DESCRIPTION

The LM109 and LM309 are complete 5 volt regulators fabricated on a single silicon chip. These regulators are designed for local "on card" regulation to eliminate many of the noise and ground loop problems associated with single-point regulation. They employ internal current limiting, thermal shutdown, and safe-area compensation which makes the circuitry essentially blow-out proof. If adequate heat sinking is provided, the devices can deliver output currents in excess of 200mA from the TO-5 package, and 1A from the TO-3 package. In addition to their use as fixed 5 volt regulators, these devices may be used with external components to obtain adjustable output levels. They may also be used as the power pass element in precision regulators.

FEATURES

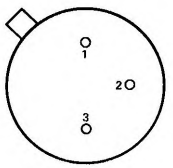
- **OUTPUT CURRENTS IN EXCESS OF 1 amp**
- **INTERNAL THERMAL OVERLOAD PROTECTION**
- **INTERNAL CURRENT LIMITING**
- **NO EXTERNAL COMPONENTS REQUIRED**

ABSOLUTE MAXIMUM RATINGS

Input Voltage	35V
Power Dissipation	Internally Limited
Operating Junction Temperature Range	
LM109	-55°C to 150°C
LM309	0°C to 125°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

PIN CONFIGURATIONS

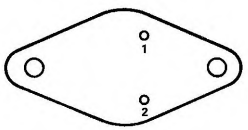
H PACKAGE
(Bottom View)



1. Input
2. Output
3. Ground

ORDER PART NOS. LM109H/LM209H/LM309H

K PACKAGE
(Bottom View)

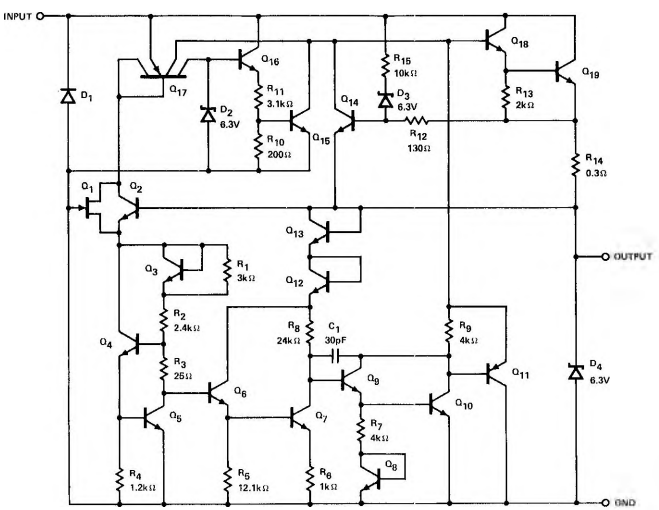


1. Input
2. Output

Case is connected to ground.

ORDER PART NOS. LM109K/LM209K/LM309K

EQUIVALENT CIRCUIT



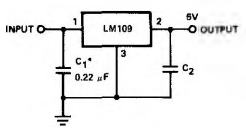
(Note 1)

PARAMETER	CONDITIONS	LM109			LM309			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Output Voltage	$T_j = 25°C$	4.7	5.05	5.3	4.8	5.05	5.2	V
Line Regulation	$T_j = 25°C$							
	$7V \leqslant V_{IN} \leqslant 25V$		4	50		4	50	mV
Load Regulation	$T_j = 25°C$							
TO-5	$5mA \leqslant I_{OUT} \leqslant 0.5A$		20	50		20	50	mV
TO-3	$5mA \leqslant I_{OUT} \leqslant 1.5A$		50	100		50	100	mV
Output Voltage	$7V \leqslant V_{IN} \leqslant 25V$							
	$5mA \leqslant I_{OUT} \leqslant I_{max}$							
	$P < P_{max}$	4.6		5.4	4.75		5.25	V
Quiescent Current	$7V \leqslant V_{IN} \leqslant 25V$		5.2	10		5.2	10	mA
Quiescent Current Change	$7V \leqslant V_{IN} \leqslant 25V$			0.5			0.5	mA
	$5mA \leqslant I_{OUT} \leqslant I_{max}$			0.8			0.8	mA
Output Noise Voltage	$T_A = 25°C$							
	$10Hz \leqslant f \leqslant 100$ kHz		40			40		μV
Long Term Stability				10			20	mV
Thermal Resistance								
Junction to Case (Note 2)								
TO-5			15			15		°C/W
TO-3			3			3		°C/W

NOTES:

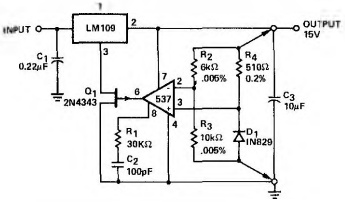
1. Unless otherwise specified, these specifications apply for $-55°C \leqslant T_j \leqslant 150°C$ for the 5109 or $0°C \leqslant T_j \leqslant 125°C$ for the 5309, V_{IN} = 10V and I_{OUT} = 0.1A for the TO-5 package or I_{OUT} = 0.5A for the TO-3 package. For the TO-5 package, I_{max} = 0.2A and P_{max} = 2.0W. For the TO-3 package, I_{max} = 1.0A and P_{max} = 20W.
2. Without a heat sink, the thermal resistance of the TO-5 package is about 150°C/W, while that of the TO-3 package is approximately 35°C/W. With a heat sink, the effective thermal resistance can only approach the values specified, depending on the efficiency of the sink.

FIXED 5V REGULATOR



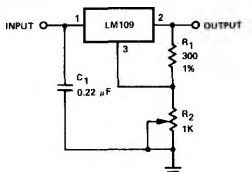
NOTES: *Required if regulator is located an appreciable distance from power supply filter.
†Although no output capacitor is needed for stability, it does improve transient response.

PRECISION VOLTAGE REGULATOR

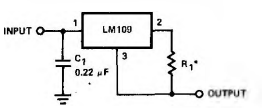


NOTES: *Regulation better than 0.01% load, line and temperature, can be obtained.
†Determines zener current. May be adjusted to minimize thermal drift.
‡Solid tantalum.

ADJUSTABLE OUTPUT REGULATOR



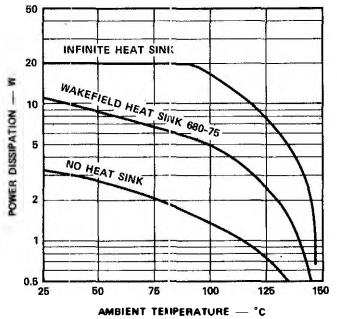
CURRENT REGULATOR



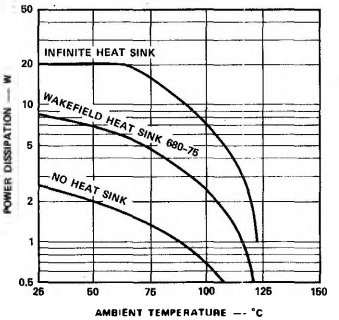
NOTES: *Determines output current.

TYPICAL CHARACTERISTIC CURVES

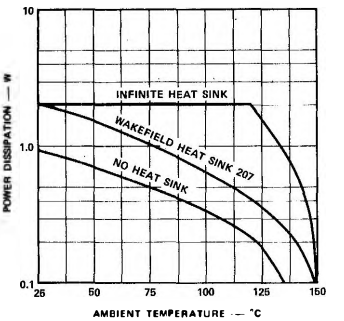
MAXIMUM AVERAGE POWER DISSIPATION LM109/LM209 (TO-3)



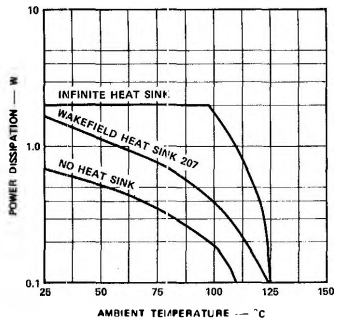
MAXIMUM AVERAGE POWER DISSIPATION LM309 (TO-3)



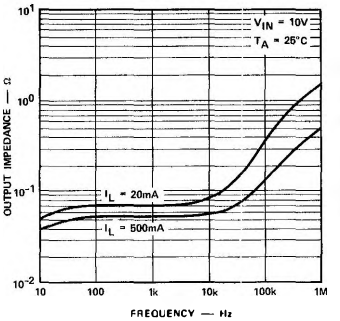
MAXIMUM AVERAGE POWER DISSIPATION LM109/LM209 (TO-5)



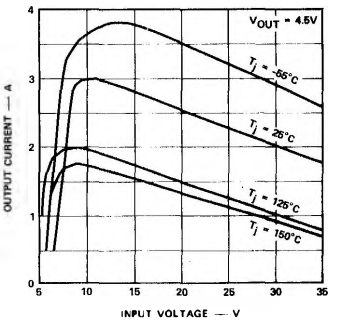
MAXIMUM AVERAGE POWER DISSIPATION LM309 (TO-5)



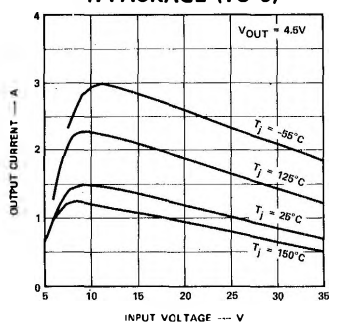
OUTPUT IMPEDANCE



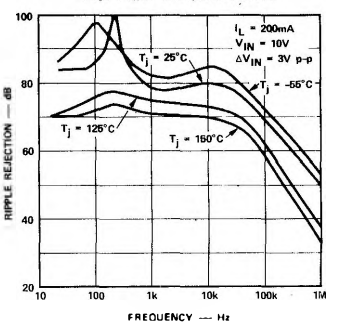
PEAK OUTPUT CURRENT K PACKAGE (TO-3)



PEAK OUTPUT CURRENT H PACKAGE (TO-5)

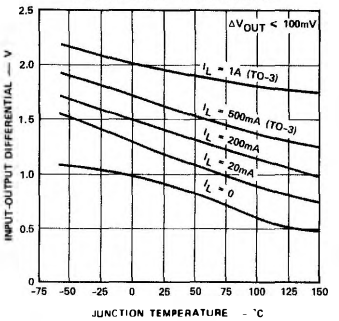


RIPPLE REJECTION

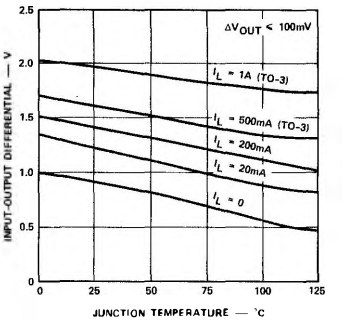


TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd.)

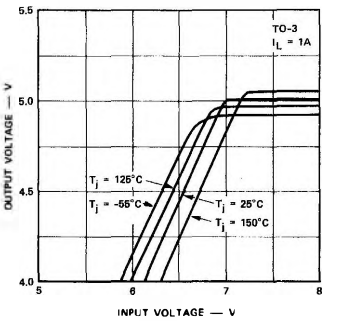
DROPOUT VOLTAGE



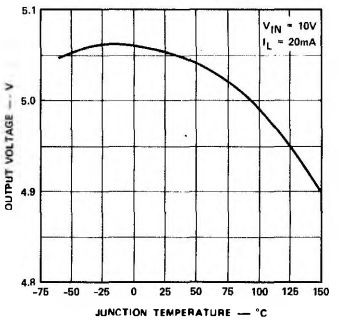
DROPOUT VOLTAGE



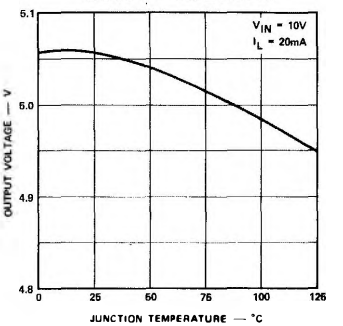
DROPOUT CHARACTERISTIC



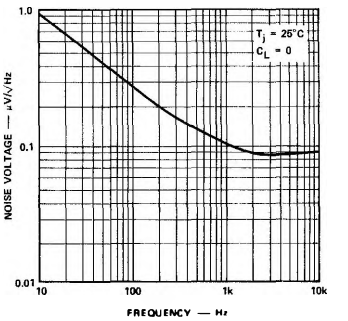
OUTPUT VOLTAGE



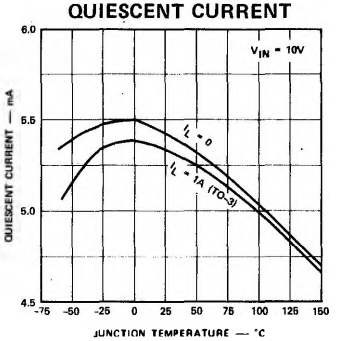
OUTPUT VOLTAGE



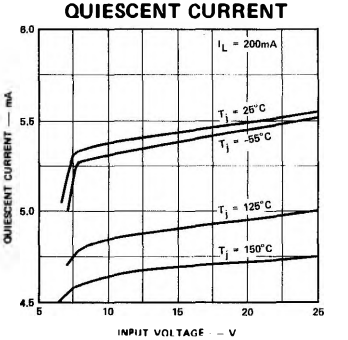
OUTPUT NOISE VOLTAGE



QUIESCENT CURRENT



QUIESCENT CURRENT



AMPS

AVERAGE INPUT OFFSET CURRENT t° COEFF – The change in input offset current divided by the change in ambient temperature producing it.

AVERAGE INPUT OFFSET VOLTAGE t° COEFF – The change in input offset voltage divided by the change in ambient temperature producing it.

COMMON MODE INPUT RESISTANCE – The resistance looking into both inputs tied together.

COMMON MODE REJECTION RATIO (CMRR) – The ratio of the change of input offset voltage to the input common mode voltage change producing it.

FULL POWER BANDWIDTH – The maximum frequency at which the full sinewave output might be obtained.

INPUT BIAS CURRENT – The average of the two input currents at zero output voltage. In some cases, the input current for either input independently.

INPUT CAPACITANCE – The capacitance looking into either input terminal with the other grounded.

INPUT CURRENT – The current into an input terminal.

INPUT NOISE VOLTAGE – The square root of the mean square narrow-band noise voltage referred to the input.

INPUT OFFSET CURRENT – The difference in the currents into the two input terminals with the output at zero volts.

INPUT OFFSET VOLTAGE – That voltage which must be applied between the input terminals to obtain zero output voltage. The input offset voltage may also be defined for the case where two equal resistances are inserted in series with the input leads.

INPUT RESISTANCE – The resistance looking into either input terminal with the other grounded.

INPUT VOLTAGE RANGE – The range of voltages on the input terminals for which the amplifier operates within specifications. In some cases, the input offset specifications apply over the input voltage range.

LARGE-SIGNAL VOLTAGE GAIN – The ratio of the maximum output voltage swing to the change in input voltage required to drive the output to this voltage.

OUTPUT RESISTANCE – The resistance seen looking into the output terminal with the output at null. This parameter is defined only under small signal conditions at frequencies above a few hundred cycles to eliminate the influence of drift and thermal feedback.

OUTPUT SHORT-CIRCUIT CURRENT – The maximum output current available from the amplifier with the output shorted to ground or to either supply.

OUTPUT VOLTAGE SWING – The peak output swing, referred to zero, that can be obtained.

POWER CONSUMPTION – The DC power required to operate the amplifier with the output at zero and with no load current.

POWER SUPPLY REJECTION RATIO – The ratio of the change in input offset voltage to the change in supply voltages producing it.

RISE TIME – The time required for an output voltage step to change from 10% to 90% of its final value.

SLEW RATE – The maximum rate of change of output voltage under large signal condition.

SUPPLY CURRENT – The current required from the power supply to operate the amplifier with no load and the output at zero.

TEMPERATURE STABILITY OF VOLTAGE GAIN – The maximum variation of the voltage gain over the specified temperature range.

REGULATORS

DROPOUT VOLTAGE – The input-output voltage differential at which the circuit ceases to regulate against further reductions in input voltage.

INPUT-OUTPUT VOLTAGE DIFFERENTIAL – The range of voltage difference between the supply voltage and the regulated output voltage over which the regulator will operate.

LINE REGULATOR – The percentage change in output voltage for a specified change in input voltage.

LOAD REGULATOR – The percentage change in output voltage for a specified change in load current.

MAXIMUM POWER DISSIPATION – The maximum total device dissipation for which the regulator will operate within specifications.

OUTPUT NOISE VOLTAGE – The rms output noise voltage with constant load and no input ripple.

OUTPUT VOLTAGE RANGE – The range of output voltage over which the regulator will operate.

QUIESCENT CURRENT – That part of input current to the regulator that is not delivered to the load.

REGULATORS (Cont'd.)

REFERENCE VOLTAGE – The output of the reference amplifier measured with respect to the negative supply.

RIPPLE REJECTION – The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

SENSE VOLTAGE – The voltage between current sense and current limit terminals necessary to cause current limiting.

SHORT CIRCUIT CURRENT LIMIT – The output current of the regulator with the output shorted to the negative supply.

STANDBY CURRENT DRAIN – The supply current drawn by the regulator with no output load and no reference voltage load.

COMPARATORS/SENSE INTERFACE

COMMON MODE FIRING VOLTAGE – The CM input voltage that exceeds the dynamic range of the inputs with strobe enabled resulting in the output switching states.

COMMON MODE RECOVERY TIME – The time from the turn off of the CM signal to the analog input threshold of the earliest sense line pulse signal that can be processed normally. Processed normally refers to bi-polar signals greater than or less than the input threshold with a corresponding proper output.

EQUIVALENT INPUT COMMON MODE NOISE VOLTAGE – The change in input offset voltage due to common mode input noise.

LOGIC INPUT HIGH VOLTAGE – The minimum voltage allowed at a bit control gate to hold the bit off.

LOGIC INPUT LOW VOLTAGE – The maximum voltage allowed at a bit control gate to hold the bit on.

OUTPUT SINK CURRENT – The maximum negative current that can be delivered by the comparator.

PEAK OUTPUT CURRENT – The maximum current that may flow into the output load without causing damage to the comparator.

PROPAGATION DELAY – The interval between the application of an input voltage step and its arrival at either output, measured at 50% of the final value.

RESPONSE TIME – The interval between the application of an input step function and the time when the output crosses the logic threshold voltage. The input step drives the comparator from some initial, saturated input voltage to an input level just barely in excess of that required to bring the output from saturation to the logic threshold voltage overdrive.

STROBE CURRENT – The maximum current drawn by the strobe terminals when it is at the zero logic level.

STROBE DELAY – The time delay measured from strobe to output threshold with a signal present exceeding the input threshold.

STROBE RELEASE TIME – The time required for the output to rise to the logic threshold voltage after the strobe terminal has been driven from the zero to the one logic level. Appropriate input conditions are assumed.

STROBED OUTPUT LEVEL – The DC output voltage, independent of input voltage, with the voltage on the strobe terminal equal to or less than a minimum specified amount.

SWITCHING SPEED – The time required to turn on the least significant bit.

THRESHOLD UNCERTAINTY – With all sense amps sharing the same input threshold less the uncertainty as a "0". This includes unit to unit, power supply and temperature variations.

THRESHOLD VOLTAGE – The typical referred to input voltage which determines whether an input is a "1" or a "0". A signal whose magnitude is greater than the threshold level is sensed as a logic "1" and a signal whose magnitude is less as a "0"

ZERO SCALE OUTPUT CURRENT – The output current for all bits turned off.

COMMUNICATIONS CIRCUITS

ACC DETECTOR SENSITIVITY – The ratio of the incremental differential DC voltage change at the ACC Detector Output Terminals to the incremental change in peak-to-peak voltage at the ACC Detector Input Terminal for a specified burst input level, with the local oscillator locked.

APC DETECTOR SENSITIVITY – The ratio of the incremental differential DC voltage change at the APC Detector Output Terminals to the incremental change in relative phase at the APC Detector Input Terminal for a specified burst input level.

AVERAGE TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE – The percentage change in output voltage for a specified change in ambient temperature.

BANDWIDTH – The frequency at which the differential gain is 3dB below its low frequency value.

COLOR-DIFFERENCE DEMODULATION ANGLE – A color-difference demodulation angle is defined as the instantaneous phase of the (+) Chroma input signal which produces the most positive voltage at the respective color-difference output with the phase of Reference "A" taken at 3 degrees and the phase of Reference "B" taken at 106 degrees.

(+) CHROMA INPUT – A composite chroma signal containing the burst at a phase of 180 degrees is demodulated to produce specified color-difference demodulation angles when applied to the (+) Chroma input.

(-) CHROMA INPUT – A composite chroma signal containing the burst at a phase of 0 degrees is demodulated to produce specified color-difference demodulation angles when applied to the (-) Chroma input.

DIFFERENTIAL OUTPUT VOLTAGE SWING – The peak differential output swing that can be obtained without clipping.

DIFFERENTIAL VOLTAGE GAIN – The ratio of the change in differential output voltage to the change in differential input voltage producing it.

OSCILLATOR CONTROL SENSITIVITY – The ratio of the incremental change in oscillator free running frequency to the incremental change in the differential DC voltage at the APC Detector Output Terminals.

OUTPUT COMMON MODE VOLTAGE – The average of the voltages at the two output terminals.

OUTPUT OFFSET VOLTAGE – The difference between the voltages at the two output terminals with the inputs grounded.

TOTAL HARMONIC DISTORTION – The ratio of the sum of the amplitudes of all signals harmonically related to the fundamental, and the amplitude of the fundamental signal.