TLV700 200-mA, Low-I_Q, Low-Dropout Regulator for Portable Devices

1 Features

- Very Low Dropout:
  - 43 mV at I_{OUT} = 50 mA, V_{OUT} = 2.8 V
  - 85 mV at I_{OUT} = 100 mA, V_{OUT} = 2.8 V
  - 175 mV at I_{OUT} = 200 mA, V_{OUT} = 2.35 V
- 2% Accuracy
- Low I_Q: 31 µA
- Available in Fixed-Output Voltages from 1.2 V to 4.8 V
- High PSRR: 68 dB at 1 kHz
- Stable With Effective Capacitance of 0.1 µF(1)
- Thermal Shutdown and Overcurrent Protection
- Available in 1.5-mm × 1.5-mm SON-6, SOT23-5, and SC-70 Packages

(1) See the *Input and Output Capacitor Requirements*.

2 Applications

- Wireless Handsets
- Smart Phones, PDAs
- ZigBee® Networks
- *Bluetooth*® Devices
- Li-Ion Operated Handheld Products
- WLAN and Other PC Add-on Cards

3 Description

The TLV700 series of low-dropout (LDO) linear regulators are low quiescent current devices with excellent line and load transient performance. These LDOs are designed for power-sensitive applications. A precision bandgap and error amplifier provides overall 2% accuracy. Low output noise, very high power-supply rejection ratio (PSRR), and low dropout voltage make this series of devices ideal for most battery-operated handheld equipment. All device versions have thermal shutdown and current limit for safety.

Furthermore, these devices are stable with an effective output capacitance of only 0.1 µF. 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.

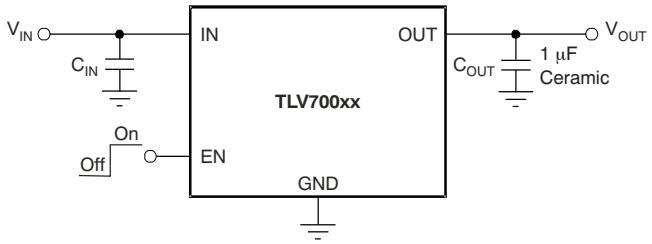
The TLV700 series of LDOs are available in 1.5-mm × 1.5-mm SON-6, SOT-5, and SC70 packages.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TL700xx	SC70 (5)	2.00 mm × 1.25 mm
	SOT (5)	2.90 mm × 1.60 mm
	WSON (6)	1.50 mm × 1.50 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application Circuit



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.

Table of Contents

1 Features ... 1
2 Applications ... 1
3 Description ... 1
4 Revision History ... 2
5 Pin Configuration and Functions ... 4
6 Specifications ... 5
6.1 Absolute Maximum Ratings ... 5
6.2 ESD Ratings ... 5
6.3 Recommended Operating Conditions ... 5
6.4 Thermal Information ... 5
6.5 Electrical Characteristics ... 6
6.6 Typical Characteristics ... 7
7 Detailed Description ... 11
7.1 Overview ... 11
7.2 Functional Block Diagram ... 11
7.3 Feature Description ... 11
7.4 Device Functional Modes ... 12
8 Application and Implementation ... 13
8.1 Application Information ... 13
8.2 Typical Application ... 13
9 Power Supply Recommendations ... 14
10 Layout ... 15
10.1 Layout Guidelines ... 15
10.2 Layout Examples ... 15
10.3 Thermal Protection ... 15
10.4 Power Dissipation ... 16
11 Device and Documentation Support ... 17
11.1 Device Support ... 17
11.2 Documentation Support ... 17
11.3 Trademarks ... 17
11.4 Electrostatic Discharge Caution ... 17
11.5 Glossary ... 17
12 Mechanical, Packaging, and Orderable Information ... 18

4 Revision History

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

Changes from Revision D (October 2012) to Revision E — **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Deleted Applications bullet for *MP3 Players* ... 1
- Changed front-page graphic ... 1
- Changed *Pin Configuration and Functions* section; updated table format ... 4
- Changed "free-air temperature" to "junction temperature" in *Absolute Maximum Ratings* condition statement ... 5
- Deleted *Dissipation Ratings* table ... 5
- Changed *Thermal Information* table; updated thermal resistance values for all packages ... 5

Changes from Revision C (July 2011) to Revision D — **Page**

- Updated Figure 5 ... 7

Changes from Revision B (December, 2010) to Revision C — **Page**

- Added footnote 2 to *Absolute Maximum Ratings* table ... 5
- Changed *output current limit* typical and maximum specifications ... 6
- Deleted previous Figure 12, *Current Limit vs Input Voltage* typical characteristic ... 7

Changes from Revision A (April, 2010) to Revision B — **Page**

- Removed TLV701xx device references throughout document ... 1
- Changed minimum output voltage available from 0.7 V to 1.2 V ... 1
- Added footnote (1) ... 1
- Deleted V_{OUT} < *1 V* specification ... 6
- Deleted *Active pulldown resistance* parameter ... 6

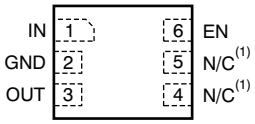
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- Changed Figure 4 title 7
- Changed Figure 5 title 7
- Removed TLV701xx block diagram..... 11
- Revised *Shutdown* section 11
- Updated *Application Information* section to reflect minimum output voltage availability of 1.2 V 13
- Deleted references to TLV701xx throughout *Application Information* 13
- Changed footnote 2 for *Ordering Information* table to reflect minimum output voltage of 1.2 V 17

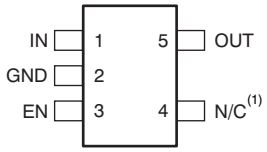
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5 Pin Configuration and Functions

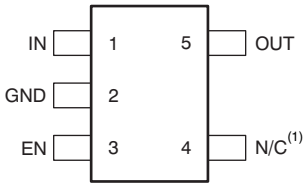
DSE Package
6-Pin WSON
Top View



DCK Package
5-Pin SC70
Top View



DDC Package
5-Pin SOT
Top View



(1) No connection.

Pin Functions

PIN				I/O	DESCRIPTION
NAME	WSON	SC70	SOT		
IN	1	1	1	I	Input pin. A small, 1-µF ceramic capacitor is recommended from this pin to ground to assure stability and good transient performance. See *Input and Output Capacitor Requirements* for more details.
GND	2	2	2	—	Ground pin
EN	6	3	3	I	Enable pin. Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode and reduces operating current to 1 µA, nominal.
NC	4, 5	4	4	—	No connection. This pin can be tied to ground to improve thermal dissipation.
OUT	3	5	5	O	Regulated output voltage pin. A small, 1-µF ceramic capacitor is needed from this pin to ground to assure stability. See *Input and Output Capacitor Requirements* for more details.

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6 Specifications

6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Voltage	V_{IN}	–0.3	6	V
	V_{EN}	–0.3	6 (2)	
	V_{OUT}	–0.3	6	
Maximum output current I_{OUT}		Internally limited		
Output short-circuit duration		Indefinite		
Temperature	Operating junction, T_J	–55	150	°C
	Storage, T_{stg}	–55	150	

(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) V_{EN} absolute maximum rating is V_{IN} + 0.3 V or 6 V, whichever is less.

6.2 ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins (1)	±2000	V
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins (2)	±500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

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

	MIN	NOM	MAX	UNIT
V_{IN}	2		5.5	V
V_{OUT}	1.2		4.8	V
I_{OUT}	0		200	mA

6.4 Thermal Information

THERMAL METRIC (1)		TLV700			UNIT
		DCK [SC70]	DDC [SOT]	DSE [WSON]	
		5 PINS	5 PINS	6 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	307.6	235.9	321.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	79.1	61.9	207.9	
$R_{\theta JB}$	Junction-to-board thermal resistance	93.7	54	281.5	
ψ_{JT}	Junction-to-top characterization parameter	1.3	0.8	42.4	
ψ_{JB}	Junction-to-board characterization parameter	92.8	53.4	284.8	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	n/a	n/a	142.3	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

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6.5 Electrical Characteristics

At V_{IN} = $V_{OUT(nom)}$ + 0.3 V or 2 V (whichever is greater); I_{OUT} = 10 mA, V_{EN} = 0.9 V, C_{OUT} = 1 µF, and T_J = –40°C to +125°C, unless otherwise noted. Typical values are at T_J = 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_J ≤ +125°C	–2%		2%	
$\Delta V_{OUT(\Delta VIN)}$	Line regulation	$V_{OUT(nom)}$ + 0.3 V ≤ V_{IN} ≤ 5.5 V, I_{OUT} = 10 mA		1	5	mV
$\Delta V_{OUT(\Delta IOUT)}$	Load regulation	0 mA ≤ I_{OUT} ≤ 200 mA		1	15	mV
V_{DO}	Dropout voltage(1)	V_{IN} = 0.98 × $V_{OUT(nom)}$, I_{OUT} = 50 mA, V_{OUT} = 2.8 V		43		mV
		V_{IN} = 0.98 × $V_{OUT(nom)}$, I_{OUT} = 100 mA, V_{OUT} = 2.8 V		85		
		V_{IN} = 0.98 × $V_{OUT(nom)}$, I_{OUT} = 200 mA, V_{OUT} = 2.35 V		175	250	
I_{CL}	Output current limit	V_{OUT} = 0.9 × $V_{OUT(nom)}$	220		860	mA
I_{GND}	Ground pin current	I_{OUT} = 0 mA		31	55	µA
		I_{OUT} = 200 mA, V_{IN} = V_{OUT} + 0.5 V		270		
I_{SHDN}	Ground pin current (shutdown)	V_{EN} ≤ 0.4 V, V_{IN} = 2 V		400		nA
		V_{EN} ≤ 0.4 V, 2 V ≤ V_{IN} ≤ 4.5 V		1	2	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}	Start-up time(2)	C_{OUT} = 1 µF, I_{OUT} = 200 mA		100		µs
$V_{EN(high)}$	Enable pin high (enabled)		0.9		V_{IN}	V
$V_{EN(low)}$	Enable pin low (disabled)		0		0.4	V
I_{EN}	Enable pin current	V_{IN} = V_{EN} = 5.5 V		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_J	Operating junction temperature		–40		125	°C

(1) V_{DO} is measured for devices with $V_{OUT(nom)}$ ≥ 2.35 V.
(2) Start-up 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 µF, unless otherwise noted. Typical values are at T_J = 25°C.

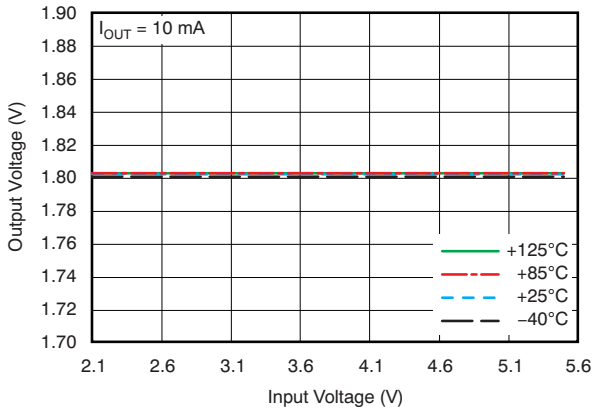


Figure 1. TLV70018 Line Regulation

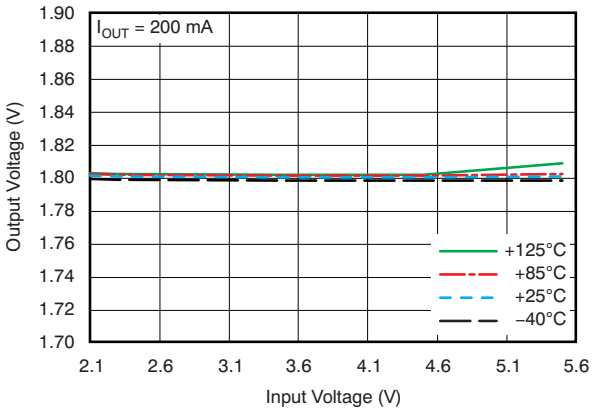


Figure 2. TLV70018 Line Regulation

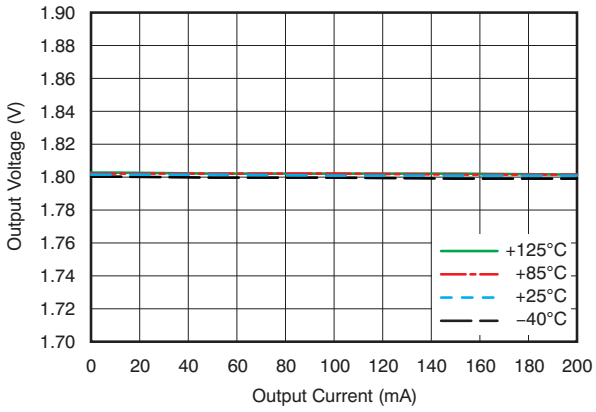


Figure 3. TLV70018 Load Regulation

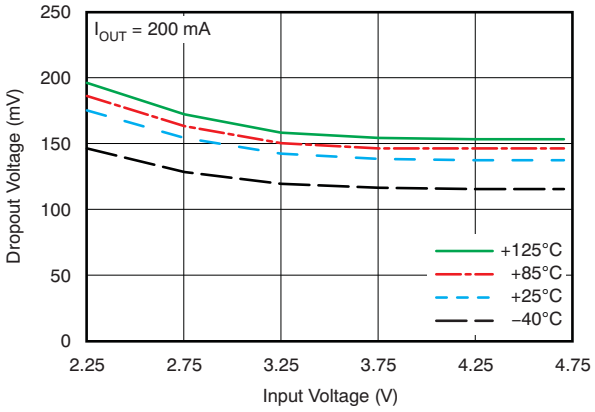


Figure 4. Dropout Voltage vs Input Voltage

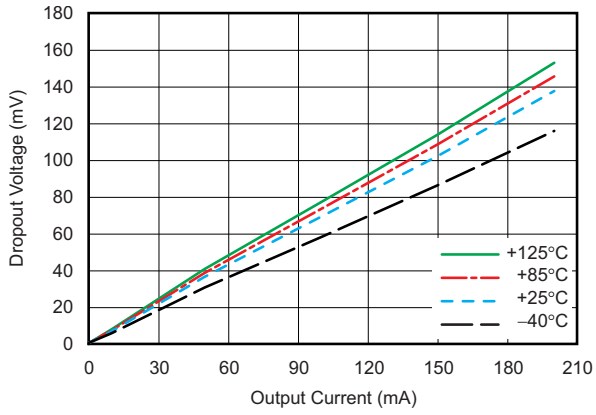


Figure 5. Dropout Voltage vs Output Current, V_{OUT} = 4.8 V

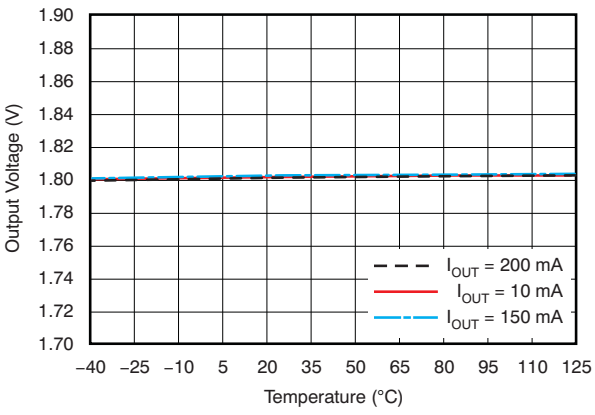


Figure 6. TLV70018 Output Voltage vs Temperature

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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 µF, unless otherwise noted. Typical values are at T_J = 25°C.

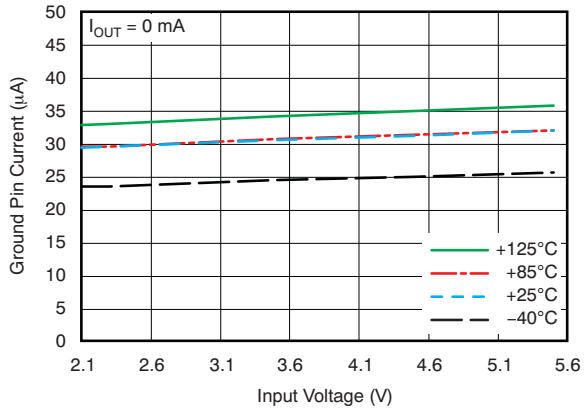


Figure 7. TLV70018 Ground Pin Current vs Input Voltage

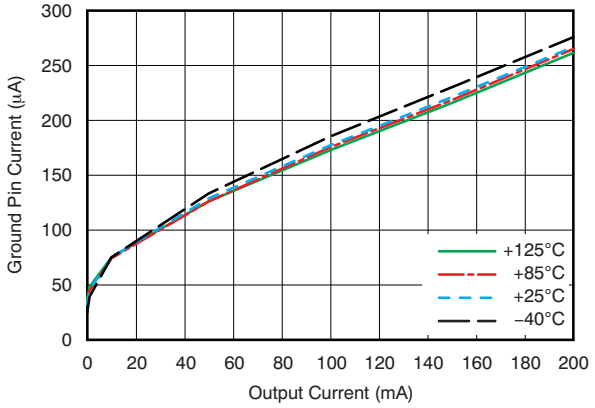


Figure 8. TLV70018 Ground Pin Current vs Load

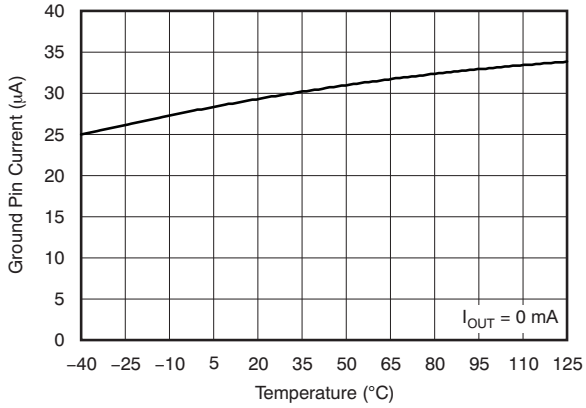


Figure 9. TLV70018 Ground Pin Current vs Temperature

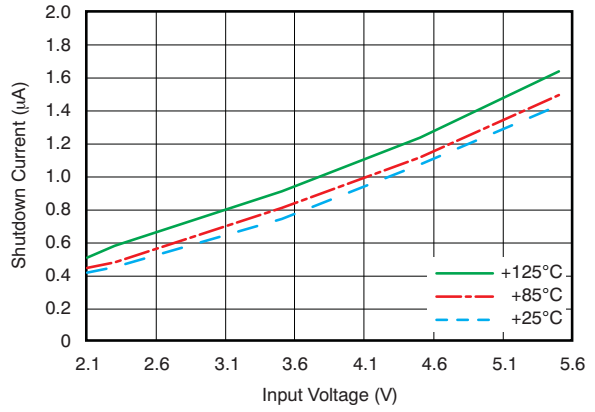


Figure 10. TLV70018 Shutdown Current vs Input Voltage

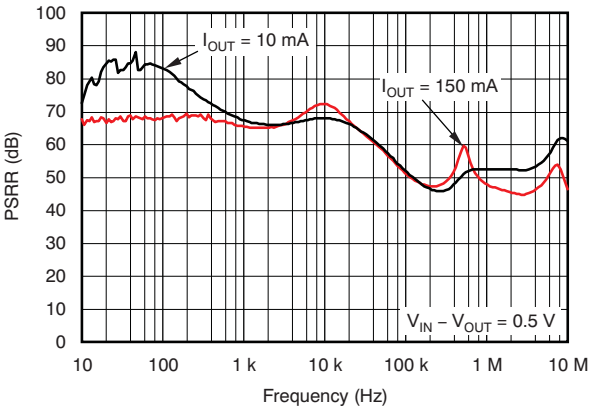


Figure 11. TLV70018 Power-Supply Ripple Rejection vs Frequency

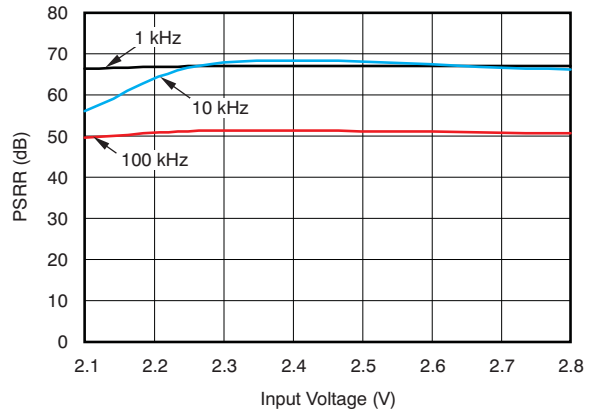


Figure 12. TLV70018 Power-Supply Ripple Rejection vs Input Voltage

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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 µF, unless otherwise noted. Typical values are at T_J = 25°C.

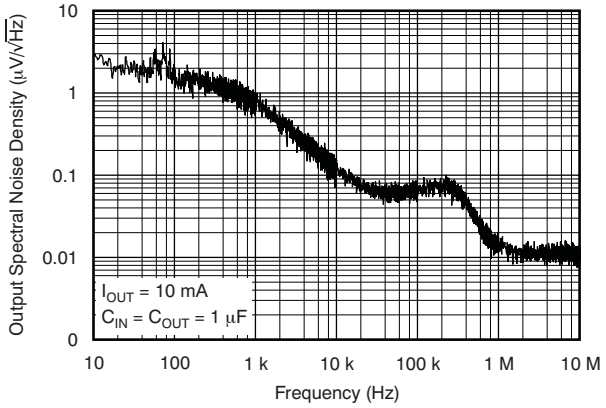


Figure 13. TLV70018 Output Spectral Noise Density vs Output Voltage

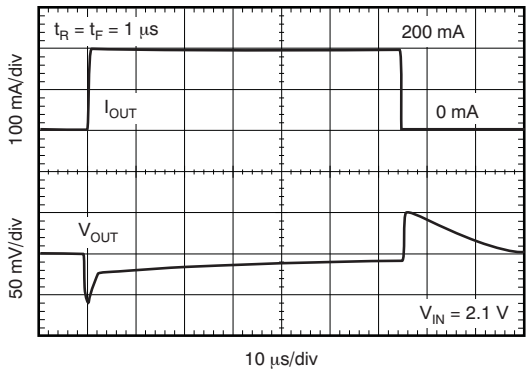


Figure 14. TLV70018 Load Transient Response

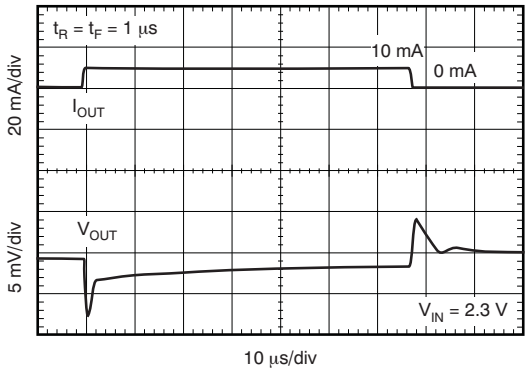


Figure 15. TLV70018 Load Transient Response

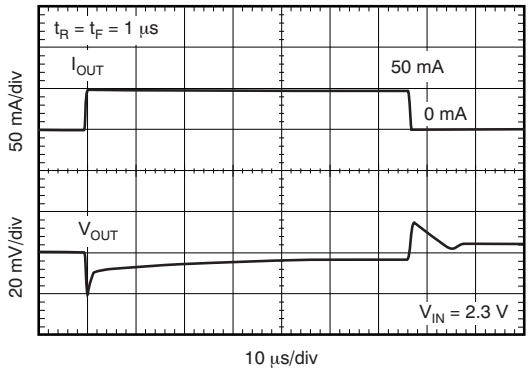


Figure 16. TLV70018 Load Transient Response

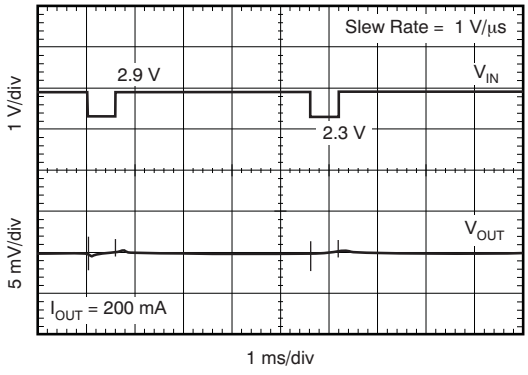


Figure 17. TLV70018 Line Transient Response

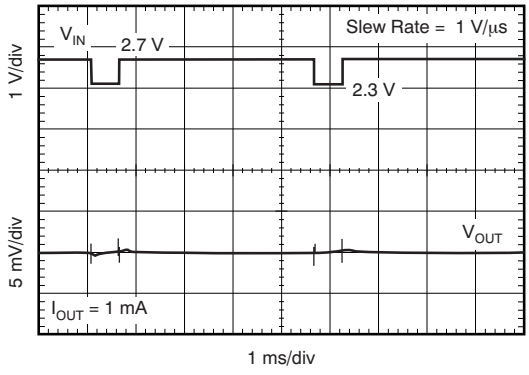


Figure 18. TLV70018 Line Transient Response

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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 µF, unless otherwise noted. Typical values are at T_J = 25°C.

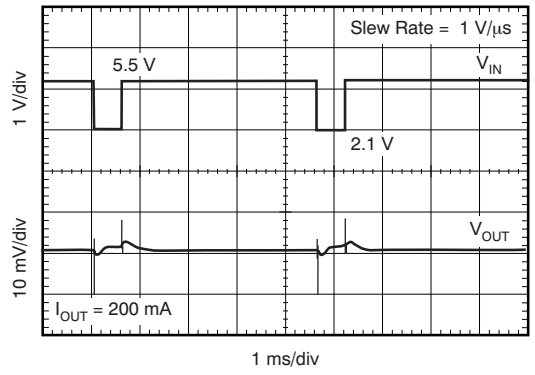


Figure 19. TLV70018 Line Transient Response

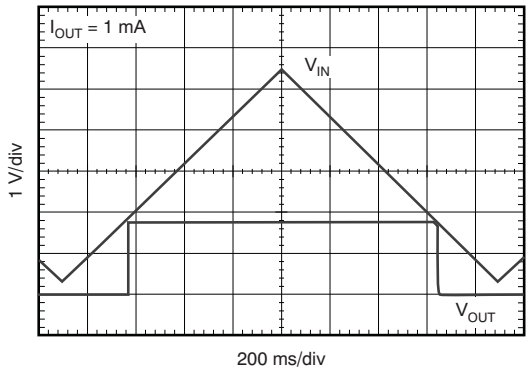


Figure 20. TLV70018 V_{IN} Ramp-Up, Ramp-Down Response

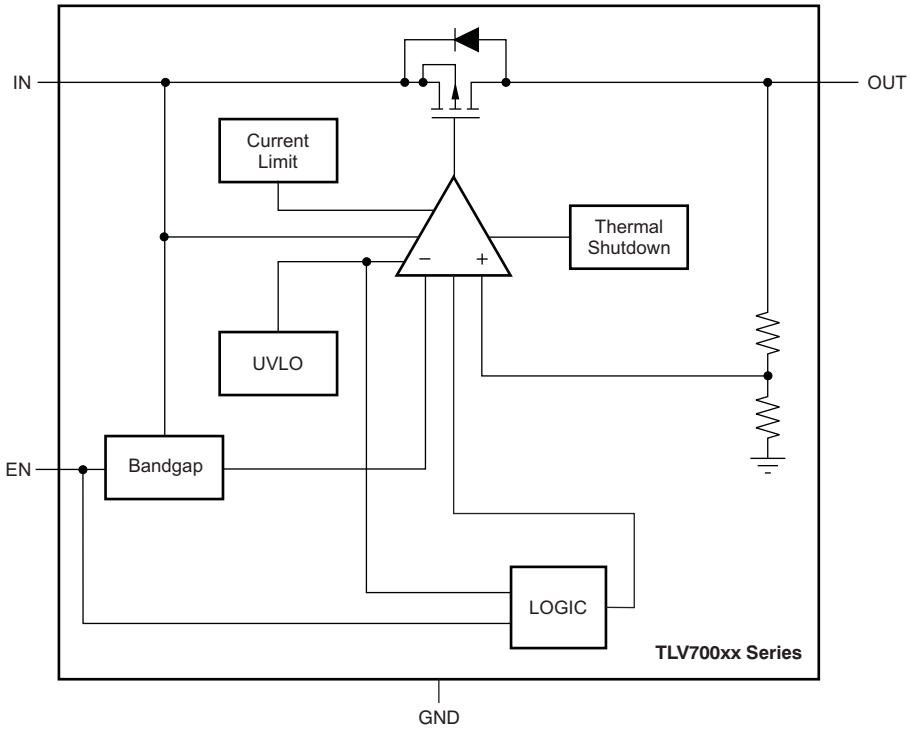
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7 Detailed Description

7.1 Overview

The TLV700 series of LDO linear regulators are low quiescent current devices with excellent line and load transient performance. These LDOs are designed for power-sensitive applications. A precision bandgap and error amplifier provides overall 2% accuracy. Low output noise, very high PSRR, and low dropout voltage make this series of devices ideal for most battery-operated handheld equipment. All device versions have integrated thermal shutdown, current limit, and undervoltage lockout (UVLO).

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Internal Current Limit

The TLV700 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 $V_{OUT} = I_{CL} \times R_{LOAD}$. The PMOS pass transistor dissipates $(V_{IN} – V_{OUT}) \times I_{CL}$ until thermal shutdown is triggered and the device turns off. As the device cools down, 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 *Thermal Protection* for more details.

The PMOS pass element in the TLV700 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 Shutdown

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

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Feature Description (continued)

7.3.3 Dropout Voltage

The TLV700 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 as (V_{IN} – V_{OUT}) approaches dropout. This effect is shown in Figure 12 in *Typical Characteristics*.

7.3.4 Undervoltage Lockout (UVLO)

The TLV700 uses a UVLO circuit to keep the output shut off until internal circuitry is operating properly.

7.4 Device Functional Modes

7.4.1 Normal Operation

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

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

7.4.2 Dropout Operation

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

Table 1 lists the conditions that lead to the different modes of operation.

Table 1. Device Functional Mode Comparison

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

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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 TLV700 belongs to a new family of next-generation value LDO regulators. These devices consume low quiescent current and deliver excellent line and load transient performance. These characteristics, combined with low noise, very good PSRR with little (V_{IN} – V_{OUT}) headroom, make this family of devices ideal for RF portable 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 shows a typical application circuit.

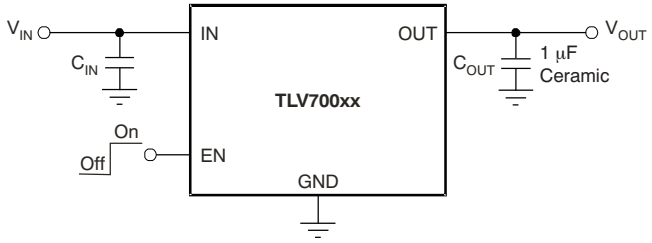


Figure 21. Typical Application Circuit

8.2.1 Design Requirements

Table 2 lists the design parameters.

Table 2. Design Parameters

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

8.2.2 Detailed Design Procedure

8.2.2.1 Input and Output Capacitor Requirements

TI recommends using 1-µF X5R- and X7R-type ceramic capacitors because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature.

However, the TLV700 is 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 cheaper 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.

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 must not be less than 0.1 µF. Maximum ESR should be less than 200 mΩ.

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Although an input capacitor is not required for stability, it is good analog design practice to connect a 0.1-µF to 1-µF, low ESR capacitor across the IN pin and GND in 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 and undershoot magnitude but increases the duration of the transient response.

8.2.3 Application Curves

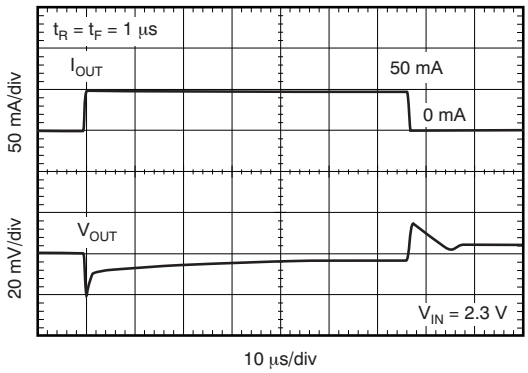


Figure 22. TLV70018 Load Transient Response

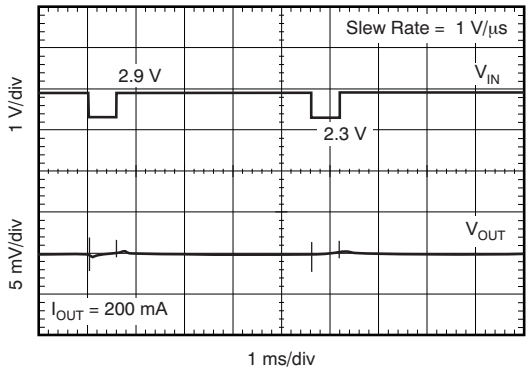


Figure 23. TLV70018 Line Transient Response

9 Power Supply Recommendations

Connect a low output impedance power supply directly to the INPUT pin of the TLV700. Inductive impedances between the input supply and the INPUT pin can create significant voltage excursions at the INPUT pin during start-up or load transient events.

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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, TI recommends designing the printed-circuit-boards 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 Examples

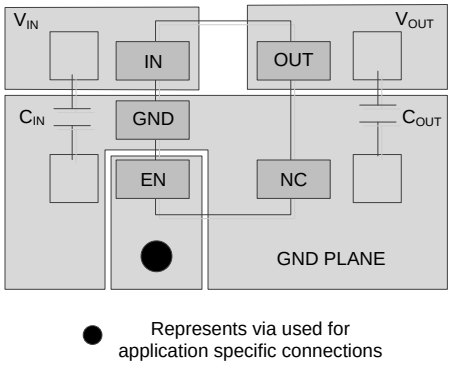


Figure 24. Layout Example for the DCK and DDC Package

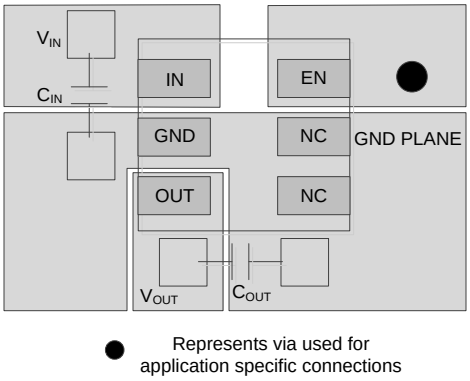


Figure 25. Layout Example for the DSE Package

10.3 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 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 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.

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Thermal Protection (continued)

The internal protection circuitry of the TLV700 has been designed to protect against overload conditions. The protection circuitry was not intended to replace proper heatsinking. Continuously running the TLV700 into thermal shutdown degrades device reliability.

10.4 Power Dissipation

The ability to remove heat from the die is different for each package type, presenting different considerations in the PCB layout. The PCB area around the device that is free of other components moves the heat from the device to the ambient air. Performance data for JEDEC low and high-K boards are given in *Thermal Information*. 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.

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

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

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11 Device and Documentation Support

11.1 Device Support

11.1.1 Development Support

11.1.1.1 Evaluation Modules

Three evaluation modules (EVMs) are available to assist in the initial circuit performance evaluation using the TLV700:

- TLV70033EVM-503
- TLV70018EVM-503
- TLV70028EVM-463

These EVMs can be requested at the Texas Instruments website through the product folders or purchased directly from the TI eStore.

11.1.1.2 Spice Models

Computer simulation of circuit performance using SPICE is often useful when analyzing the performance of analog circuits and systems. A SPICE model for the TLV700 is available through the product folders under *Tools & Software*.

11.1.2 Device Nomenclature

Table 3. Ordering Information(1)

PRODUCT	V_{OUT} (2)
TLV700**xx** ***yyyz***	**XX** is nominal output voltage (for example, 28 = 2.8 V). **YYY** is the package designator. **Z** is tape and reel quantity (R = 3000, T = 250).

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or visit the device product folder at www.ti.com.
(2) Output voltages from 1.2 V to 4.8 V in 50-mV increments are available. Contact factory for details and availability.

11.2 Documentation Support

11.2.1 Related Documentation

- *Using the TLV700xxEVM-463 Evaluation Module*, SLUU390
- *Using the TLV700xxEVM-503 Evaluation Module*, SLUU391

11.3 Trademarks

Bluetooth is a registered trademark of Bluetooth SIG.
ZigBee is a registered trademark of the ZigBee Alliance.
All other trademarks are the property of their respective owners.

11.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

11.5 Glossary

SLYZ022 — *TI Glossary*.

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

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12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV70012DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODT	Samples
TLV70012DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODT	Samples
TLV70012DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODO	Samples
TLV70012DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODO	Samples
TLV70012DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NH	Samples
TLV70012DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NH	Samples
TLV70013DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAH	Samples
TLV70013DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAH	Samples
TLV70015DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODU	Samples
TLV70015DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODU	Samples
TLV70015DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODP	Samples
TLV70015DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODP	Samples
TLV70015DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NJ	Samples
TLV70015DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NJ	Samples
TLV70018DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODV	Samples
TLV70018DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODV	Samples
TLV70018DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODK	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV70018DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODK	Samples
TLV70018DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NK	Samples
TLV70018DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	NK	Samples
TLV70019DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCJ	Samples
TLV70019DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCJ	Samples
TLV70022DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCI	Samples
TLV70022DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCI	Samples
TLV70025DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QTP	Samples
TLV70025DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QTP	Samples
TLV70025DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	DAU	Samples
TLV70025DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	DAU	Samples
TLV70025DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QY	Samples
TLV70025DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QY	Samples
TLV70028DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODW	Samples
TLV70028DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODW	Samples
TLV70028DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODL	Samples
TLV70028DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODL	Samples
TLV70028DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NL	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV70028DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NL	Samples
TLV70029DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QJ	Samples
TLV70029DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	QJ	Samples
TLV70030DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODR	Samples
TLV70030DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODR	Samples
TLV70030DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODM	Samples
TLV70030DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODM	Samples
TLV70030DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NP	Samples
TLV70030DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NP	Samples
TLV70031DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C4	Samples
TLV70031DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C4	Samples
TLV70032DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCH	Samples
TLV70032DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCH	Samples
TLV70033DCKR	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODS	Samples
TLV70033DCKT	ACTIVE	SC70	DCK	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	ODS	Samples
TLV70033DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODN	Samples
TLV70033DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ODN	Samples
TLV70033DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NR	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLV70033DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	NR	Samples
TLV70036DDCR	ACTIVE	SOT	DDC	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCG	Samples
TLV70036DDCT	ACTIVE	SOT	DDC	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SCG	Samples
TLV70036DSER	ACTIVE	WSON	DSE	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	UG	Samples
TLV70036DSET	ACTIVE	WSON	DSE	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	UG	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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

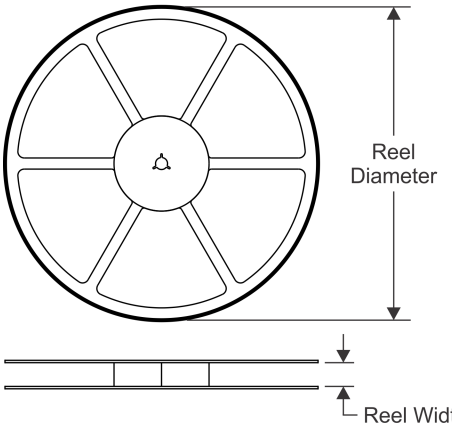
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and 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. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

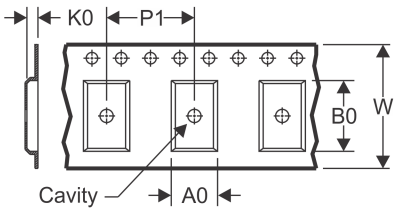
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

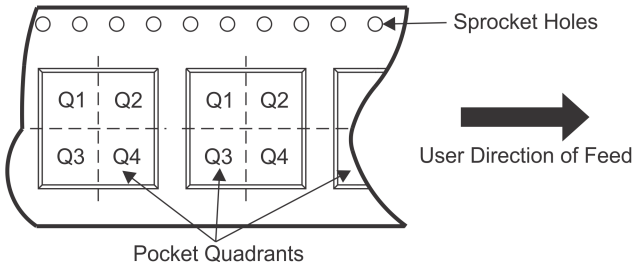


TAPE DIMENSIONS



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



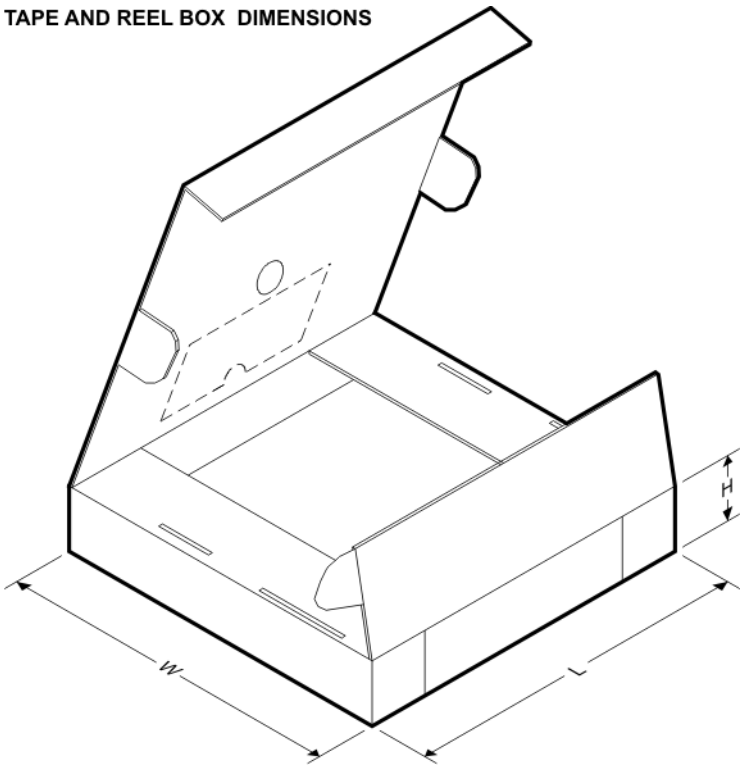
*All dimensions are nominal

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
TLV70012DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70012DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70012DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70012DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70012DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70012DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70012DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70012DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70012DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70012DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70013DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70013DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70015DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70015DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70015DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70015DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70015DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70015DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV70015DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70015DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70015DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70015DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70018DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70018DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70018DCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70018DCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70018DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70018DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70018DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70018DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70018DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70018DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70018DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70018DSER	WSON	DSE	6	3000	179.0	8.4	1.8	1.8	1.0	4.0	8.0	Q2
TLV70018DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70019DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70019DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70022DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70022DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70025DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70025DCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70025DCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70025DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70025DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70025DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70025DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70025DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70025DSER	WSON	DSE	6	3000	179.0	8.4	1.8	1.8	1.0	4.0	8.0	Q2
TLV70025DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70025DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70025DSET	WSON	DSE	6	250	179.0	8.4	1.8	1.8	1.0	4.0	8.0	Q2
TLV70028DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70028DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70028DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70028DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70028DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70028DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70028DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70028DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70028DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70028DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2

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
TLV70029DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70029DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70030DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70030DCKR	SC70	DCK	5	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70030DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70030DCKT	SC70	DCK	5	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TLV70030DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70030DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70030DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70030DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70030DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70030DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70030DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70030DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70031DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70031DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70032DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70032DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70033DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70033DCKR	SC70	DCK	5	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70033DCKT	SC70	DCK	5	250	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3
TLV70033DCKT	SC70	DCK	5	250	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
TLV70033DDCR	SOT	DDC	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70033DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70033DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70033DDCT	SOT	DDC	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV70033DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70033DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70036DDCR	SOT	DDC	5	3000	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70036DDCT	SOT	DDC	5	250	180.0	8.4	3.1	3.05	1.1	4.0	8.0	Q3
TLV70036DSER	WSON	DSE	6	3000	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2
TLV70036DSET	WSON	DSE	6	250	180.0	8.4	1.83	1.83	0.89	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



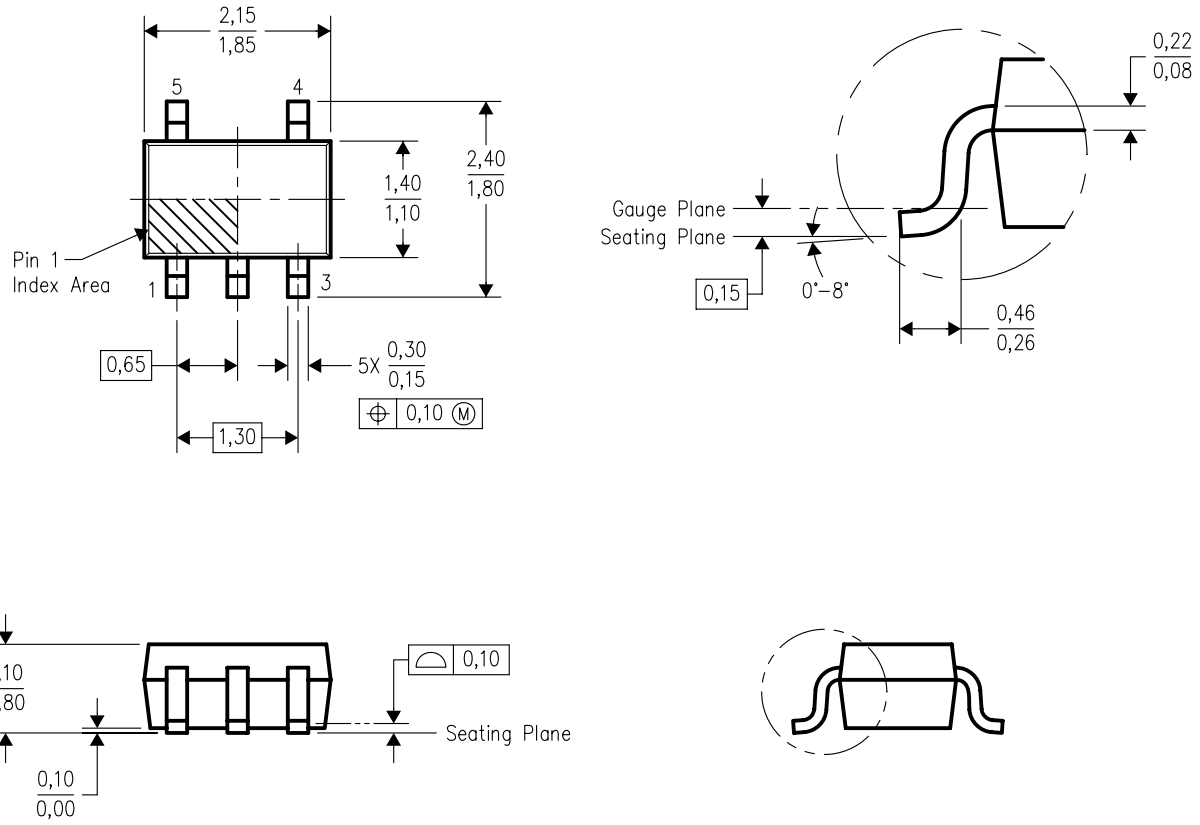
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70012DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70012DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TLV70012DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70012DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70012DDCR	SOT	DDC	5	3000	406.0	348.0	63.0
TLV70012DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70012DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70012DDCT	SOT	DDC	5	250	202.0	201.0	28.0
TLV70012DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70012DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70013DDCR	SOT	DDC	5	3000	202.0	201.0	28.0
TLV70013DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70015DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70015DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TLV70015DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70015DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70015DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70015DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70015DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70015DDCT	SOT	DDC	5	250	195.0	200.0	45.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70015DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70015DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70018DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TLV70018DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70018DCKR	SC70	DCK	5	3000	203.0	203.0	35.0
TLV70018DCKT	SC70	DCK	5	250	203.0	203.0	35.0
TLV70018DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70018DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70018DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70018DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70018DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70018DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70018DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70018DSER	WSON	DSE	6	3000	203.0	203.0	35.0
TLV70018DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70019DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70019DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70022DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70022DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70025DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70025DCKR	SC70	DCK	5	3000	203.0	203.0	35.0
TLV70025DCKT	SC70	DCK	5	250	203.0	203.0	35.0
TLV70025DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70025DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70025DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70025DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70025DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70025DSER	WSON	DSE	6	3000	203.0	203.0	35.0
TLV70025DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70025DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70025DSET	WSON	DSE	6	250	203.0	203.0	35.0
TLV70028DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70028DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TLV70028DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70028DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70028DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70028DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70028DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70028DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70028DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70028DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70029DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70029DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70030DCKR	SC70	DCK	5	3000	202.0	201.0	28.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV70030DCKR	SC70	DCK	5	3000	203.0	203.0	35.0
TLV70030DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70030DCKT	SC70	DCK	5	250	203.0	203.0	35.0
TLV70030DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70030DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70030DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70030DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70030DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70030DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70030DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70030DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70031DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70031DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70032DDCR	SOT	DDC	5	3000	202.0	201.0	28.0
TLV70032DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70033DCKR	SC70	DCK	5	3000	202.0	201.0	28.0
TLV70033DCKR	SC70	DCK	5	3000	180.0	180.0	18.0
TLV70033DCKT	SC70	DCK	5	250	202.0	201.0	28.0
TLV70033DCKT	SC70	DCK	5	250	180.0	180.0	18.0
TLV70033DDCR	SOT	DDC	5	3000	195.0	200.0	45.0
TLV70033DDCR	SOT	DDC	5	3000	223.0	270.0	35.0
TLV70033DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70033DDCT	SOT	DDC	5	250	195.0	200.0	45.0
TLV70033DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70033DSET	WSON	DSE	6	250	202.0	201.0	28.0
TLV70036DDCR	SOT	DDC	5	3000	202.0	201.0	28.0
TLV70036DDCT	SOT	DDC	5	250	223.0	270.0	35.0
TLV70036DSER	WSON	DSE	6	3000	202.0	201.0	28.0
TLV70036DSET	WSON	DSE	6	250	202.0	201.0	28.0

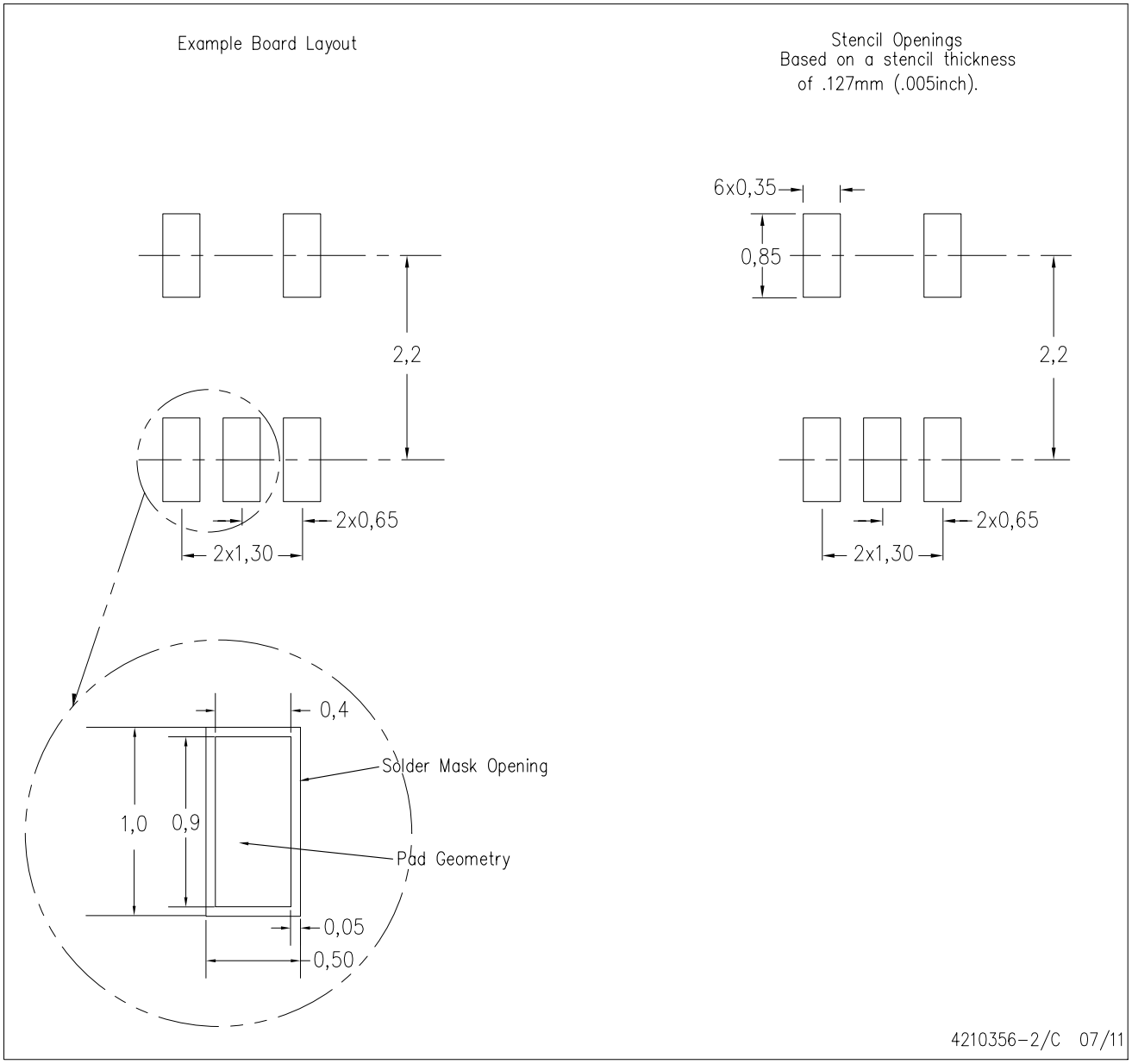
DCK (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



4093553–3/G 01/2007

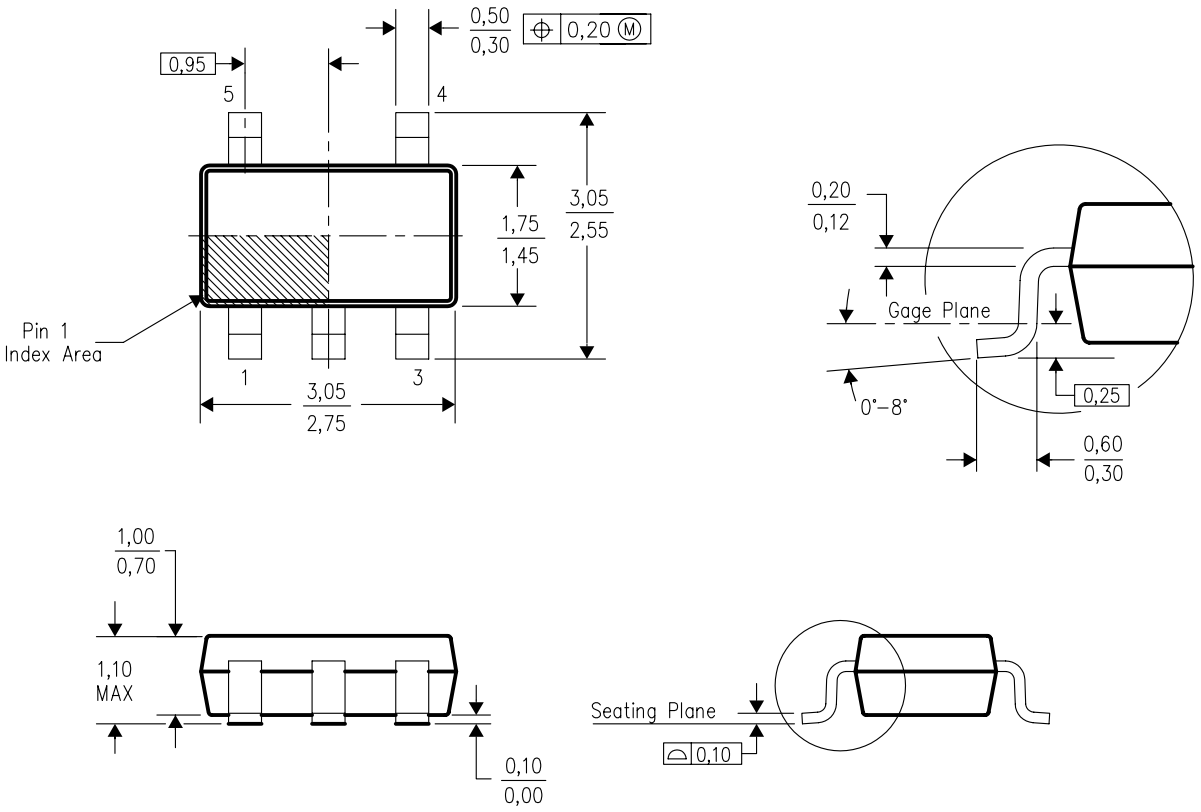
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–203 variation AA.

DCK (R–PDSO–G5) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

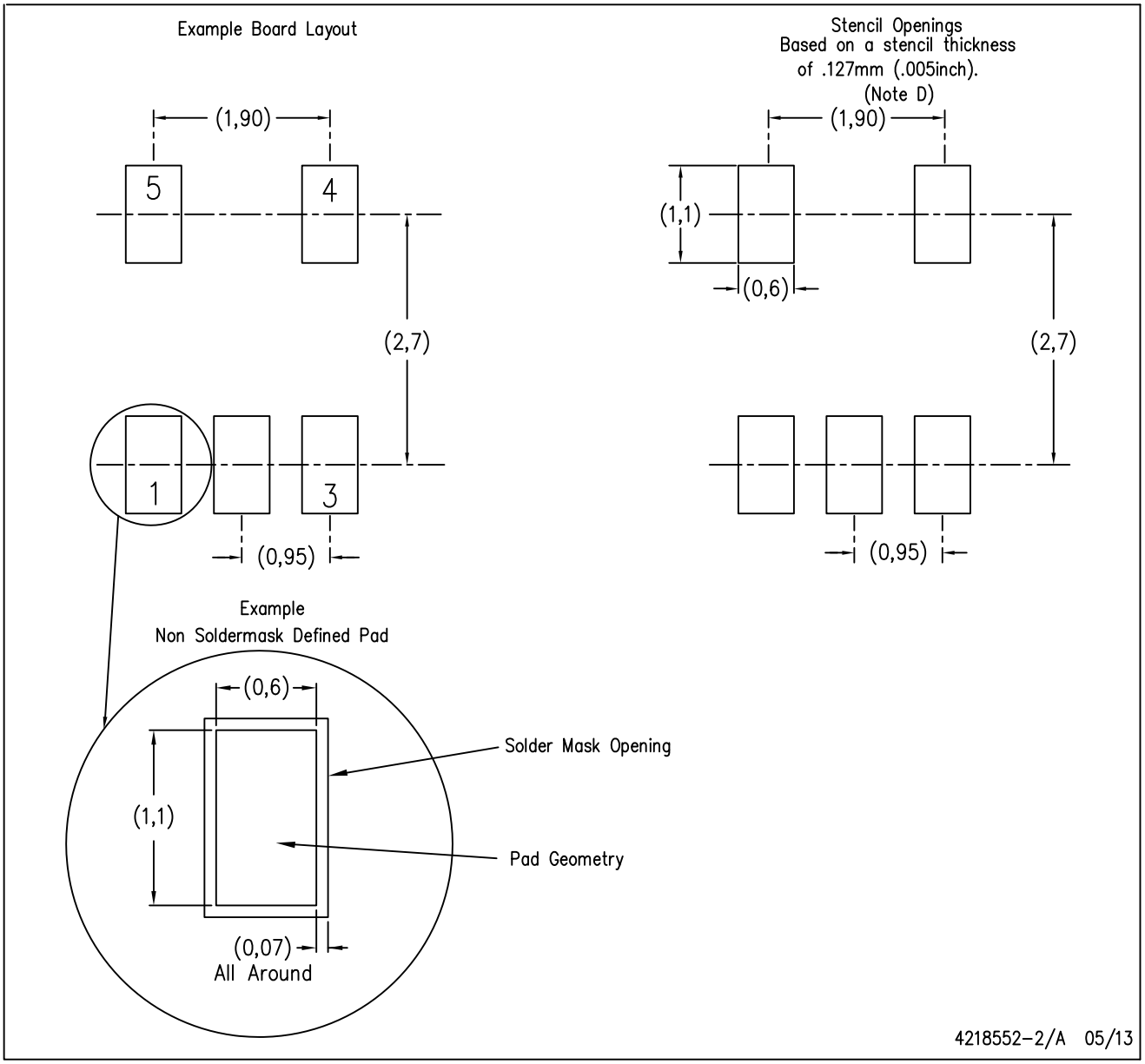
DDC (R–PDSO–G5) PLASTIC SMALL–OUTLINE



4204403–2/E 06/05

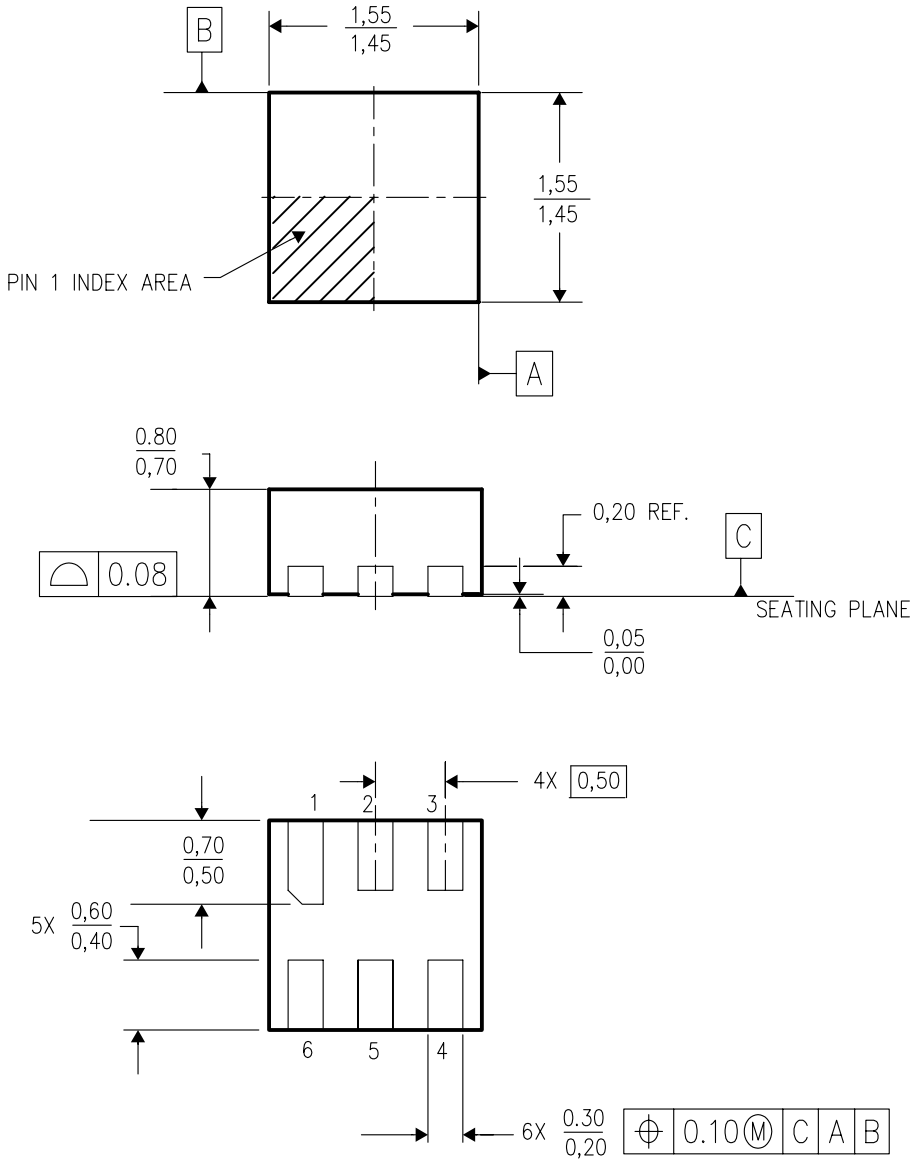
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–193 variation AB (5 pin).

DDC (R–PDSO–G5) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

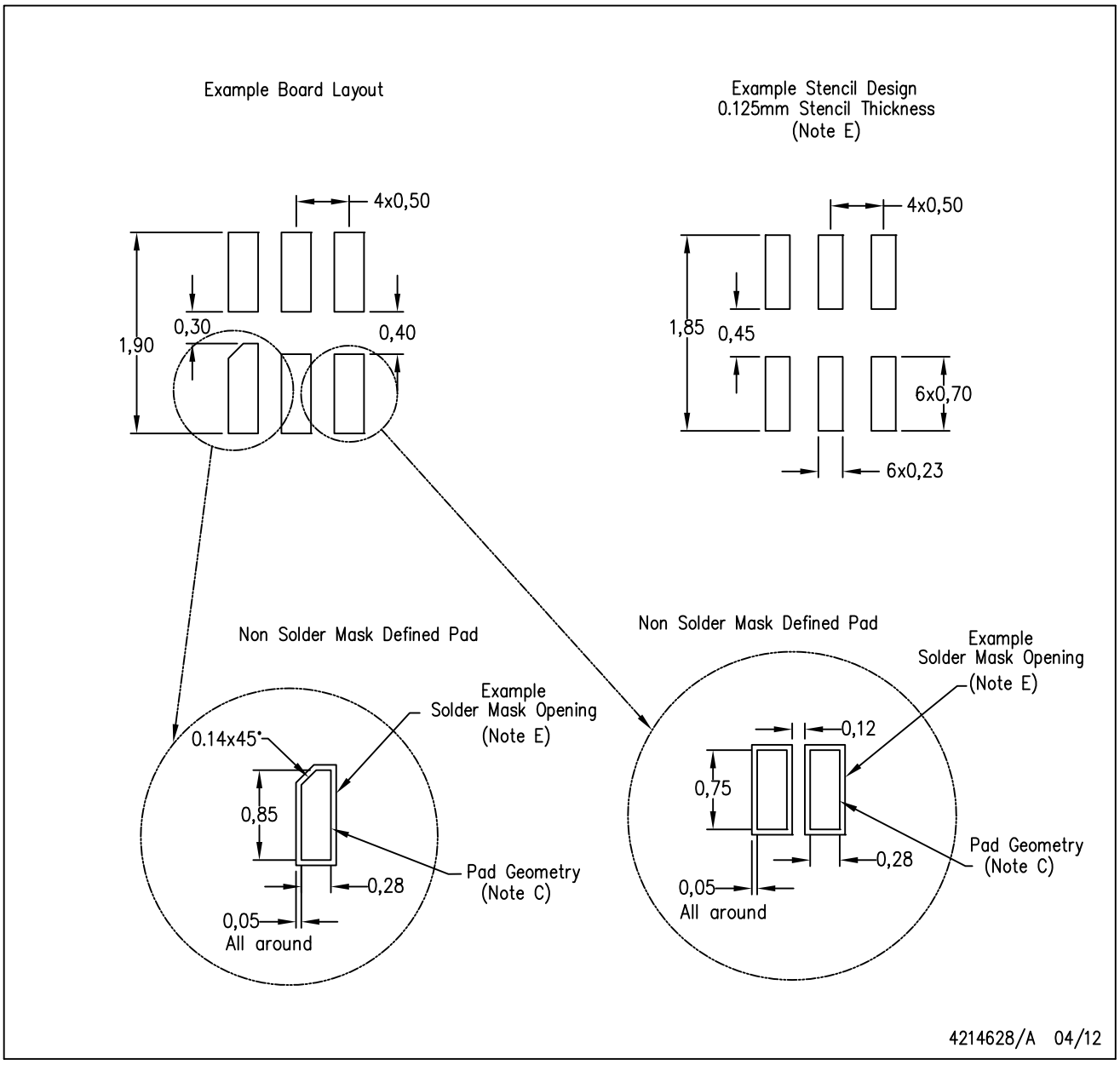
DSE (S–PDSO–N6) PLASTIC SMALL OUTLINE



4207810/A 03/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Small Outline No–Lead (SON) package configuration.
D. This package is lead–free.

DSE (S–PWSON–N6) PLASTIC SMALL OUTLINE NO–LEAD



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
E. Customers should contact their board fabrication site for solder mask tolerances.

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