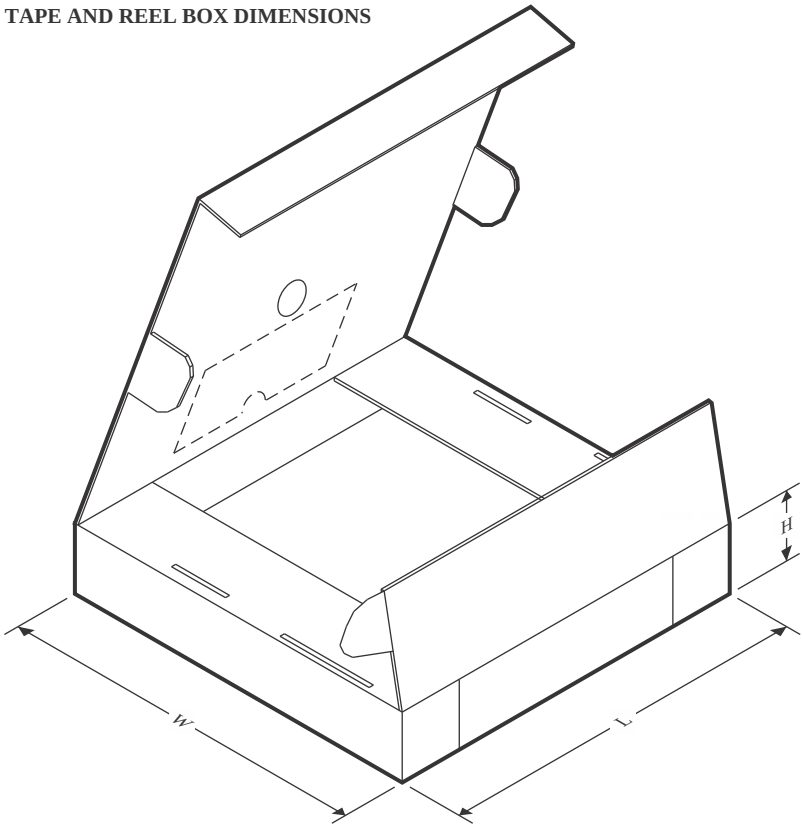
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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

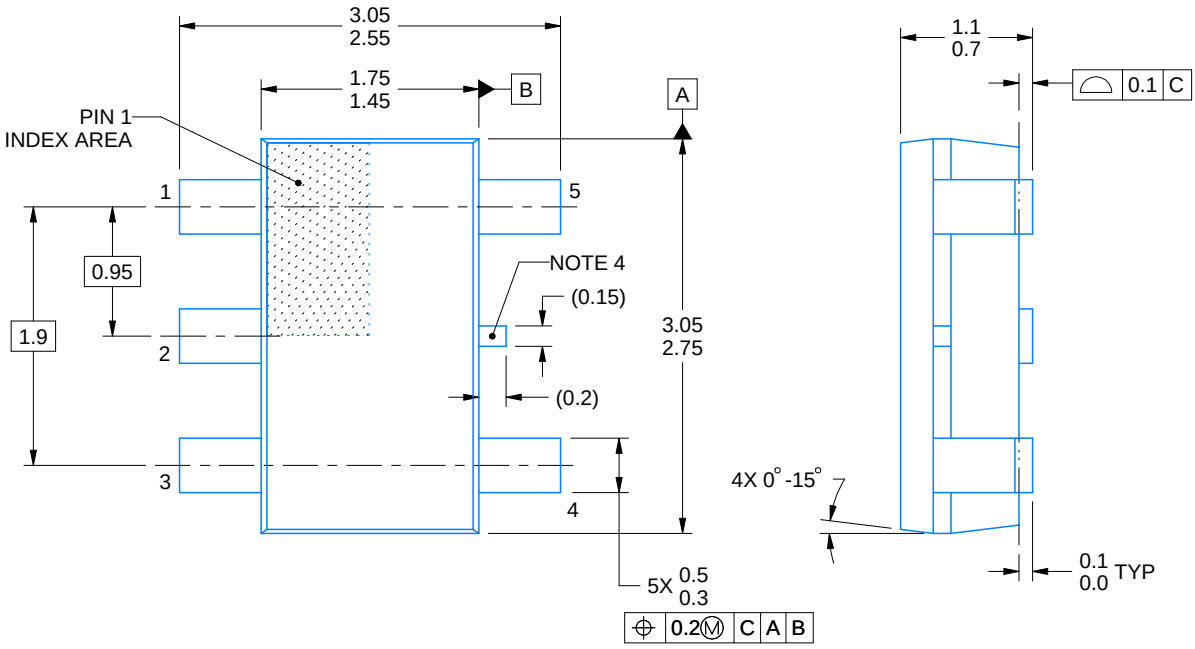
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70025QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70028QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70032QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70033QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0

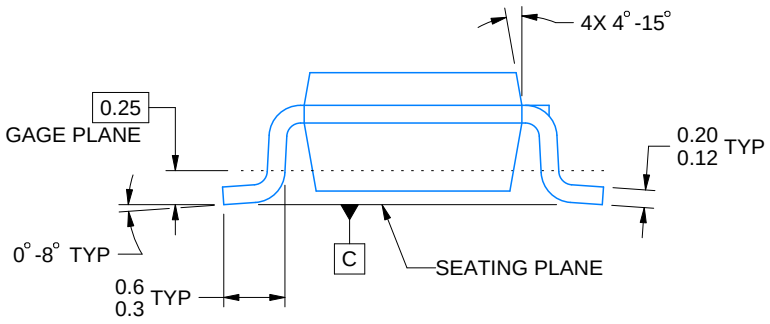
PACKAGE OUTLINE

DDC0005A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR





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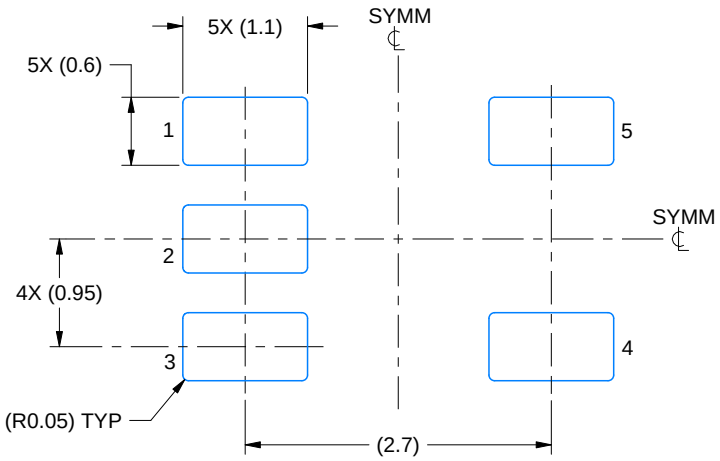
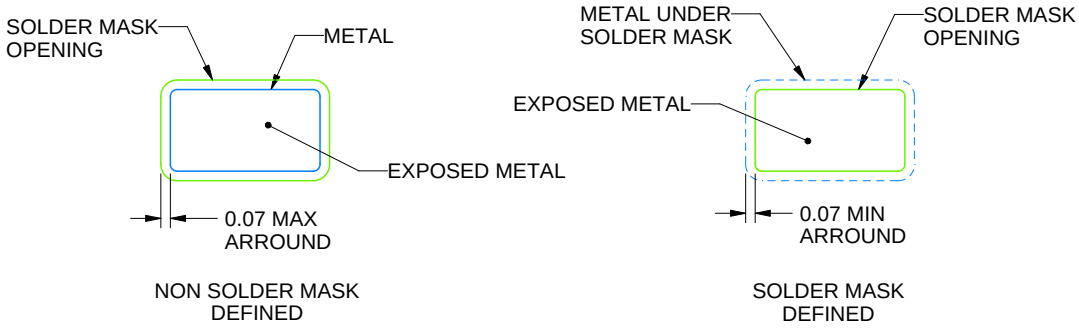
NOTES:

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.



LAND PATTERN EXAMPLE
EXPLOSED METAL SHOWN
SCALE:15X



SOLDERMASK DETAILS

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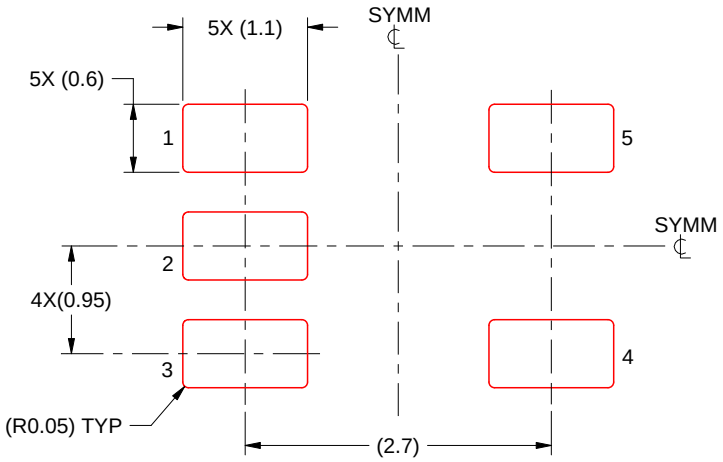
NOTES: (continued)

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



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

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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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