

ADP3333

FEATURES

**High Accuracy Over Line and Load: $\pm 0.8\%$ @ 25°C,
 $\pm 1.8\%$ Over Temperature**
Ultralow Dropout Voltage: 230 mV (Max) @ 300 mA
Requires Only $C_O = 1.0 \mu\text{F}$ for Stability
**anyCAP = Stable with Any Type of Capacitor
 (Including MLCC)**
Current and Thermal Limiting
Low Noise
Low Shutdown Current: $< 1 \mu\text{A}$
2.6 V to 12 V Supply Range
-40°C to +85°C Ambient Temperature Range
Ultrasmall 8-Lead MSOP Package

APPLICATIONS

Cellular Phones
PCMCIA Cards
Personal Digital Assistants (PDAs)
DSP/ASIC Supplies

GENERAL DESCRIPTION

ADP3333 is a member of the ADP333x family of precision low dropout anyCAP voltage regulators. Pin-compatible with the MAX8860, the ADP3333 operates with a wider input voltage range of 2.6 V to 12 V and delivers a load current up to 300 mA. ADP3333 stands out from other conventional LDOs with a novel architecture and an enhanced process that enables it to offer performance advantages over its competition. Its patented design requires only a $1.0 \mu\text{F}$ output capacitor for stability. This device is insensitive to output capacitor Equivalent Series Resistance (ESR), and is stable with any good quality capacitor, including ceramic (MLCC) types for space-restricted applications. ADP3333 achieves exceptional accuracy of $\pm 0.8\%$ at room temperature and $\pm 1.8\%$ over temperature, line and load variations. The dropout voltage of ADP3333 is only 140 mV (typical) at 300 mA. This device also includes a safety current limit, thermal overload protection and a shutdown limit. In shutdown mode, the ground current is reduced to less than $1 \mu\text{A}$. The ADP3333 has ultralow quiescent current, $70 \mu\text{A}$ (typ) in light load situations.

FUNCTIONAL BLOCK DIAGRAM

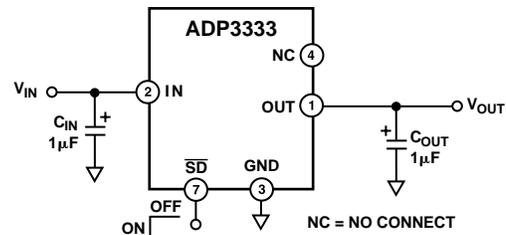
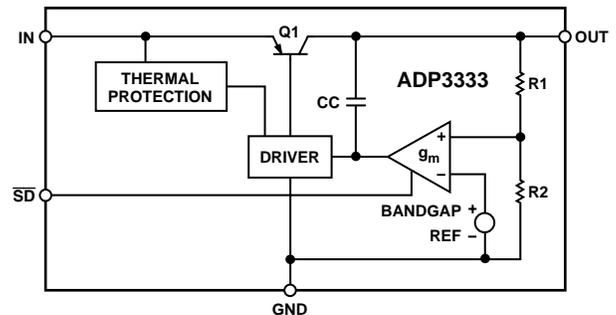


Figure 1. Typical Application Circuit

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ADP3333–SPECIFICATIONS¹ ($V_{IN} = 6.0\text{ V}$, $C_{IN} = C_{OUT} = 1.0\ \mu\text{F}$, $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
OUTPUT						
Voltage Accuracy ²	V_{OUT}	$V_{IN} = V_{OUTNOM}$ 0.3 V to 12 V $I_L = 0.1\text{ mA}$ to 300 mA $T_J = 25^\circ\text{C}$	0.8		0.8	%
		$V_{IN} = V_{OUTNOM}$ 0.3 V to 12 V $I_L = 0.1\text{ mA}$ to 300 mA $T_J = 25^\circ\text{C}$	-1.8		+1.8	%
Line Regulation ²		$V_{IN} = V_{OUTNOM}$ 0.3 V to 12 V $T_J = 25^\circ\text{C}$		0.04		mV/V
Load Regulation		$I_L = 0.1\text{ mA}$ to 300 mA $T_J = 25^\circ\text{C}$		0.04		mV/mA
Dropout Voltage	V_{DROP}	$V_{OUT} = 98\%$ of V_{OUTNOM} $I_L = 300\text{ mA}$		140	230	mV
		$I_L = 200\text{ mA}$		105	185	mV
		$I_L = 0.1\text{ mA}$		30		mV
Peak Load Current	I_{LDPK}	$V_{IN} = V_{OUTNOM} + 1\text{ V}$		600		mA
Output Noise	V_{NOISE}	$f = 10\text{ Hz}$ -100 kHz, $C_L = 10\ \mu\text{F}$ $I_L = 300\text{ mA}$		45		$\mu\text{V rms}$
GROUND CURRENT						
In Regulation	I_{GND}	$I_L = 300\text{ mA}$		2.0	5.5	mA
		$I_L = 300\text{ mA}$, $T_J = 25^\circ\text{C}$		2.0	4.3	mA
		$I_L = 300\text{ mA}$, $T_J = 85^\circ\text{C}$		1.5	3.3	mA
		$I_L = 200\text{ mA}$		1.4		mA
		$I_L = 10\text{ mA}$		200	275	μA
In Dropout	I_{GND}	$I_L = 0.1\text{ mA}$ $V_{IN} = V_{OUTNOM} - 100\text{ mV}$		70	100	μA
		$I_L = 0.1\text{ mA}$, $V_{IN} = V_{OUTNOM} - 100\text{ mV}$		70	160	μA
In Shutdown	I_{GNDSD}	$I_L = 0.1\text{ mA}$, $T_J = 0^\circ\text{C}$ to 125°C $SD = 0\text{ V}$, $V_{IN} = 12\text{ V}$		0.01	1	μA
SHUTDOWN						
Threshold Voltage	$V_{\overline{THSD}}$	ON	2.0			V
		OFF			0.4	V
\overline{SD} Input Current	$I_{\overline{SD}}$	$0 \leq \overline{SD} \leq 12\text{ V}$		0.85	7	μA
		$0 \leq \overline{SD} \leq 5\text{ V}$		0.8	4.5	μA
Output Current In Shutdown	$I_{\overline{OSD}}$	$T_J = 25^\circ\text{C}$ $V_{IN} = 12\text{ V}$ $T_J = 125^\circ\text{C}$ $V_{IN} = 12\text{ V}$		0.01	1	μA

NOTES

¹Application stable with no load.

² $V_{IN} = 2.6\text{ V}$ for models with $V_{OUTNOM} \leq 2.3\text{ V}$.

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
Power Dissipation	Internally Limited
Operating Ambient Temperature Range	-40°C to +85°C
Operating Junction Temperature Range	-40°C to +125°C
θ_{JA} (4-layer)	158°C/W
θ_{JA} (2-layer)	220°C/W
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 sec)	300°C
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C

*This is a stress rating only; operation beyond these limits can cause the device to be permanently damaged.

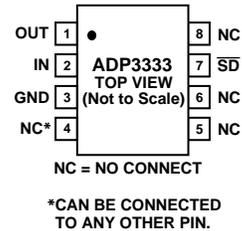
PIN FUNCTION DESCRIPTIONS

Pin	Mnemonic	Function
1	OUT	Output of the Regulator. Bypass to ground with a 1.0 μ F or larger capacitor.
2	IN	Input pin. Bypass to ground with a 1.0 μ F or larger capacitor.
3	GND	Ground Pin
4-6, 8	NC	No Connect
7	\overline{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

ORDERING GUIDE

Model	Output Voltage	Package Option	Branding Information
ADP3333ARM-1.5	1.5 V	RM-8 (MSOP-8)	LKA
ADP3333ARM-1.8	1.8 V	RM-8 (MSOP-8)	LKB
ADP3333ARM-2.5	2.5 V	RM-8 (MSOP-8)	LKC
ADP3333ARM-2.77	2.77 V	RM-8 (MSOP-8)	LKD
ADP3333ARM-3	3 V	RM-8 (MSOP-8)	LKE
ADP3333ARM-3.15	3.15 V	RM-8 (MSOP-8)	LKF
ADP3333ARM-3.3	3.3 V	RM-8 (MSOP-8)	LKG
ADP3333ARM-5	5 V	RM-8 (MSOP-8)	LKH

PIN CONFIGURATION

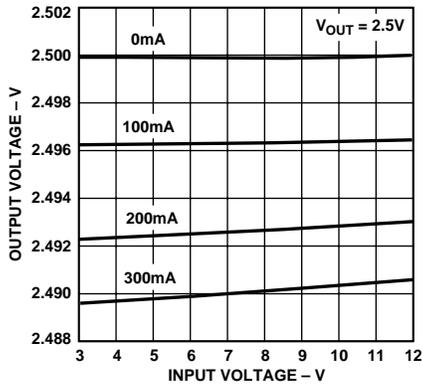


CAUTION

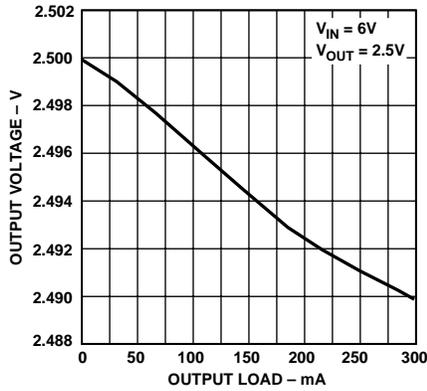
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADP3333 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



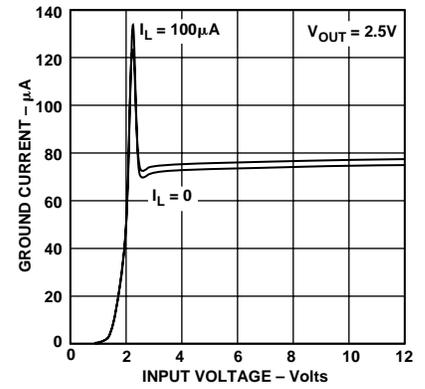
ADP3333–Typical Performance Characteristics



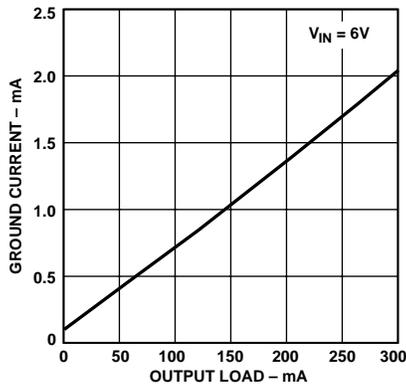
TPC 1. Line Regulation Output Voltage vs. Supply Voltage



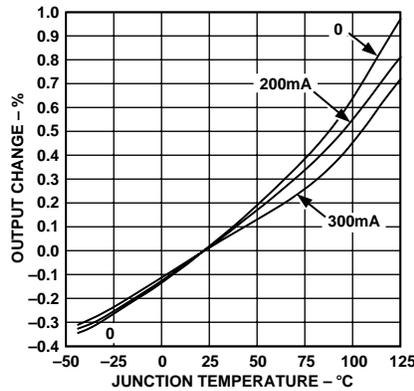
TPC 2. Output Voltage vs. Load Current



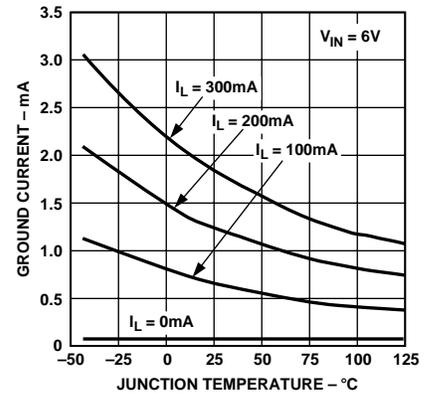
TPC 3. Ground Current vs. Supply Voltage



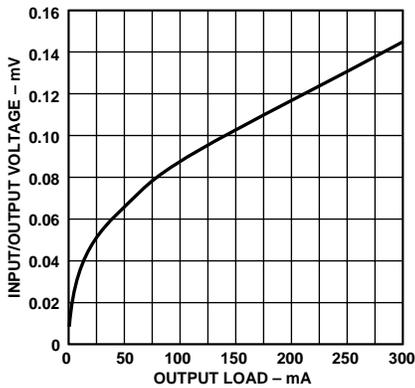
TPC 4. Ground Current vs. Load Current



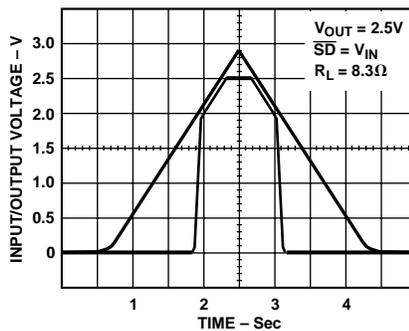
TPC 5. Output Voltage Variation % vs. Junction Temperature



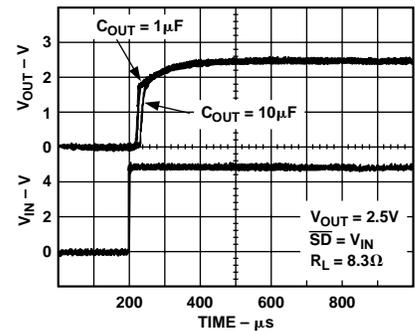
TPC 6. Ground Current vs. Junction Temperature



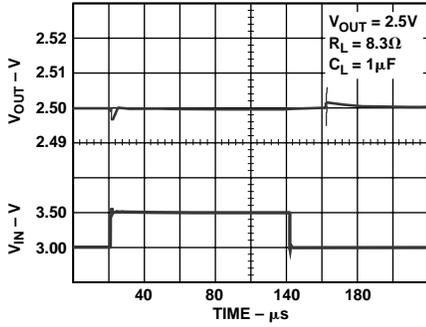
TPC 7. Dropout Voltage vs. Output Current



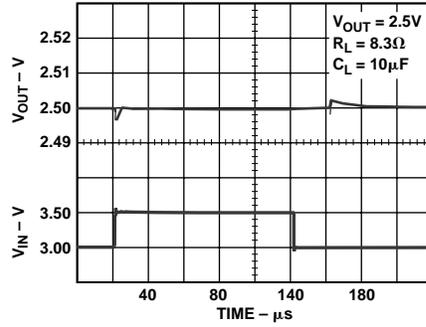
TPC 8. Power-Up/Power-Down



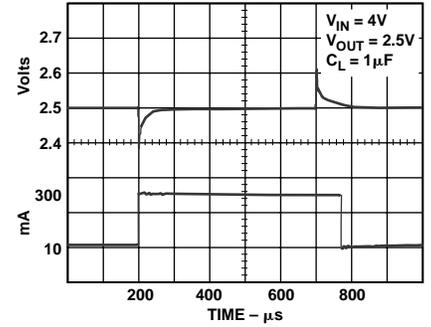
TPC 9. Power-Up Response



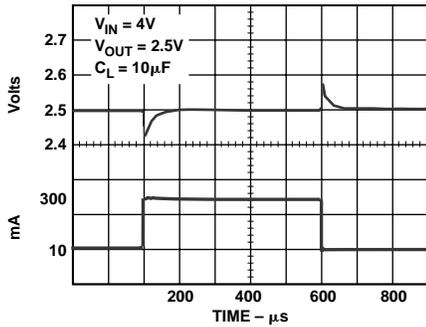
TPC 10. Line Transient Response



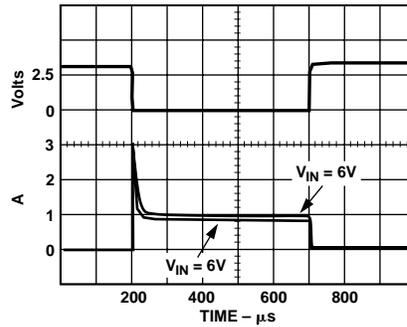
TPC 11. Line Transient Response



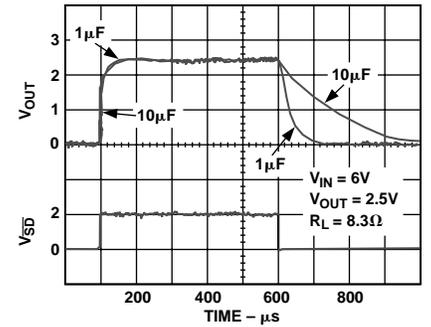
TPC 12. Load Transient Response



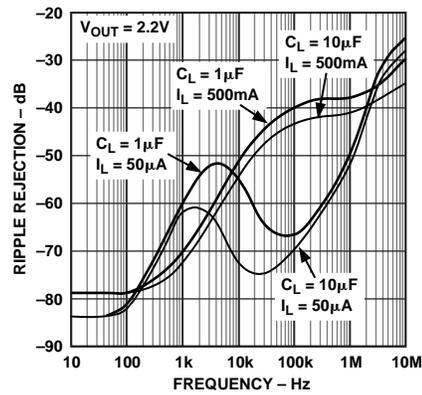
TPC 13. Load Transient Response



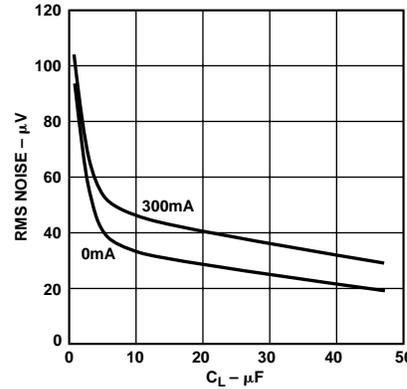
TPC 14. Short Circuit Current



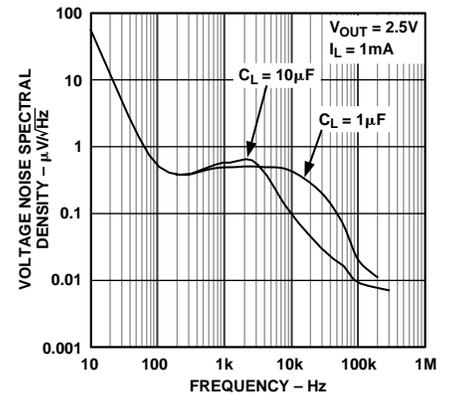
TPC 15. Turn ON-Turn OFF Response



TPC 16. Power Supply Ripple Rejection



TPC 17. RMS Noise vs. C_L (10 Hz–100 kHz)



TPC 18. Output Noise Density

Calculating Junction Temperature

Device power dissipation is calculated as follows:

$$P_D = (V_{IN} - V_{OUT}) I_{LOAD} + (V_{IN}) I_{GND}$$

Where I_{LOAD} and I_{GND} are load current and ground current, V_{IN} and V_{OUT} are the input and output voltages respectively.

Assuming the worst-case operating conditions are $I_{LOAD} = 300$ mA, $I_{GND} = 2.6$ mA, $V_{IN} = 4.0$ V and $V_{OUT} = 3.0$ V, the device power dissipation is:

$$P_D = (4.0\text{ V} - 3.0\text{ V}) 300\text{ mA} + (4.2\text{ V}) 2.0\text{ mA} = 308\text{ mW}$$

The package used on the ADP3333 has a thermal resistance of $158^\circ\text{C}/\text{W}$ for 4-layer boards. The junction temperature rise above ambient will be approximately equal to:

$$T_{JA} = 0.308\text{ W} \times 158^\circ\text{C} / \text{W} = 48.7^\circ\text{C}$$

So, to limit the junction temperature to 125°C , the maximum allowable ambient temperature is:

$$T_{A(MAX)} = 125^\circ\text{C} - 48.7^\circ\text{C} = 76.3^\circ\text{C}$$

Shutdown Mode

Applying a high signal to the shutdown pin, or connecting it to the input pin, will turn the output ON. Pulling the shutdown pin to 0.3 V or below, or connecting it to ground, will turn the output OFF. In shutdown mode, the quiescent current is reduced to less than 1 μA .

Printed Circuit Board Layout Considerations

Use the following general guidelines when designing printed circuit boards:

1. Keep the output capacitor as close to the output and ground pins as possible.
2. Keep the input capacitor as close to the input and ground pins as possible.
3. PC board traces with larger cross sectional areas will remove more heat from the ADP3333. For optimum heat transfer, specify thick copper and use wide traces.
4. Connect the NC pins (Pins 5, 6, and 8) to ground for better thermal performance.
5. The thermal resistance can be decreased by approximately 10% by adding a few square centimeters of copper area to the lands connected to the pins of the LDO.
6. Use additional copper layers or planes to reduce the thermal resistance. Again, connecting the other layers to the ground and NC pins of the ADP3333 is best, but not necessary. When connecting the ground pad to other layers use multiple vias.

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

**8-Lead Mini/micro SOIC Package [Mini_SO]
(RM-8)**

