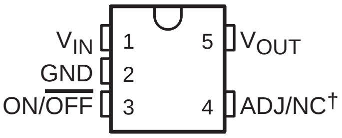
LP2981
100-mA ULTRA-LOW DROPOUT REGULATOR WITH SHUTDOWN

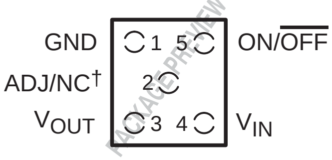
SLVS521B − JULY 2004 − REVISED OCTOBER 2004

- **Available in the Texas Instruments NanoStar™ Chip Scale Package**
- **Fixed/ADJ Versions**
- **Output Tolerance of:**
  - **0.75% (A Grade)**
  - **1.25% (Standard Grade)**
- **Ultra-Low Dropout, Typically**
  - **200 mV at Full Load of 100 mA**
  - **7 mV at 1 mA**
- **Wide V_{IN} Range . . . 16 V Max**
- **Low I_Q . . . 600 µA Typ at Full Load of 100 mA**
- **Shutdown Current . . . 0.01 µA Typ**
- **Fast Transient Response to Line and Load**
- **Overcurrent and Thermal Protection**
- **High Peak Current Capability**
- **Portable Applications**
  - **Mobile Phones**
  - **Laptops**
  - **Personal Digital Assistants (PDAs)**
  - **Digital Cameras and Camcorders**
  - **CD and MP3 Players**

DBV (SOT-23) PACKAGE
(TOP VIEW)



YEQ, YEU, YZQ, OR YZU (WCSP) PACKAGE
(TOP VIEW)



† Must be left open in fixed-output versions

description/ordering information

The LP2981 family of fixed-output, low-dropout regulators offers exceptional, cost-effective performance for both portable and nonportable applications. Available in adjustable version and in fixed voltages of 1.8 V, 2.5 V, 2.7 V, 2.8 V, 2.9 V, 3 V, 3.2 V, 3.3 V, 3.6 V, and 5 V, the family has an output tolerance of 0.75% for the A-grade devices (1.25% for the standard grade) and is capable of delivering 100-mA continuous load current. Standard regulator features, such as over-current and over-temperature protection, are included.

The LP2981 has features that make the regulator an ideal candidate for a variety of portable applications:

- Low dropout: A PNP pass element allows a typical dropout of 200 mV at 100-mA load current and 7 mV at 1-mA load.
- Low quiescent current: The use of a vertical PNP process allows for quiescent currents that are considerably lower than those associated with traditional lateral PNP regulators.
- Shutdown: A shutdown feature is available, allowing the regulator to consume only 0.01 µA when the ON/$\overline{OFF}$ pin is pulled low.
- Small packaging: For the most space-constraint needs, the regulator is available in SOT-23 package and NanoStar™ chip scale packaging. NanoStar package technology is a major breakthrough in IC packaging concepts, using the die as the package.

NanoStar is a trademark of Texas Instruments.

description/ordering information (continued)

ORDERING INFORMATION

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE[†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING[‡]
−40°C to 125°C	A grade: 0.75% tolerance	ADJ	SOT23-5 (DBV)	Reel of 3000	LP2981DBVR	PREVIEW
				Reel of 250	LP2981DBVT	
		1.25 V		Reel of 3000	LP2981A-125DBVR	PREVIEW
				Reel of 250	LP2981A-125DBVT	
		1.8 V		Reel of 3000	LP2981A-18DBVR	PREVIEW
				Reel of 250	LP2981A-18DBVT	
		2.5 V		Reel of 3000	LP2981A-25DBVR	PREVIEW
				Reel of 250	LP2981A-25DBVT	
		2.7 V		Reel of 3000	LP2981A-27DBVR	PREVIEW
				Reel of 250	LP2981A-27DBVT	
		2.8 V		Reel of 3000	LP2981A-28DBVR	LP6_
				Reel of 250	LP2981A-28DBVT	
		2.9 V		Reel of 3000	LP2981A-29DBVR	PREVIEW
				Reel of 250	LP2981A-29DBVT	
		3 V		Reel of 3000	LP2981A-30DBVR	LP8_
				Reel of 250	LP2981A-30DBVT	
		3.2 V		Reel of 3000	LP2981A-32DBVR	PREVIEW
				Reel of 250	LP2981A-32DBVT	
		3.3 V		Reel of 3000	LP2981A-33DBVR	LPC_
				Reel of 250	LP2981A-33DBVT	
		3.6 V		Reel of 3000	LP2981A-36DBVR	PREVIEW
				Reel of 250	LP2981A-36DBVT	
		5 V		Reel of 3000	LP2981A-50DBVR	PREVIEW
				Reel of 250	LP2981A-50DBVT	

[†] Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

[‡] DBV: The actual top-side marking has one additional character that designates the assembly/test site.

ORDERING INFORMATION (continued)

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
−40°C to 125°C	A grade: 0.75% tolerance	ADJ	NanoStar™ − WCSP 0.17-mm Bump (YEQ)	Reel of 3000	LP2981YEQR	
		1.25 V			LP2981A-125YEQR	
		1.8 V			LP2981A-18YEQR	
		2.5 V			LP2981A-25YEQR	
		2.7 V			LP2981A-27YEQR	
		2.8 V			LP2981A-28YEQR	
		2.9 V			LP2981A-29YEQR	
		3 V			LP2981A-30YEQR	
		3.2 V			LP2981A-32YEQR	
		3.3 V			LP2981A-33YEQR	
		5 V			LP2981A-50YEQR	
		ADJ	NanoFree™ − WCSP 0.17-mm Bump (YZQ, Pb-free)	Reel of 3000	LP2981YZQR	
		1.25 V			LP2981A-125YZQR	
		1.8 V			LP2981A-18YZQR	
		2.5 V			LP2981A-25YZQR	
		2.7 V			LP2981A-27YZQR	
		2.8 V			LP2981A-28YZQR	
		2.9 V			LP2981A-29YZQR	
		3 V			LP2981A-30YZQR	
		3.2 V			LP2981A-32YZQR	
		3.3 V			LP2981A-33YZQR	
		5 V			LP2981A-50YZQR	

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‡ YEQ/YZQ: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).

ORDERING INFORMATION (continued)

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
−40°C to 125°C	A grade: 0.75% tolerance	ADJ	NanoStar™ − WCSP 0.30-mm Bump (YEU)	Reel of 3000	LP2981YEUR	
		1.25 V			LP2981A-125YEUR	
		1.8 V			LP2981A-18YEUR	
		2.5 V			LP2981A-25YEUR	
		2.7 V			LP2981A-27YEUR	
		2.8 V			LP2981A-28YEUR	
		2.9 V			LP2981A-29YEUR	
		3 V			LP2981A-30YEUR	
		3.2 V			LP2981A-32YEUR	
		3.3 V			LP2981A-33YEUR	
		5 V			LP2981A-50YEUR	
		ADJ	NanoFree™ − WCSP 0.30-mm Bump (YZU, Pb-free)	Reel of 3000	LP2981YZUR	
		1.25 V			LP2981A-125YZUR	
		1.8 V			LP2981A-18YZUR	
		2.5 V			LP2981A-25YZUR	
		2.7 V			LP2981A-27YZUR	
		2.8 V			LP2981A-28YZUR	
		2.9 V			LP2981A-29YZUR	
		3 V			LP2981A-30YZUR	
		3.2 V			LP2981A-32YZUR	
		3.3 V			LP2981A-33YZUR	
		5 V			LP2981A-50YZUR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ YEU/YZU: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, ● = Pb-free).

ORDERING INFORMATION (continued)

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
−40°C to 125°C	Standard grade: 1.25% tolerance	ADJ	SOT-23 (DBV)	Reel of 3000	LP2981DBVR	PREVIEW
				Reel of 250	LP2981DBVT	
		1.25 V		Reel of 3000	LP2981-125DBVR	PREVIEW
				Reel of 250	LP2981-125DBVT	
		1.8 V		Reel of 3000	LP2981-18DBVR	PREVIEW
				Reel of 250	LP2981-18DBVT	
		2.5 V		Reel of 3000	LP2981-25DBVR	PREVIEW
				Reel of 250	LP2981-25DBVT	
		2.7 V		Reel of 3000	LP2981-27DBVR	PREVIEW
				Reel of 250	LP2981-27DBVT	
		2.8 V		Reel of 3000	LP2981-28DBVR	LP5_
				Reel of 250	LP2981-28DBVT	
		2.9 V		Reel of 3000	LP2981-29DBVR	PREVIEW
				Reel of 250	LP2981-29DBVT	
		3 V		Reel of 3000	LP2981-30DBVR	LP7_
				Reel of 250	LP2981-30DBVT	
		3.2 V		Reel of 3000	LP2981-32DBVR	PREVIEW
				Reel of 250	LP2981-32DBVT	
		3.3 V		Reel of 3000	LP2981-33DBVR	LPB_
				Reel of 250	LP2981-33DBVT	
		3.6 V		Reel of 3000	LP2981-36DBVR	PREVIEW
				Reel of 250	LP2981-36DBVT	
		5 V		Reel of 3000	LP2981-50DBVR	PREVIEW
				Reel of 250	LP2981-50DBVT	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

‡ DBV: The actual top-side marking has one additional character that designates the assembly/test site.

ORDERING INFORMATION (continued)

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE[†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING[‡]
−40°C to 125°C	Standard grade: 1.25% tolerance	ADJ	NanoStar™ − WCSP 0.17-mm Bump (YEQ)	Reel of 3000	LP2981YEQR	
		1.25 V			LP2981−125YEQR	
		1.8 V			LP2981−18YEQR	
		2.5 V			LP2981-25YEQR	
		2.7 V			LP2981-27YEQR	
		2.8 V			LP2981-28YEQR	
		2.8 V			LP2981-29YEQR	
		3 V			LP2981-30YEQR	
		3.2 V			LP2981-32YEQR	
		3.3 V			LP2981-33YEQR	
		5 V			LP2981-50YEQR	
		ADJ	NanoFree™ − WCSP 0.17-mm Bump (YZQ, Pb-free)	Reel of 3000	LP2981YZQR	
		1.25 V			LP2981−125YZQR	
		1.8 V			LP2981−18YZQR	
		2.5 V			LP2981-25YZQR	
		2.7 V			LP2981-27YZQR	
		2.8 V			LP2981-28YZQR	
		2.8 V			LP2981-29YZQR	
		3 V			LP2981-30YZQR	
		3.2 V			LP2981-32YZQR	
		3.3 V			LP2981-33YZQR	
		5 V			LP2981-50YZQR	

[†] Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

[‡] YEQ/YZQ: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, ● = Pb-free).

ORDERING INFORMATION (continued)

T_J	PART GRADE	V_{OUT} (NOM)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING‡
−40°C to 125°C	Standard grade: 1.25% tolerance	ADJ	NanoStar™ − WCSP 0.30-mm Bump (YEU)	Reel of 3000	LP2981YEUR	
		1.25 V			LP2981−125YEUR	
		1.8 V			LP2981−18YEUR	
		2.5 V			LP2981-25YEUR	
		2.7 V			LP2981-27YEUR	
		2.8 V			LP2981-28YEUR	
		2.8 V			LP2981-29YEUR	
		3 V			LP2981-30YEUR	
		3.2 V			LP2981-32YEUR	
		3.3 V			LP2981-33YEUR	
		5 V			LP2981-50YEUR	
		ADJ	NanoFree™ − WCSP 0.30-mm Bump (YZU, Pb-free)	Reel of 3000	LP2981YZUR	
		1.25 V			LP2981−125YZUR	
		1.8 V			LP2981−18YZUR	
		2.5 V			LP2981-25YZUR	
		2.7 V			LP2981-27YZUR	
		2.8 V			LP2981-28YZUR	
		2.8 V			LP2981-29YZUR	
		3 V			LP2981-30YZUR	
		3.2 V			LP2981-32YZUR	
		3.3 V			LP2981-33YZUR	
		5 V			LP2981-50YZUR	

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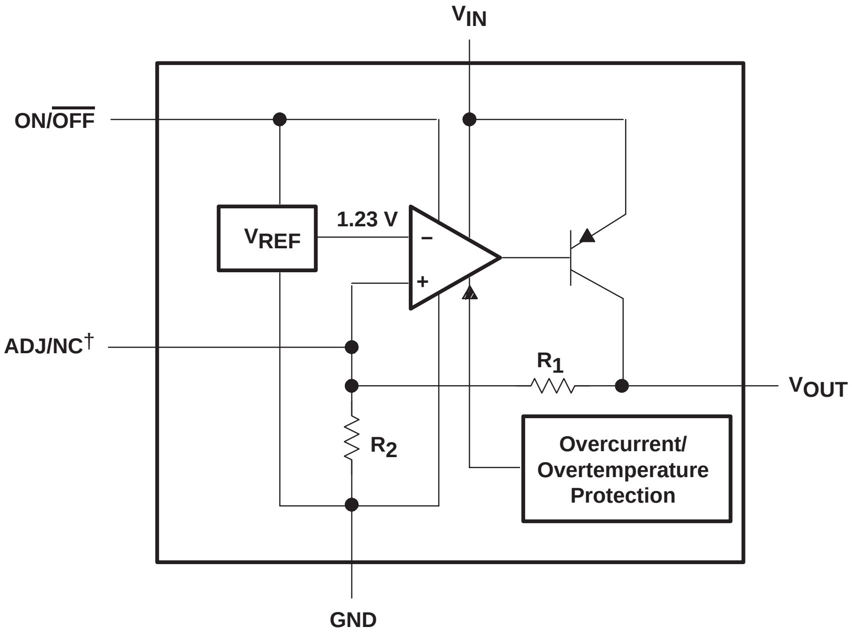
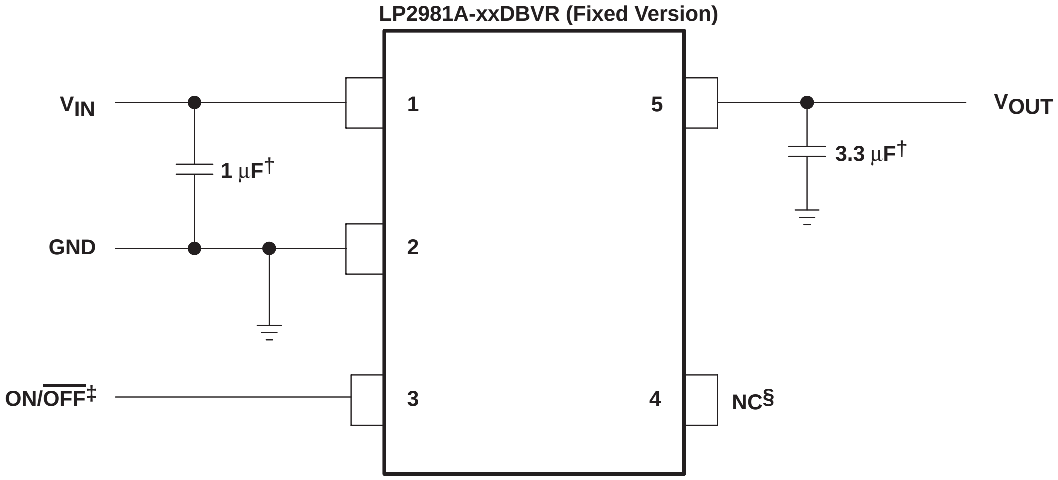
functional block diagram



[†] Fixed versions: Must be left open
ADJ versions: $R_1 = \infty$, $R_2 = \infty$

Figure 1

basic application circuit

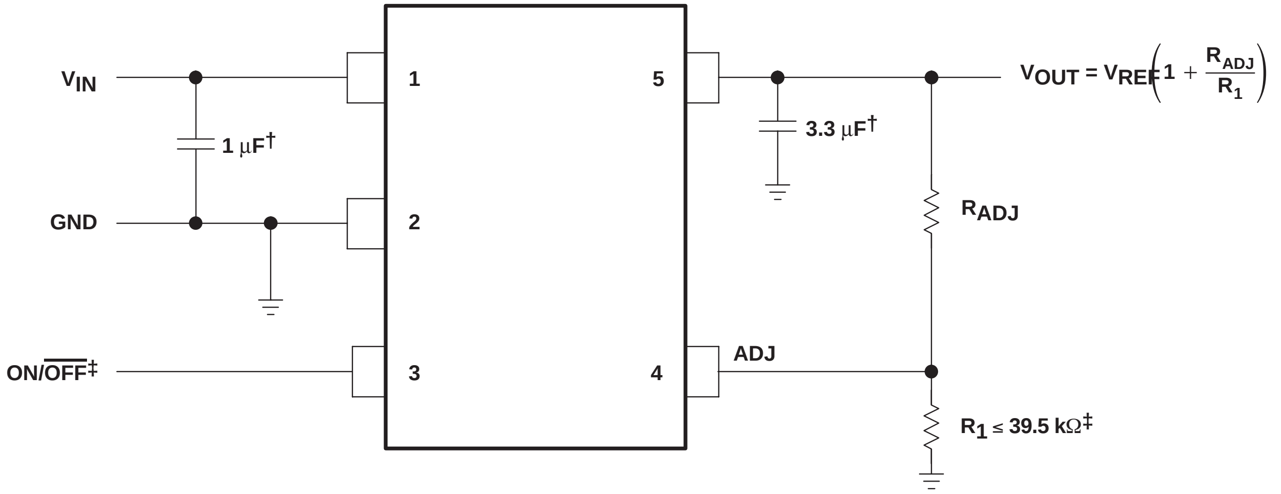


[†] Minimum C_{out} value for stability (can be increased without limit for improved stability and transient response)
[‡] ON/$\overline{\text{OFF}}$ must be actively terminated. Connect to V_{IN} if shutdown feature is not used.
[§] Must be left open

Figure 2

basic application circuit (continued)

LP2981-xxDBVR (Adjustable Version)



† Minimum C_{out} value for stability (can be increased without limit for improved stability and transient response)
‡ See Application Information

Figure 3

absolute maximum ratings over the virtual junction temperature range (unless otherwise noted)†

Continuous input voltage range, V_{IN}		−0.3 V to 16 V
ON/$\overline{OFF}$ input voltage range, $V_{ON/\overline{OFF}}$		−0.3 V to 16 V
Output voltage range (see Note 1)		−0.3 V to 9 V
Input/output voltage differential range, V_{IN}-V_{OUT} (see Note 2)		−0.3 V to 16 V
Output current, I_{OUT} (see Note 3)		Internally limited (short-circuit protected)
Package thermal impedance, θ_{JA} (see Notes 3 and 4):	DBV package	206°C/W
	YEQ/YZQ package	TBD°C/W
	YEU/YZU package	TBD°C/W
Operating virtual junction temperature, T_J		150°C
Storage temperature range, T_{stg}		−65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:
1. If load is returned to a negative power supply, the output must be diode clamped to GND.
2. The PNP pass transistor has a parasitic diode connected between the input and output. This diode normally is reverse biased ($V_{IN} > V_{OUT}$), but will be forward biased if the output voltage exceeds the input voltage by a diode drop (see Application Information for more details).
3. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
4. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

		MIN	MAX	UNIT
V_{IN}	Supply input voltage	2.2†	16	V
$V_{ON/\overline{OFF}}$	ON/$\overline{\text{OFF}}$ input voltage	0	V_{IN}	V
V_{IN}-V_{OUT}	Input-output differential	0.7	11	V
I_{OUT}	Output current		100	mA
T_J	Virtual junction temperature	−40	125	°C

† Minimum V_{IN} of 2.2 V is needed for proper biasing of LDO control circuitry.

electrical characteristics at specified free-air temperature range, $V_{IN} = V_{OUT(NOM)} + 1$ V, $V_{ON/\overline{OFF}} = 2$ V, $C_{IN} = 1$ µF, IL = 1 mA, $C_{OUT} = 4.7$ µF, ADJ version: ADJ connected to V_{OUT} (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	LP2981A-XX			LP2981-XX			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
ΔV_{OUT}	Output voltage tolerance (see Note 5)	$I_L = 1$ mA	25°C	−0.75		0.75	−1.25		1.25	$\%V_{NOM}$
		$I_L = 1$ mA to 100 mA	25°C	−1		1	−2		2	
			−40°C to 125°C	−2.5		2.5	−3.5		3.5	
$\Delta V_{OUT}/\Delta V_{IN}$	Output voltage line regulation	$V_{IN} = [V_{OUT(NOM)} + 1\text{ V}]$ to 16 V	25°C		0.007	0.014		0.007	0.014	%/V
			−40°C to 125°C			0.032			0.032	
V_{IN}-V_{OUT}	Dropout voltage (see Note 6)	$I_L = 0$	25°C		1	3		1	3	mV
			−40°C to 125°C			5			5	
		$I_L = 1$ mA	25°C		7	10		7	10	
			−40°C to 125°C			15			15	
		$I_L = 25$ mA	25°C		70	100		70	100	
			−40°C to 125°C			150			150	
		$I_L = 100$ mA	25°C		200	250		200	250	
			−40°C to 125°C			375			375	
I_{GND}	Ground pin current	$I_L = 0$	25°C		65	95		65	95	µA
			−40°C to 125°C			125			125	
		$I_L = 1$ mA	25°C		80	110		80	110	
			−40°C to 125°C			170			170	
		$I_L = 25$ mA	25°C		200	300		200	300	
			−40°C to 125°C			550			550	
		$I_L = 100$ mA	25°C		600	800		600	800	
			−40°C to 125°C			1500			1500	
		$V_{ON/\overline{OFF}} < 0.3$ V (OFF)	25°C		0.01	0.8		0.01	0.8	
		$V_{ON/\overline{OFF}} < 0.15$ V (OFF)	−40°C to 105°C		0.05	2		0.05	2	
			−40°C to 125°C			5			5	
$V_{ON/\overline{OFF}}$	ON/$\overline{\text{OFF}}$ input voltage (see Note 7)	High = O/P ON	25°C		1.4			1.4		V
			−40°C to 125°C	1.6			1.6			
		Low = O/P OFF	25°C		0.5			0.5		
			−40°C to 125°C			0.15			0.15	

NOTES: 5. $V_{OUT} = V_{REF}$ for ADJ version

6. Dropout voltage is defined as the input-to-output differential at which the output voltage drops 100 mV below the value measured with a 1-V differential. This dropout specification does not apply to the 1.8-V option, as the minimum $V_{IN} = 2.2$ V must be observed for proper biasing of LDO control circuitry.

7. The ON/$\overline{\text{OFF}}$ input must be actively terminated. Connect to V_{IN} if this function is not used (see Application Information).

electrical characteristics at specified free-air temperature range, $V_{IN} = V_{OUT(NOM)} + 1$ V, $V_{ON/\overline{OFF}} = 2$ V, $C_{IN} = 1$ µF, IL = 1 mA, $C_{OUT} = 4.7$ µF, ADJ version: ADJ connected to V_{OUT} (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS	T_A	LP2981A-XX			LP2981-XX			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
$I_{ON/\overline{OFF}}$	ON/$\overline{\text{OFF}}$ input current	$V_{ON/\overline{OFF}} = 0$	25°C		0.01			0.01		µA
			−40°C to 125°C			−1			−1	
		$V_{ON/\overline{OFF}} = 5$ V	25°C		5			5		
			−40°C to 125°C			15			15	
$I_{OUT(PK)}$	Peak output current	$V_{OUT} \geq V_{OUT(NOM)} - 5\%$	25°C	150	400		150	400		mA
V_n	Output noise voltage (RMS)	BW = 300 Hz to 50 kHz, $C_{OUT} = 10$ µF	25°C		160			160		µV
$\Delta V_{OUT}/\Delta V_{IN}$	Ripple rejection	f = 1kHz, $C_{OUT} = 10$ µF	25°C		63			63		dB
$I_{OUT(MAX)}$	Short-circuit current	$R_L = 0$ (steady state)	25°C		150			150		mA

APPLICATION INFORMATION

capacitors

input capacitor (C_{in})

A minimum value of 1 μF (over the entire operating temperature range) is required at the input of the LP2981. In addition, this input capacitor should be located within 1 cm of the input pin and connected to a clean analog ground. There is no Equivalent Series Resistance (ESR) requirement for this capacitor, and the capacitance can be increased without limit. A good quality ceramic or tantalum capacitor can be used.

output capacitor (C_{out})

As a PNP regulator, the LP2981 requires the output capacitor to meet both a minimum capacitance and ESR value. Required ESR values as a function of load current are provided for various output voltages, load currents, and capacitances (see Figures 1–4).

Minimum C_{out}: 3.3 μF (can be increased without limit to improve transient response stability margin)

ESR range: see Figures 1–4

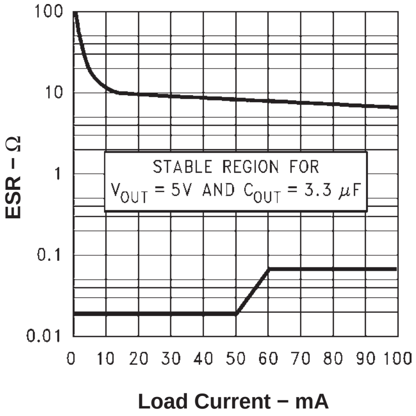


Figure 4. 5-V/3.3-μF ESR Curves

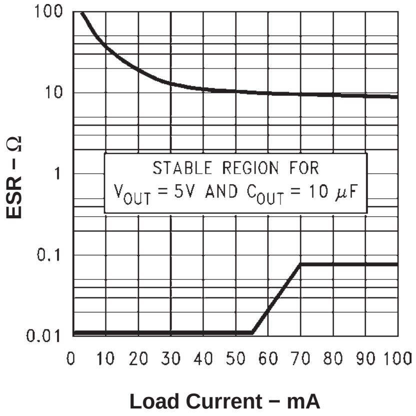


Figure 5. 5-V/10-μF ESR Curves

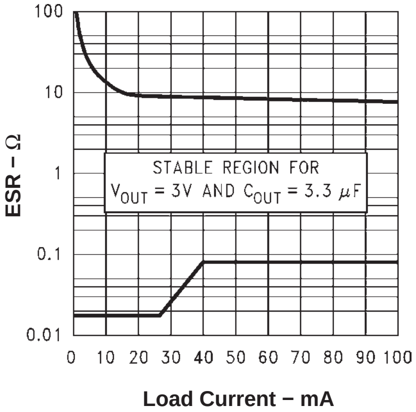


Figure 6. 3-V/3.3-μF ESR Curves

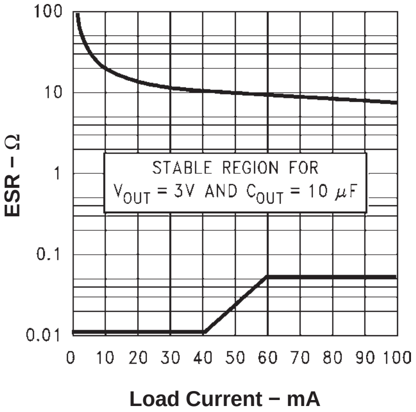


Figure 7. 3-V/10-μF ESR Curves

APPLICATION INFORMATION

output capacitor (C_{out}) (continued)

It is critical that both the minimum capacitance and ESR requirement be met over the entire operating temperature range. Depending on the type of capacitor used, both of these parameters can vary significantly with temperature (see capacitor characteristics section).

capacitor characteristics

ceramics

Due to their very low ESR values, ceramic capacitors are not suitable for use as the output capacitor. For instance, a typical 2.2-µF ceramic capacitor has an ESR in the range of 10 mΩ to 20 mΩ and, thus, easily can fall out of minimum ESR requirements under certain operating conditions.

If a ceramic capacitor is used at the output, a 1-Ω resistor should be placed in series with the capacitor to raise the ESR seen by the regulator.

tantalum

Solid tantalum capacitors are optimal choices for the LP2981, but they still must meet the minimum ESR requirement. Note that the ESR of a tantalum capacitor increases as temperature drops, as much as double from 25°C to −40°C. Thus, ESR margins must be maintained over the temperature range to prevent regulator instability. For operation at very low temperatures, paralleling a tantalum capacitor with a ceramic one keeps the combined ESR from increasing near the upper limit of the ESR curve.

aluminum

Aluminum capacitors can be used, but use with the LP2981 is impractical due to their large physical dimensions. They also must meet the ESR requirements over the full temperature range. In this regard, aluminium capacitors are at a big disadvantage due to their sharp ESR increase as temperature drops. For example, over a temperature drop from 20°C to −40°C, the ESR of an aluminum electrolytic capacitor can increase by a factor of 50. In addition, some of the electrolytes used in these capacitors can freeze at −25°C, making the capacitor nonoperational.

ON/$\overline{\text{OFF}}$ operation

The LP2981 allows for a shutdown mode via the ON/$\overline{\text{OFF}}$ pin. If the shutdown feature is not used, ON/$\overline{\text{OFF}}$ should be connected to the input to ensure that the regulator is on at all times. To drive ON/$\overline{\text{OFF}}$:

- A LOW (≤0.3 V) turns the regulator OFF; a HIGH (≥1.6 V) turns it ON.
- Use either a totem-pole output or an open-collector output with a pullup resistor tied to V_{IN} (or another logic supply). The HIGH signal can exceed V_{IN}, but must not exceed the absolute maximum ratings of 20 V for the ON/$\overline{\text{OFF}}$ pin.
- Apply a signal with a slew rate of ≥40 mV/µs. A slow slew rate can cause the shutdown function to operate incorrectly.

ADJ version

From Figure 3, V_{OUT} is set according to the following equation:

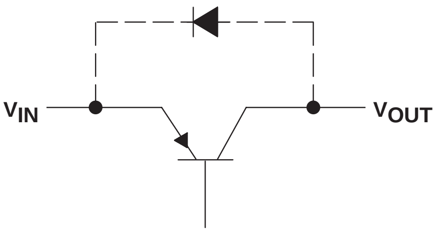
$$V_{OUT} = V_{REF}\left(1 + \frac{R_{ADJ}}{R_1}\right)$$

where V_{REF} = 1.23 V (nominal). Under no-load conditions, a minimum “bias” current is required through the R_{ADJ} and R_1 divider to maintain regulator stability. Therefore, the maximum value for R_1 should be ∼39.5 kΩ.

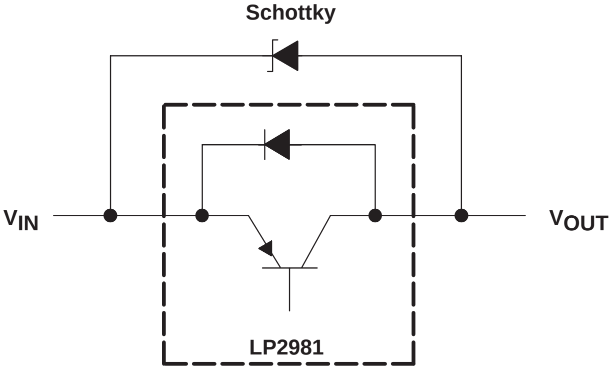
APPLICATION INFORMATION

reverse input-output voltage

An inherent diode is present across the PNP pass element of the LP2981.



With the anode connected to the output, this diode is reverse biased during normal operation, since the input voltage is higher than the output. However, if the output is pulled one V_{BE} higher than the input, or if the input is abruptly stepped below the output, this diode is forward biased and can cause a parasitic silicon-controlled rectifier (SCR) to latch, resulting in current flowing from the output to the input (values in excess of 100 mA can cause damage). Thus, to prevent possible damage to the regulator in any application where the output may be pulled above the input, an external Schottky diode must be connected between the output and input. With the anode on output, this Schottky limits the reverse voltage across the output and input pins to ∼0.3 V, preventing the regulator’s internal diode from forward biasing.

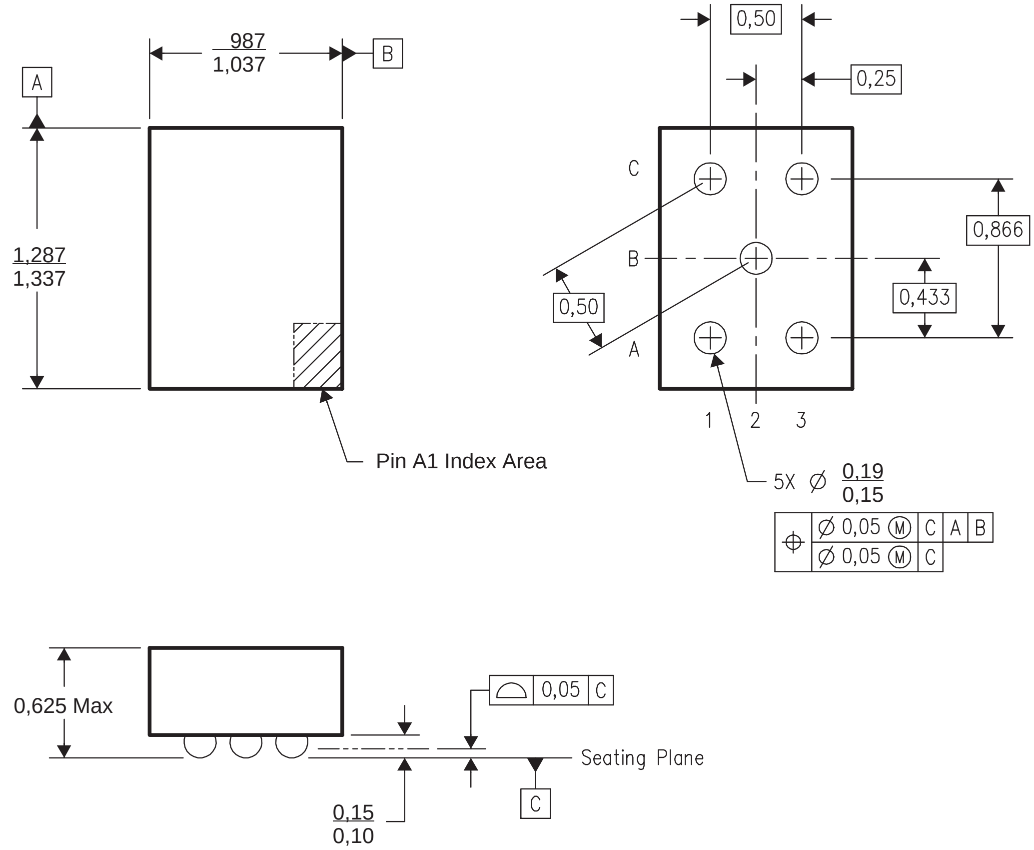


pin 4: NC

Pin 4 must be left OPEN. Do not connect anything to this pin, as it is used for post package trim.

WAFER CHIP SCALE INFORMATION

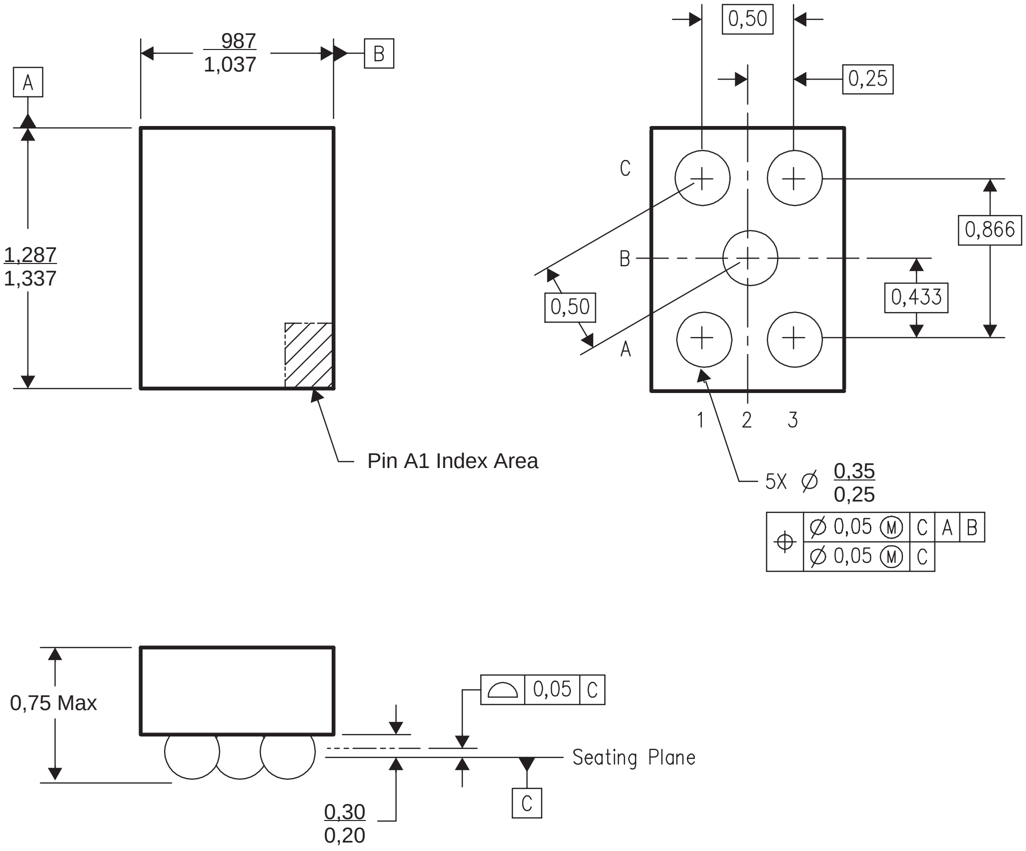
LP2981x-xxYEQ NanoStar (0.17-mm Bump)
LP2981x-xxYZQ NanoFree (0.17-mm Pb-Free Bump)



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. NanoStar package configuration.
- D. This package is tin-lead (SnPb); consult the factory for availability of lead-free material.

WAFER CHIP SCALE INFORMATION

LP2981x-xxYEU NanoStar (0.30-mm Bump)
LP2981x-xxYZU NanoFree (0.30-mm Pb-Free Bump)



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. NanoStar package configuration.
- D. This package is tin-lead (SnPb); consult the factory for availability of lead-free material.

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
LP2981-28DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-28DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-28DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-28DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-30DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-30DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-30DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-30DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-33DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-33DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-33DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981-33DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-28DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-28DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-28DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-28DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-30DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-30DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-30DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-30DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-33DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-33DBVRE4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-33DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
LP2981A-33DBVTE4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

[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) 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.
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.

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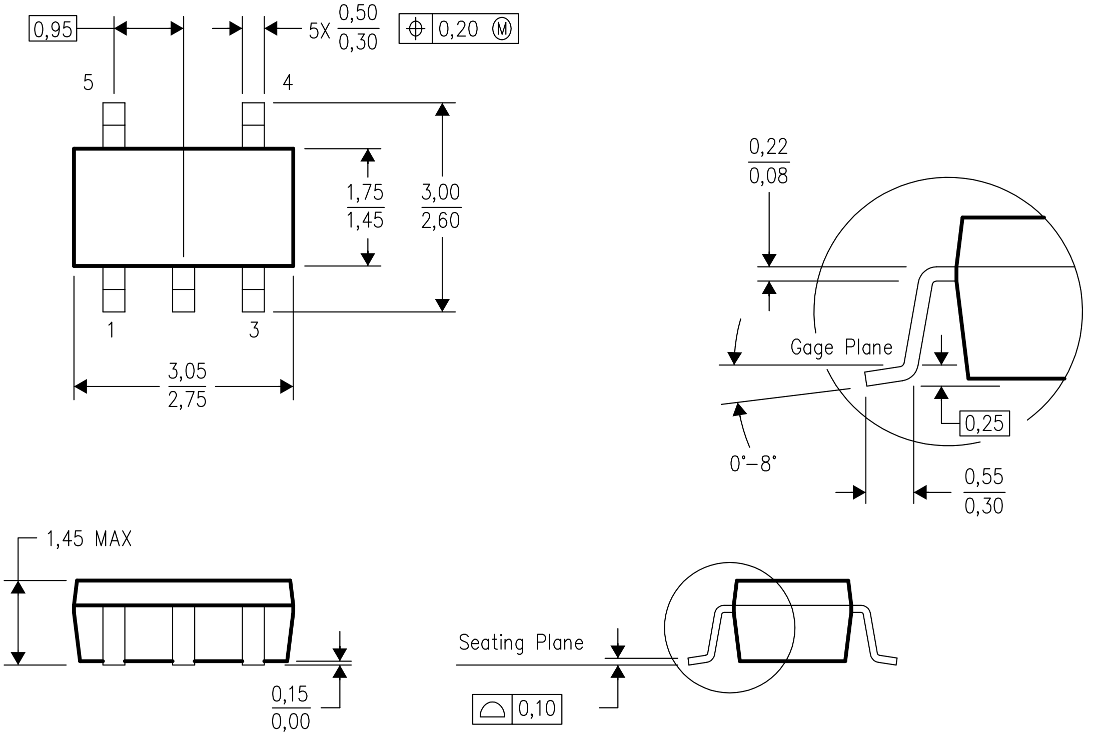
DBV (R-PDSO-G5) PLASTIC SMALL-OUTLINE PACKAGE



4073253-4/I 04/2005

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-178 Variation AA.

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