Voltage Regulators

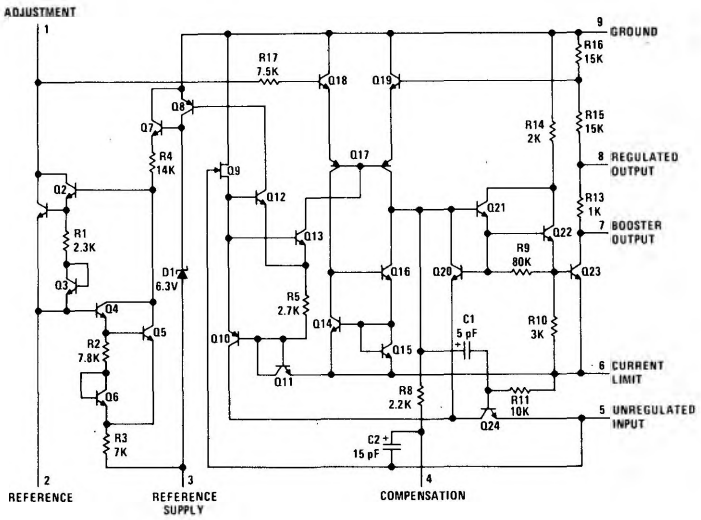
LM104/LM204 negative regulators general description

The LM104 and LM204 are precision voltage regulators which can be programmed by a single external resistor to supply any voltage from 40V down to zero while operating from a single unregulated supply. They 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 linear, series regulators, the circuits can be used as switching regulators, current regulators or in a number of other control applications. Typical performance characteristics are:

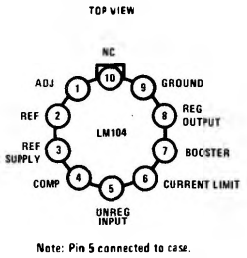
- 1 mV regulation no load to full load
- 0.01%/V line regulation
- 0.2 mV/V ripple rejection
- 0.3% temperature stability over military temperature range

The LM104 and LM204 are complements of the LM100 and LM105 positive regulators, intended for systems requiring regulated negative voltages which have a common ground with the unregulated supply. By themselves, they 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.

schematic and connection diagrams

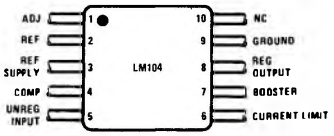


Metal Can



Note: Pin 5 connected to case.

Flat Package

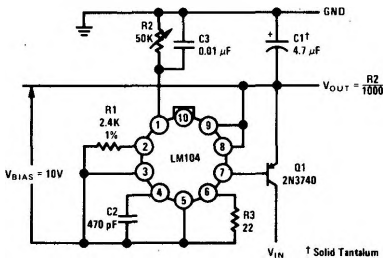


Note: Pin 5 connected to bottom of package.

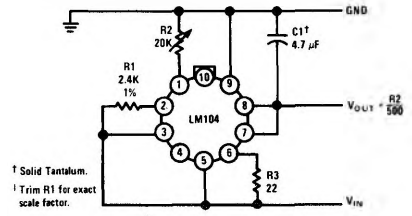
TOP VIEW

typical applications

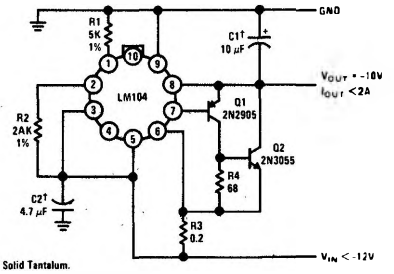
Operating with Separate Bias Supply



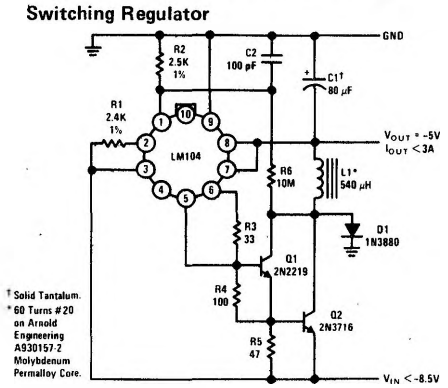
Basic Regulator Circuit



High Current Regulator



Switching Regulator



absolute maximum ratings

Input Voltage	50V
Input-Output Voltage Differential	50V
Power Dissipation (Note 1)	500 mW
Operating Temperature Range	
LM104	−55°C to 125°C
LM204	−25°C to 85°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		−50		−8	V
Output Voltage Range		−40		−0.015	V
Output-Input Voltage Differential (Note 3)	I_O = 20 mA	2.0		50	V
	I_O = 5 mA	0.5		50	V
Load Regulation (Note 4)	$0 \leq I_O \leq 20$ mA				
	R_{SC} = 15Ω		1	5	mV
Line Regulation (Note 5)	$V_{OUT} \leq -5V$				
	ΔV_{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	$V_O \leq -1V$		0.3	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 = −40V		3.6	5.0	mA
Long Term Stability	$V_O \leq -1V$		0.1	1.0	%

Note 1: The maximum junction temperature of the LM104 is 150°C, while that of the LM204 is 100°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors.

Note 2: These specifications apply for junction temperatures between −55°C and 150°C (between −25°C and 100°C for the LM204) 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.

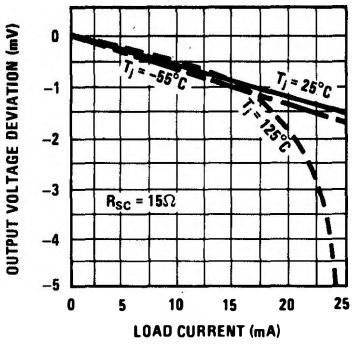
Note 3: When external booster transistors are used, the minimum output-input voltage differential is increased, in the worst case, by approximately 1V.

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.

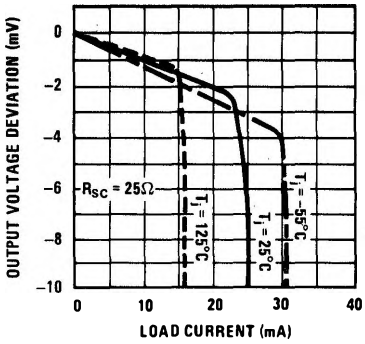
Note 5: With zero output, the dc line regulation is determined from the ripple rejection. Hence, with output voltages between 0V and −5V, a dc output variation, determined from the ripple rejection, must be added to find the worst-case line regulation.

typical performance characteristics

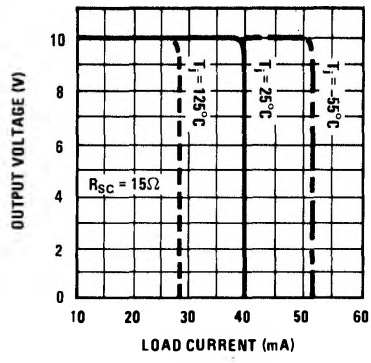
Load Regulation



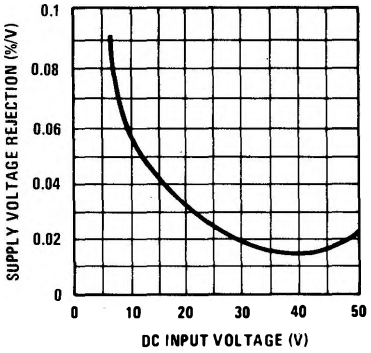
Load Regulation



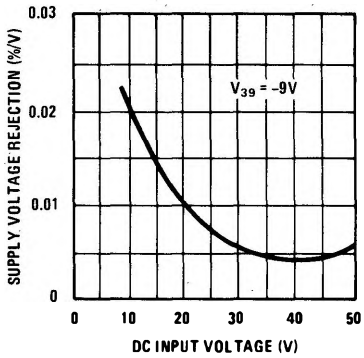
Current Limiting



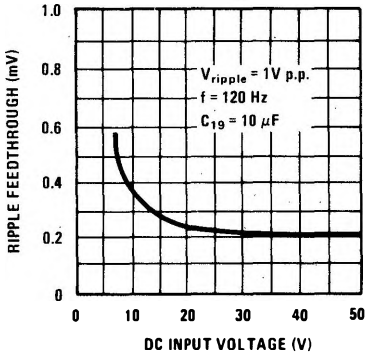
Supply Voltage Rejection



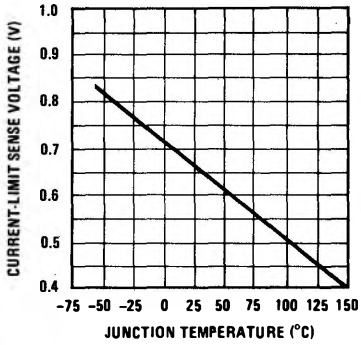
Supply Voltage Rejection With Preregulated Reference Supply



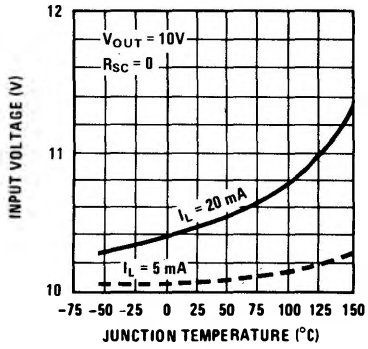
Ripple Rejection



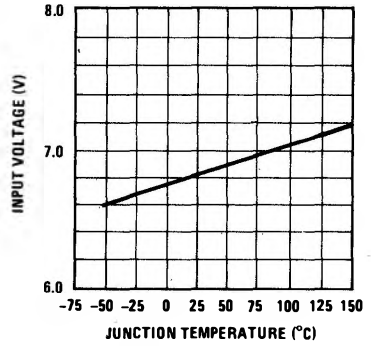
Current Limit Sense Voltage



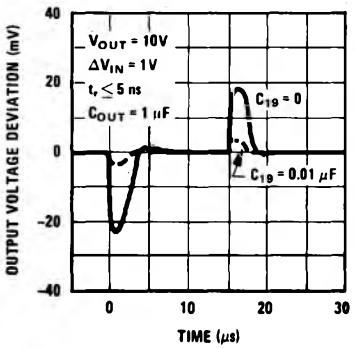
Regulator Dropout Voltage



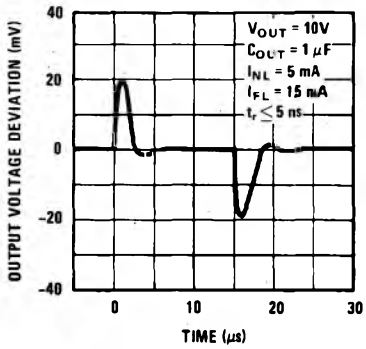
Minimum Input Voltage



Line Transient Response



Load Transient Response



Standby Current Drain