TEXAS INSTRUMENTS

TLV70018-Q1, TLV70012-Q1

ZHCS844C – NOVEMBER 2011 – REVISED JUNE 2017

TLV700xx-Q1 300mA、低 I_Q、低压差稳压器

1 特性

- 符合汽车应用 要求
- 具有符合 AEC-Q100 标准的下列结果：
  - 器件温度 1 级：-40°C 至 125°C 的环境运行温度范围
  - 器件人体放电模式 (HBM) 静电放电 (ESD) 分类等级 H2
  - 器件组件充电模式 (CDM) ESD 分类等级 C3B
- 精度 2%
- 低 I_Q：35μA
- 固定输出电压：1.2V 和 1.8V
- 高电源抑制比 (PSRR)：频率 1kHz 时为 68dB
- 可在采用 0.1 μF(1) 的有效电容时保持稳定
- 热关断保护和过流保护

(1) 请参阅 *输入和输出电容器要求*。

2 应用

- 汽车音响主机
- 摄像头传感器和模块
- 抬头显示 (HUD)
- 远程信息处理控制单元

3 说明

TLV70018-Q1 和 TLV70012-Q1 低压差 (LDO) 线性稳压器为低静态电流器件，具有出色的线路和负载瞬态性能。高精度带隙与误差放大器支持 2% 的总精度。本系列器件具有低输出噪声、高电源抑制比 (PSRR) 和低压差电压等特性，非常适合为功率敏感型负载供电。所有器件版本均具有热关断保护和电流限制，以便检测故障状况。

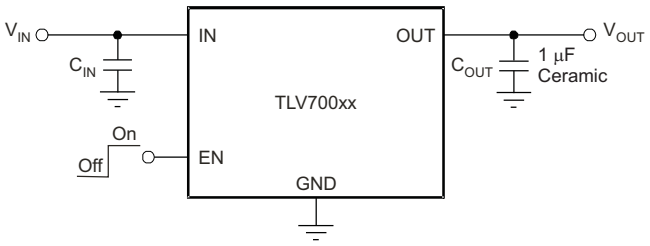
此外，这些器件在有效输出电容只有 0.1μF 时保持稳定。这一特性允许使用具有较高偏置电压和温度降额的成本效益型电容器。这些器件在不产生输出负载的情况下可调节至特定的精度。

器件信息(1)

器件型号	封装	封装尺寸（标称值）
TLV70018-Q1	小外形尺寸晶体管 (SOT) (5)	2.90mm x 1.60mm
TLV70012-Q1		

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

典型应用



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

目录

4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

Changes from Revision B (January 2016) to Revision C **Page**

- 已更改 *固定输出电压* 特性 由*固定输出电压组合（可能为 1.2V 至 4.8V）*更改为*固定输出电压（1.2V 和 1.8V）* ... 1
- 已更改 *应用*部分 ... 1
- 已更改 说明*部分的*第一段：将 *TLV700xx-Q1 系列*更改为 *TLV70018-Q1 和 TLV70012-Q1*、删除了第二句、将*多种电池供电型手持设备*更改为*为功率敏感型负载供电，并将安全*更改为*检测故障状况* ... 1
- 已删除 典型应用标题中的固定电压版本 ... 1
- Changed *Input voltage* parameter: changed symbol from V_I to V_{IN}, moved EN and OUT rows to standalone parameters ... 5
- Changed maximum specification of *Output voltage* parameter from 5.5 V to 1.8 V ... 5
- Added I_{OUT} symbol to *Current output* parameter ... 5
- Deleted TLV70018-Q1 column from *Thermal Information* table ... 5
- Added TLV70018-Q1 to TLV70012-Q1 column in *Thermal Information* table; all thermal values for TLV70018-Q1 changed to the TLV70012-Q1 thermal values ... 5
- Changed $V_{OUT(TYP)}$ to $V_{OUT(NOM)}$ in conditions statement of *Electrical Characteristics* table ... 6
- Changed symbols for *Line regulation*, *Load regulation*, and *Output noise voltage* parameters from $\Delta V_O/\Delta V_{IN}$ to $\Delta V_{OUT}/\Delta V_{IN}$, $\Delta V_O/\Delta I_{OUT}$ to $\Delta V_{OUT}/\Delta I_{OUT}$, and V_N to V_n (respectively) in *Electrical Characteristics* table ... 6
- Changed $V_{OUT(TYP)}$ to $V_{OUT(NOM)}$ in *Typical Characteristics* conditions statement ... 7
- Deleted *Dropout Voltage vs Input Voltage* and *Dropout Voltage vs Output Current* curves ... 7
- Changed *TLV700xx-Q1* to *TLV70018-Q1 and TLV70012-Q1* in *Overview* section ... 11
- Added *TLV70012-Q1* to sub-sections of *Feature Description* and *Device Functional Modes* sections ... 11
- Changed 160°C to 165°C, 140°C to 145°C, and 35°C to 40°C in *Thermal Shutdown* section ... 12
- Changed *Application Information* section: changed first two sentences, deleted second paragraph ... 13
- Changed *Example Value* column values for 2nd and 3rd rows in Design Parameters table ... 13
- Added TLV70012-Q1 to *Input and Output Capacitor Requirements* section ... 14
- Deleted first and last paragraphs from *Thermal Considerations* section ... 15
- Deleted second sentence from second paragraph of *Power Dissipation* section ... 15
- Added TLV70012-Q1 to *Power Dissipation* section ... 15

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修订历史记录 (接下页)

Changes from Revision A (March 2012) to Revision B **Page**

- 已添加 *ESD 额定值表*、*建议运行条件表*、*热性能信息表*、*详细 说明*部分、*应用和实施*部分、*应用和实施*部分、*布局*部分、*器件和文档支持*部分以及*机械、封装和可订购信息*部分 1
- Deleted the *Dissipation Ratings* table 5

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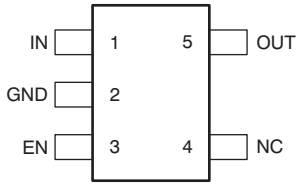
5 Pin Configuration and Functions

DDC Package
5-Pin SOT
Top View



Pin Functions

PIN		DESCRIPTION
NO.	NAME	
1	IN	Input pin. A small 1-μF ceramic capacitor is recommended from this pin to ground to assure stability and good transient performance. (1)
2	GND	Ground pin
3	EN	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 μA, nominal.
4	NC	No connection. This pin can be tied to ground to improve thermal dissipation.
5	OUT	Regulated output voltage pin. A small 1-μF ceramic capacitor is needed from this pin to ground to assure stability. (1)

(1) See *Input and Output Capacitor Requirements* section for more details.

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6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range, unless otherwise noted.(1)

		MIN	MAX	UNIT
Voltage(2)	IN	–0.3	6.0	V
	EN	–0.3	6.0	V
	OUT	–0.3	6.0	V
Current (source)	OUT	Internally Limited		
Output short-circuit duration		Indefinite		
Operating virtual junction, T_J		–55	150	°C
Storage temperature, 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.

6.2 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.

6.3 Recommended Operating Conditions

over operating free-air temperature range, unless otherwise noted.

			MIN	MAX	UNIT
V_{IN}	Input voltage	IN	2	5.5	V
V_{EN}	Enable voltage	EN	0	5.5	V
V_{OUT}	Output voltage	OUT	0	1.8	V
I_{OUT}	Current output		0	300	mA
T_J	Operating junction temperature		–40	150	°C

6.4 Thermal Information

THERMAL METRIC(1)		TLV70018-Q1, TLV70012-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	NA	°C/W

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

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6.5 Electrical Characteristics

At V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2 V (whichever is greater); I_{OUT} = 10 mA, V_{EN} = 0.9 V, C_{OUT} = 1.0 μF, and T_A = –40°C to 125°C, unless otherwise noted. Typical values are at T_A = 25°C, unless otherwise noted.

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	–2%	0.5%	2%	
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	$V_{OUT(NOM)}$ + 0.5 V ≤ V_{IN} ≤ 5.5 V, I_{OUT} = 10 mA		1	5	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	0 mA ≤ I_{OUT} ≤ 300 mA, TLV70018-Q1		1	15	mV
		0 mA ≤ I_{OUT} ≤ 300 mA, TLV70012-Q1		1	20	
I_{CL}	Output current limit	V_{OUT} = 0.9 × $V_{OUT(NOM)}$	320	500	860	mA
I_{GND}	Ground pin current	I_{OUT} = 0 mA		35	55	μA
		I_{OUT} = 300 mA, V_{IN} = V_{OUT} + 0.5 V		370		μA
I_{SHDN}	Ground pin current (shutdown)	V_{EN} ≤ 0.4 V, V_{IN} = 2.0 V		400		nA
		V_{EN} ≤ 0.4 V, 2.0 V ≤ V_{IN} ≤ 4.5 V, T_A = –40°C to 85°C		1	2	μA
		V_{EN} ≤ 0.4 V, 2.0 V ≤ V_{IN} ≤ 4.5 V, T_A = 85°C to 125°C		1	2.5	μA
PSRR	Power-supply rejection ratio	V_{IN} = 2.3 V, V_{OUT} = 1.8 V, I_{OUT} = 10 mA, f = 1 kHz		68		dB
V_n	Output noise voltage	BW = 100 Hz to 100 kHz, V_{IN} = 2.3 V, V_{OUT} = 1.8 V, I_{OUT} = 10 mA		48		μV_{RMS}
t_{STR}	Startup time(1)	C_{OUT} = 1.0 μF, I_{OUT} = 300 mA		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_{IN} = V_{EN} = 5.5 V		0.04		μA
UVLO	Undervoltage lockout	V_{IN} rising		1.9		V
T_{SD}	Thermal shutdown temperature	Shutdown, temperature increasing		165		°C
		Reset, temperature decreasing		145		°C
T_A	Operating temperature		–40		125	°C

(1) Startup time = time from EN assertion to 0.98 × $V_{OUT(NOM)}$.

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6.6 Typical Characteristics

Over operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2 V, whichever is greater; I_{OUT} = 10 mA, V_{EN} = V_{IN}, C_{OUT} = 1.0 µF, unless otherwise noted. Typical values are at T_J = 25°C.

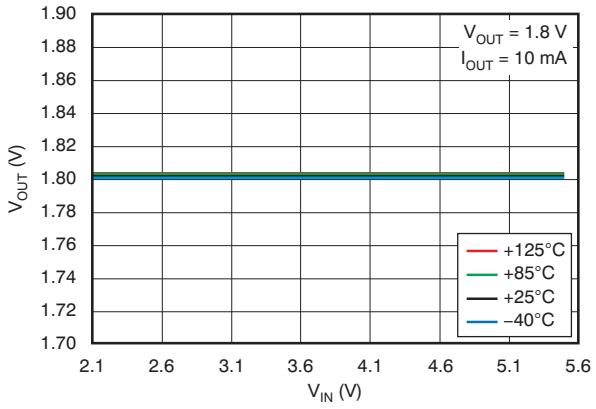

Figure 1. Line Regulation 10 mA

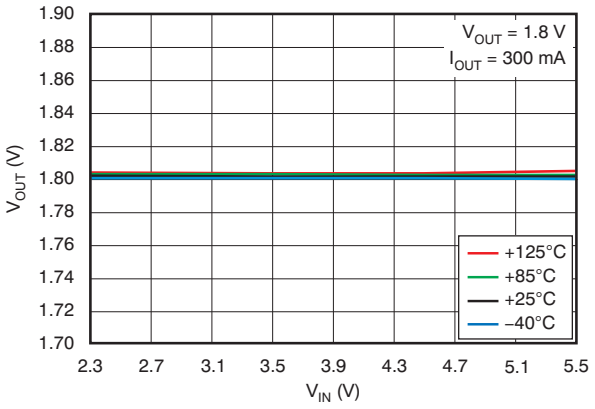

Figure 2. Line Regulation 300 mA

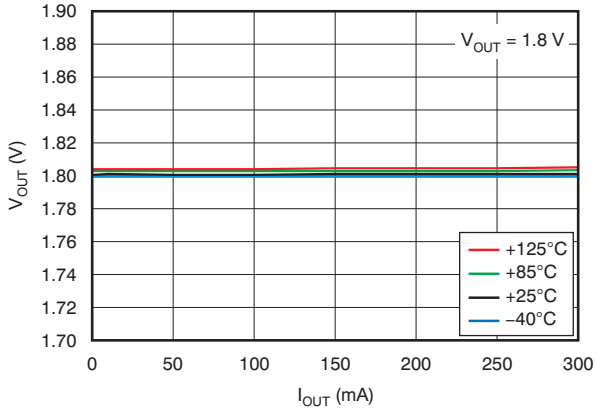

Figure 3. Load Regulation

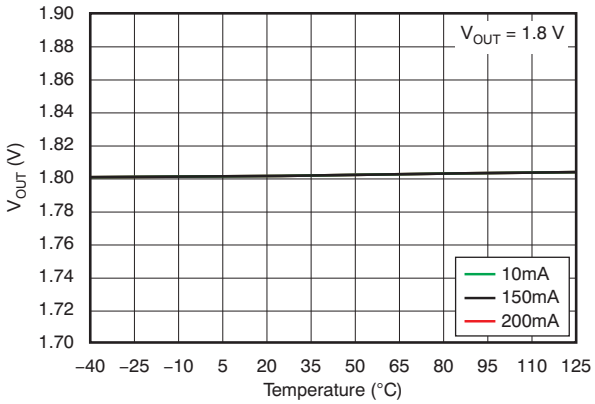

Figure 4. Output Voltage vs Temperature

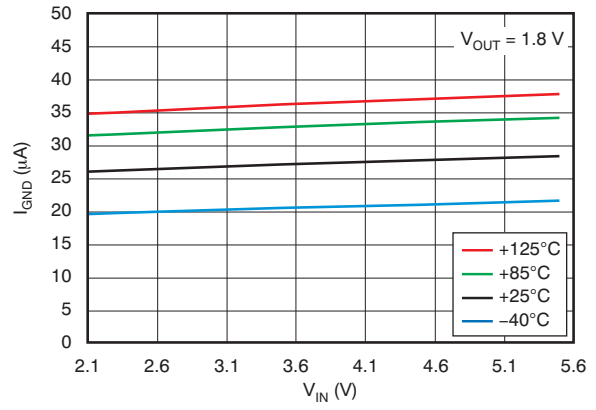

Figure 5. Ground Pin Current vs Input Voltage

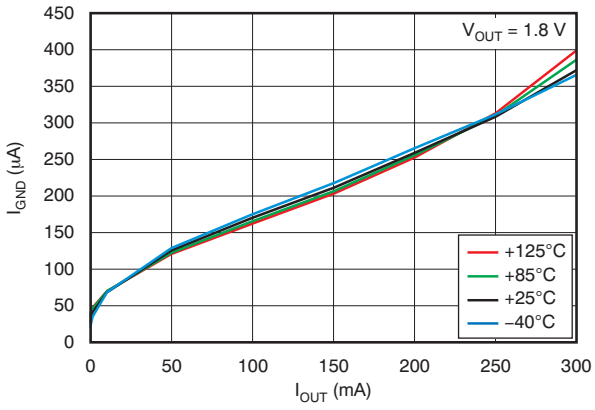

Figure 6. Ground Pin Current vs Load

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Typical Characteristics (continued)

Over operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2 V, whichever is greater; I_{OUT} = 10 mA, V_{EN} = V_{IN}, C_{OUT} = 1.0 µF, unless otherwise noted. Typical values are at T_J = 25°C.

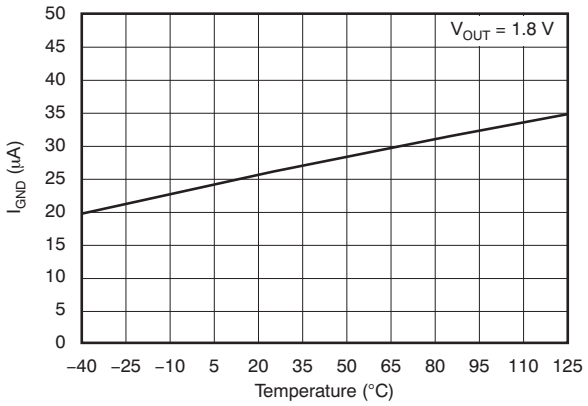

Figure 7. Ground Pin Current vs Temperature

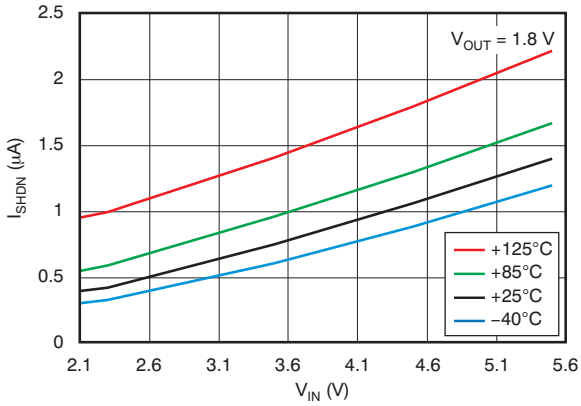

Figure 8. Shutdown Current vs Input Voltage

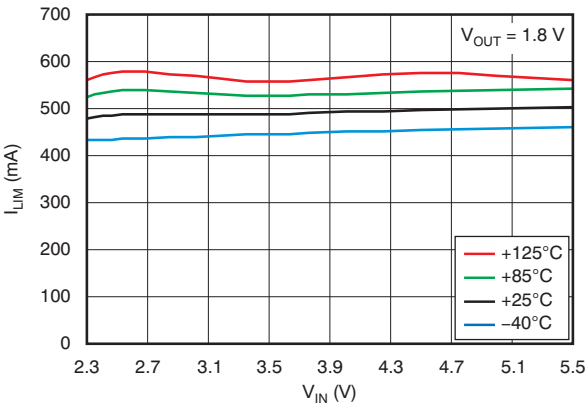

Figure 9. Current Limit vs Input Voltage

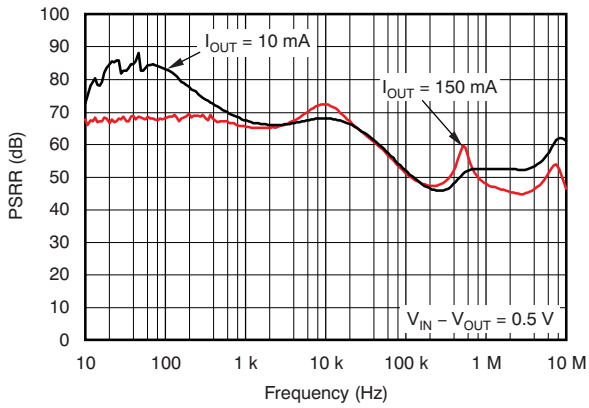

Figure 10. Power-Supply Ripple Rejection vs Frequency

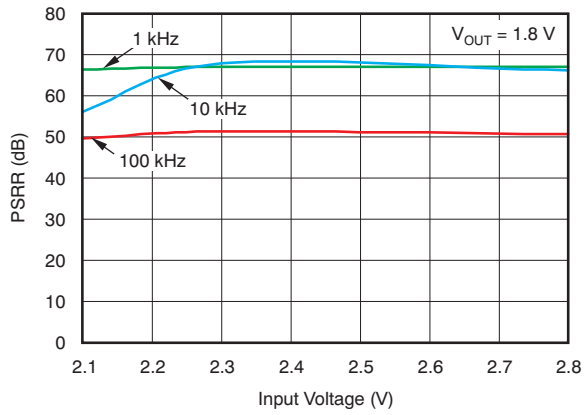

Figure 11. Power-Supply Ripple Rejection vs Input Voltage

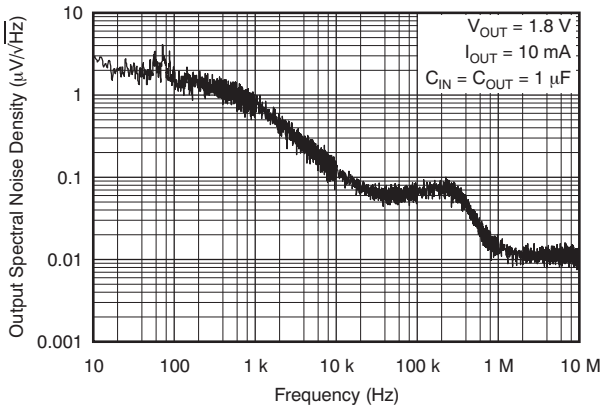

Figure 12. Output Spectral Noise Density vs Frequency

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Typical Characteristics (continued)

Over operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2 V, whichever is greater; I_{OUT} = 10 mA, V_{EN} = V_{IN}, C_{OUT} = 1.0 μF, unless otherwise noted. Typical values are at T_J = 25°C.

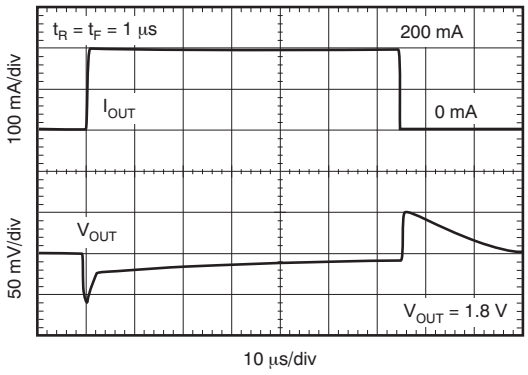

Figure 13. Load Transient Response

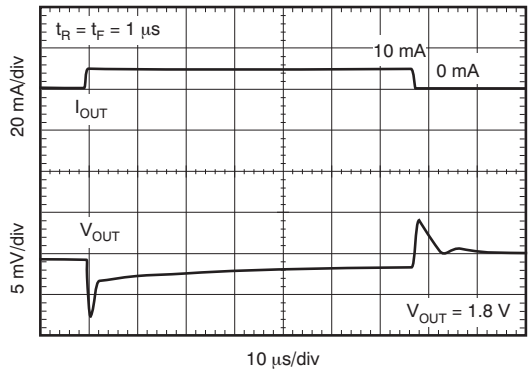

Figure 14. Load Transient Response

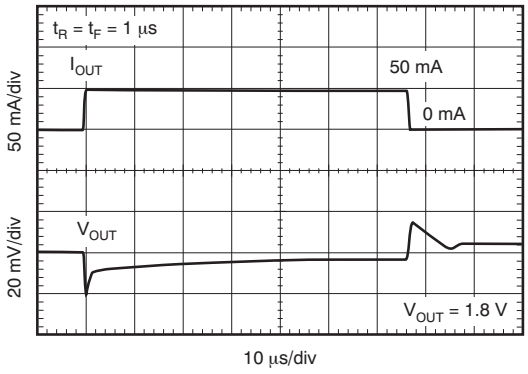

Figure 15. Load Transient Response

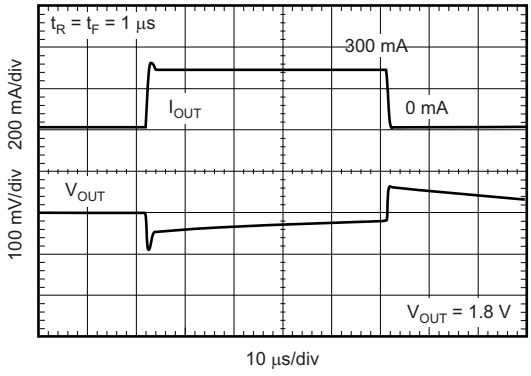

Figure 16. Load Transient Response

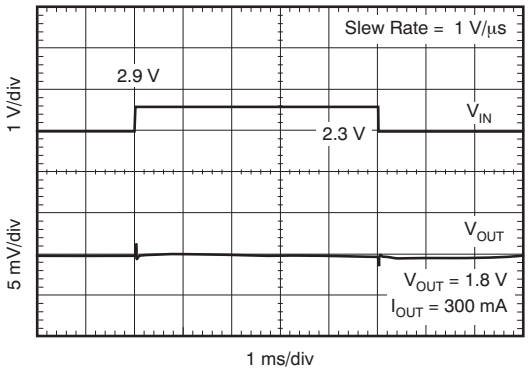

Figure 17. Line Transient Response

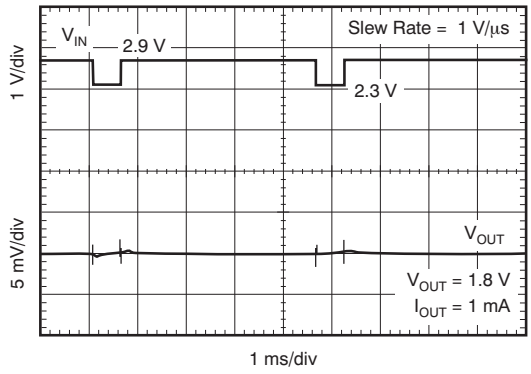

Figure 18. Line Transient Response

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Typical Characteristics (continued)

Over operating temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(NOM)}$ + 0.5 V or 2 V, whichever is greater; I_{OUT} = 10 mA, V_{EN} = V_{IN}, C_{OUT} = 1.0 µF, unless otherwise noted. Typical values are at T_J = 25°C.

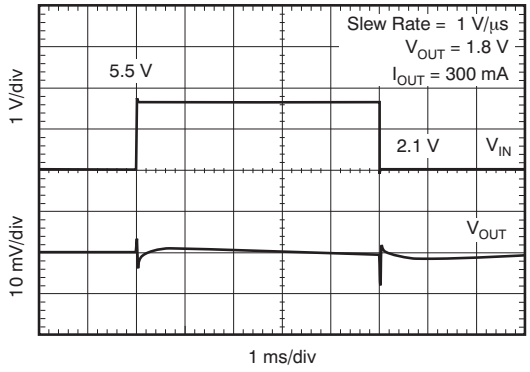

Figure 19. Line Transient Response

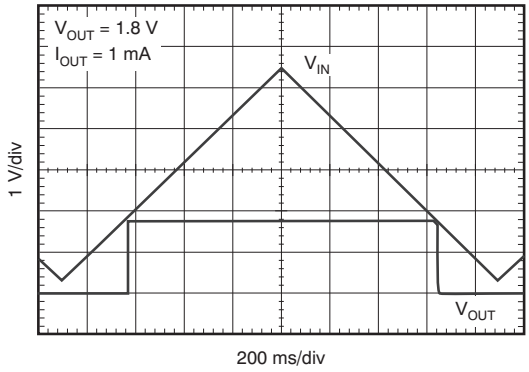

Figure 20. V_{IN} Ramp Up, Ramp Down Response

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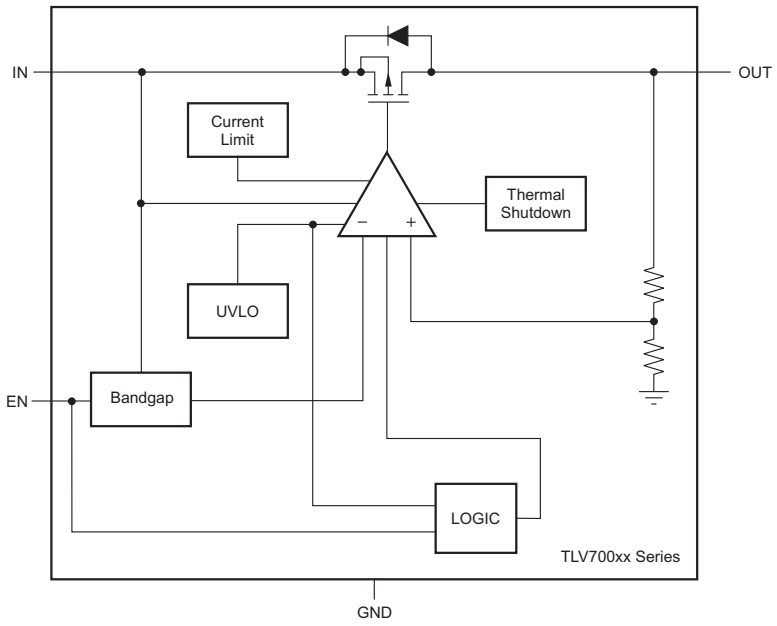
7 Detailed Description

7.1 Overview

The TLV70018-Q1 and TLV70012-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 bandgap and error amplifier provides overall 2% accuracy together with low output noise, very high power-supply rejection ratio (PSRR), and low dropout voltage.

7.2 Functional Block Diagrams



7.3 Feature Description

7.3.1 Internal Current Limit

The TLV70018-Q1 and TLV70012-Q1 internal current limit helps to 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. As the device cools, it 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 Considerations* section for more details.

The PMOS pass element in the TLV70018-Q1 and TLV70012-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.

7.3.2 Dropout Voltage

The TLV70018-Q1 and TLV70012-Q1 use 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 as $(V_{IN} – V_{OUT})$ approaches dropout. Figure 11 illustrates this effect.

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Feature Description (continued)

7.3.3 Undervoltage Lockout (UVLO)

The TLV70018-Q1 and TLV70012-Q1 use an undervoltage lockout circuit to keep the output shut off until internal circuitry is operating properly.

7.3.4 Thermal Shutdown

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, junction temperature should be limited 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 should trigger at least 40°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 TLV70018-Q1 and TLV70012-Q1 has been designed to protect against overload conditions. It was not intended to replace proper heatsinking. Continuously running the TLV70018-Q1 or TLV70012-Q1 into thermal shutdown degrades device reliability.

7.4 Device Functional Modes

7.4.1 Shutdown

The enable pin (EN) is active high. The device is enabled when voltage at EN pin goes above 0.9 V. This relatively lower value of voltage required to turn the LDO on can be exploited to power the LDO with a GPIO of recent processors whose GPIO Logic 1 voltage level is lower than traditional microcontrollers. The device is turned off when the EN pin is held at less than 0.4 V. When shutdown capability is not required, EN can be connected to the IN pin.

7.4.2 Operation with V_{IN} Less than 2 V

The TLV70018-Q1 and TLV70012-Q1 devices operate with input voltages above 2 V. The typical UVLO voltage is 1.9 V and the device operates at an input voltage above 2 V. When input voltage falls below UVLO voltage, the device will shutdown.

7.4.3 Operation with V_{IN} Greater than 2 V

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

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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 TLV70018-Q1 and TLV70012-Q1 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°C.

8.2 Typical Application

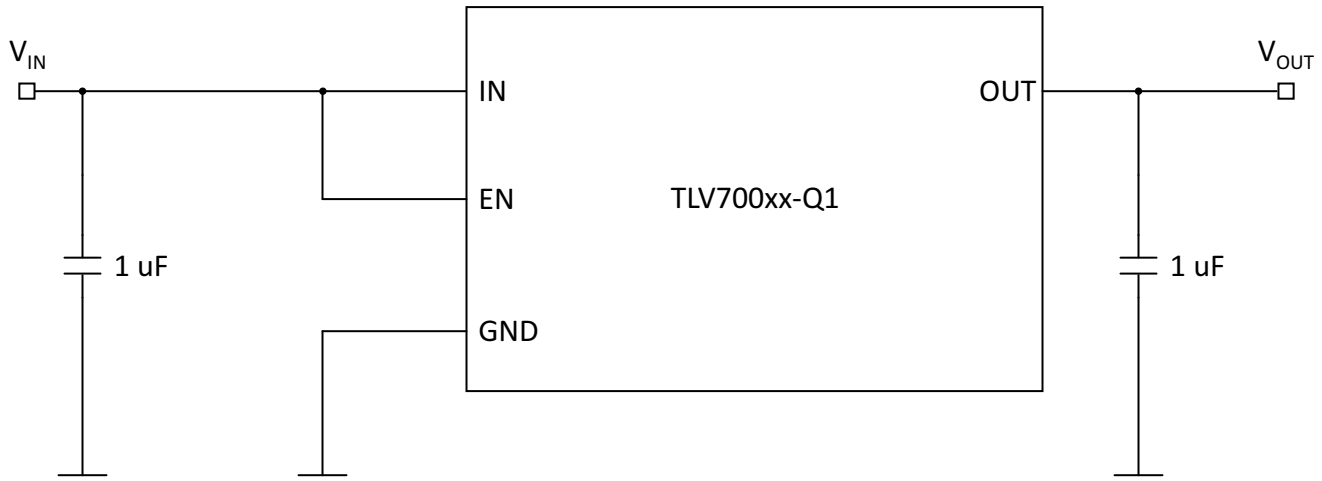

Figure 21. Simplified Schematic

8.2.1 Design Requirements

For this design example use, the parameters listed in Table 1 as the input parameters.

Table 1. Design Parameters

PARAMETER	EXAMPLE VALUE
Input voltage range	2 V to 5.5 V
Output voltage	1.2 V, 1.8 V
Output current rating	300 mA
Effective output capacitor range	>0.1 µF
Maximum output capacitor ESR range	<200 mΩ

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8.2.2 Detailed Design Procedure

8.2.2.1 Input and Output Capacitor Requirements

1.0-μF 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 TLV70018-Q1 and TLV70012-Q1 are designed to be stable with an *effective capacitance* of 0.1 μF 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 μF. 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-μF effective capacitance also enables the use of smaller-footprint capacitors that have higher derating in size- and space-constrained applications.

NOTE

Using a 0.1-μF rated capacitor at the output of the LDO does not ensure stability because the effective capacitance under the specified operating conditions would be less than 0.1 μF. Maximum ESR should be less than 200 mΩ.

Although an input capacitor is not required for stability, it is good analog design practice to connect a 0.1-μF to 1.0-μF, 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-μF input capacitor may be necessary to ensure stability.

8.2.2.2 Transient Response

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

8.2.3 Application Curve

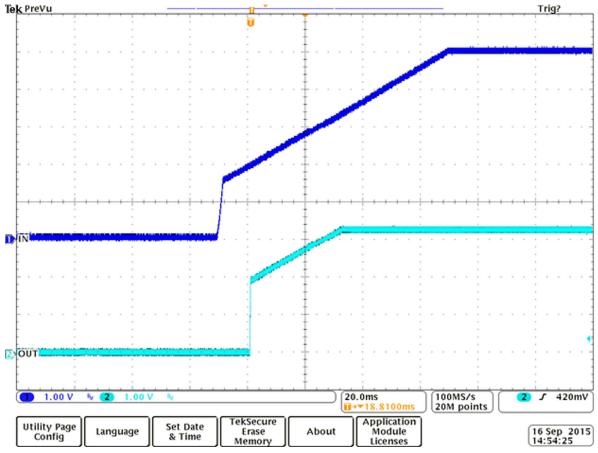

Figure 22. Power Up

9 Power Supply Recommendations

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

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10 Layout

10.1 Layout Guidelines

Input and output capacitors should be placed 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, the ground connection for the output capacitor should be connected directly to the GND pin of the device. High ESR capacitors may degrade PSRR performance.

10.2 Layout Example

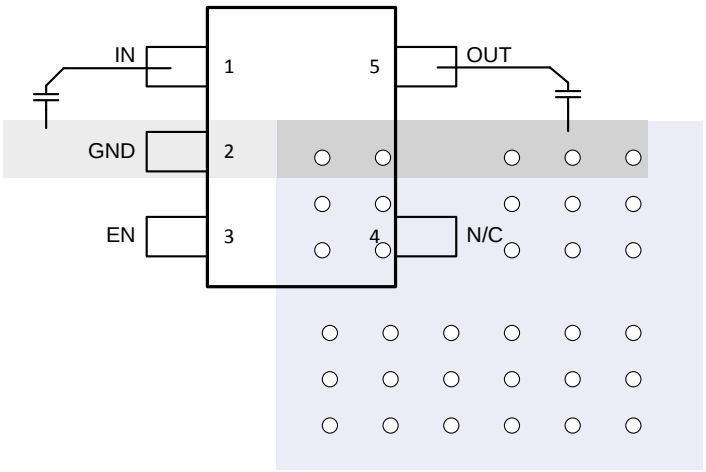

Figure 23. TLV700xx Layout Example

10.3 Thermal Considerations

Any tendency to activate the thermal protection circuit indicates excessive power dissipation or an inadequate heatsink. For reliable operation, junction temperature should be limited 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.

10.4 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.

Thermal performance data for TLV70018-Q1 and TLV70012-Q1 were gathered using the TLV700 evaluation module (EVM), a 2-layer board with two ounces of copper per side. Corresponding thermal performance data are given in *Thermal Information*. Note that this board has provision for soldering not only the SOT23-5 package on the bottom layer, but also the SC-70 package on the top layer. Using heavier copper increases the effectiveness in removing heat from the device. The addition of plated through-holes to heat-dissipating layers also improves heatsink effectiveness.

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Power Dissipation (continued)

10.4.1 Thermal Calculations

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.

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

where

- P_D is continuous power dissipation
- I_{OUT} is output current
- V_{IN} is input voltage
- V_{OUT} is output voltage

Since I_Q << 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 Equation 2 to calculate the junction temperature (T_J).

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

where

- $Z_{\theta JA}$ is the junction-to-ambient air temperature thermal impedance

Use Equation 3 to calculate the rise in junction temperature due to power dissipation.

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

For a given maximum junction temperature ($T_{J(MAX)}$, use Equation 4 to calculate the maximum ambient air temperature ($T_{A(MAX)}$ at which the device can operate.

$$T_{A\,max} = T_{J\,max} - (R_{\theta JA} \times P_D) \quad (4)$$

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11 器件和文档支持

11.1 器件支持

11.1.1 封装

有关 TLV70018-Q1 焊盘尺寸建议，可访问德州仪器 (TI) 网站 www.ti.com.cn。

11.2 文档支持

11.2.1 相关文档

相关文档如下：

TLV700 评估模块

11.3 相关链接

下表列出了快速访问链接。类别包括技术文档、支持和社区资源、工具和软件，以及立即购买的快速链接。

表 2. 相关链接

器件	产品文件夹	立即订购	技术文档	工具和软件	支持和社区
TLV70018-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处
TLV70012-Q1	请单击此处	请单击此处	请单击此处	请单击此处	请单击此处

11.4 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。请单击右上角的*通知我* 进行注册，即可收到任意产品信息更改每周摘要。有关更改的详细信息，请查看任意已修订文档中包含的修订历史记录。

11.5 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”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》。

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设计支持 ***TI 参考设计支持*** **可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。**

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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。

11.8 Glossary

SLYZ022 — *TI Glossary*.

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

12 机械、封装和可订购信息

以下页面包括机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据发生变化时，我们可能不会另行通知或修订此文档。如欲获取此产品说明书的浏览器版本，请参见左侧的导航栏。

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
TLV70012QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SDO	Samples
TLV70018QDDCRQ1	ACTIVE	SOT-23-THIN	DDC	5	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	DAL	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.

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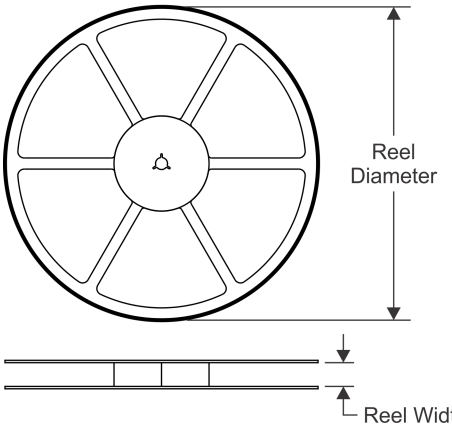
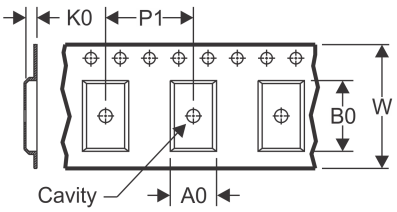
TAPE AND REEL INFORMATION

REEL DIMENSIONS

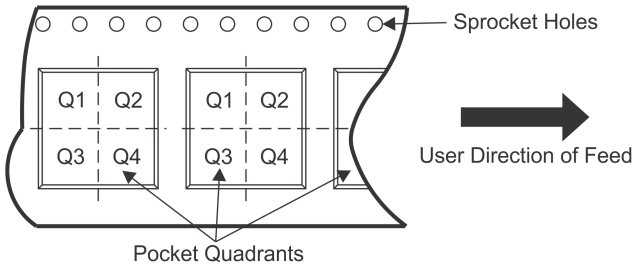


TAPE DIMENSIONS



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

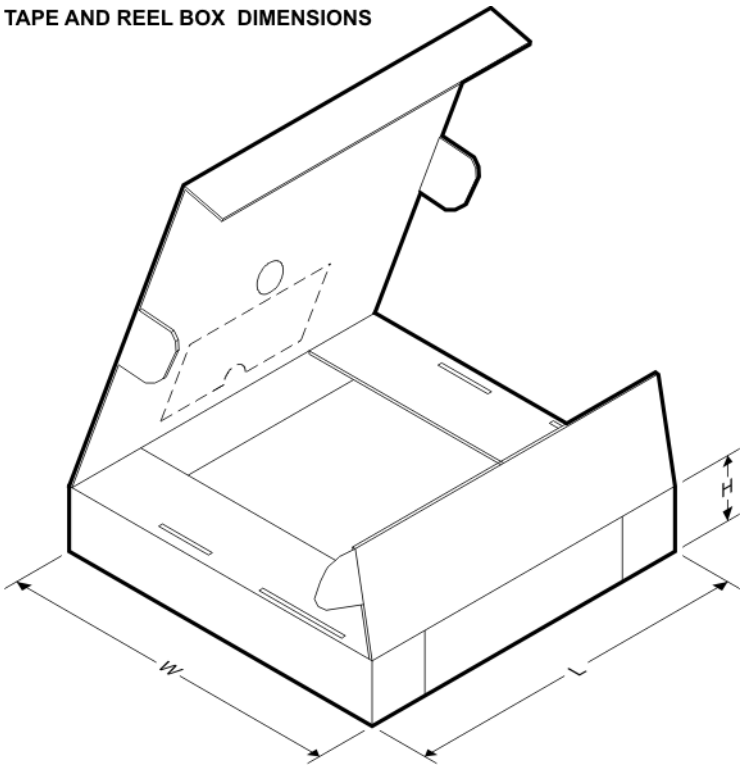
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLV70012QDDCRQ1	SOT-23-THIN	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70018QDDCRQ1	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

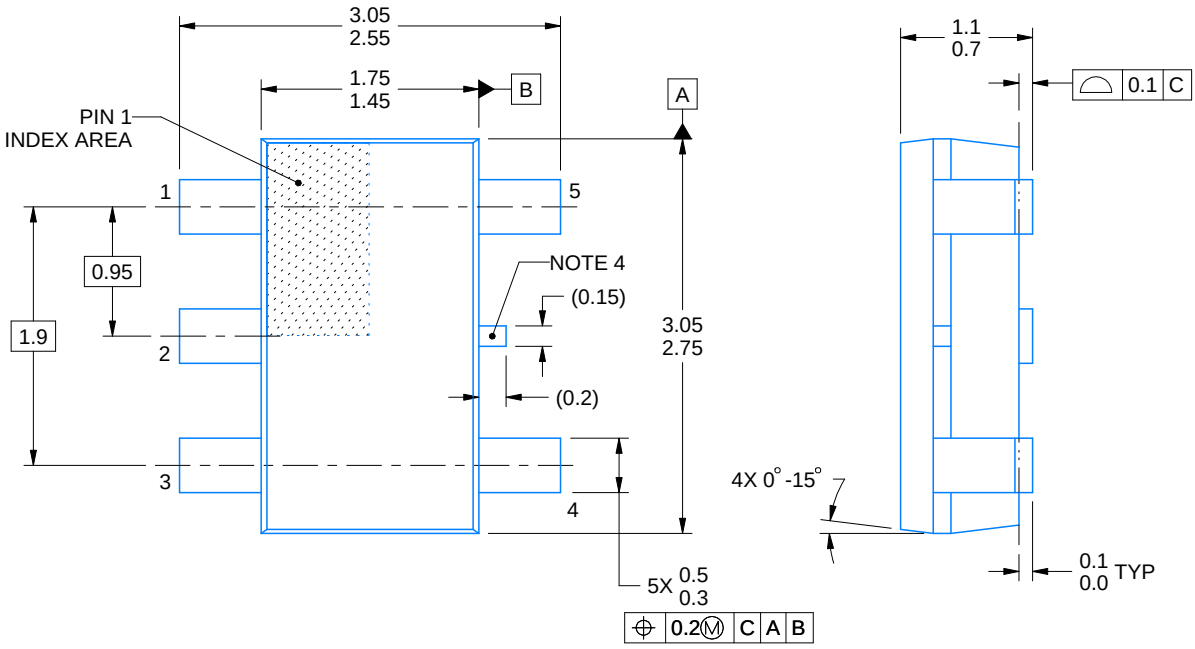
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70012QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70018QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0

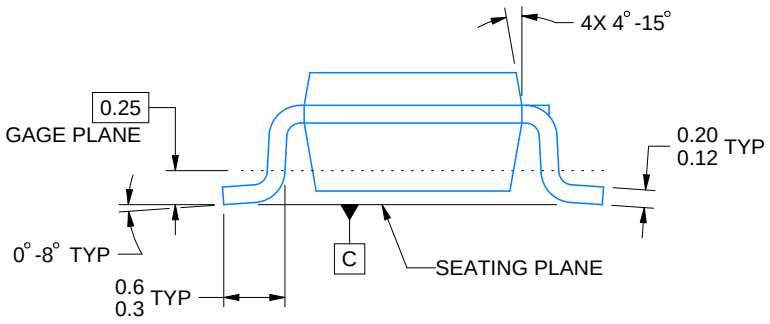
PACKAGE OUTLINE

DDC0005A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR





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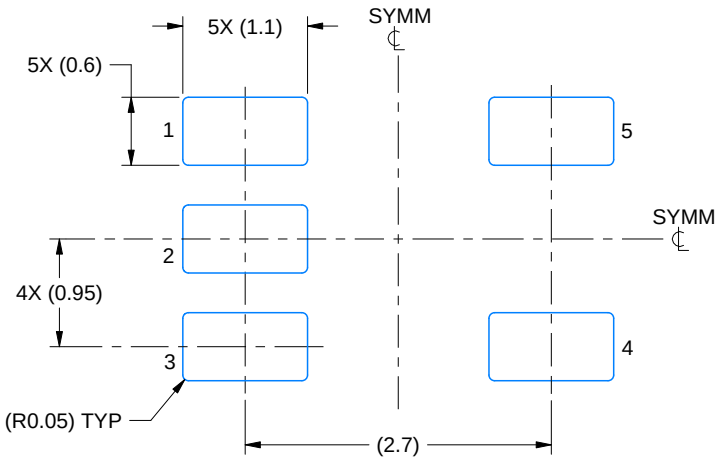
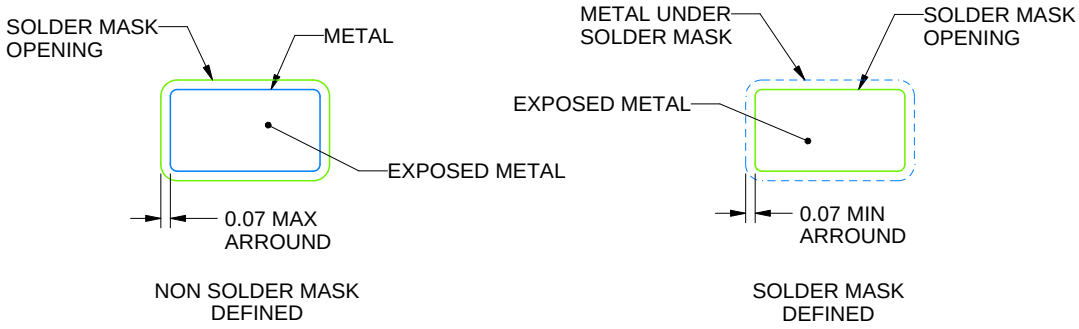
NOTES:

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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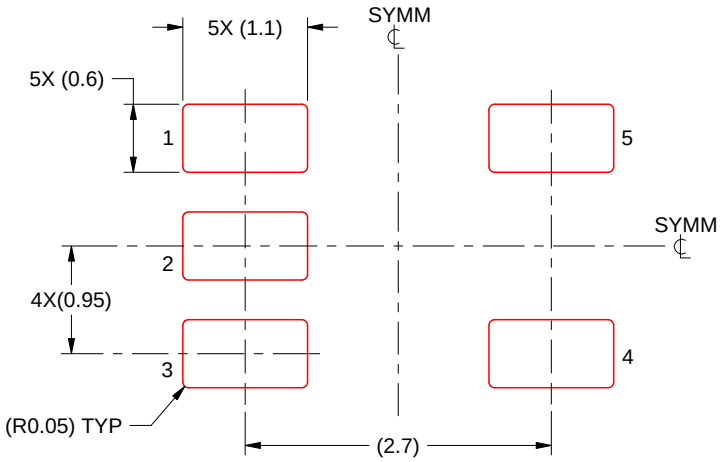
NOTES: (continued)

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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