National Semiconductor

LM330 3-Terminal Positive Regulator

General Description

The LM330 5V 3-terminal positive voltage regulator features an ability to source 150 mA of output current with an input-output differential of 0.6V or less. Familiar regulator features such as current limit and thermal overload protection are also provided.

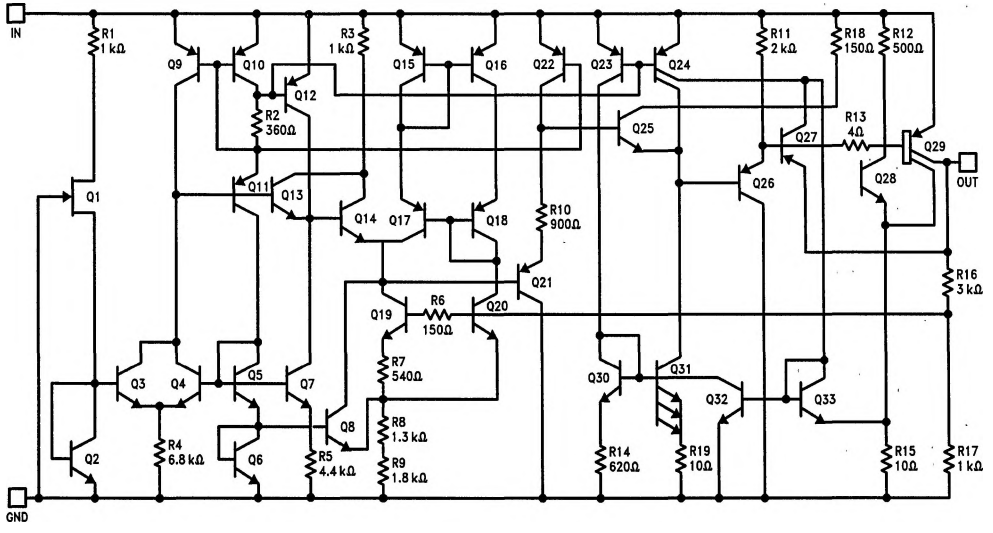
The low dropout voltage makes the LM330 useful for certain battery applications since this feature allows a longer battery discharge before the output falls out of regulation. For example, a battery supplying the regulator input voltage may discharge to 5.6V and still properly regulate the system and load voltage. Supporting this feature, the LM330 protects both itself and regulated systems from negative voltage inputs resulting from reverse installations of batteries.

Other protection features include line transient protection up to 26V, when the output actually shuts down to avoid damaging internal and external circuits. Also, the LM330 regulator cannot be harmed by a temporary mirror-image insertion.

Features

- Input-output differential less than 0.6V
- Output current of 150 mA
- Reverse battery protection
- Line transient protection
- Internal short circuit current limit
- Internal thermal overload protection
- Mirror-image insertion protection
- 100% electrical burn-in in the thermal limit

Schematic and Connection Diagrams



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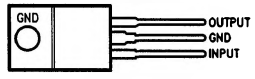
(TO-220)
Plastic Package



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Front View

Order Number LM330T-5.0
See NS Package Number T03B

Absolute Maximum Ratings

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

Input Voltage	
Operating Range	26V
Line Transient Protection (1000 ms)	40V
Internal Power Dissipation	Internally Limited
Operating Temperature Range	0°C to +70°C
Maximum Junction Temperature	+125°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	+300°C

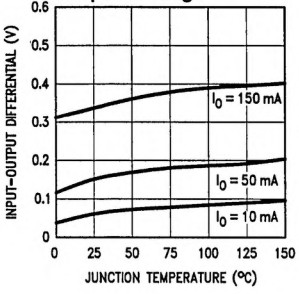
Electrical Characteristics (Note 1)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_o	Output Voltage	$T_j = 25°C$	4.8	5	5.2	V
	Output Voltage Over Temp	$5 < I_o < 150$ mA $6 < V_{IN} < 26V$; $0°C \le T_j \le 100°C$	4.75		5.25	
ΔV_o	Line Regulation	$9 < V_{IN} < 16V$, $I_o = 5$ mA $6 < V_{IN} < 26V$, $I_o = 5$ mA		7 30	25 60	mV
	Load Regulation	$5 < I_o < 150$ mA		14	50	
	Long Term Stability			20		mV/1000 hrs
I_Q	Quiescent Current	$I_o = 10$ mA $I_o = 50$ mA $I_o = 150$ mA		3.5 5 18	7 11 40	mA
	Line Transient Reverse Polarity	$V_{IN} = 40V$, $R_L = 100\Omega$, 1s $V_{IN} = -6V$, $R_L = 100\Omega$		14 −80		
ΔI_Q	Quiescent Current Change	$6 < V_{IN} < 26V$		10		%
V_{IN}	Overvoltage Shutdown Voltage		26	38		V
	Max Line Transient			60		
		1s, $V_o \le 5.5V$		50		
	Reverse Polarity Input Voltage			−30		
		DC $V_o > -0.3V$, $R_L = 100\Omega$		−12		
	Output Noise Voltage	10 Hz–100 kHz		50		μV
	Output Impedance	$I_o = 100$ mADC + 10 mArms		200		mΩ
	Ripple Rejection			56		dB
	Current Limit		150	400	700	mA
	Dropout Voltage	$I_o = 150$ mA		0.32	0.6	V
	Thermal Resistance	Junction to Case Junction to Ambient		4 50		°C/W

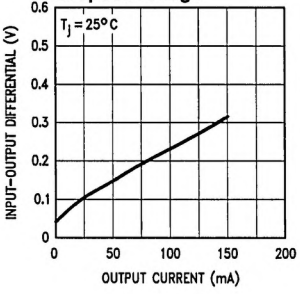
Note 1: Unless otherwise specified: $V_{IN} = 14V$, $I_o = 150$ mA, $T_j = 25°C$, C1 = 0.1 μF, C2 = 10 μF. All characteristics except noise voltage and ripple rejection are measured using pulse techniques ($t_W \le 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

Typical Performance Characteristics

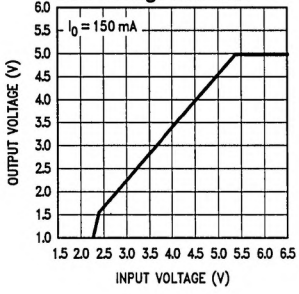
Dropout Voltage



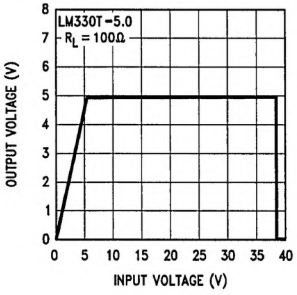
Dropout Voltage



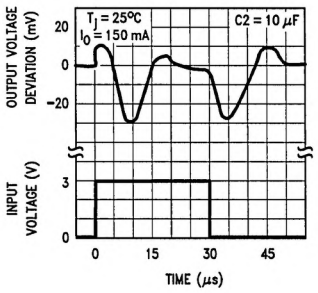
Low Voltage Behavior



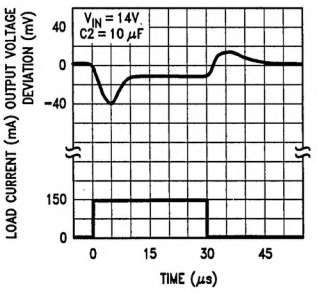
High Voltage Behavior



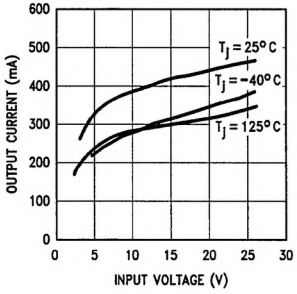
Line Transient Response



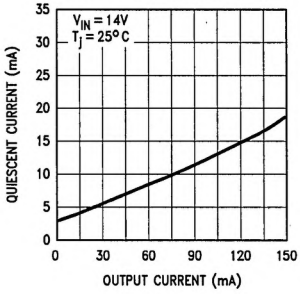
Load Transient Response



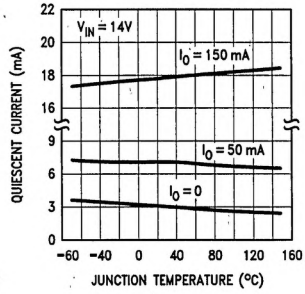
Peak Output Current



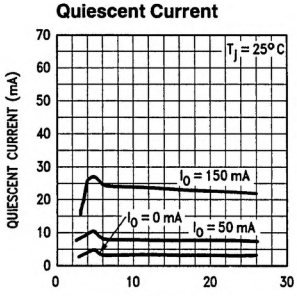
Quiescent Current



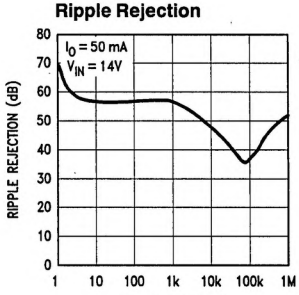
Quiescent Current



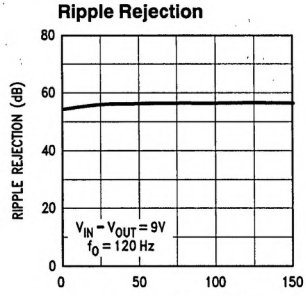
Quiescent Current



Ripple Rejection



Ripple Rejection



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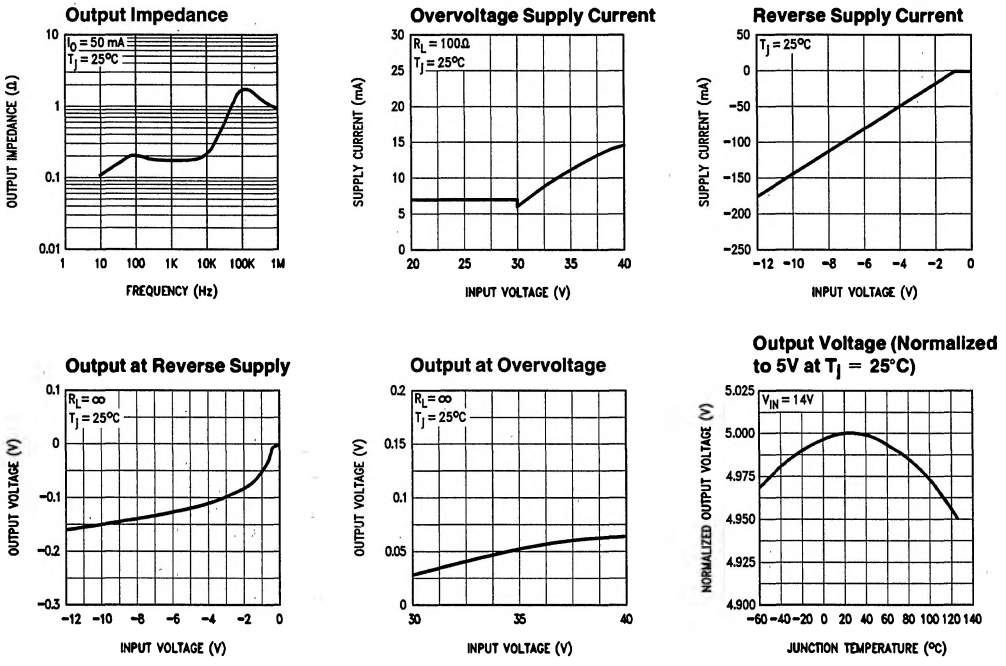
Typical Performance Characteristics (Continued)



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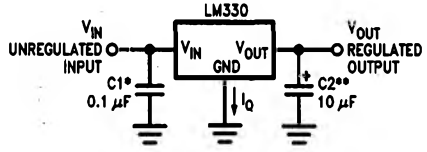
Typical Applications

The LM330 is designed specifically to operate at lower input to output voltages. The device is designed utilizing a power lateral PNP transistor which reduces dropout voltage from 2.0V to 0.3V when compared to IC regulators using NPN pass transistors. Since the LM330 can operate at a much lower input voltage, the device power dissipation is reduced, heat sinking can be simpler and device reliability improved through lower chip operating temperature. Also, a cost savings can be utilized through use of lower power/voltage components. In applications utilizing battery power, the LM330 allows the battery voltage to drop to within 0.3V of output voltage prior to the voltage regulator dropping out of regulation.



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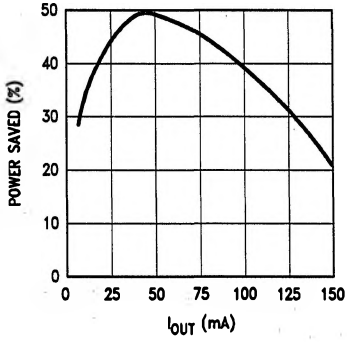
* Required if regulator is located far from power supply filter.

** C2 may be either an Aluminum or Tantalum type capacitor but must be rated to operate at −40°C to guarantee regulator stability to that temperature extreme. 10 μF is the minimum value required for stability and may be increased without bound. Locate as close as possible to the regulation.



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Note: Compared to IC regulator with 2.0V dropout voltage and $I_{Qmax.}$ = 6.0 mA.

Definition of Terms

Dropout Voltage: The input-output voltage differential at which the circuit ceases to regulate against further reduction in input voltage. Measured when the output voltage has dropped 100 mV from the nominal value obtained at 14V input, dropout voltage is dependent upon load current and junction temperature.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Input-Output Differential: The voltage difference between the unregulated input voltage and the regulated output voltage for which the regulator will operate.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature.

Long Term Stability: Output voltage stability under accelerated life-test conditions after 1000 hours with maximum rated voltage and junction temperature.

Output Noise Voltage: The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

Quiescent Current: That part of the positive input current that does not contribute to the positive load current. The regulator ground lead current.

Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Temperature Stability of V_O: The percentage change in output voltage for a thermal variation from room temperature to either temperature extreme.