National Semiconductor

LP2957/LP2957A
5V Low-Dropout Regulator for µP Applications

General Description

The LP2957 is a 5V micropower voltage regulator with electronic shutdown, error flag, very low quiescent current (150 µA typical at 1 mA load), and very low dropout voltage (470 mV typical at 250 mA load current).

Output can be wired for snap-on/snap-off operation to eliminate transition voltage states where µP operation may be unpredictable.

Output crowbar (50 mA typical pull-down current) will bring down the output quickly when the regulator snaps off or when the shutdown function is activated.

The part has tight line and load regulation (0.04% typical) and low output temperature coefficient (20 ppm/˚C typical).

The accuracy of the 5V output is guaranteed at room temperature and over the full operating temperature range.

The LP2957 is available in the five-lead TO-220 and TO-263 packages.

Features

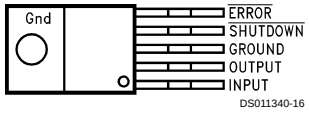
- 5V output within 1.4% over temperature (A grade)
- Easily programmed for snap-on/snap-off output
- Guaranteed 250 mA output current
- Extremely low quiescent current
- Low Input-Output voltage required for regulation
- Reverse battery protection
- Extremely tight line and load regulation
- Very low temperature coefficient
- Current and thermal limiting
- Error flag signals when output is out of regulation

Applications

- High-efficiency linear regulator
- Battery-powered regulator

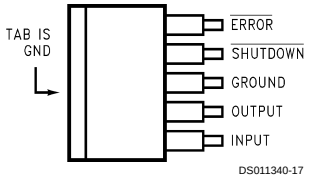
Package Outline

Bent, Staggered Leads
5-Lead TO-220 (T)

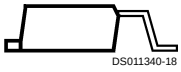


Top View
Order Number LP2957AIT or LP2957IT
See NS Package Number T05D

Plastic Surface Mount Package
5-Lead TO-263 (S)



Top View



Side View
Order Number LP2957AIS or LP2957IS
See NS Package Number TS5B

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Operating Junction Temperature Range	−40˚C to +125˚C
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 5 Seconds)	260˚C
Power Dissipation (Note 2)	Internally Limited
Input Supply Voltage	−20V to +30V
$\overline{\text{Shutdown}}$ Input	−0.3V to +30V
ESD Rating	2 kV

Electrical Characteristics

Limits in standard typeface are for T_J = 25˚C, and limits in **boldface type** apply over the full operating temperature range. Unless otherwise specified: V_{IN} = 6V, I_L = 1 mA, C_L = 2.2 µF, V_{SD} = 3V.

Symbol	Parameter	Conditions	Typical	LP2957AI		LP2957I		Units
				Min	Max	Min	Max	
V_O	Output Voltage (Note 9)		5.0	4.975 **4.940**	5.025 **5.060**	4.950 **4.900**	5.050 **5.100**	V
		1 mA ≤ I_L ≤ 250 mA	5.0	**4.930**	**5.070**	**4.880**	**5.120**	
$\frac{\Delta V_O}{\Delta T}$	Output Voltage Temperature Coefficient	(Note 3)	**20**		**100**		**150**	ppm/˚C
$\frac{\Delta V_O}{V_O}$	Line Regulation	V_{IN} = 6V to 30V	0.03		0.10 **0.20**		0.20 **0.40**	%
$\frac{\Delta V_O}{V_O}$	Load Regulation	I_L = 1 mA to 250 mA I_L = 0.1 mA to 1 mA (Note 4)	0.04		0.16 **0.20**		0.20 **0.30**	%
$V_{IN}–V_O$	Dropout Voltage (Note 5)	I_L = 1 mA	60		100 **150**		100 **150**	mV
		I_L = 50 mA	240		300 **420**		300 **420**	
		I_L = 100 mA	310		400 **520**		400 **520**	
		I_L = 250 mA	470		600 **800**		600 **800**	
I_{GND}	Ground Pin Current (Note 6)	I_L = 1 mA	150		200 **230**		200 **230**	µA
		I_L = 50 mA	1.1		2 **2.5**		2 **2.5**	mA
		I_L = 100 mA	3		6 **8**		6 **8**	
		I_L = 250 mA	16		28 **33**		28 **33**	
I_{GND}	Ground Pin Current in Shutdown (Note 6)	I_L = 0 V_{SD} = 0.4V	130		180 **200**		180 **200**	µA
I_{GND}	Ground Pin Current at Dropout (Note 6)	V_{IN} = 4.5V I_L = 0.1 mA	180		230 **250**		230 **250**	µA
I_O (Sink)	Off-State Output Pulldown Current	V_{IN} = 5.3V V_O = 5V, V_{SD} = 0.4V	50	30 **20**		30 **20**		mA
I_O (Off)	Output Leakage in Shutdown	$I_{(SD\ IN)}$ ≥ 1 µA V_{IN} = 30V, V_{OUT} = 0V	3		10 **20**		10 **20**	µA
I_{LIMIT}	Current Limit	R_L = 1Ω	400		500 **530**		500 **530**	mA
$\frac{\Delta V_O}{\Delta Pd}$	Thermal Regulation	(Note 7)	0.05		0.2		0.2	%/W

Electrical Characteristics (Continued)

Limits in standard typeface are for T_J = 25˚C, and limits in **boldface type** apply over the full operating temperature range. Unless otherwise specified: V_{IN} = 6V, I_L = 1 mA, C_L = 2.2 µF, V_{SD} = 3V.

Symbol	Parameter	Conditions	Typical	LP2957AI		LP2957I		Units
				Min	Max	Min	Max	
e_n	Output Noise Voltage (10 Hz to 100 kHz) I_L = 100 mA	C_L = 2.2 µF	500					µV RMS
		C_L = 33 µF	320					
$\overline{\text{SHUTDOWN}}$ INPUT								
V_{SD} (ON)	Output Turn-On Threshold Voltage			1.155	1.305	1.155	1.305	V
				1.140	**1.320**	**1.140**	**1.320**	
HYST	Hysteresis		6					mV
I_B	Input Bias Current	$V_{IN(SD)}$ = 0V to 5V	10	−30	30	−30	30	nA
				−50	**50**	**−50**	**50**	
DROPOUT DETECTION COMPARATOR								
I_{OH}	Output “HIGH” Leakage	V_{OH} = 30V	0.01		1		1	µA
					2		**2**	
V_{OL}	Output “LOW” Voltage	V_{IN} = 4V I_O(COMP) = 400 µA	150		250		250	mV
					400		**400**	
V_{THR} (Max)	Upper Threshold Voltage	(Note 8)	−240	−320	−150	−320	−150	mV
				−380	**−100**	**−380**	**−100**	
V_{THR} (Min)	Lower Threshold Voltage	(Note 8)	−350	−450	−230	−450	−230	mV
				−640	**−160**	**−640**	**−160**	
HYST	Hysteresis	(Note 8)	60					mV

Note 1: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

Note 2: The maximum allowable power dissipation is a function of the maximum junction temperature, T_J(MAX), the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using:

$$P(MAX) = \frac{T_J(MAX) - T_A}{\theta_{JA}}$$

Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. The junction-to-ambient thermal resistance of the TO-220 (without heatsink) is 60˚C/W and 73˚C/W for the TO-263. If the TO-263 package is used, the thermal resistance can be reduced by increasing the P.C. board copper area thermally connected to the package: Using 0.5 Square inches of copper area, θ_{JA} is 50˚C/W, with 1 square inch of copper area, θ_{JA} is 37˚C/W; and with 1.6 or more square inches of copper area, θ_{JA} is 32˚C/W. The junction-to-case thermal resistance is 3˚C/W. If an external heatsink is used, the effective junction-to-ambient thermal resistance is the sum of the junction-to-case resistance (3˚C/W), the specified thermal resistance of the heatsink selected, and the thermal resistance of the interface between the heatsink and the LP2957 (see Application Hints).

Note 3: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 4: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested separately for load regulation in the load ranges 0.1 mA–1 mA and 1 mA–250 mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 5: Dropout voltage is defined as the input to output voltage differential at which the output voltage drops 100 mV below the value measured with a 1V input to output differential.

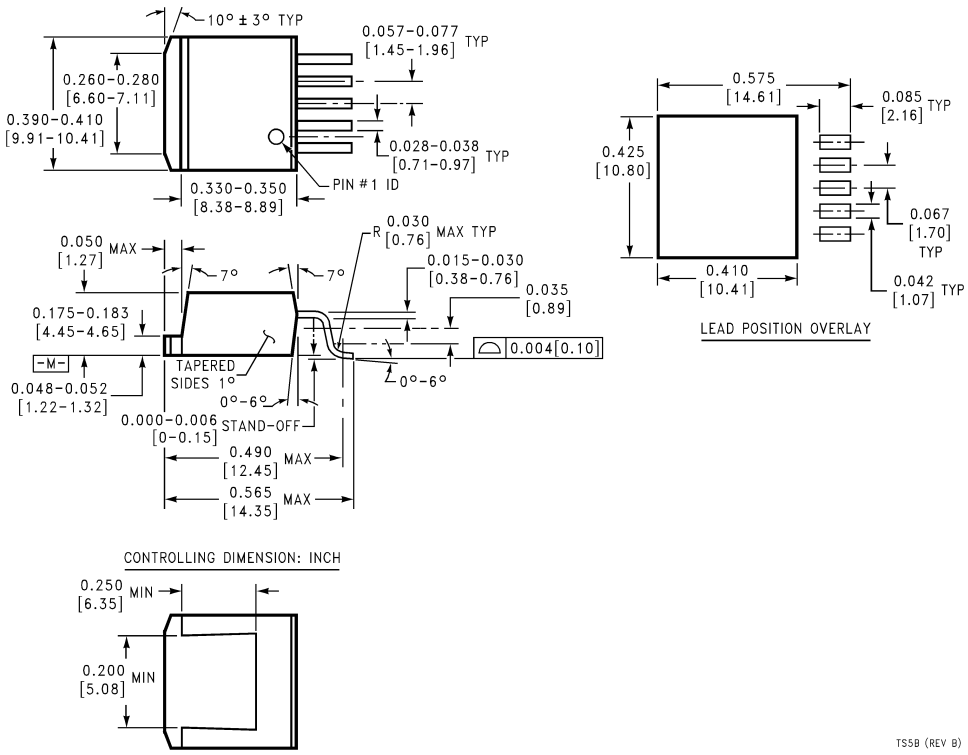
Note 6: Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current plus the ground pin current.

Note 7: Thermal regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 200 mA load pulse at V_{IN} = 20V (3W pulse) for T = 10 ms.

Note 8: Voltages are referenced to the nominal regulated output voltage.

Note 9: When used in dual-supply systems where the regulator load is returned to a negative supply, the output voltage must be diode-clamped to ground.

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



TO-263 5-Lead Plastic Surface Mount Package
Order Number LP2957AIS or LP2957IS
NS Package Number TS5B

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.