TLV700xx-Q1 Automotive, 300mA, Low-I_Q, Low-Dropout Regulator

1 Features

- AEC-Q100 qualified for automotive applications:
  - Device temperature grade 1: –40°C to 125°C ambient operating temperature range
  - Device HBM ESD classification level H2
  - Device CDM ESD classification level C3B
- 2% accuracy
- Low I_Q: 35µA
- Fixed-output voltages: 1.2V and 1.8V
- High PSRR: 68dB at 1kHz
- Stable with effective capacitance of 0.1µF(1)
- Thermal shutdown and overcurrent protection [1]

2 Applications

- Automotive head units
- Camera sensors and modules
- Heads-up displays (HUD)
- Telematics control units

3 Description

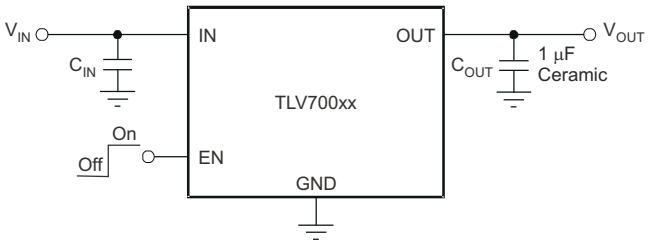
The TLV70018-Q1 and TLV70012-Q1 low-dropout (LDO) linear regulators are low quiescent current devices with excellent line and load transient performance. A precision band-gap and error amplifier provides overall 2% accuracy. Low output noise, high power-supply rejection ratio (PSRR), and low-dropout voltage make this series of devices ideal for powering power-sensitive loads. All device versions have thermal shutdown and current limit for detecting fault conditions.

Furthermore, these devices are stable with an effective output capacitance of only 0.1µF. This feature enables the use of cost-effective capacitors that have higher bias voltages and temperature derating. The devices regulate to specified accuracy with no output load.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
TLV70018-Q1	DDC (SOT, 5)	2.9mm × 2.8mm
TLV70012-Q1		

(1) For more information, see the *Mechanical, Packaging, and Orderable Information*.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Typical Application

[1] See the *Input and Output Capacitor Requirements*.

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4 Pin Configuration and Functions

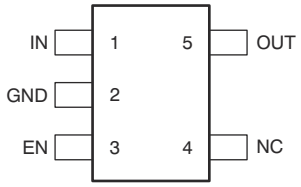


Figure 4-1. DDC Package, 5-Pin SOT (Top View)

Table 4-1. Pin Functions

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

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

5 Specifications

5.1 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.

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	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

5.4 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 note.

5.5 Electrical Characteristics

at V_{IN} = $V_{OUT(NOM)}$ + 0.5V or 2V (whichever is greater); I_{OUT} = 10mA, V_{EN} = 0.9V, C_{OUT} = 1.0µF, 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	$V_{OUT(NOM)}$ + 0.5V ≤ V_{IN} ≤ 5.5V, I_{OUT} = 10mA		1	5	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	0mA ≤ I_{OUT} ≤ 300mA, TLV70018-Q1		1	15	mV
		0mA ≤ I_{OUT} ≤ 300mA, 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} = 0mA		35	55	µA
		I_{OUT} = 300mA, V_{IN} = V_{OUT} + 0.5V		370		µA
I_{SHDN}	Ground pin current (shutdown)	V_{EN} ≤ 0.4V, V_{IN} = 2.0V		400		nA
		V_{EN} ≤ 0.4V, 2.0V ≤ V_{IN} ≤ 4.5V, T_A = –40°C to 85°C		1	2	µA
		V_{EN} ≤ 0.4V, 2.0V ≤ V_{IN} ≤ 4.5V, T_A = 85°C to 125°C		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(1)	C_{OUT} = 1.0µF, I_{OUT} = 300mA		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} = 5.5V		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 × $V_{OUT(NOM)}$.

5.6 Typical Characteristics

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

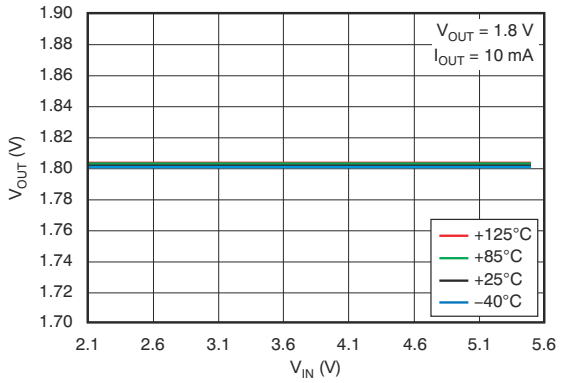


Figure 5-1. Line Regulation 10mA

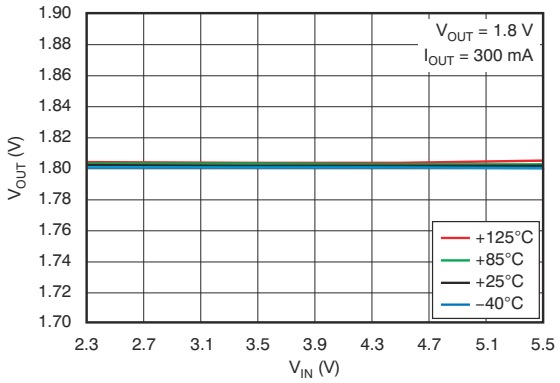


Figure 5-2. Line Regulation 300mA

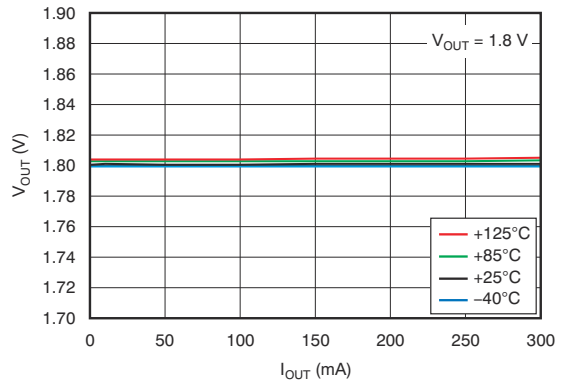


Figure 5-3. Load Regulation

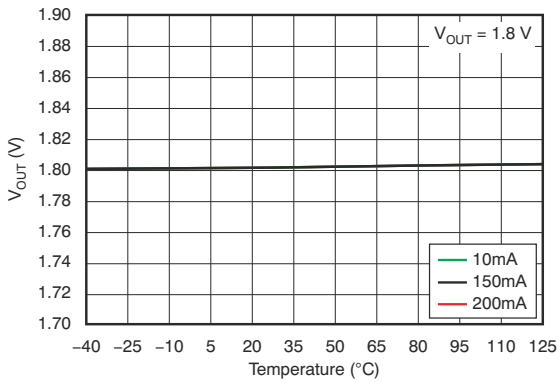


Figure 5-4. Output Voltage vs Temperature

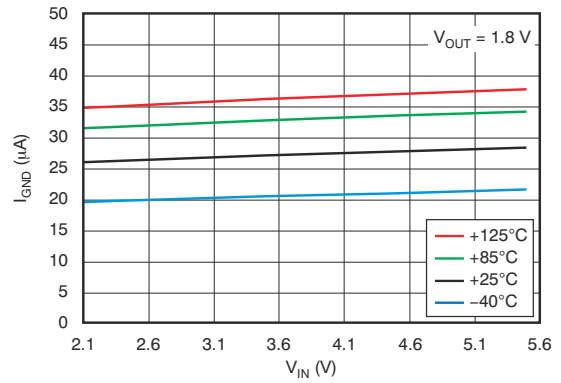


Figure 5-5. Ground Pin Current vs Input Voltage

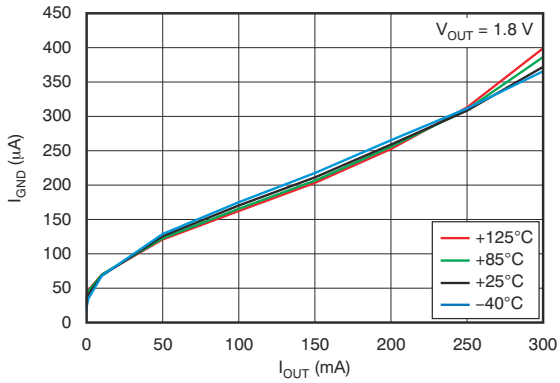


Figure 5-6. Ground Pin Current vs Load

5.6 Typical Characteristics (continued)

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

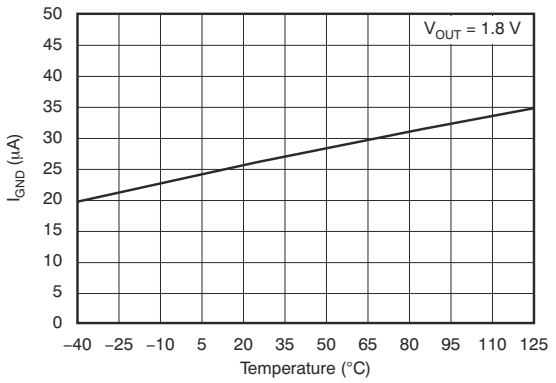


Figure 5-7. Ground Pin Current vs Temperature

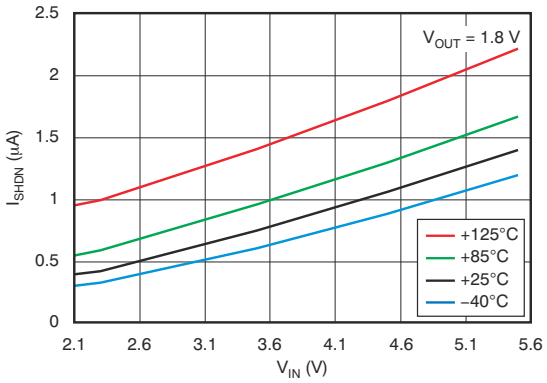


Figure 5-8. Shutdown Current vs Input Voltage

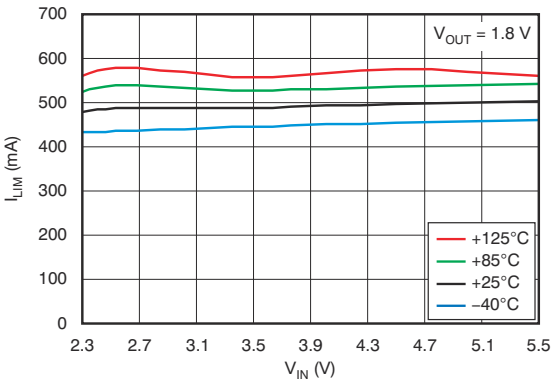


Figure 5-9. Current Limit vs Input Voltage

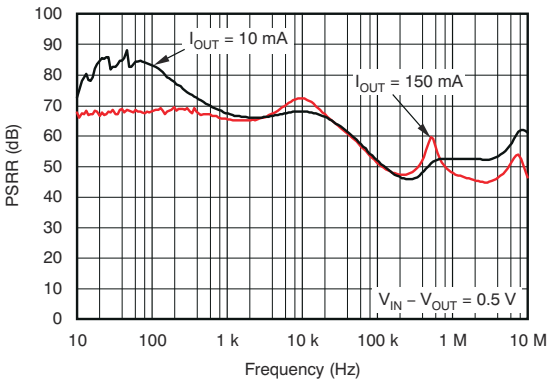


Figure 5-10. Power-Supply Ripple Rejection vs Frequency

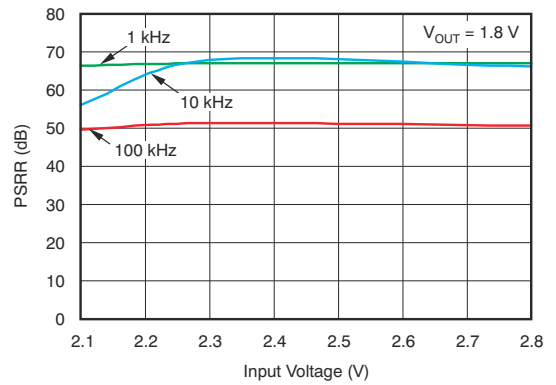


Figure 5-11. Power-Supply Ripple Rejection vs Input Voltage

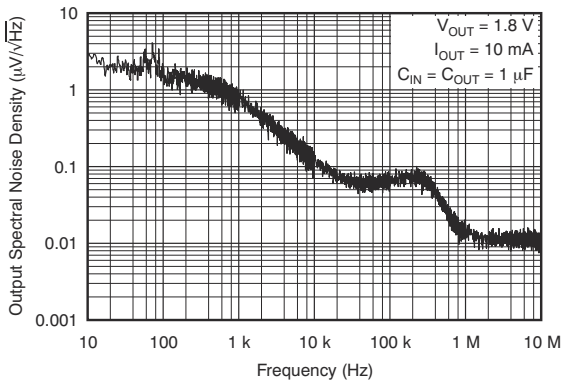


Figure 5-12. Output Spectral Noise Density vs Frequency

5.6 Typical Characteristics (continued)

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

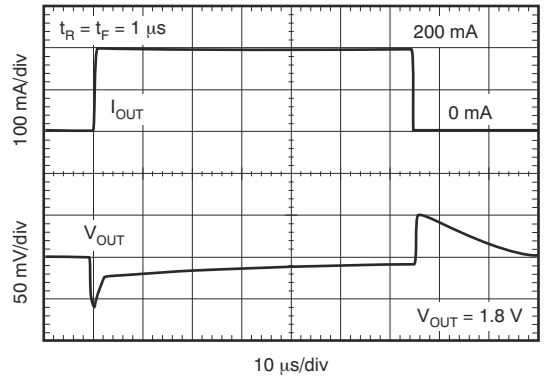


Figure 5-13. Load Transient Response

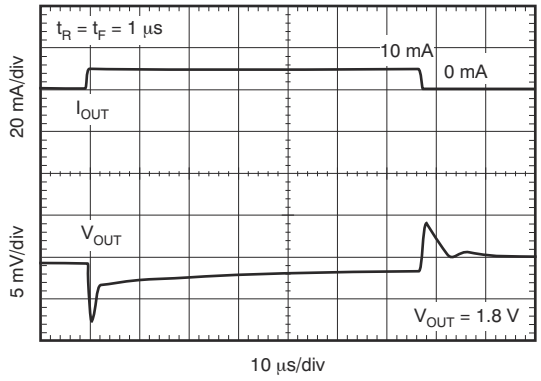


Figure 5-14. Load Transient Response

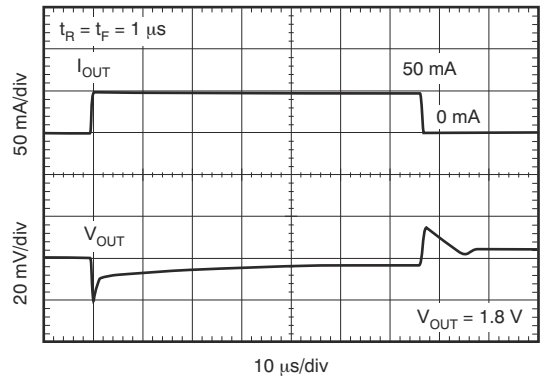


Figure 5-15. Load Transient Response

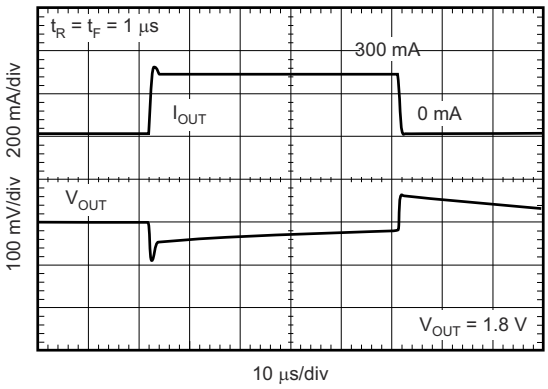


Figure 5-16. Load Transient Response

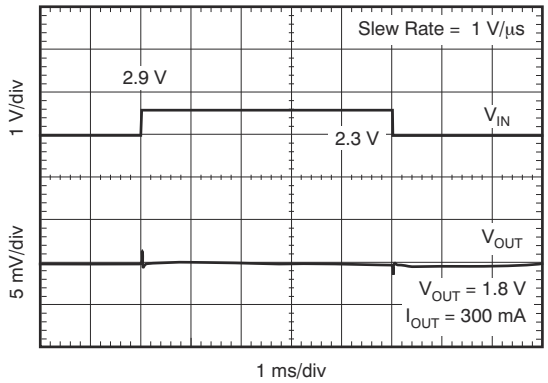


Figure 5-17. Line Transient Response

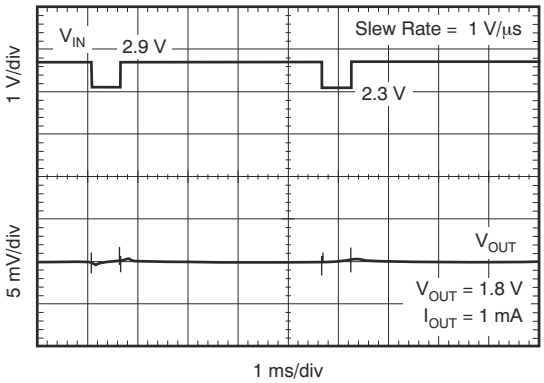


Figure 5-18. Line Transient Response

5.6 Typical Characteristics (continued)

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

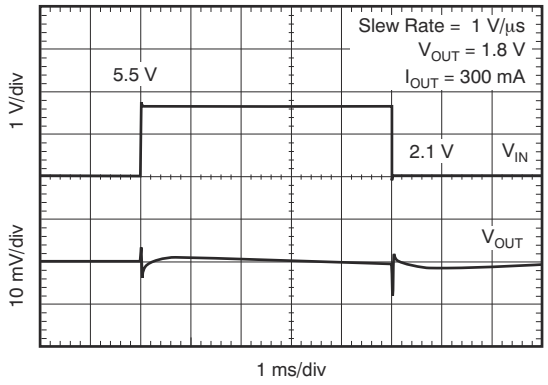


Figure 5-19. Line Transient Response

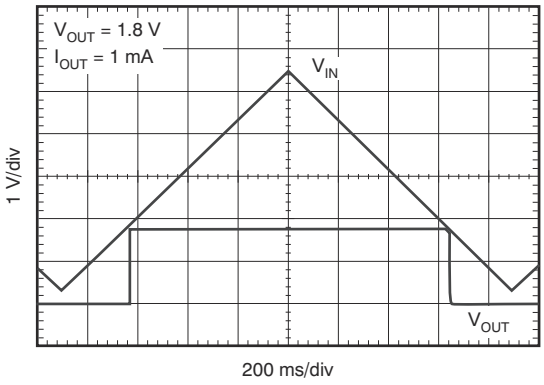


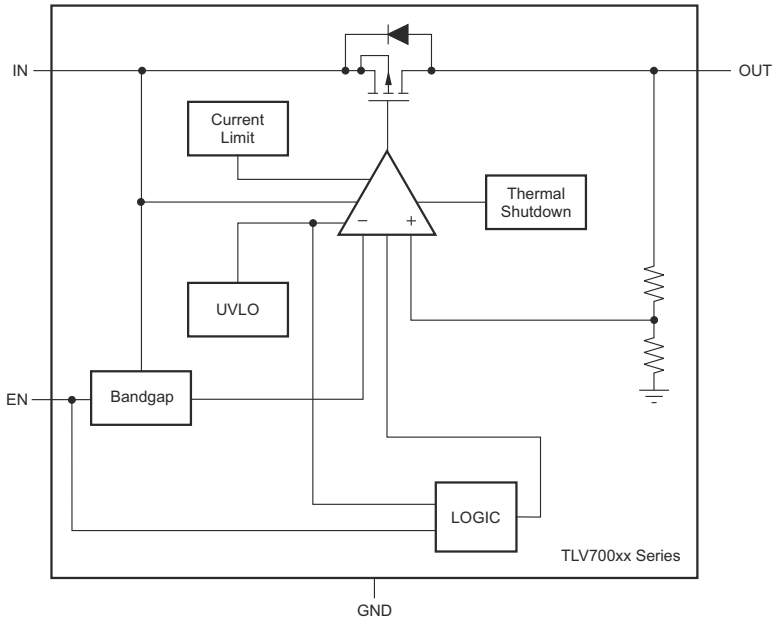
Figure 5-20. V_{IN} Ramp-Up, Ramp-Down Response

6 Detailed Description

6.1 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.

6.2 Functional Block Diagram



6.3 Feature Description

6.3.1 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 transistor 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.

6.3.2 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 transistor is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass transistor. V_{DO} scales approximately with output current because the PMOS transistor 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 5-11 illustrates this effect.

6.3.3 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.

6.3.4 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.

6.4 Device Functional Modes

6.4.1 Shutdown

The enable pin (EN) is active high. The device is enabled when voltage at EN pin goes above 0.9V. 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 0.4V. When shutdown capability is not required, EN can be connected to the IN pin.

6.4.2 Operation with V_{IN} Less than 2V

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

6.4.3 Operation with V_{IN} Greater than 2V

When V_{IN} is greater than 2V, 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.

7 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, as well as validating and testing their design implementation to confirm system functionality.

7.1 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.

7.2 Typical Application

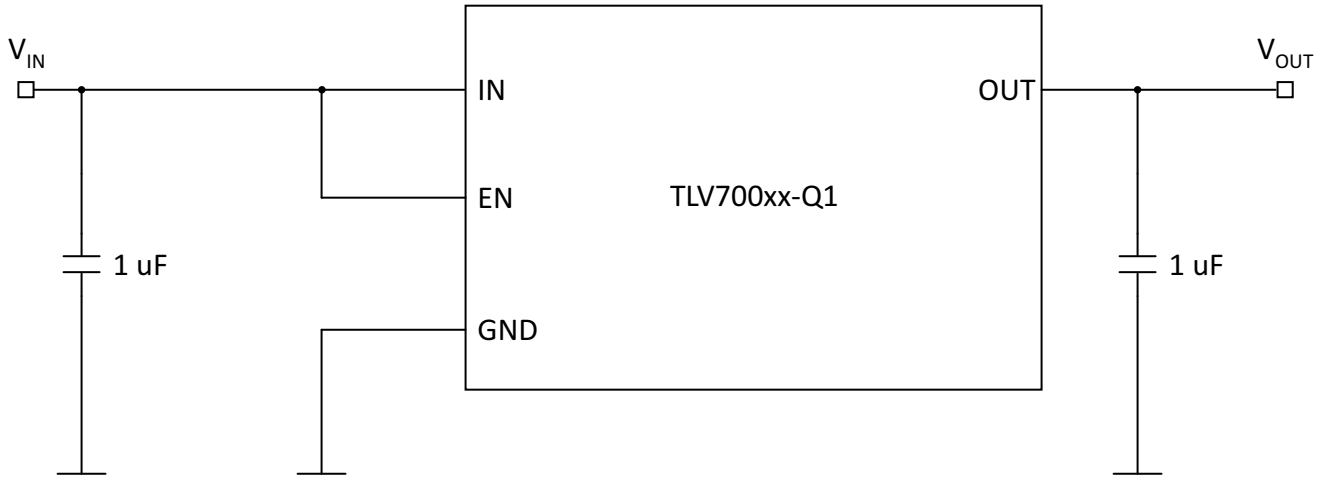


Figure 7-1. Simplified Schematic

7.2.1 Design Requirements

For this design example use, the parameters listed in Table 7-1 as the input parameters.

Table 7-1. Design Parameters

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

7.2.2 Detailed Design Procedure

7.2.2.1 Input and Output Capacitor Requirements

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

Note

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 would be less than 0.1µF. Maximum ESR should be less than 200mΩ.

Although an input capacitor is not required for stability, good analog design practice is to connect a 0.1µF to 1.0µF, 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 2Ω, a 0.1µF input capacitor may be necessary to ensure stability.

7.2.2.2 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.

7.2.3 Application Curve

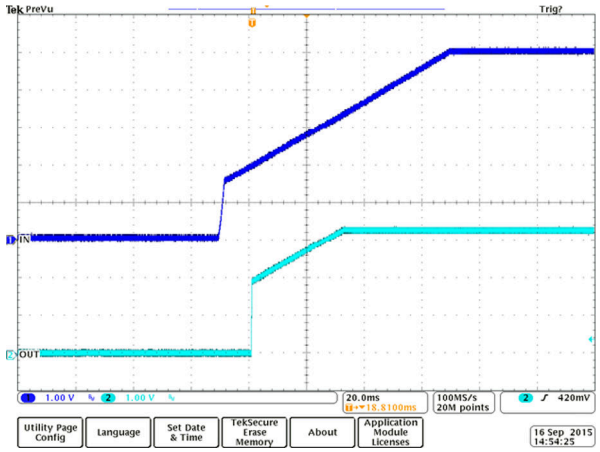


Figure 7-2. Power-Up

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 device, TI recommends adding a capacitor with a value of 0.1µF and a ceramic bypass capacitor at the input.

7.4 Layout

7.4.1 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.

7.4.1.1 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.

7.4.1.2 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.

7.4.1.2.1 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 transistor, 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

Because 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.

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

7.4.2 Layout Example

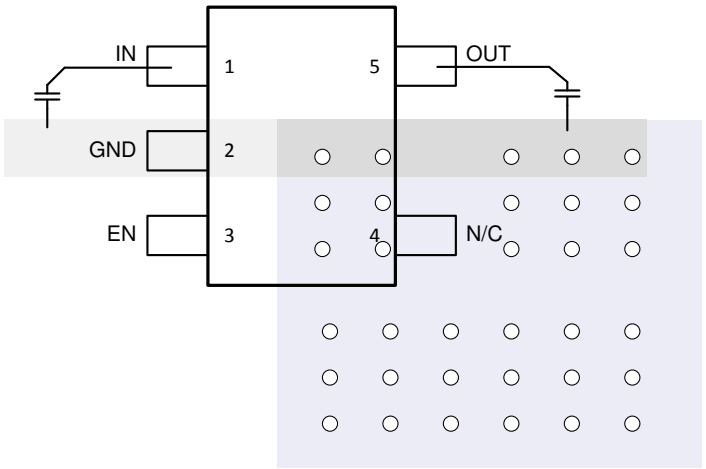


Figure 7-3. TLV700xx-Q1 Layout Example

8 Device and Documentation Support

8.1 Device Support

8.1.1 Device Nomenclature

Table 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.

8.1.2 Package Mounting

Solder pad footprint recommendations for the TLV70018-Q1 are available from the Texas Instruments web site at www.ti.com.

8.2 Documentation Support

8.2.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, TLV700 evaluation module

8.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

8.5 Trademarks

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8.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.7 Glossary

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

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision C (June 2017) to Revision D (January 2025) **Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Added *Device Nomenclature* table..... 15

Changes from Revision B (January 2016) to Revision C (June 2017) **Page**

- Changed *Fixed-Output Voltage* Features bullet from *Fixed-Output Voltage Combinations Possible from 1.2V to 4.8V* to *Fixed-Output Voltages: 1.2V and 1.8V* 1
- Changed *Applications* section 1
- Changed first paragraph of *Description* section: changed *TLV700xx-Q1 series* to *TLV70018-Q1 and TLV70012-Q1*, deleted second sentence, changed *a wide selection of battery-operated handheld equipment* to *powering power-sensitive loads*, and changed *safety* to *detecting fault conditions* 1
- Deleted *Fixed-Voltage Version* from *Typical Application* title 1
- Changed *Input voltage* parameter: changed symbol from V_I to V_{IN}, moved EN and OUT rows to standalone parameters 3
- Changed maximum specification of *Output voltage* parameter from 5.5V to 1.8V 3
- Added I_{OUT} symbol to *Current output* parameter 3
- Deleted TLV70018-Q1 column from *Thermal Information* table 3
- Added TLV70018-Q1 to TLV70012-Q1 column in *Thermal Information* table; all thermal values for TLV70018-Q1 changed to the TLV70012-Q1 thermal values..... 3
- Changed $V_{OUT(TYP)}$ to $V_{OUT(NOM)}$ in conditions statement of *Electrical Characteristics* table 4
- 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 4
- Changed $V_{OUT(TYP)}$ to $V_{OUT(NOM)}$ in *Typical Characteristics* conditions statement 5
- Deleted *Dropout Voltage vs Input Voltage* and *Dropout Voltage vs Output Current* curves 5
- Changed *TLV700xx-Q1* to *TLV70018-Q1 and TLV70012-Q1* in *Overview* section..... 9
- Added *TLV70012-Q1* to sub-sections of *Feature Description* and *Device Functional Modes* sections 9
- Changed 160°C to 165°C, 140°C to 145°C, and 35°C to 40°C in *Thermal Shutdown* section 10
- Changed *Application Information* section: changed first two sentences, deleted second paragraph 11
- Changed *Example Value* column values for 2nd and 3rd rows in Design Parameters table.....11
- Added TLV70012-Q1 to *Input and Output Capacitor Requirements* section.....12
- Deleted first and last paragraphs from *Thermal Considerations* section 13
- Deleted second sentence from second paragraph of *Power Dissipation* section 13
- Added TLV70012-Q1 to *Power Dissipation* section 13

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
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.

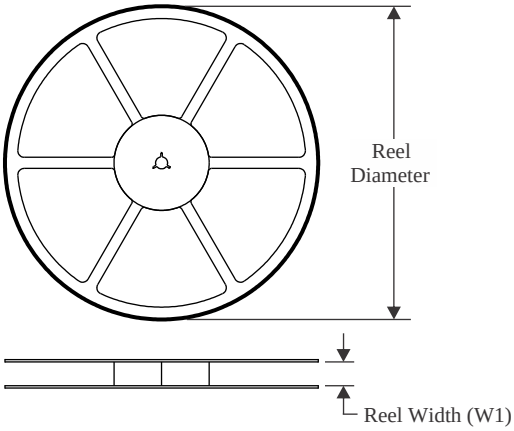
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

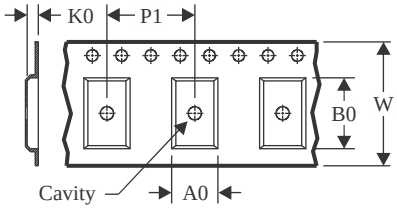
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

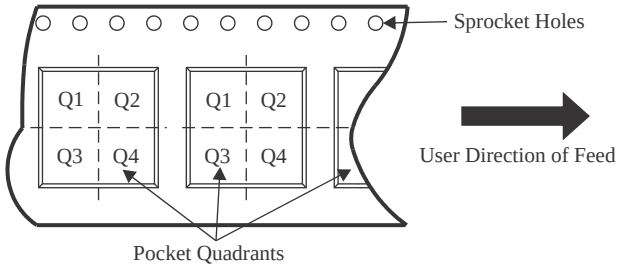


TAPE DIMENSIONS



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

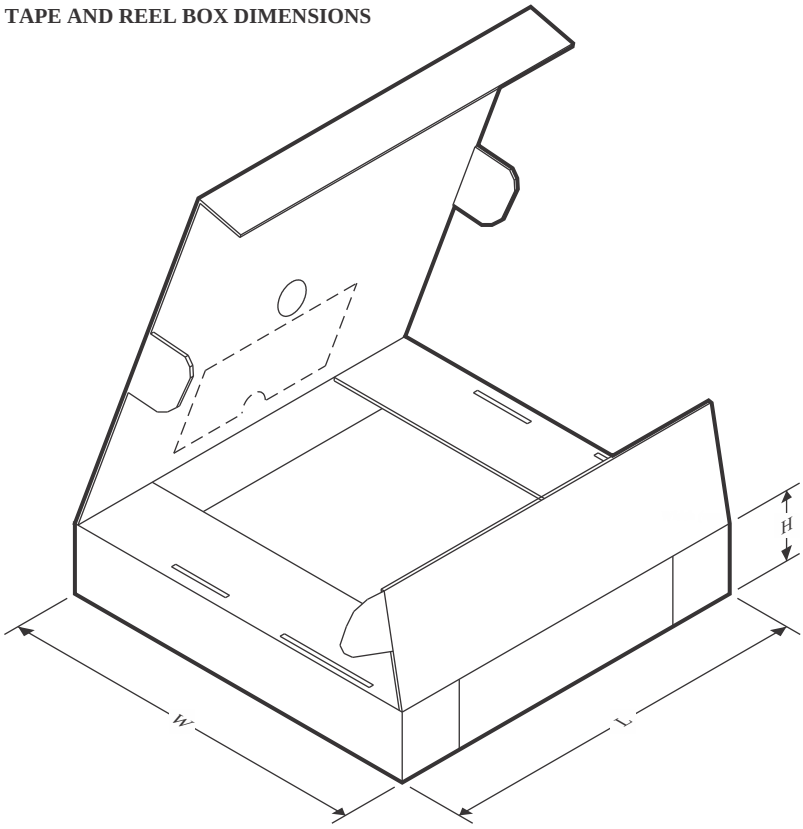
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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

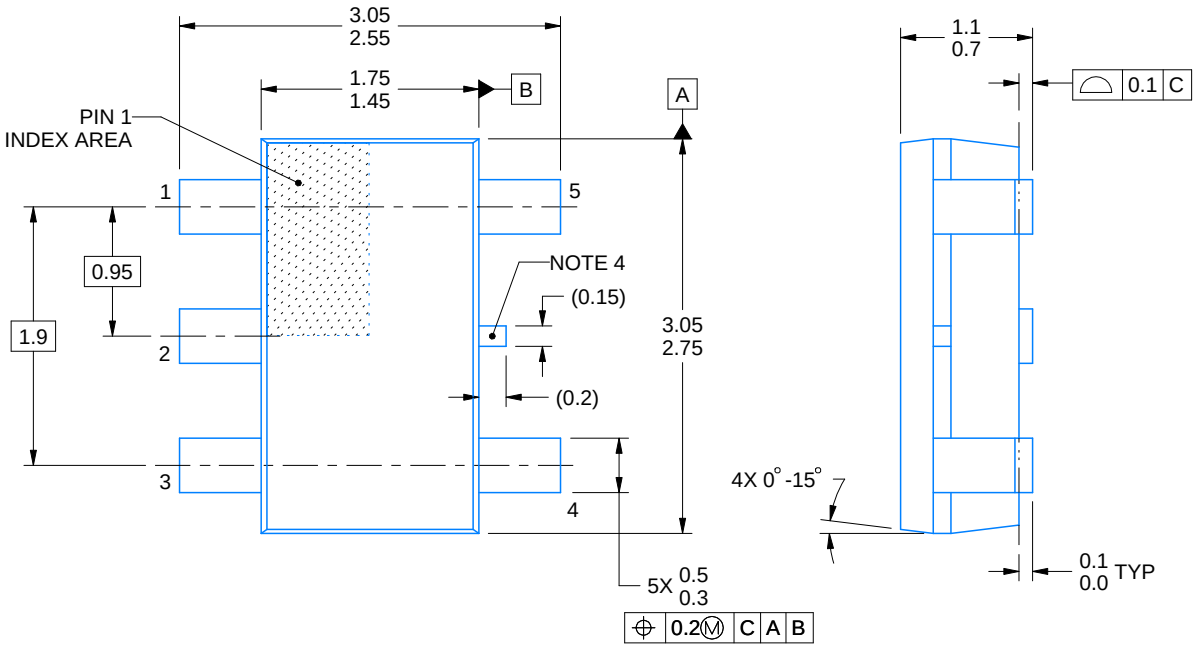
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70012QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0
TLV70018QDDCRQ1	SOT-23-THIN	DDC	5	3000	213.0	191.0	35.0

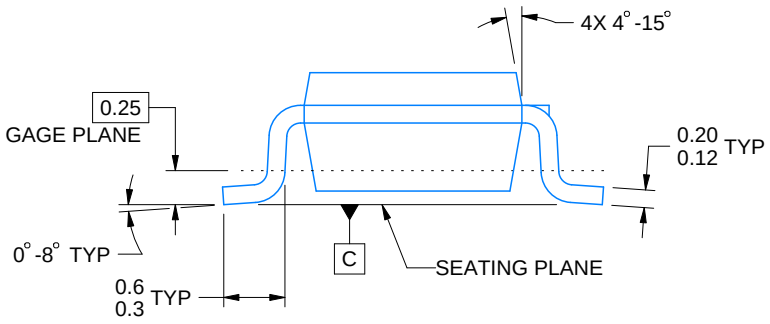
PACKAGE OUTLINE

DDC0005A

SOT-23 - 1.1 max height

SMALL OUTLINE TRANSISTOR





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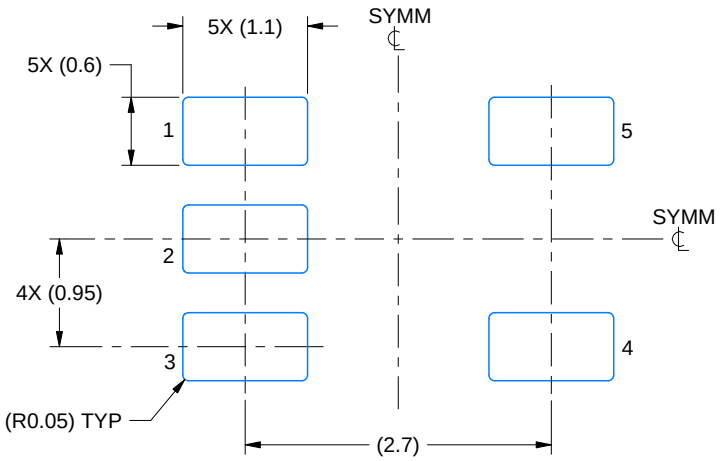
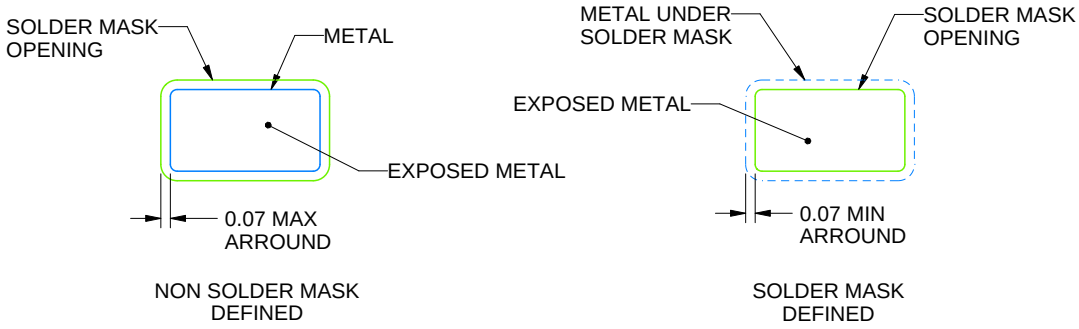
NOTES:

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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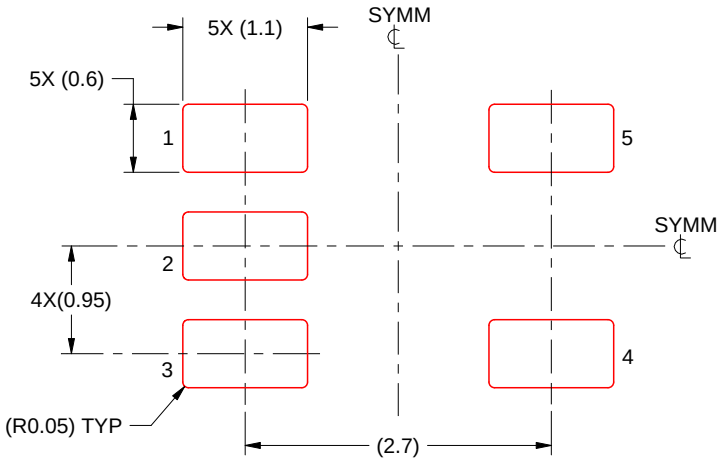
NOTES: (continued)

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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