LP2986

LP2986 Micropower, 200 mA Ultra Low-Dropout Fixed or Adjustable Voltage Regulator

Literature Number: SNVS137G

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National Semiconductor

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Micropower, 200 mA Ultra Low-Dropout Fixed or Adjustable Voltage Regulator

General Description

The LP2986 is a 200 mA precision LDO voltage regulator which offers the designer a higher performance version of the industry standard LP2951.

Using an optimized VIP™ (Vertically Integrated PNP) process, the LP2986 delivers superior performance:

Dropout Voltage: Typically 180 mV @ 200 mA load, and 1 mV @ 1 mA load.

Ground Pin Current: Typically 1 mA @ 200 mA load, and 200 µA @ 10 mA load.

Sleep Mode: The LP2986 draws less than 1 µA quiescent current when shutdown pin is pulled low.

Error Flag: The built-in error flag goes low when the output drops approximately 5% below nominal.

Precision Output: The standard product versions available can be pin-strapped (using the internal resistive divider) to provide output voltages of 5.0V, 3.3V, or 3.0V with guaranteed accuracy of 0.5% (“A” grade) and 1% (standard grade) at room temperature.

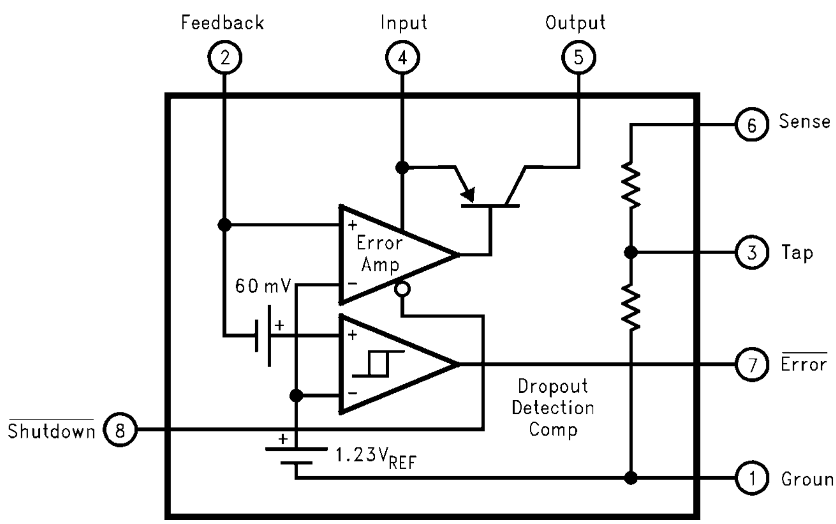
Features

- Ultra low dropout voltage
- Guaranteed 200 mA output current
- SO-8 and mini-SO8 surface mount packages
- <1 µA quiescent current when shutdown
- Low ground pin current at all loads
- 0.5% output voltage accuracy (“A” grade)
- High peak current capability (400 mA typical)
- Wide supply voltage range (16V max)
- Overtemperature/overcurrent protection
- −40°C to +125°C junction temperature range

Applications

- Cellular Phone
- Palmtop/Laptop Computer
- Camcorder, Personal Stereo, Camera

Block Diagram



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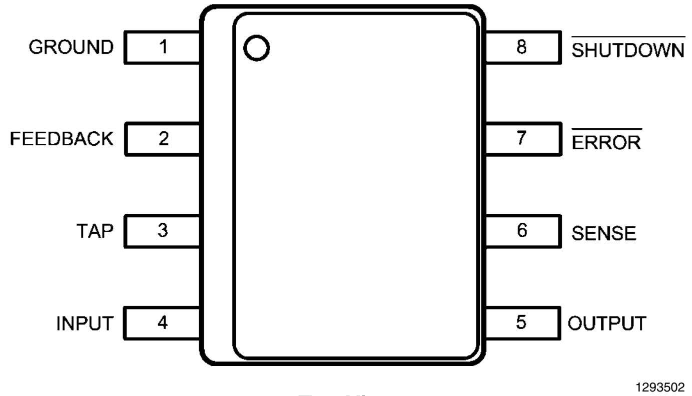
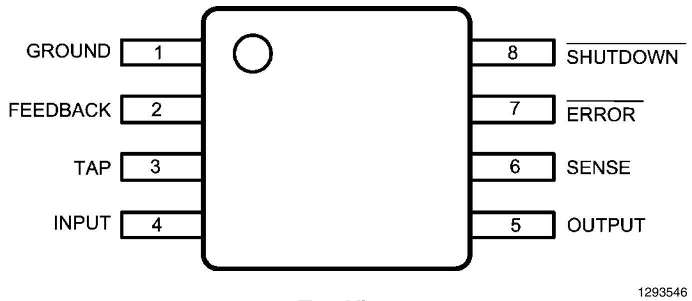
Connection Diagrams

8-Lead SOIC Narrow Package



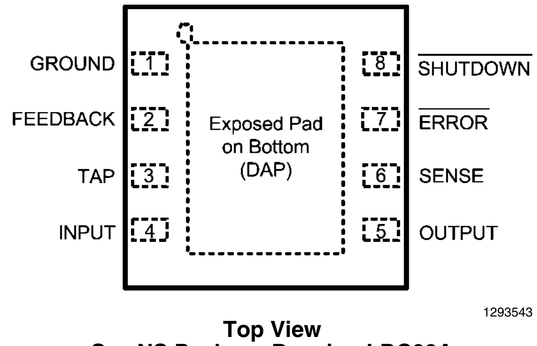
Top View
See NS Package Drawing Number M08A

8-Lead Mini-SOIC Package



Top View
See NS Package Drawing Number MUA08A

8-Lead LLP Package



Top View
See NS Package Drawing LDC08A
See *LLP MOUNTING* section

Ordering Information

TABLE 1. Package Marking and Ordering Information

Output Voltage	Grade	Order Information	Package Marking	Supplied as:
Mini SO-8				
5	A	LP2986AIMMX-5.0	L41A	3500 Units on Tape and Reel
5	A	LP2986AIMM-5.0	L41A	1000 Units on Tape and Reel
5	STD	LP2986IMMX-5.0	L41B	3500 Units on Tape and Reel
5	STD	LP2986IMM-5.0	L41B	1000 Units on Tape and Reel
3.3	A	LP2986AIMMX-3.3	L40A	3500 Units on Tape and Reel
3.3	A	LP2986AIMM-3.3	L40A	1000 Units on Tape and Reel
3.3	STD	LP2986IMMX-3.3	L40B	3500 Units on Tape and Reel
3.3	STD	LP2986IMM-3.3	L40B	1000 Units on Tape and Reel
3.0	A	LP2986AIMMX-3.0	L39A	3500 Units on Tape and Reel
3.0	A	LP2986AIMM-3.0	L39A	1000 Units on Tape and Reel
3.0	STD	LP2986IMMX-3.0	L39B	3500 Units on Tape and Reel
3.0	STD	LP2986IMM-3.0	L39B	1000 Units on Tape and Reel
SO-8				
5	A	LP2986AIMX-5.0	2986AIM5.0	2500 Units on Tape and Reel
5	A	LP2986AIM-5.0	2986AIM5.0	Shipped in Anti-Static Rails
5	STD	LP2986IMX-5.0	2986IM5.0	2500 Units on Tape and Reel
5	STD	LP2986IM-5.0	2986IM5.0	Shipped in Anti-Static Rails
3.3	A	LP2986AIMX-3.3	2986AIM3.3	2500 Units on Tape and Reel
3.3	A	LP2986AIM-3.3	2986AIM3.3	Shipped in Anti-Static Rails
3.3	STD	LP2986IMX-3.3	2986IM3.3	2500 Units on Tape and Reel
3.3	STD	LP2986IM-3.3	2986IM3.3	Shipped in Anti-Static Rails
3.0	A	LP2986AIMX-3.0	2986AIM3.0	2500 Units on Tape and Reel
3.0	A	LP2986AIM-3.0	2986AIM3.0	Shipped in Anti-Static Rails
3.0	STD	LP2986IMX-3.0	2986IM3.0	2500 Units on Tape and Reel
3.0	STD	LP2986IM-3.0	2986IM3.0	Shipped in Anti-Static Rails
8-Lead LLP				
5	A	LP2986AILD-5	L006A	1000 Units on Tape and Reel
5	A	LP2986AILDX-5	L006A	4500 Units on Tape and Reel
5	STD	LP2986ILD-5	L006AB	1000 Units on Tape and Reel
5	STD	LP2986ILDX-5	L006AB	4500 Units on Tape and Reel
3.3	A	LP2986AILD-3.3	L005A	1000 Units on Tape and Reel
3.3	A	LP2986AILDX-3.3	L005A	4500 Units on Tape and Reel
3.3	STD	LP2986ILD-3.3	L005AB	1000 Units on Tape and Reel
3.3	STD	LP2986ILDX-3.3	L005AB	4500 Units on Tape and Reel
3.0	A	LP2986AILD-3.0	L004A	1000 Units on Tape and Reel
3.0	A	LP2986AILDX-3.0	L004A	4500 Units on Tape and Reel
3.0	STD	LP2986ILD-3.0	L004AB	1000 Units on Tape and Reel
3.0	STD	LP2986ILDX-3.0	L004AB	4500 Units on Tape and Reel

For LP2986 Ordering and Availability Information see: http://www.national.com/mpf/LP/LP2986.html#Order

Absolute Maximum Ratings (Note 1)

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

Storage Temperature Range	−65°C to +150°C
Operating Junction Temperature Range	−40°C to +125°C
Lead Temperature (Soldering, 5 seconds)	260°C
ESD Rating (Note 2)	2 kV
Power Dissipation (Note 3)	Internally Limited
Input Supply Voltage (Survival)	−0.3V to +16V
Input Supply Voltage (Operating)	2.1V to +16V
Shutdown Pin	−0.3V to +16V
Feedback Pin	−0.3V to +5V
Output Voltage (Survival) (Note 4)	−0.3V to +16V
I_{OUT} (Survival)	Short Circuit Protected
Input-Output Voltage (Survival) (Note 5)	−0.3V to +16V

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: $V_{IN} = V_O(NOM) + 1V$, I_L = 1 mA, C_{OUT} = 4.7 µF, C_{IN} = 2.2 µF, $V_{S/D}$ = 2V.

Symbol	Parameter	Conditions	Typical	LM2986AI-X.X (Note 6)		LM2986I-X.X (Note 6)		Units
				Min	Max	Min	Max	
V_O	Output Voltage (5.0V Versions)		5.0	4.975	5.025	4.950	5.050	V
		0.1 mA < I_L < 200 mA	5.0	4.960	5.040	4.920	5.080	
				4.910	**5.090**	**4.860**	**5.140**	
	Output Voltage (3.3V Versions)		3.3	3.283	3.317	3.267	3.333	
		0.1 mA < I_L < 200 mA	3.3	3.274	3.326	3.247	3.353	
				3.241	**3.359**	**3.208**	**3.392**	
	Output Voltage (3.0V Versions)		3.0	2.985	3.015	2.970	3.030	
		0.1 mA < I_L < 200 mA	3.0	2.976	3.024	2.952	3.048	
				2.946	**3.054**	**2.916**	**3.084**	
$\frac{V_O}{\Delta V_{IN}}$	Output Voltage Line Regulation	$V_O(NOM) + 1V \le V_{IN} \le 16V$	0.007		0.014		0.014	%/V
					0.032		**0.032**	
$V_{IN}-V_O$	Dropout Voltage (Note 7)	I_L = 100 µA	1		2.0		2.0	mV
					3.5		**3.5**	
		I_L = 75 mA	90		120		120	
					170		**170**	
		I_L = 200 mA	180		230		230	
					350		**350**	
I_{GND}	Ground Pin Current	I_L = 100 µA	100		120		120	µA
					150		**150**	
		I_L = 75 mA	500		800		800	
					1400		**1400**	
		I_L = 200 mA	1		2.1		2.1	mA
					3.7		**3.7**	
		$V_{S/D}$ < 0.3V	0.05		**1.5**		**1.5**	µA
I_O(PK)	Peak Output Current	$V_{OUT} \ge V_O(NOM) - 5\%$	400	250		250		mA
I_O(MAX)	Short Circuit Current	R_L = 0 (Steady State) (Note 11)	400					
e_n	Output Noise Voltage (RMS)	BW = 300 Hz to 50 kHz, C_{OUT} = 10 µF	160					µV(RMS)
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Ripple Rejection	f = 1 kHz, C_{OUT} = 10 µF	65					dB
$\frac{\Delta V_{OUT}}{\Delta T}$	Output Voltage Temperature Coefficient	(Note 9)	20					ppm/°C

Symbol	Parameter	Conditions	Typical	LM2986AI-X.X (Note 6)		LM2986I-X.X (Note 6)		Units
				Min	Max	Min	Max	
FEEDBACK PIN								
V_{FB}	Feedback Pin Voltage		1.23	1.21	1.25	1.20	1.26	V
				1.20	**1.26**	**1.19**	**1.27**	
		(Note 10)	1.23	**1.19**	**1.28**	**1.18**	**1.29**	
$\frac{\Delta V_{FB}}{\Delta T}$	FB Pin Voltage Temperature Coefficient	(Note 9)	20					ppm/°C
I_{FB}	Feedback Pin Bias Current	I_L = 200 mA	150		330		330	nA
					760		**760**	
$\frac{I_{FB}}{\Delta T}$	FB Pin Bias Current Temperature Coefficient	(Note 9)	0.1					nA/°C
SHUTDOWN INPUT								
$V_{S/D}$	S/D Input Voltage (Note 8)	V_H = O/P ON	1.4	**1.6**		**1.6**		V
		V_L = O/P OFF	0.55		**0.18**		**0.18**	
$I_{S/D}$	S/D Input Current	$V_{S/D}$ = 0	0		**–1**		**–1**	µA
		$V_{S/D}$ = 5V	5		**15**		**15**	
ERROR COMPARATOR								
I_{OH}	Output “HIGH” Leakage	V_{OH} = 16V	0.01		1		1	µA
					2		**2**	
V_{OL}	Output “LOW” Voltage	V_{IN} = V_O(NOM) – 0.5V, I_O (COMP) = 300 µA	150		220		220	mV
					350		**350**	
V_{THR} (MAX)	Upper Threshold Voltage		–4.6	–5.5	–3.5	–5.5	–3.5	$\%V_{OUT}$
				–7.7	**–2.5**	**–7.7**	**–2.5**	
V_{THR} (MIN)	Lower Threshold Voltage		–6.6	–8.9	–4.9	–8.9	–4.9	
				–13.0	**–3.3**	**–13.0**	**–3.3**	
HYST	Hysteresis		2.0					

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 ESD rating of the Feedback pin is 500V. The ESD rating of the V_{IN} pin is 1kV and the Tap pin is 1.5 kV.

Note 3: The maximum allowable power dissipation is a function of the maximum junction temperature, T_J(MAX), the junction-to-ambient thermal resistance, θ_{J-A}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using:

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

The value of θ_{J-A} for the SO-8 (M) package is 160°C/W, and the mini SO-8 (MM) package is 200°C/W. The value θ_{J-A} for the LLP (LD) package is specifically dependent on PCB trace area, trace material, and the number of layers and thermal vias. For improved thermal resistance and power dissipation for the LLP package, refer to Application Note AN-1187. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown.

Note 4: If used in a dual-supply system where the regulator load is returned to a negative supply, the LM2986 output must be diode-clamped to ground.

Note 5: The output PNP structure contains a diode between the V_{IN} and V_{OUT} terminals that is normally reverse-biased. Forcing the output above the input will turn on this diode and may induce a latch-up mode which can damage the part (see Application Hints).

Note 6: Limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate National's Average Outgoing Quality Level (AOQL).

Note 7: Dropout voltage is defined as the input to output differential at which the output voltage drops 100 mV below the value measured with a 1V differential.

Note 8: To prevent mis-operation, the Shutdown input must be driven by a signal that swings above V_H and below V_L with a slew rate not less than 40 mV/µs (see Application Hints).

Note 9: Temperature coefficient is defined as the maximum (worst-case) change divided by the total temperature range.

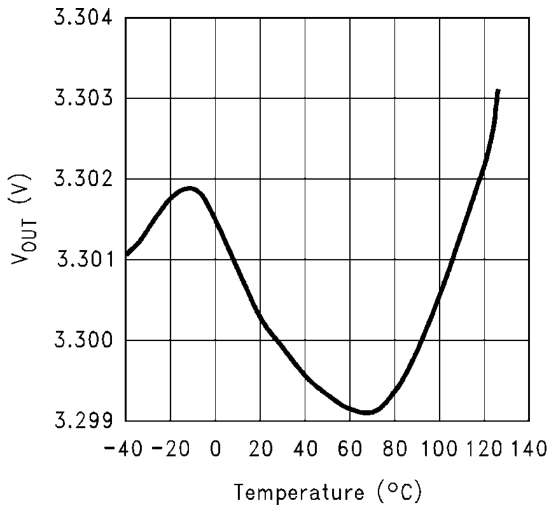
Note 10: $V_{FB} \leq V_{OUT} \leq (V_{IN} - 1)$, $2.5V \leq V_{IN} \leq 16V$, $100\ \mu A \leq I_L \leq 200$ mA, $T_J \leq 125°C$.

Note 11: See Typical Performance Characteristics curves.

Typical Performance Characteristics

Unless otherwise specified: T_A = 25°C, C_{OUT} = 4.7 µF, C_{IN} = 2.2 µF, S/D is tied to V_{IN}, V_{IN} = V_O(NOM) + 1V, I_L = 1 mA.

V_{OUT} vs Temperature



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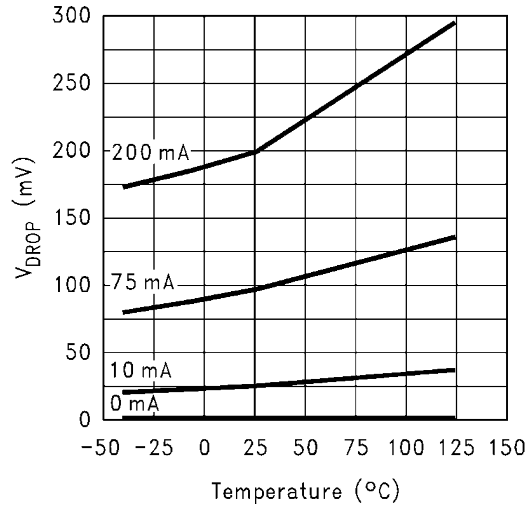
Dropout Voltage vs Temperature



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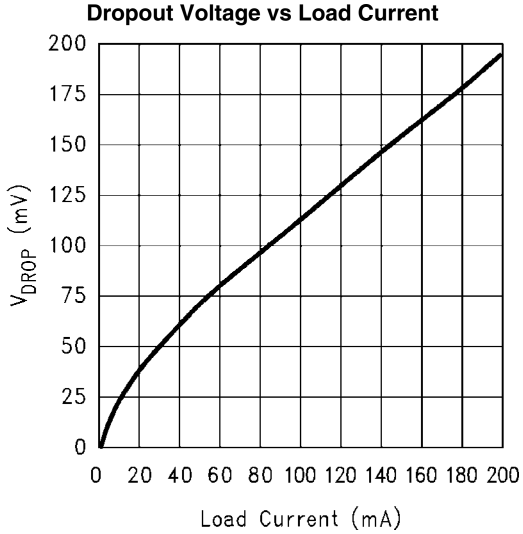
Dropout Voltage vs Load Current



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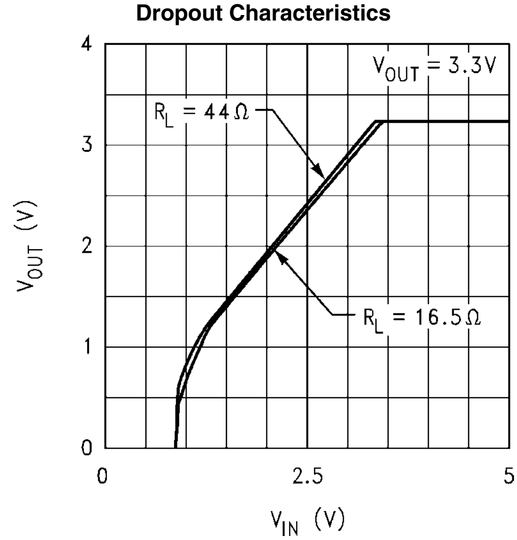
Dropout Characteristics



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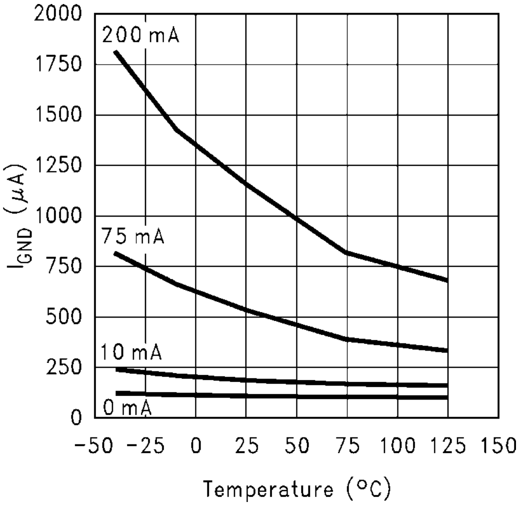
Ground Pin Current vs Temperature and Load



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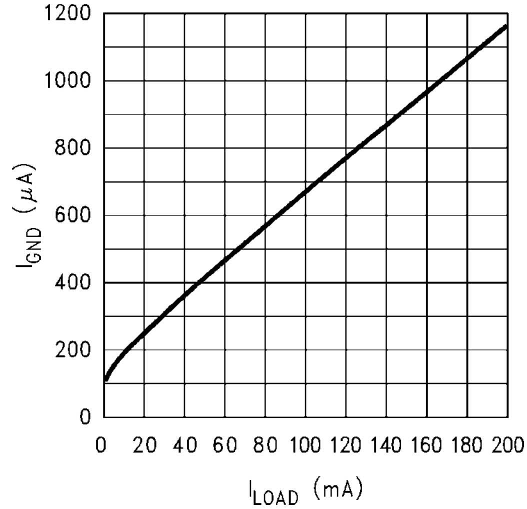
Ground Pin Current vs Load Current



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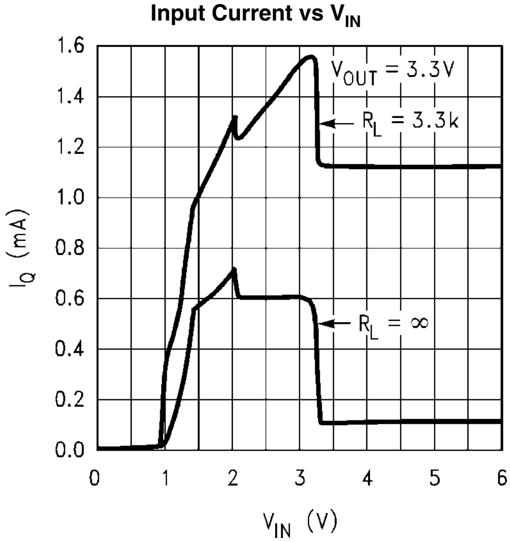
Input Current vs V_{IN}



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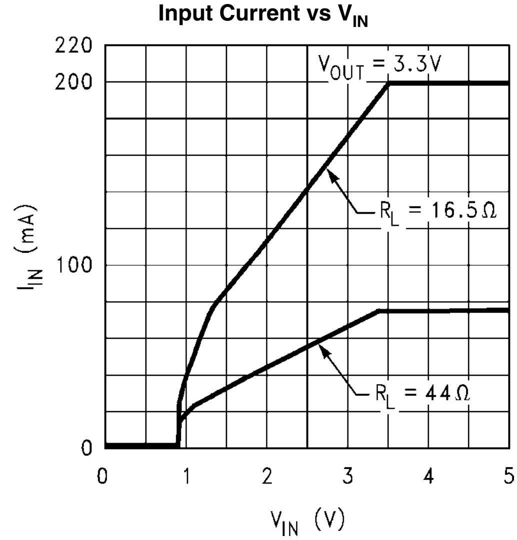
Input Current vs V_{IN}



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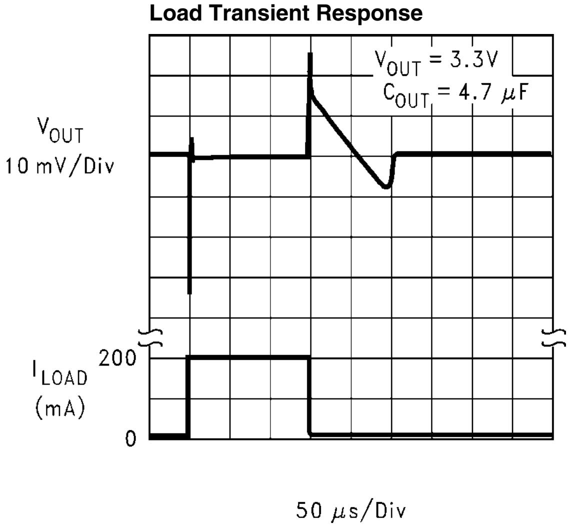
Load Transient Response



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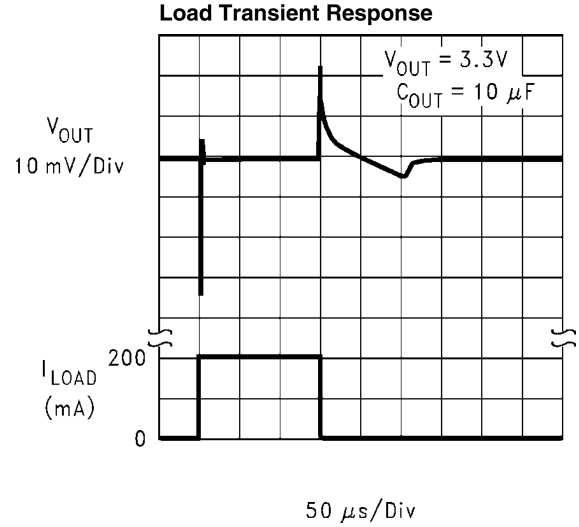
Load Transient Response



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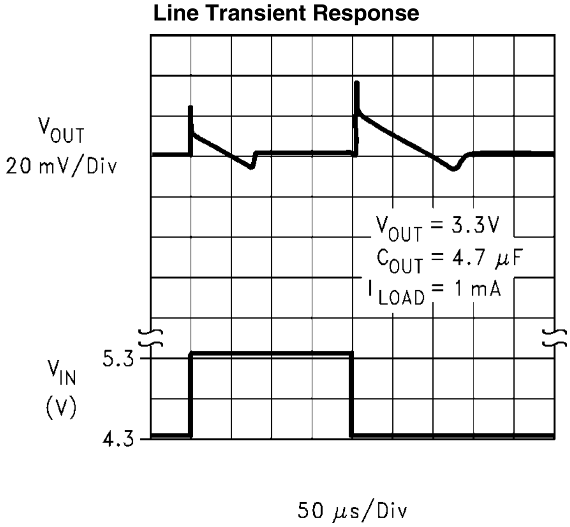
Line Transient Response



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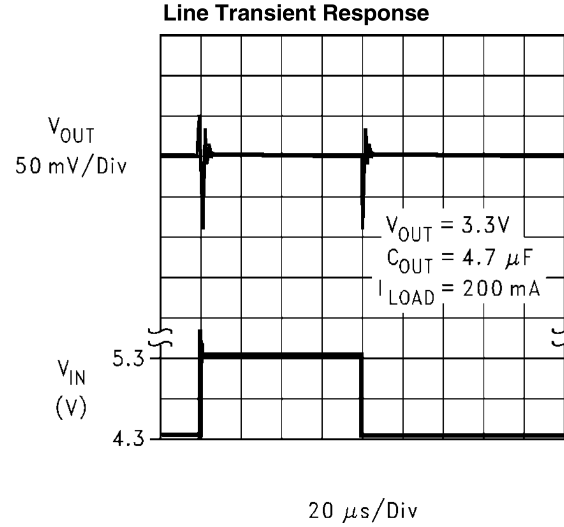
Line Transient Response



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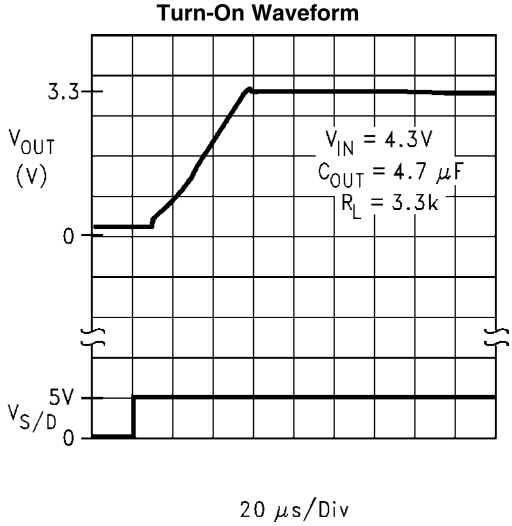
Turn-On Waveform



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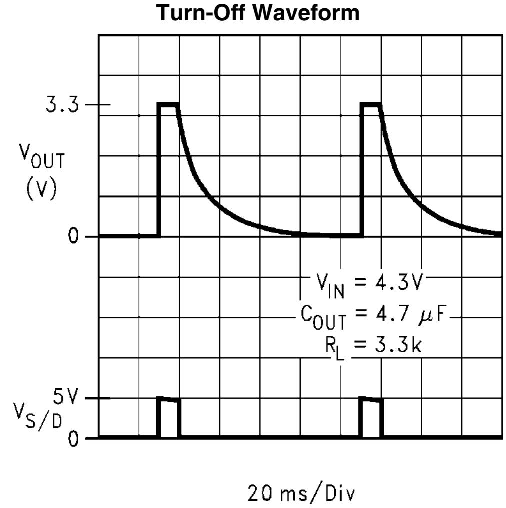
Turn-Off Waveform



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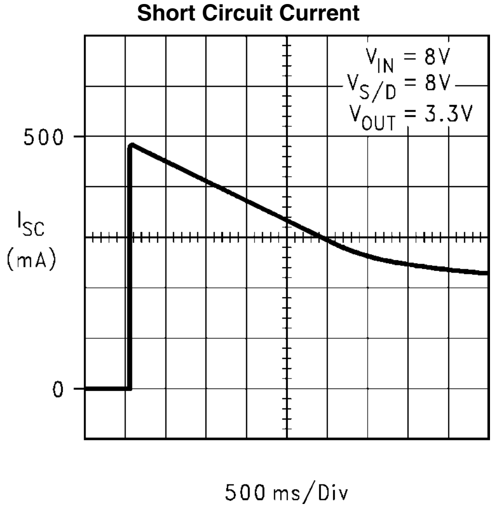
Short Circuit Current



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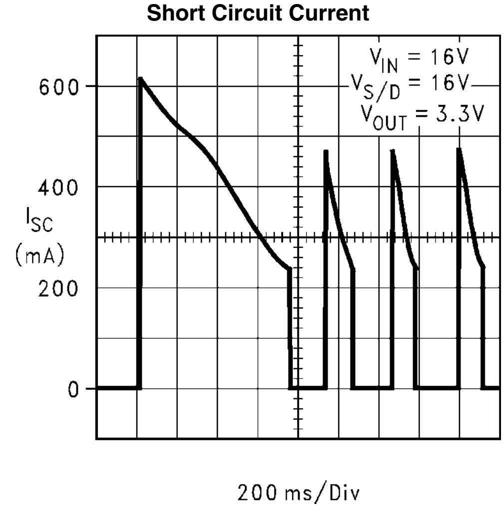
Short Circuit Current



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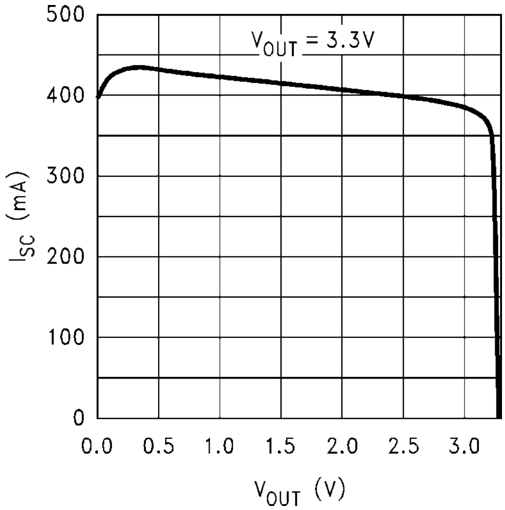
Short Circuit Current vs Output Voltage



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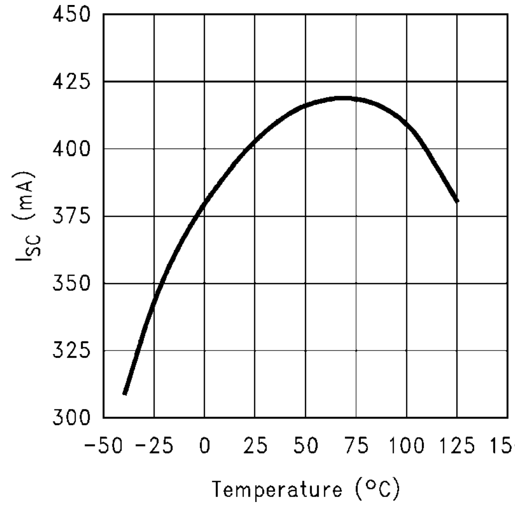
Instantaneous Short Circuit Current vs Temperature



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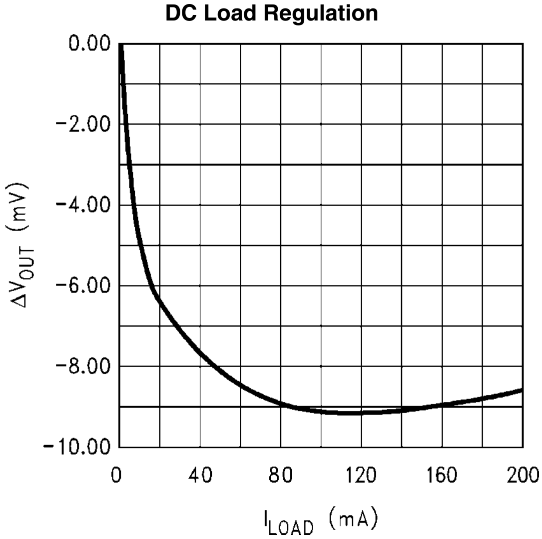
DC Load Regulation



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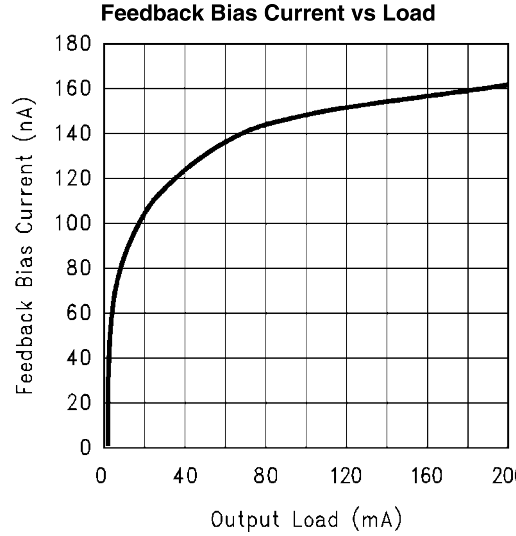
Feedback Bias Current vs Load



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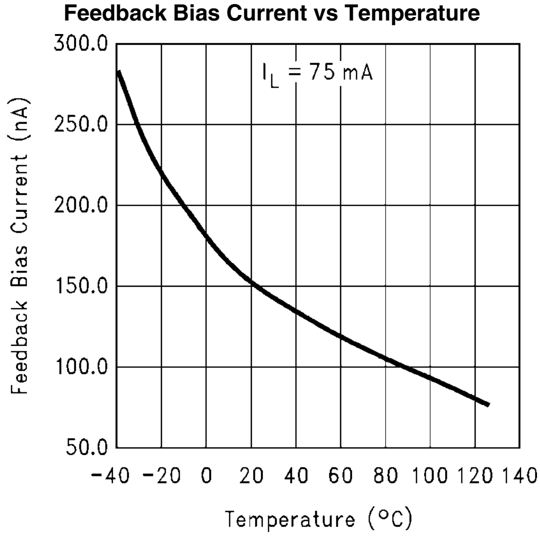
Feedback Bias Current vs Temperature



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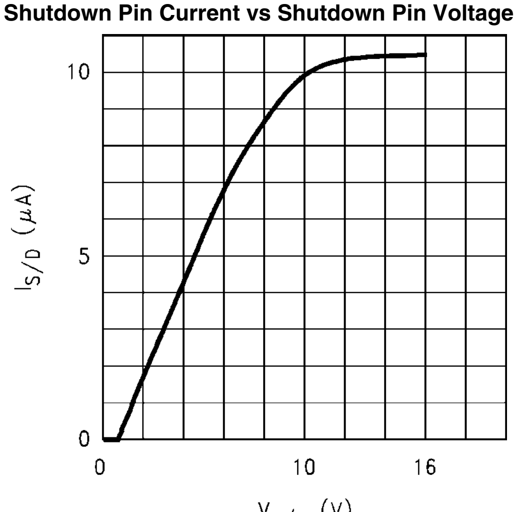
Shutdown Pin Current vs Shutdown Pin Voltage



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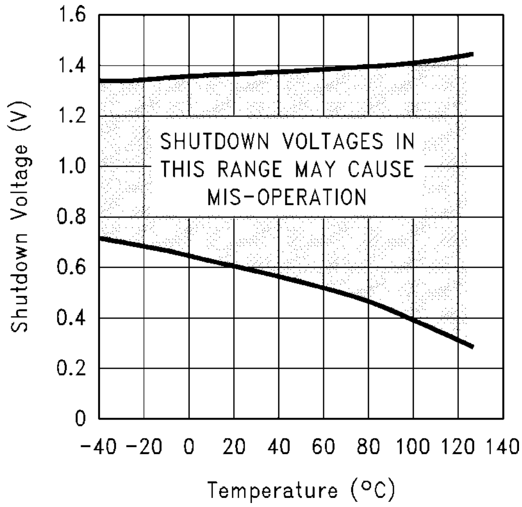
Shutdown Voltage vs Temperature



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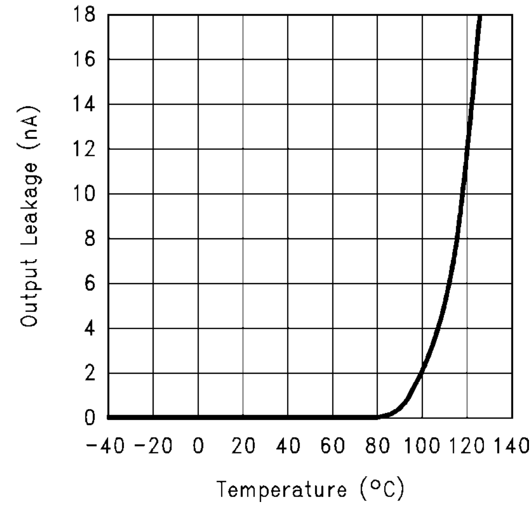
Input to Output Leakage vs Temperature



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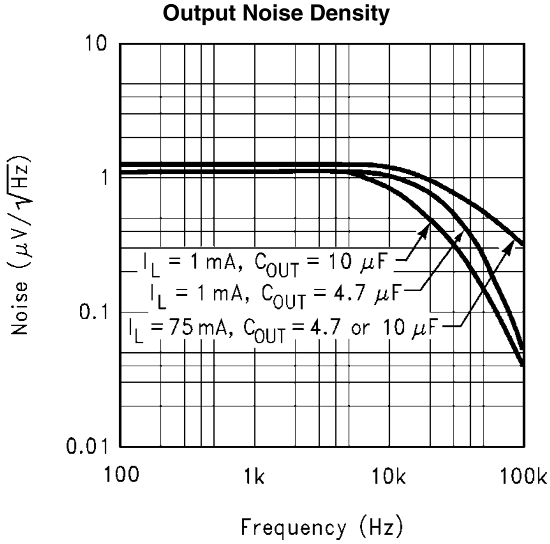
Output Noise Density



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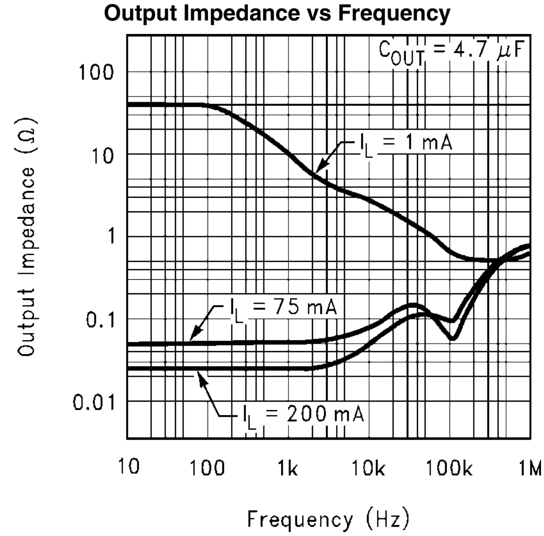
Output Impedance vs Frequency



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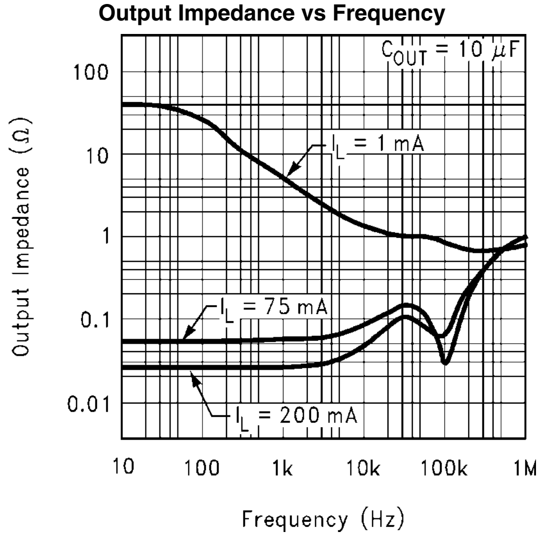
Output Impedance vs Frequency



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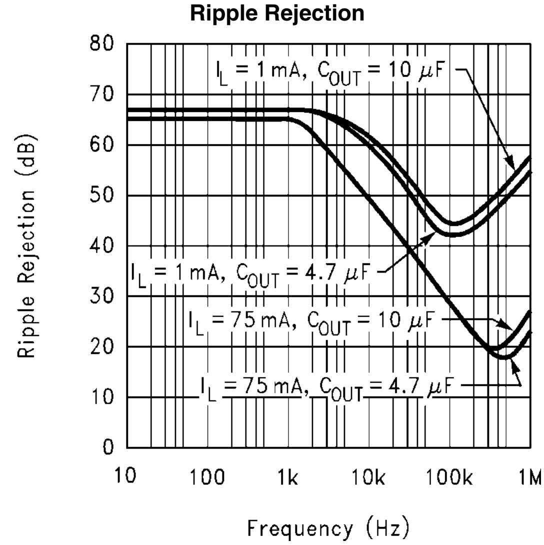
Ripple Rejection



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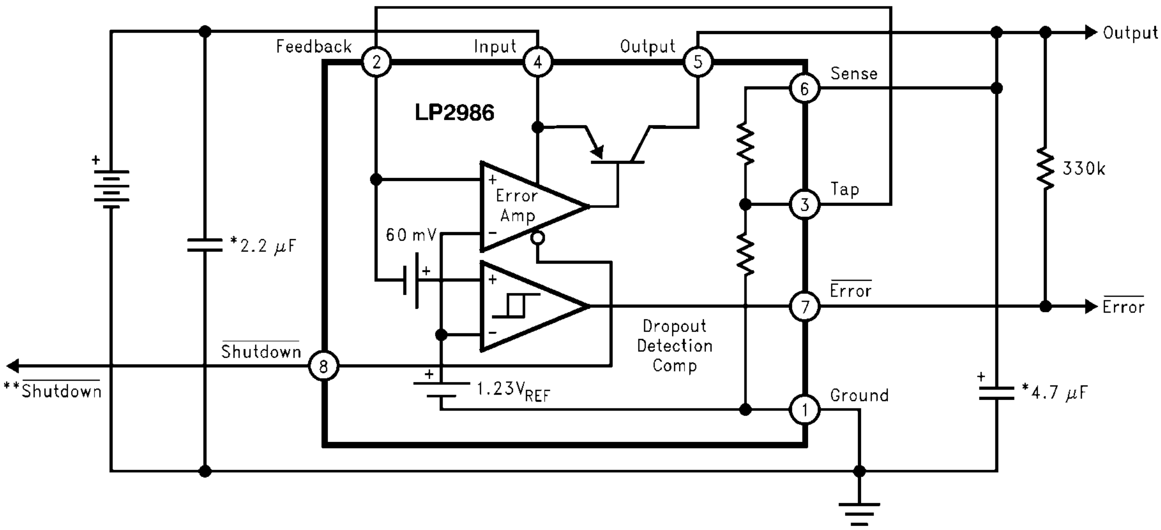
Basic Application Circuits

Application Using Internal Resistive Divider



* Minimum capacitance shown to assure stability, but may be increased without limit. Larger output capacitor provides improved dynamic response.

** Shutdown input must be actively terminated. Tie to V_{IN} if not used.

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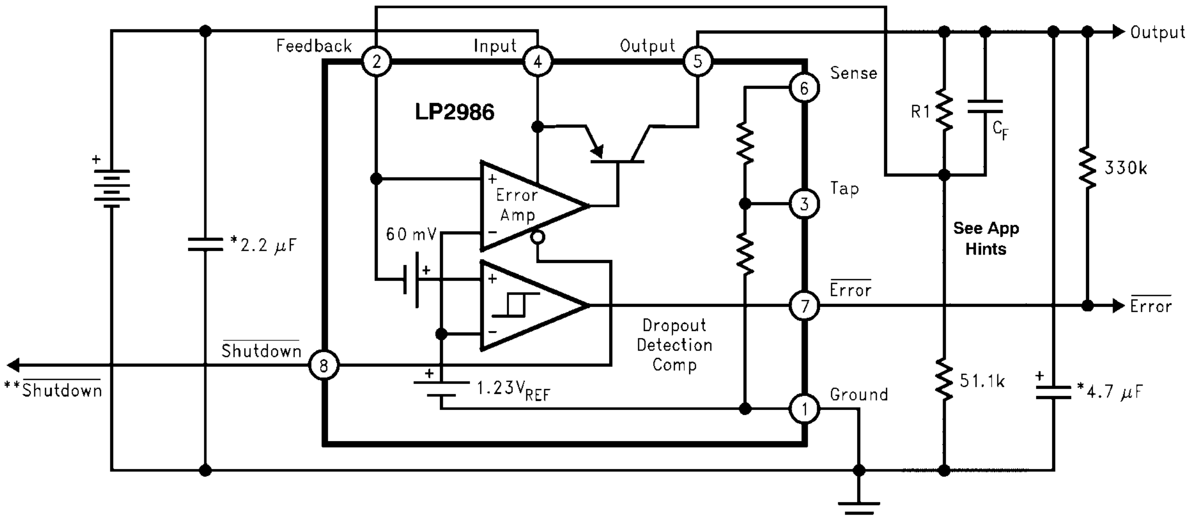
Application Using External Divider



* Minimum capacitance shown to assure stability, but may be increased without limit. Larger output capacitor provides improved dynamic response.

** Shutdown input must be actively terminated. Tie to V_{IN} if not used.

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Application Hints

LLP PACKAGE DEVICES

The LP2986 is offered in the 8 lead LLP surface mount package to allow for increased power dissipation compared to the SO-8 and Mini SO-8. For details on LLP thermal performance as well as mounting and soldering specifications, refer to the *LLP MOUNTING* section.

EXTERNAL CAPACITORS

Like any low-dropout regulator, external capacitors are required to assure stability. These capacitors must be correctly selected for proper performance.

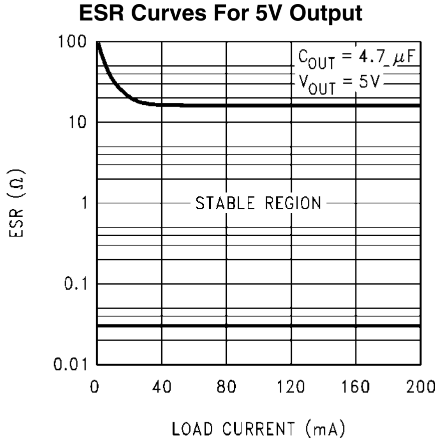
INPUT CAPACITOR: An input capacitor (≥ 2.2 µF) is required between the LP2986 input and ground (amount of capacitance may be increased without limit).

This capacitor must be located a distance of not more than 0.5” from the input pin and returned to a clean analog ground. Any good quality ceramic or tantalum may be used for this capacitor.

OUTPUT CAPACITOR: The output capacitor must meet the requirement for minimum amount of capacitance and also have an appropriate E.S.R. (equivalent series resistance) value.

Curves are provided which show the allowable ESR range as a function of load current for various output voltages and capacitor values (see ESR curves below).

ESR Curves For 5V Output



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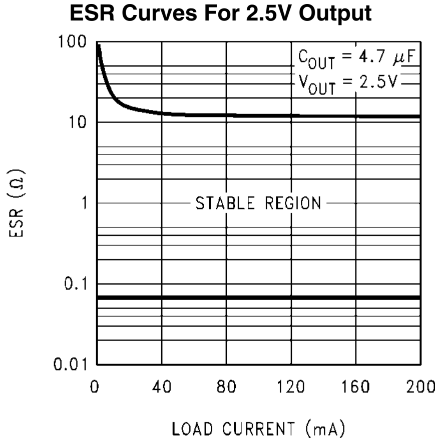
ESR Curves For 2.5V Output



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***IMPORTANT*:** The output capacitor must maintain its ESR in the stable region *over the full operating temperature range of the application* to assure stability.

The minimum required amount of output capacitance is 4.7 µF. Output capacitor size can be increased without limit.

It is important to remember that capacitor tolerance and variation with temperature must be taken into consideration when selecting an output capacitor so that the minimum required amount of output capacitance is provided over the full operating temperature range. A good Tantalum capacitor will show very little variation with temperature, but a ceramic may not be as good (see next section).

CAPACITOR CHARACTERISTICS

TANTALUM: The best choice for size, cost, and performance are solid tantalum capacitors. Available from many sources, their typical ESR is very close to the ideal value required on the output of many LDO regulators.

Tantalums also have good temperature stability: a 4.7 µF was tested and showed only a 10% decline in capacitance as the temperature was decreased from +125°C to –40°C. The ESR increased only about 2:1 over the same range of temperature.

However, it should be noted that the increasing ESR at lower temperatures present in all tantalums can cause oscillations when marginal quality capacitors are used (where the ESR of the capacitor is near the upper limit of the stability range at room temperature).

CERAMIC: For a given amount of a capacitance, ceramics are usually larger and more costly than tantalums.

Be warned that the ESR of a ceramic capacitor can be low enough to cause instability: a 2.2 µF ceramic was measured and found to have an ESR of about 15 mΩ.

If a ceramic capacitor is to be used on the LP2986 output, a 1Ω resistor should be placed in series with the capacitor to provide a minimum ESR for the regulator.

Another disadvantage of ceramic capacitors is that their capacitance varies a lot with temperature:

Large ceramic capacitors are typically manufactured with the Z5U temperature characteristic, which results in the capacitance dropping by a 50% as the temperature goes from 25°C to 80°C.

This means you have to buy a capacitor with twice the minimum C_{OUT} to assure stable operation up to 80°C.

ALUMINUM: The large physical size of aluminum electrolytics makes them unattractive for use with the LP2986. Their ESR characteristics are also not well suited to the requirements of LDO regulators.

The ESR of an aluminum electrolytic is higher than a tantalum, and it also varies greatly with temperature.

A typical aluminum electrolytic can exhibit an ESR increase of 50X when going from 20°C to –40°C. Also, some aluminum electrolytics can not be used below –25°C because the electrolyte will freeze.

USING AN EXTERNAL RESISTIVE DIVIDER

The LP2986 output voltage can be programmed using an external resistive divider (see Basic Application Circuits).

The resistor connected between the Feedback pin and ground should be 51.1k. The value for the other resistor (R1) connected between the Feedback pin and the regulated output is found using the formula:

$$V_{OUT} = V_{FB} \times (1 + (R1 / 51.1k))$$

It should be noted that the 25 µA of current flowing through the external divider is approximately equal to the current saved by not connecting the internal divider, which means the quiescent current is not increased by using external resistors.

A lead compensation capacitor (C_F) must also be used to place a zero in the loop response at about 50 kHz. The value for C_F can be found using:

$$C_F = 1/(2\pi \times R1 \times 50k)$$

A good quality capacitor must be used for C_F to ensure that the value is accurate and does not change significantly over temperature. Mica or ceramic capacitors can be used, assuming a tolerance of ±20% or better is selected.

If a ceramic is used, select one with a temperature coefficient of NPO, COG, Y5P, or X7R. Capacitor types Z5U, Y5V, and Z4V can not be used because their value varies more that 50% over the −25°C to +85°C temperature range.

SHUTDOWN INPUT OPERATION

The LP2986 is shut off by driving the Shutdown input low, and turned on by pulling it high. If this feature is not to be used, the Shutdown input should be tied to V_{IN} to keep the regulator output on at all times.

To assure proper operation, the signal source used to drive the Shutdown input must be able to swing above and below the specified turn-on/turn-off voltage thresholds listed as V_H and V_L, respectively (see Electrical Characteristics).

Since the Shutdown input comparator does not have hysteresis, It is also important that the turn-on (and turn-off) voltage signals applied to the Shutdown input have a slew rate which is not less than 40 mV/µs when moving between the V_H and V_L thresholds.

CAUTION: The regulator output state (either On or Off) can not be guaranteed if a slow-moving AC (or DC) signal is applied that is in the range between V_H and V_L.

LLP MOUNTING

The LDC08A (Pullback) 8-Lead LLP package requires specific mounting techniques which are detailed in National Semiconductor Application Note # 1187. Referring to the section ***PCB Design Recommendations*** in AN-1187 (Page 5), it should be noted that the pad style which should be used with this LLP package is the NSMD (non-solder mask defined) type. Additionally, for optimal reliability, there is a recommended 1:1 ratio between the package pad and the PCB pad for the Pullback LLP..

The thermal dissipation of the LLP package is directly related to the printed circuit board construction and the amount of additional copper area connected to the DAP.

The DAP (exposed pad) on the bottom of the LLP package is connected to the die substrate with a conductive die attach adhesive. The DAP has no direct electrical (wire) connection to any of the eight pins. There is a parasitic PN junction between the die substrate and the device ground. As such, it is strongly recommend that the DAP be connected directly to the ground at device lead 1 (i.e. GROUND). Alternately, but not recommended, the DAP may be left floating (i.e. no electrical connection). The DAP must not be connected to any potential other than ground.

For the LP2986 in the LDC08A 8-Lead LLP package, the junction-to-case thermal rating (θ_{JC}) is 7.2°C/W, where the 'case' is on the bottom of the package at the center of the DAP.

The junction-to-ambient thermal performance for the LP2986 in the LDC08A 8-Lead LLP package, using the JEDEC JESD51 standards is summarized in the following table:

Board Type	Thermal Vias	θ_{JC}	θ_{JA}
JEDEC 2-Layer JESD 51-3	None	7.2°C/W	184°C/W
JEDEC 4-Layer JESD 51-7	1	7.2°C/W	64°C/W
	2	7.2°C/W	55°C/W
	4	7.2°C/W	46°C/W
	6	7.2°C/W	43°C/W

REVERSE INPUT-OUTPUT VOLTAGE

The PNP power transistor used as the pass element in the LP2986 has an inherent diode connected between the regulator output and input.

During normal operation (where the input voltage is higher than the output) this diode is reverse-biased.

However, if the output voltage is pulled above the input, or the input voltage is pulled below the output, this diode will turn ON and current will flow into the regulator output pin.

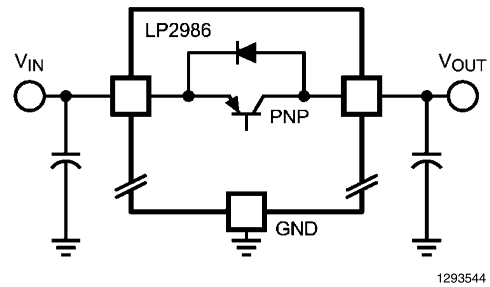


FIGURE 1. LP2986 Reverse Current Path

In such cases, a parasitic SCR can latch which will allow a high current to flow into V_{IN} (and out the ground pin), which can damage the part.

In any application where the output voltage may be higher than the input, an external Schottky diode must be connected from V_{IN} to V_{OUT} (cathode on V_{IN}, anode on V_{OUT}), to limit the reverse voltage across the LP2986 to 0.3V (see the *Absolute Maximum Ratings* section.

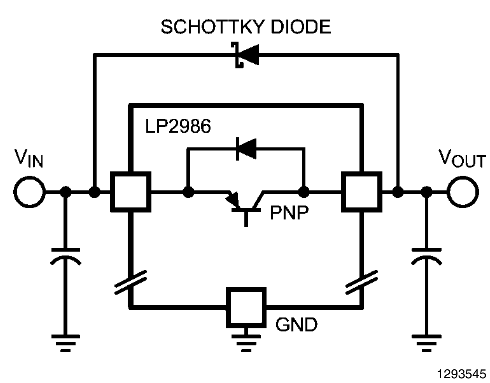
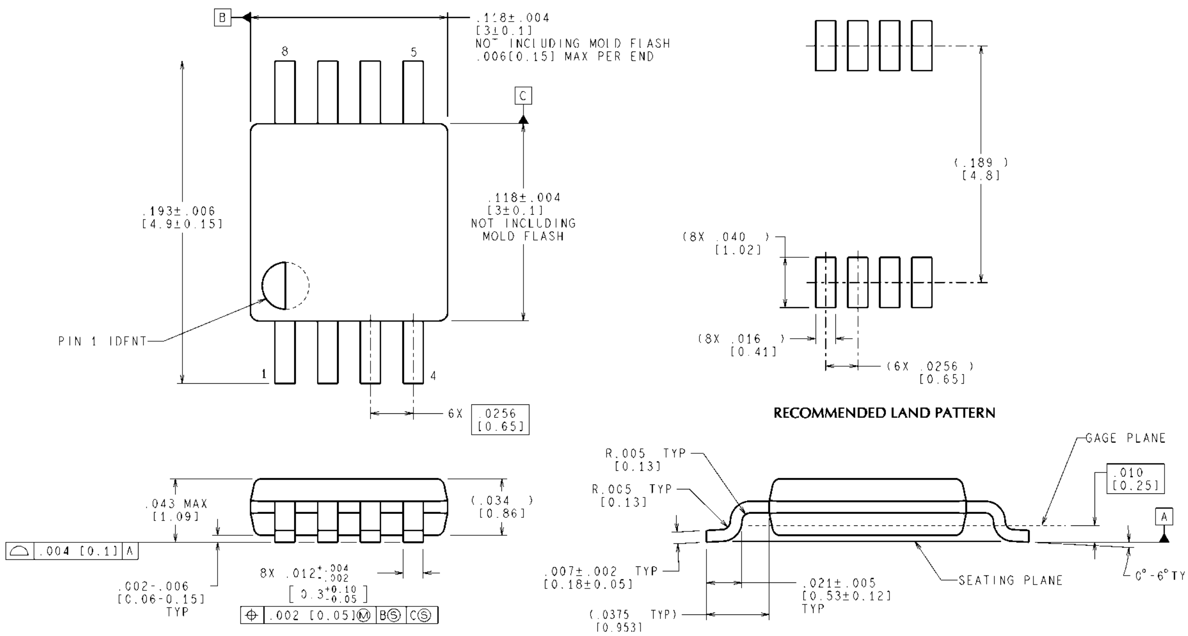


FIGURE 2. Adding External Schottky Diode Protection

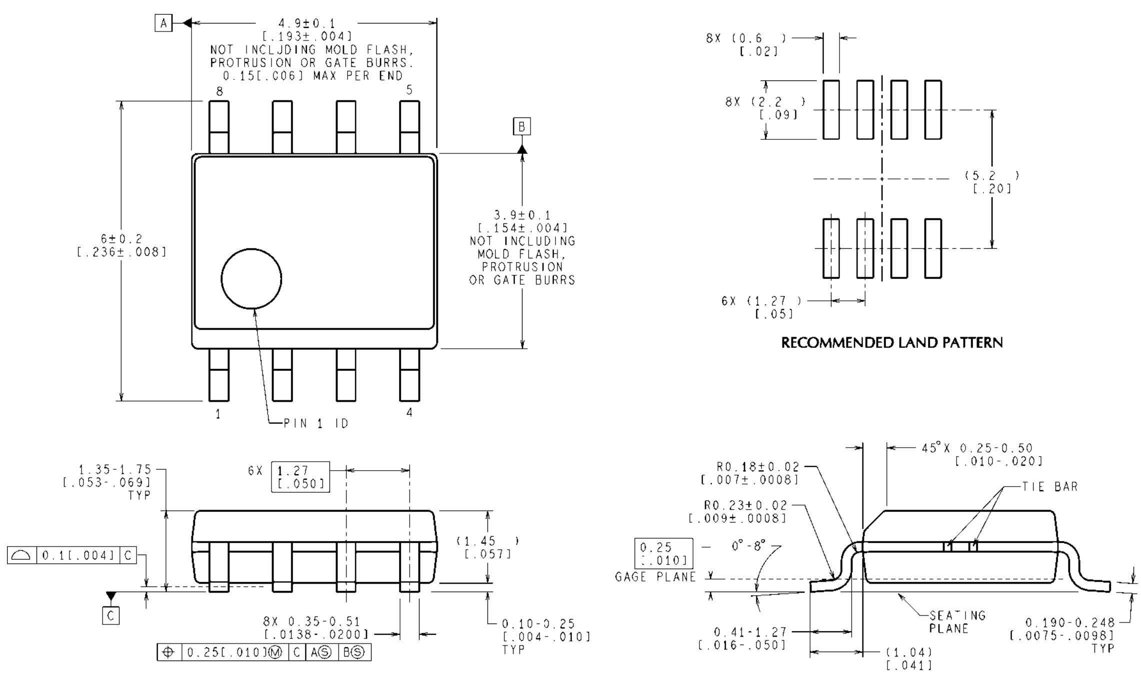
Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MUA08A (Rev F)

8-Lead Mini SOIC (118 mils wide), JEDEC MO-187-AA
NS Package Number MUA08A



CONTROLLING DIMENSION IS MILLIMETER
VALUES IN [ ] ARE INCHES
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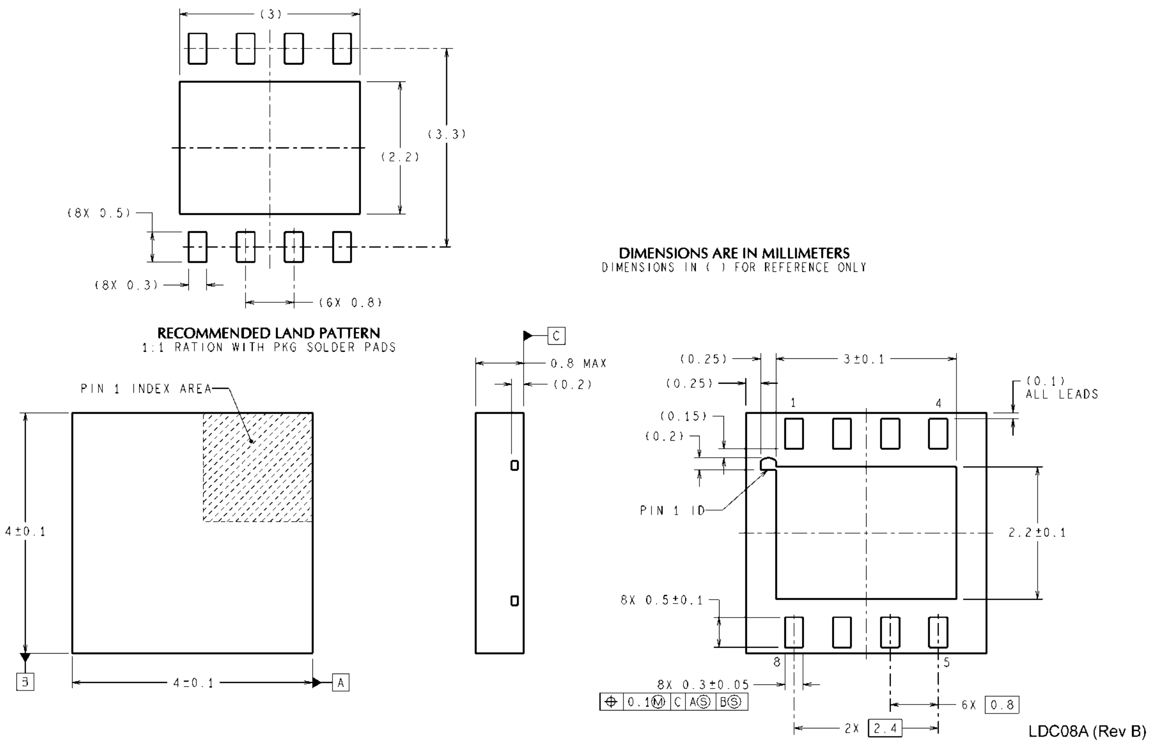
M08A (Rev M)

8-Lead SOIC NARROW (154 mils wide), JEDEC MS-012-AA
NS Package Number M08A



8-Lead LLP Surface Mount Package
NS Package Number LDC08A

Notes

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