Voltage Regulators

LM309 five-volt regulator

general description

The LM309 is a complete 5V regulator fabricated on a single silicon chip. It is designed for local regulation on digital logic cards, eliminating the distribution problems associated with single-point regulation. The device is available in two common transistor packages. In the solid-kovar TO-5 header, it can deliver output currents in excess of 200 mA, if adequate heat sinking is provided. With the TO-3 power package, the available output current is greater than 1A.

The regulator is essentially blow-out proof. Current limiting is included to limit the peak output current to a safe value. In addition, thermal shutdown is provided to keep the IC from overheating. If internal dissipation becomes too great, the regulator will shut down to prevent excessive heating.

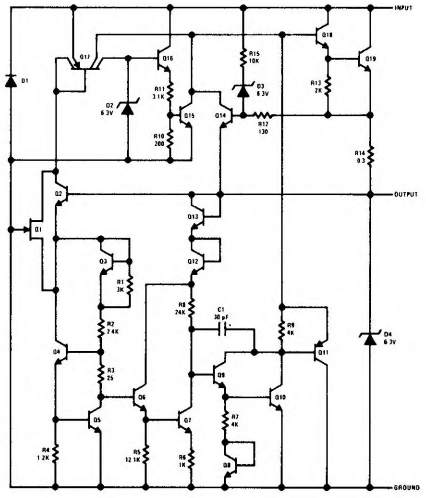
Considerable effort was expended to make the LM309 easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response somewhat. Input bypassing is needed, however, if the regulator is located very far from the filter capacitor of the power supply. Stability is also achieved by methods that provide very good rejection of load or line transients as are usually seen with TTL logic.

Although designed primarily as a fixed-voltage regulator, the output of the LM309 can be set to voltages above 5V, as shown below. It is also possible to use the circuit as the control element in precision regulators, taking advantage of the good current-handling capability and the thermal overload protection.

To summarize, outstanding features of the regulator are:

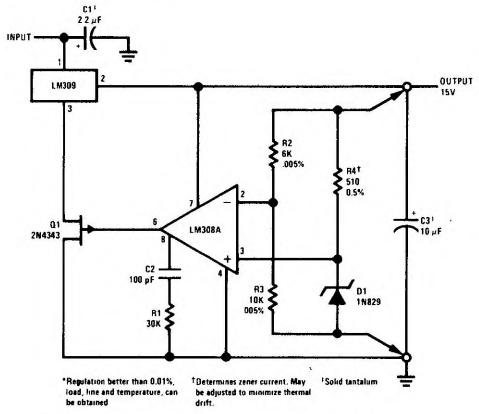
- Specified to be compatible, worst case, with TTL and DTL
- Output current in excess of 1A
- Internal thermal overload protection
- No external components required

schematic diagram

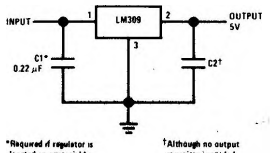


typical applications

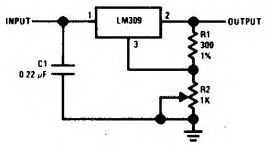
High Stability Regulator*



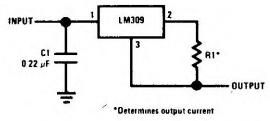
Fixed 5V Regulator



Adjustable Output Regulator



Current Regulator



absolute maximum ratings

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

design characteristics (Note 1)

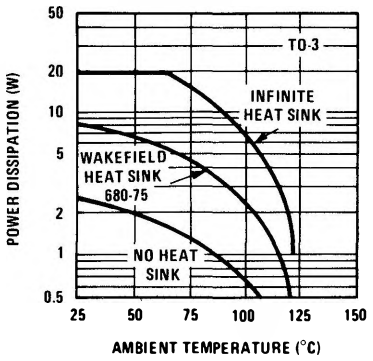
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage	$T_j = 25°C$	4.8	5.05	5.2	V
Line Regulation	$T_j = 25°C$ $7V \leq V_{IN} \leq 25V$		4.0	50	mV
Load Regulation	$T_j = 25°C$				
LM309H	$5\ mA \leq I_{OUT} \leq 0.5A$		20	50	mV
LM309K	$5\ mA \leq I_{OUT} \leq 1.5A$		50	100	mV
Output Voltage	$7V \leq V_{IN} \leq 25V$ $5\ mA \leq I_{OUT} \leq I_{max}$ $P < P_{max}$	4.75		5.25	V
Quiescent Current	$7V \leq V_{IN} \leq 25V$		5.2	10	mA
Quiescent Current Change	$7V \leq V_{IN} \leq 25V$			0.5	mA
	$5\ mA \leq I_{OUT} \leq I_{max}$			0.8	mA
Output Noise Voltage	$T_A = 25°C$ $10\ Hz \leq f \leq 100\ kHz$		40		μV
Long Term Stability				20	mV
Thermal Resistance					
Junction to Case (Note 2)					
LM309H			15		°C/W
LM309K			3.0		°C/W

Note 1: Unless otherwise specified, these specifications apply for $0°C \leq T_j \leq 125°C$, $V_{IN} = 10V$ and $I_{OUT} = 0.1A$ for the LM309H or $I_{OUT} = 0.5A$ for the LM309K. For the LM309H, $I_{max} = 0.2A$ and $P_{max} = 2.0W$. For the LM309K, $I_{max} = 1.0A$ and $P_{max} = 20W$.

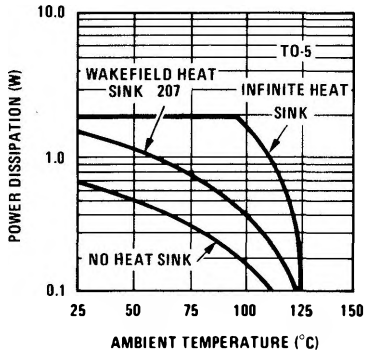
Note 2: Without a heat sink, the thermal resistance of the TO-5 package is about 150°C/W, while that of the TO-3 package is approximately 35°C/W. With a heat sink, the effective thermal resistance can only approach the values specified, depending on the efficiency of the sink.

typical performance

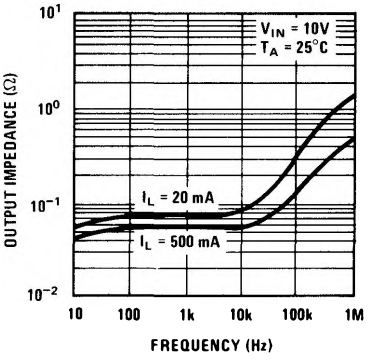
Maximum Average Power Dissipation



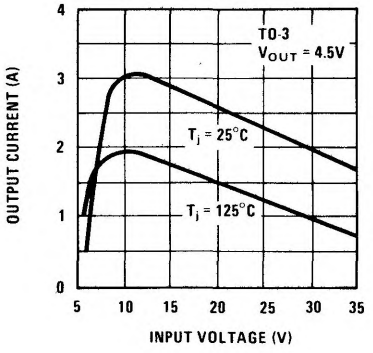
Maximum Average Power Dissipation



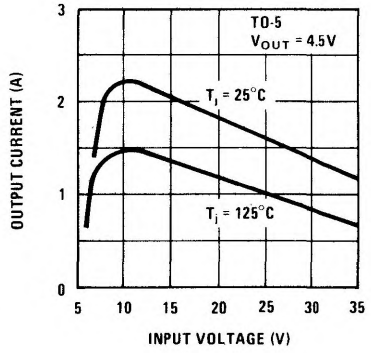
Output Impedance



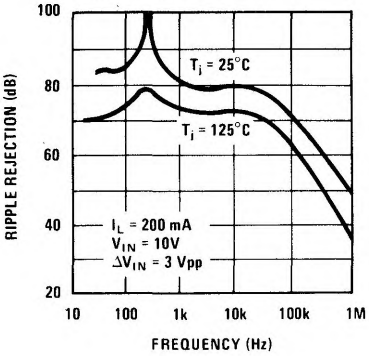
Peak Output Current



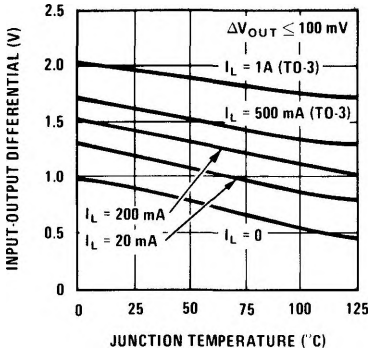
Peak Output Current



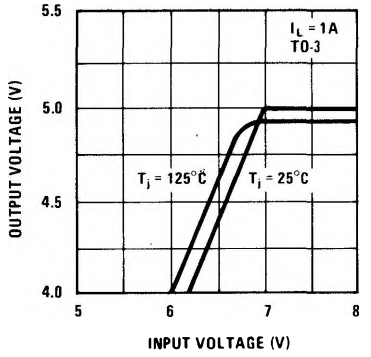
Ripple Rejection



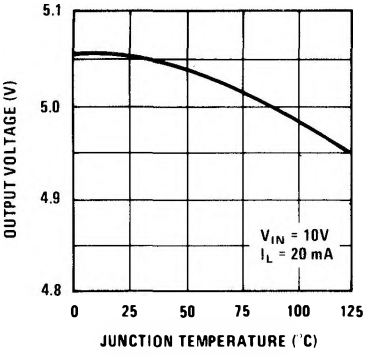
Dropout Voltage



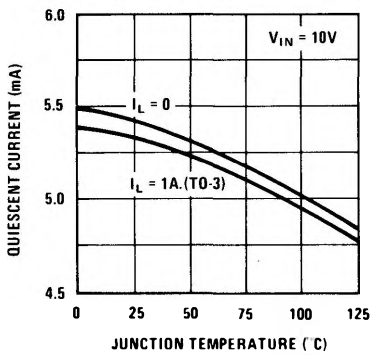
Dropout Characteristic



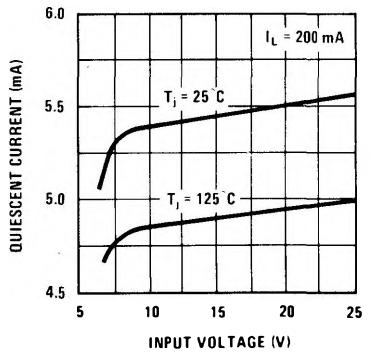
Output Voltage



Quiescent Current



Quiescent Current



Output Noise Voltage