Voltage Regulators

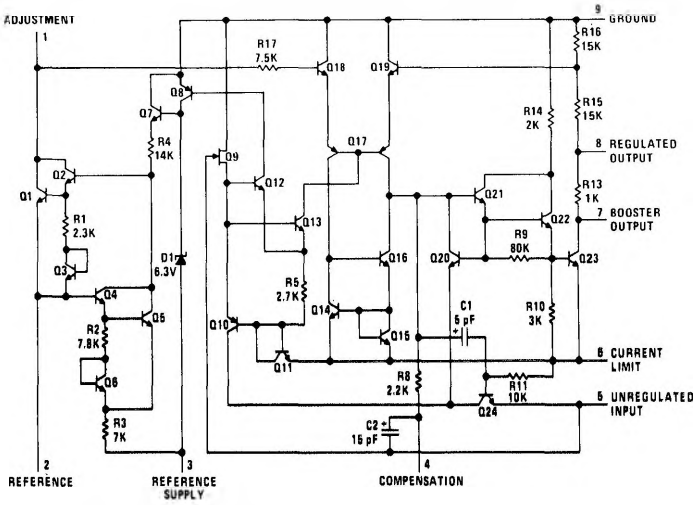
LM304 negative regulator general description

The LM304 is a precision voltage regulator which can be programmed by a single external resistor to supply any voltage from 30V down to zero while operating from a single unregulated supply. It can also provide 0.01-percent regulation in circuits using a separate, floating bias supply, where the output voltage is limited only by the breakdown of external pass transistors. Although designed primarily as a linear, series regulator, the circuit can be used as a switching regulator, a current regulator or in a number of other control applications. Typical performance characteristics are:

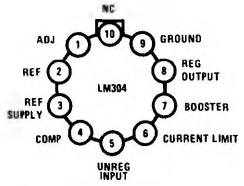
- 1 mV regulation no load to full load
- 0.01%/V line regulation
- 0.2 mV/V ripple rejection

The LM304 is a complement of the LM300 and LM305 positive regulators, intended for systems requiring regulated negative voltages which have a common ground with the unregulated supply. By itself, it can deliver output currents to 25 mA, but external transistors can be added to get any desired current. The output voltage is set by external resistors, and either constant or foldback current limiting is made available. The LM304 is a commercial/industrial version of the LM104 and LM204.

schematic and connection diagrams



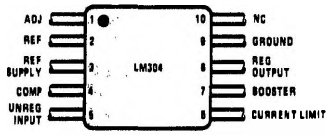
Metal Can



Note: Pin 5 connected to case.

TOP VIEW

Flat Package

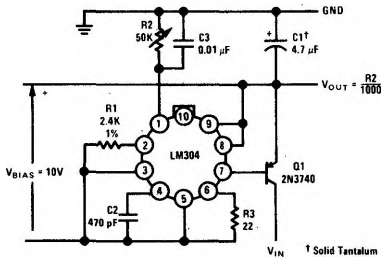


Note: Pin 5 connected to bottom of package.

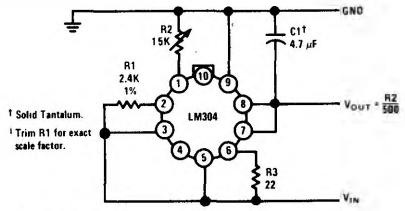
TOP VIEW

typical applications

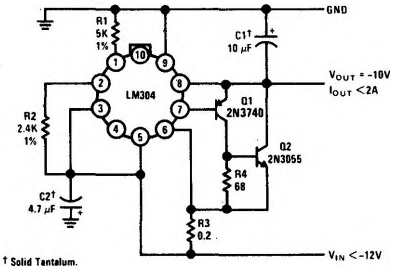
Operating with Separate Bias Supply



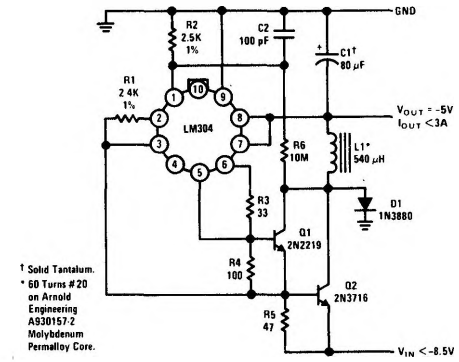
Basic Regulator Circuit



High Current Regulator



Switching Regulator



absolute maximum ratings

Input Voltage	40V
Input-Output Voltage Differential	40V
Power Dissipation (Note 1)	500 mW
Operating Temperature Range	0°C to 70°C
Storage Temperature Range	−65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

electrical characteristics (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		−40		−8	V
Output Voltage Range		−30		−0.035	V
Output-Input Voltage Differential (Note 3)	I_O = 20 mA	2.0		40	V
	I_O = 5 mA	0.5		40	V
Load Regulation (Note 4)	$0 \leq I_O \leq 20$ mA				
	R_{SC} = 15Ω		1	5	mV
Line Regulation (Note 5)	$V_{OUT} \leq -5V$				
	$\Delta V_{IN} = 0.1\ V_{IN}$		0.056	0.1	%
Ripple Rejection	C_{19} = 10 μF, f = 120 Hz				
	$V_{IN} < -15V$		0.2	0.5	mV/V
	$-7V \geq V_{IN} \geq -15V$		0.5	1.0	mV/V
Output Voltage Scale Factor	R_{23} = 2.4K	1.8	2.0	2.2	V/KΩ
Temperature Stability	$V_O \leq -1V, 0°C \leq T_A \leq 70°C$		0.3	1.0	%
Output Noise Voltage	10 Hz ≤ f ≤ 10 KHz				
	$V_O \leq -5V$, C_{19} = 0		0.007		%
	C_{19} = 10 μF		15		μV
Standby Current Drain	I_L = 5 mA, V_O = 0		1.7	2.5	mA
	V_O = −30V		3.6	5.0	mA
Long Term Stability	$V_O \leq -1V$		0.1	1.0	%

Note 1: For operating at elevated temperatures, the device must be derated based on an 85°C maximum junction temperature and a thermal resistance of 45°C/W junction to case or 150°C/W junction to ambient. Peak dissipations to 1.0W are allowable providing the dissipation rating is not exceeded with the power averaged over a two second interval.

Note 2: These specifications apply for junction temperatures between 0°C and 85°C and for input and output voltages within the ranges given, unless otherwise specified. The load and line regulation specifications are for constant junction temperature. Temperature drift effects must be taken into account separately when the unit is operating under conditions of high dissipation.

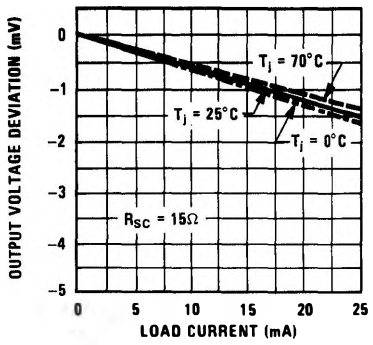
Note 3: When external booster transistors are used, the minimum output-input voltage differential is increased, in the worst case, by approximately 1V.

Note 4: The output currents given, as well as the load regulation, can be increased by the addition of external transistors. The improvement factor will be roughly equal to the composite current gain of the added transistors.

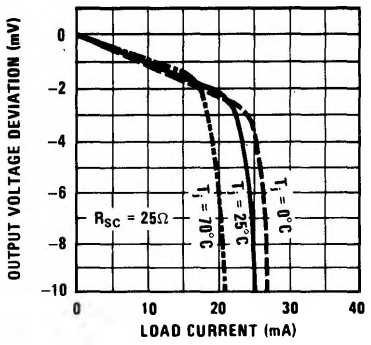
Note 5: With zero output, the dc line regulation is determined from the ripple rejection. Hence, with output voltages between 0V and −5V, a dc output variation, determined from the ripple rejection, must be added to find the worst-case line regulation.

typical performance characteristics

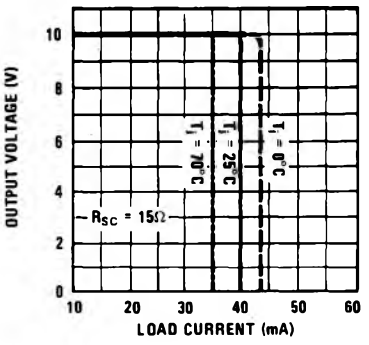
Load Regulation



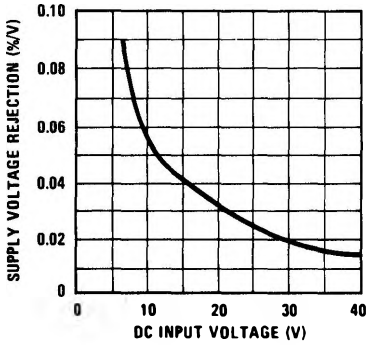
Load Regulation



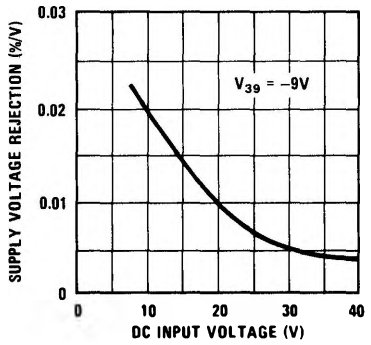
Current Limiting



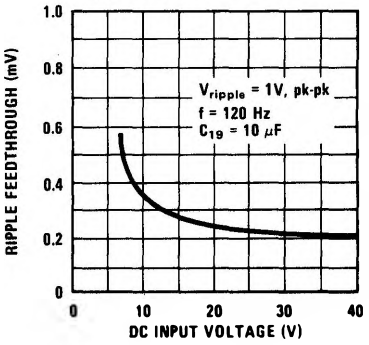
Supply Voltage Rejection



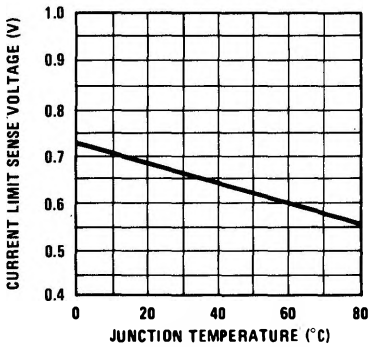
Supply Voltage Rejection With Preregulated Reference Supply



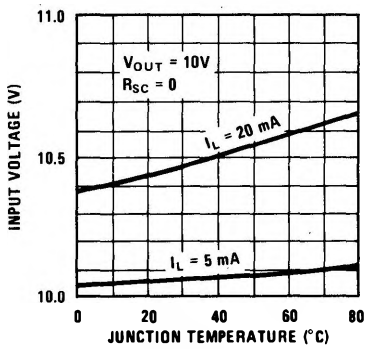
Ripple Rejection



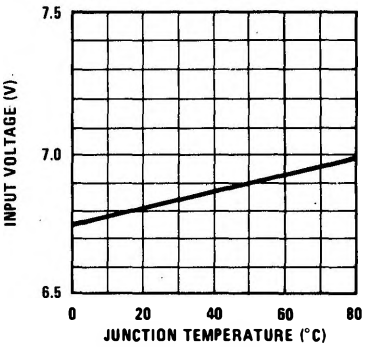
Current Limit Sense Voltage



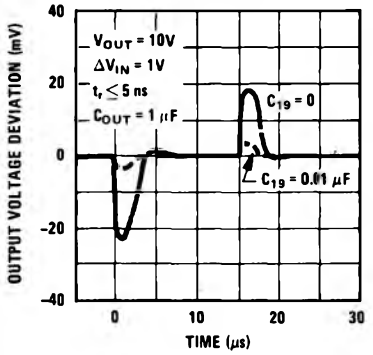
Regulator Dropout Voltage



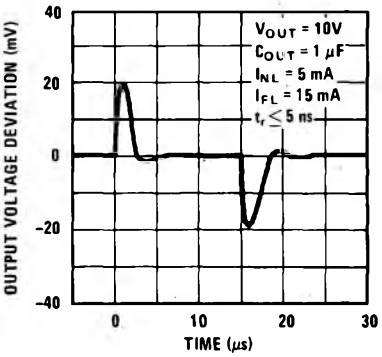
Minimum Input Voltage



Line Transient Response



Load Transient Response



Standby Current Drain