

## ADP3301

### FEATURES

High Accuracy (Over Line and Load Regulations  
at +25°C):  $\pm 0.8\%$   
Ultralow Dropout Voltage: 100 mV Typical @ 100 mA  
Requires Only  $C_o = 0.47 \mu F$  for Stability  
anyCAP™\* = Stable with All Types of Capacitors  
Current and Thermal Limiting  
Low Noise  
Dropout Detector  
Low Shutdown Current: 1  $\mu A$   
Several Fixed Voltage Options  
3.0 V to 12 V Supply Range  
-20°C to +85°C Ambient Temperature Range  
Thermally Enhanced SO-8 Package  
Excellent Line and Load Regulations

### APPLICATIONS

Cellular Telephones  
Notebook, Palmtop Computers  
Battery Powered Systems  
Portable Instruments  
Post Regulator for Switching Supplies  
Bar Code Scanners

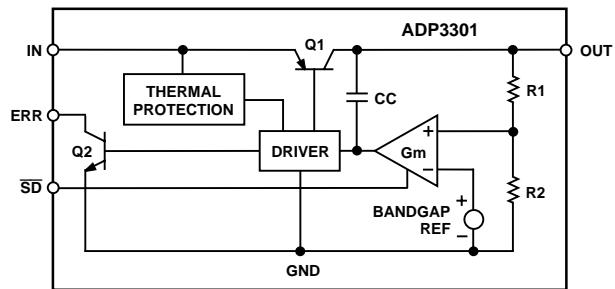
### GENERAL DESCRIPTION

The ADP3301 is a member of the ADP330x family of precision low dropout anyCAP™\* voltage regulators. The ADP3301 stands out from the conventional LDOs with a novel architecture, an enhanced process and a new package. Its patented design includes a noninverting wideband driver and a stage that permits the use of an internal "pole splitting" capacitor to stabilize the feedback loop with a single output capacitor as small as  $0.47 \mu F$ . This device is stable with any type of capacitor regardless of its ESR (Equivalent Serial Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3301 achieves exceptional accuracy of  $\pm 0.8\%$  at room temperature and  $\pm 1.4\%$  overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3301 is only 100 mV (typical) at 100 mA.

In addition to the new architecture and process, ADI's new proprietary thermally enhanced package (Thermal Coastline) can handle 1 W of power dissipation without external heat sink or large copper surface on the PC board. This keeps PC board real estate to a minimum and makes the ADP3301 very attractive for use in portable equipment.

\*anyCAP is a trademark of Analog Devices Inc.

### FUNCTIONAL BLOCK DIAGRAM



The ADP3301 operates with a wide input voltage range from 3 V to 12 V and delivers a load current in excess of 100 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP™\* LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3300 (50 mA, SOT-23)  
ADP3302 (100 mA, Dual Output)  
ADP3304 (100 mA, Dual Output with Separate Grounds)  
ADP3303 (200 mA)  
ADP3306 (300 mA)

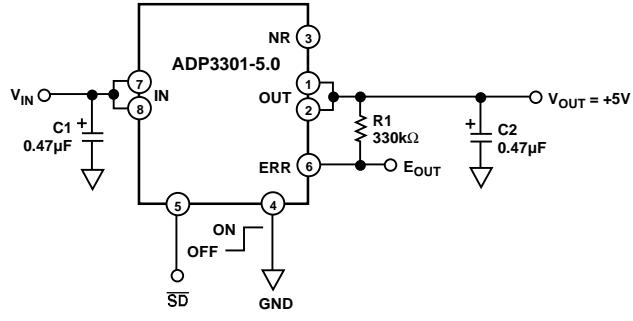


Figure 1. Typical Application Circuit

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# ADP3301-xx-SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS (@ $T_A = -20^\circ\text{C}$ to $+85^\circ\text{C}$ , $V_{IN} = 7\text{ V}$ , $C_{IN} = 0.47\text{ }\mu\text{F}$ , $C_{OUT} = 0.47\text{ }\mu\text{F}$ , unless otherwise noted)<sup>1</sup>

Parameter	Symbol	Conditions	Min	Typ	Max	Units
OUTPUT VOLTAGE ACCURACY	$V_{OUT}$	$V_{IN} = \text{Nom } V_{OUT} + 0.3\text{ V to } 12\text{ V}$ $I_L = 0.1\text{ mA to } 100\text{ mA}$ $T_A = +25^\circ\text{C}$ $V_{IN} = \text{Nom } V_{OUT} + 0.3\text{ V to } 12\text{ V}$ $I_L = 0.1\text{ mA to } 100\text{ mA}$	-0.8		+0.8	%
			-1.4		+1.4	%
LINE REGULATION	$\frac{\Delta V_O}{\Delta V_{IN}}$	$V_{IN} = \text{Nom } V_{OUT} + 0.3\text{ V to } 12\text{ V}$ $T_A = +25^\circ\text{C}$		0.024		$\text{mV/V}$
LOAD REGULATION	$\frac{\Delta V_O}{\Delta I_L}$	$I_L = 0.1\text{ mA to } 100\text{ mA}$ $T_A = +25^\circ\text{C}$		0.014		$\text{mV/mA}$
GROUND CURRENT	$I_{GND}$	$I_L = 100\text{ mA}$ $I_L = 0.1\text{ mA}$	0.85	2		$\text{mA}$
			0.18	0.3		$\text{mA}$
GROUND CURRENT IN DROPOUT	$I_{GND}$	$V_{IN} = 2.5\text{ V}$ $I_L = 0.1\text{ mA}$	0.6	1.2		$\text{mA}$
DROPOUT VOLTAGE	$V_{DROP}$	$V_{OUT} = 98\%$ of $V_O$ Nominal $I_L = 100\text{ mA}$ $I_L = 10\text{ mA}$ $I_L = 1\text{ mA}$	0.1	0.2		$\text{V}$
			0.02	0.07		$\text{V}$
			0.003	0.03		$\text{V}$
SHUTDOWN THRESHOLD	$V_{THSD}$	ON OFF	2.0	0.9		$\text{V}$
				0.9	0.3	$\text{V}$
SHUTDOWN PIN INPUT CURRENT	$I_{SDIN}$	$0 < V_{SD} < 5\text{ V}$ $5 \leq V_{SD} \leq 12\text{ V} @ V_{IN} = 12\text{ V}$		1		$\mu\text{A}$
				22		$\mu\text{A}$
GROUND CURRENT IN SHUTDOWN MODE	$I_Q$	$V_{SD} = 0, V_{IN} = 12\text{ V}$ $T_A = +25^\circ\text{C}$ $V_{SD} = 0, V_{IN} = 12\text{ V}$ $T_A = +85^\circ\text{C}$		1		$\mu\text{A}$
				5		$\mu\text{A}$
OUTPUT CURRENT IN SHUTDOWN MODE	$I_{OSD}$	$T_A = +25^\circ\text{C} @ V_{IN} = 12\text{ V}$ $T_A = +85^\circ\text{C} @ V_{IN} = 12\text{ V}$		2		$\mu\text{A}$
				4		$\mu\text{A}$
ERROR PIN OUTPUT LEAKAGE	$I_{EL}$	$V_{EO} = 5\text{ V}$		13		$\mu\text{A}$
ERROR PIN OUTPUT "LOW" VOLTAGE	$V_{EOL}$	$I_{SINK} = 400\text{ }\mu\text{A}$	0.13	0.3		$\text{V}$
PEAK LOAD CURRENT	$I_{LDPK}$	$V_{IN} = \text{Nom } V_{OUT} + 1\text{ V}$	200			$\text{mA}$
THERMAL REGULATION	$\frac{\Delta V_O}{V_O}$	$V_{IN} = 12\text{ V}, I_L = 100\text{ mA}$ $T = 10\text{ ms}$		0.015		$\%/\text{W}$
OUTPUT NOISE @ 5 V OUTPUT	$V_{NOISE}$	$f = 10\text{ Hz-100 kHz}$ $C_{NR} = 0$ $C_{NR} = 10\text{ nF}, C_L = 10\text{ }\mu\text{F}$	100			$\mu\text{V rms}$
			30			$\mu\text{V rms}$

### NOTES

<sup>1</sup>Ambient temperature of  $+85^\circ\text{C}$  corresponds to a typical junction temperature of  $+125^\circ\text{C}$  under typical full load test conditions.

Specifications subject to change without notice.

## ABSOLUTE MAXIMUM RATINGS\*

Input Supply Voltage	-0.3 V to +16 V
Shutdown Input Voltage	-0.3 V to +16 V
Error Flag Output Voltage	-0.3 V to +16 V
Noise Bypass Pin Voltage	-0.3 V to +5 V
Power Dissipation	Internally Limited
Operating Ambient Temperature Range	-55°C to +125°C
Operating Junction Temperature Range	-55°C to +125°C
θ <sub>JA</sub>	96°C/W
θ <sub>JC</sub>	55°C/W
Storage Temperature Range	-65°C to +150°C
Lead Temperature Range (Soldering 10 sec)	+300°C
Vapor Phase (60 sec)	+215°C
Infrared (15 sec)	+220°C

\*This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operation section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ORDERING GUIDE

Model	Voltage Output	Package Option*
ADP3301AR-2.7	2.7 V	SO-8
ADP3301AR-3	3.0 V	SO-8
ADP3301AR-3.2	3.2 V	SO-8
ADP3301AR-3.3	3.3 V	SO-8
ADP3301AR-5	5.0 V	SO-8

Contact the factory for the availability of other output voltage options.

\*SO = Small Outline.

Other Members of anyCAP™ Family<sup>1</sup>

Model	Output Current	Package Option <sup>2</sup>	Comments
ADP3300	50 mA	SOT-23	High Accuracy
ADP3302	100 mA	SO-8	Dual Output
ADP3304	100 mA	SO-8	Dual Output with Separate Grounds
ADP3303	200 mA	SO-8	High Accuracy
ADP3306	300 mA	SO-8, TSSOP-14	High Accuracy, High Current

## NOTES

<sup>1</sup>See individual data sheets for detailed ordering information.

<sup>2</sup>SO = Small Outline, SOT = Surface Mount, TSSOP = Thin Shrink Small Outline.

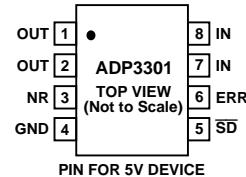
## CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADP3301 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

## PIN FUNCTION DESCRIPTIONS

Pin	Mnemonic	Function
1 & 2	OUT	Output of the Regulator, fixed 2.7, 3.0, 3.2, 3.3 or 5 volts output voltage. Bypass to ground with a 0.47 µF or larger capacitor. <b>Pins 1 and 2 must be connected together for proper operation.</b>
3	NR	Noise Reduction Pin. Used for further reduction of the output noise. (See text for details.) No connection if not used.
4	GND	Ground Pin.
5	SD	Active Low Shutdown Pin. Connect to ground to disable the regulator output. When shutdown is not used, this pin should be connected to the input pin.
6	ERR	Open Collector Output which goes low to indicate that the output is about to go out of regulation.
7 & 8	IN	Regulator Input. <b>Pins 7 and 8 must be connected together for proper operation.</b>

## PIN CONFIGURATION



# ADP3301—Typical Performance Characteristics

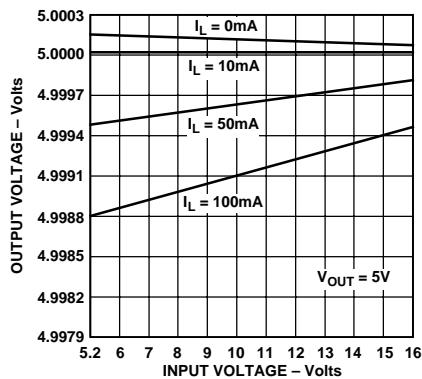


Figure 2. Line Regulation: Output Voltage vs. Input Voltage

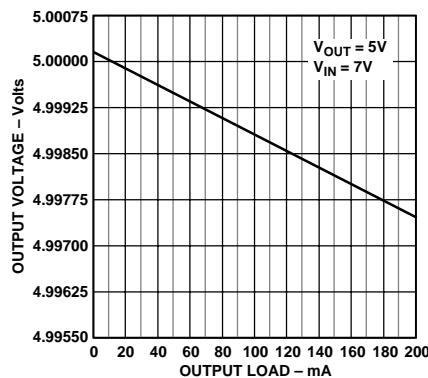


Figure 3. Output Voltage vs. Load Current Up to 200 mA

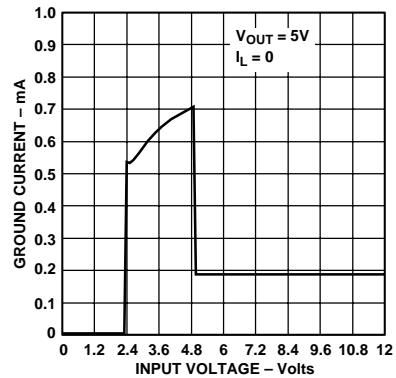


Figure 4. Quiescent Current vs. Supply Voltage

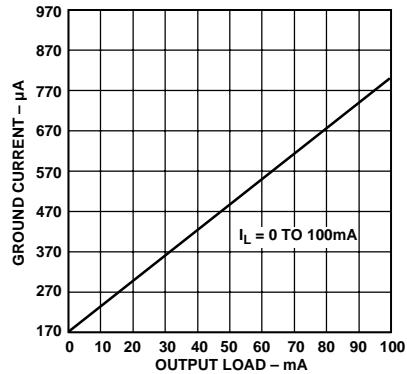


Figure 5. Quiescent Current vs. Load Current

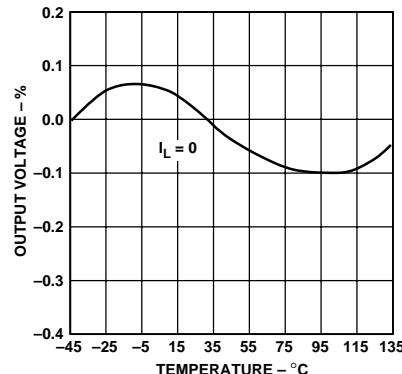


Figure 6. Output Voltage Variation % vs. Temperature

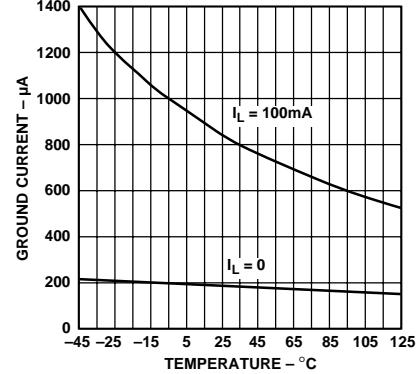


Figure 7. Quiescent Current vs. Temperature

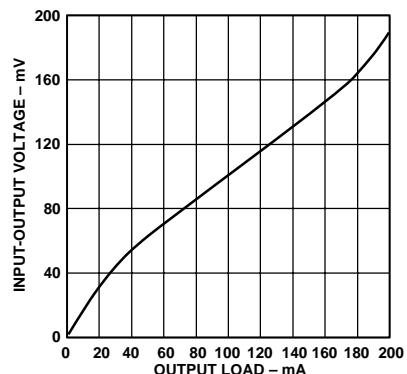


Figure 8. Dropout Voltage vs. Output Current

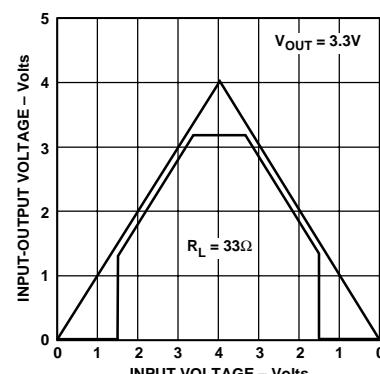


Figure 9. Power-Up/Power-Down

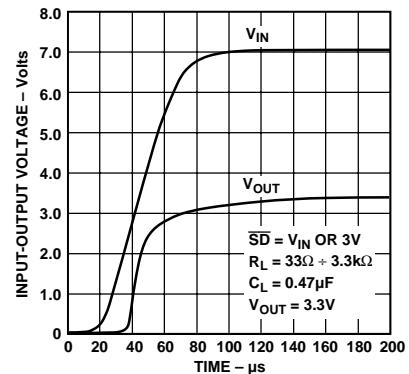


Figure 10. Power-Up Overshoot

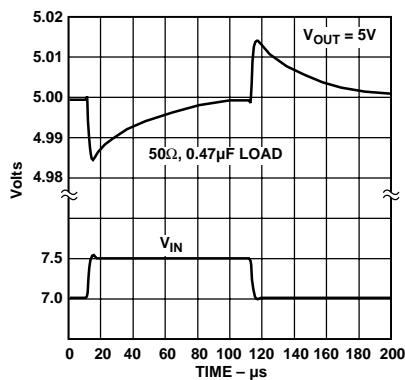


Figure 11. Line Transient Response

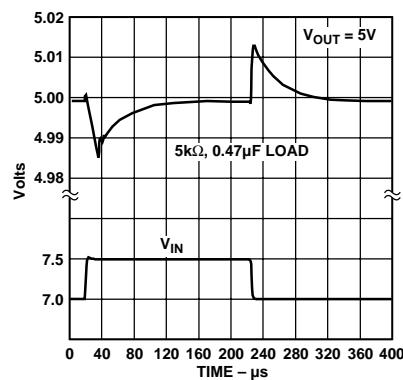


Figure 12. Line Transient Response

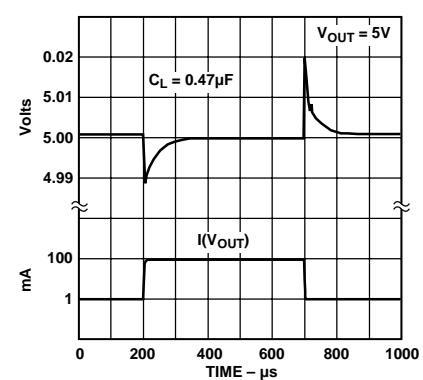


Figure 13. Load Transient for 1 mA to 100 mA Pulse

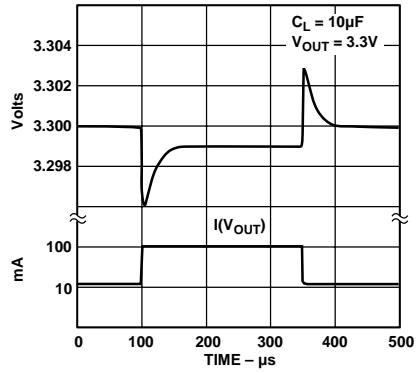


Figure 14. Load Transient for 10 mA to 100 mA Pulse

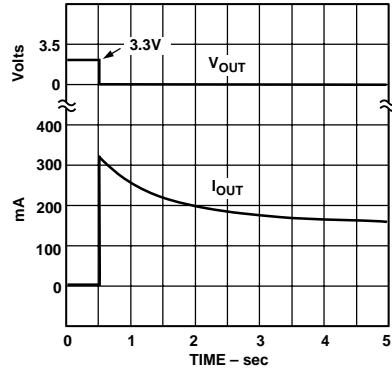


Figure 15. Short Circuit Current

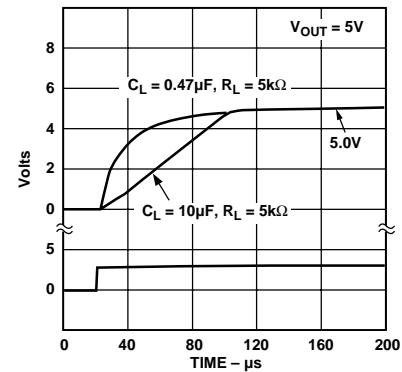


Figure 16. Turn-On

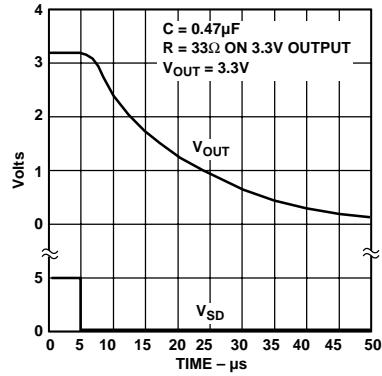


Figure 17. Turn-Off

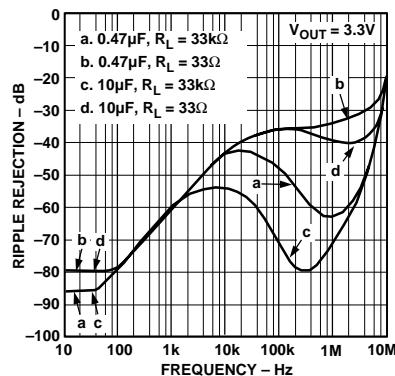


Figure 18. Power Supply Ripple Rejection

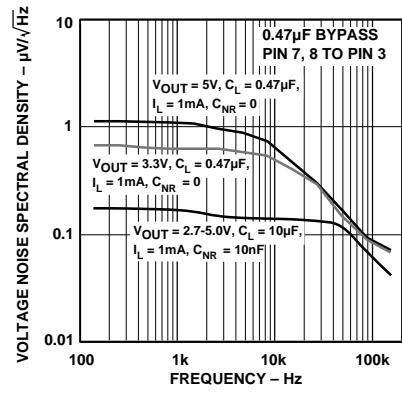


Figure 19. Output Noise Density



It is not recommended to use solder mask or silkscreen on the PCB traces adjacent to the ADP3301's pins since it will increase the junction to ambient thermal resistance of the package.

#### Shutdown Mode

Applying a TTL high signal to the shutdown pin, or tying it to the input pin, will turn the output ON. Pulling the shutdown pin low, or tying it to ground, will turn the output OFF. In shutdown mode, quiescent current is reduced to less than 1  $\mu$ A.

#### Error Flag Dropout Detector

The ADP3301 will maintain its output voltage over a wide range of load, input voltage and temperature conditions. If, for example, regulation is lost by reducing the supply voltage below the combined regulated output and dropout voltages, the ERRor flag will be activated. The ERR output is an open collector, which will be driven low.

Once set, the ERRor flag's hysteresis will keep the output low until a small margin of operating range is restored either by raising the supply voltage or reducing the load.

### APPLICATION CIRCUITS

#### Crossover Switch

The circuit in Figure 21 shows that two ADP3301s can be used to form a mixed supply voltage system. The output switches between two different levels selected by an external digital input. Output voltages can be any combination of voltages from the Ordering Guide.

#### Higher Output Current

The ADP3301 can source up to 100 mA without any heatsink or pass transistor. If higher current is needed, an appropriate pass transistor can be used, as in Figure 22, to increase the output current to 1 A.

#### Step-Up/Step-Down Post Regulator

The circuit in Figure 23 provides a high precision, low dropout regulated output voltage. It significantly reduces the ripple from a switching regulator. The ADP3000 used in this circuit is a switching regulator in the step-up configuration.

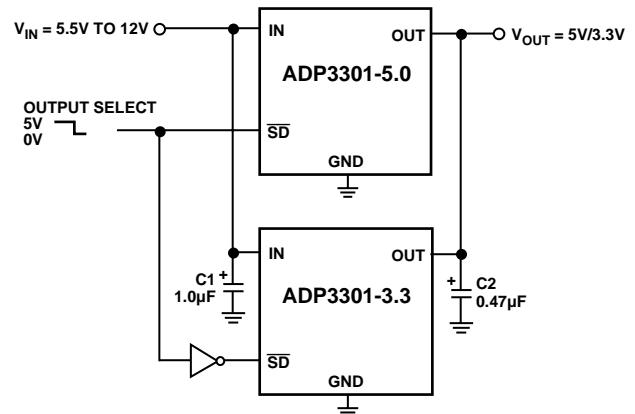


Figure 21. Crossover Switch

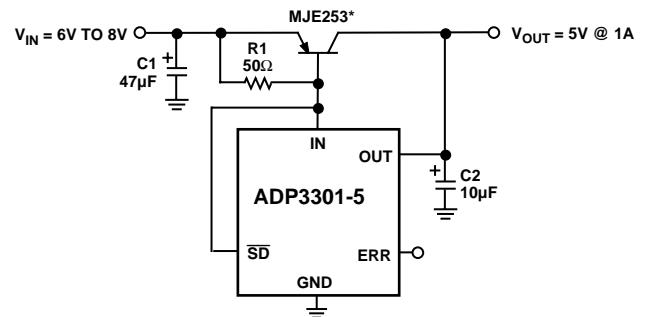


Figure 22. High Output Current Linear Regulator

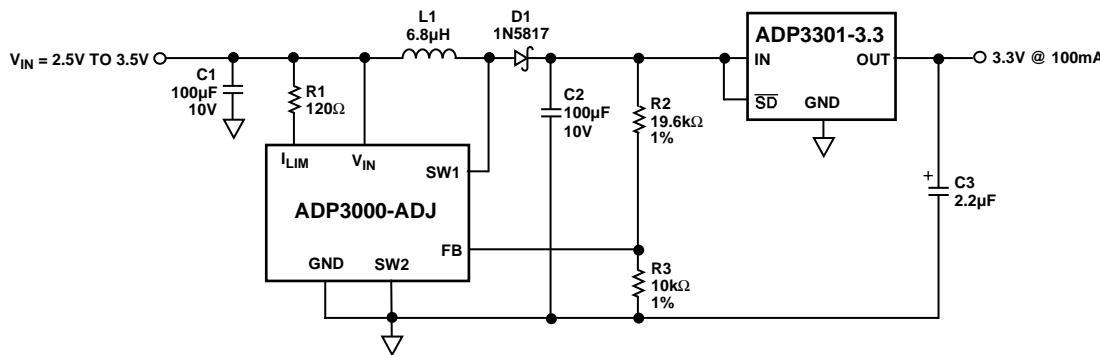


Figure 23. Step-Up/Step-Down Post Regulator

## OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

### 8-Pin Small Outline Package (SO-8)

