

LM109/LM309 5-Volt Regulator

General Description

The LM109 series are complete 5V regulators fabricated on a single silicon chip. They are designed for local regulation on digital logic cards, eliminating the distribution problems association with single-point regulation. The devices are available in two standard 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 regulators are essentially blowout 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 these devices easy to use and to minimize the number of external components. It is not necessary to bypass the output, although this

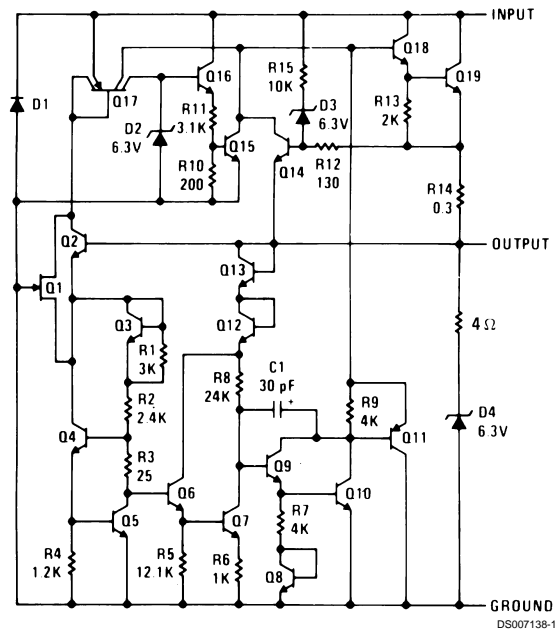
does improve transient response somewhat. Input bypassing is needed, however, if the regulator is located very far from the filter capacitor of the power supply. Stability is also achieved by methods that provide very good rejection of load or line transients as are usually seen with TTL logic.

Although designed primarily as a fixed-voltage regulator, the output of the LM109 series can be set to voltages above 5V, as shown. It is also possible to use the circuits as the control element in precision regulators, taking advantage of the good current-handling capability and the thermal overload protection.

Features

- 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



Absolute Maximum Ratings (Note 1)

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

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

Electrical Characteristics (Note 2)

Parameter	Conditions	LM109			LM309			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage	$T_j = 25^\circ\text{C}$	4.7	5.05	5.3	4.8	5.05	5.2	V
Line Regulation	$T_j = 25^\circ\text{C}$ $7.10\text{V} \leq V_{\text{IN}} \leq 25\text{V}$		4.0	50		4.0	50	mV
Load Regulation	$T_j = 25^\circ\text{C}$							
TO-39 Package	$5\text{ mA} \leq I_{\text{OUT}} \leq 0.5\text{A}$		15	50		15	50	mV
TO-3 Package	$5\text{ mA} \leq I_{\text{OUT}} \leq 1.5\text{A}$		15	100		15	100	mV
Output Voltage	$7.40\text{V} \leq V_{\text{IN}} \leq 25\text{V}$, $5\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$, $P < P_{\text{MAX}}$	4.6		5.4	4.75		5.25	V
Quiescent Current	$7.40\text{V} \leq V_{\text{IN}} \leq 25\text{V}$		5.2	10		5.2	10	mA
Quiescent Current Change	$7.40\text{V} \leq V_{\text{IN}} \leq 25\text{V}$ $5\text{ mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}$			0.5			0.5	mA
				0.8			0.8	mA
Output Noise Voltage	$T_A = 25^\circ\text{C}$ $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40			40		μV
Long Term Stability			10			20		mV
Ripple Rejection	$T_j = 25^\circ\text{C}$	50			50			dB
Thermal Resistance, Junction to Case	(Note 3)							
TO-39 Package			15			15		$^\circ\text{C/W}$
TO-3 Package			2.5			2.5		$^\circ\text{C/W}$

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

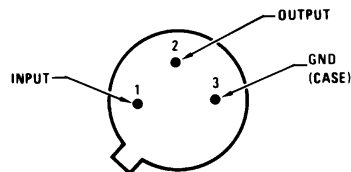
Note 2: Unless otherwise specified, these specifications apply $-55^\circ\text{C} \leq T_j \leq +150^\circ\text{C}$ for the LM109 and $0^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$ for the LM309; $V_{\text{IN}} = 10\text{V}$; and $I_{\text{OUT}} = 0.1\text{A}$ for the TO-39 package or $I_{\text{OUT}} = 0.5\text{A}$ for the TO-3 package. For the TO-39 package, $I_{\text{MAX}} = 0.2\text{A}$ and $P_{\text{MAX}} = 2.0\text{W}$. For the TO-3 package, $I_{\text{MAX}} = 1.0\text{A}$ and $P_{\text{MAX}} = 20\text{W}$.

Note 3: Without a heat sink, the thermal resistance of the TO-39 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.

Note 4: Refer to RETS109H drawing for LM109H or RETS109K drawing for LM109K military specifications.

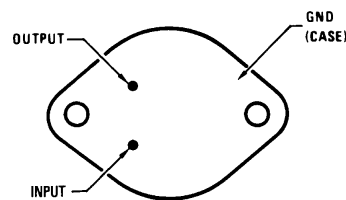
Connection Diagrams

Metal Can Packages



DS007138-33

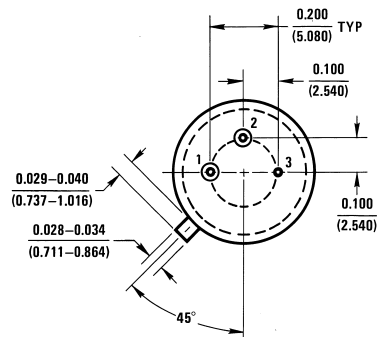
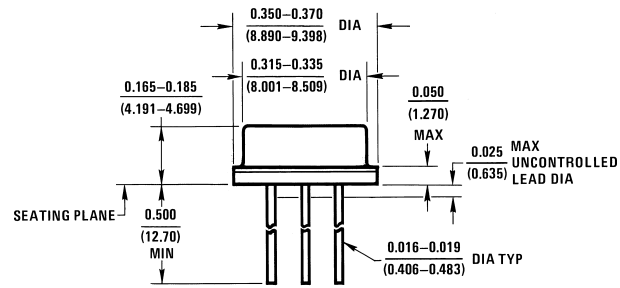
Order Number LM109H, LM109H/883 or LM309H
See NS Package Number H03A



DS007138-34

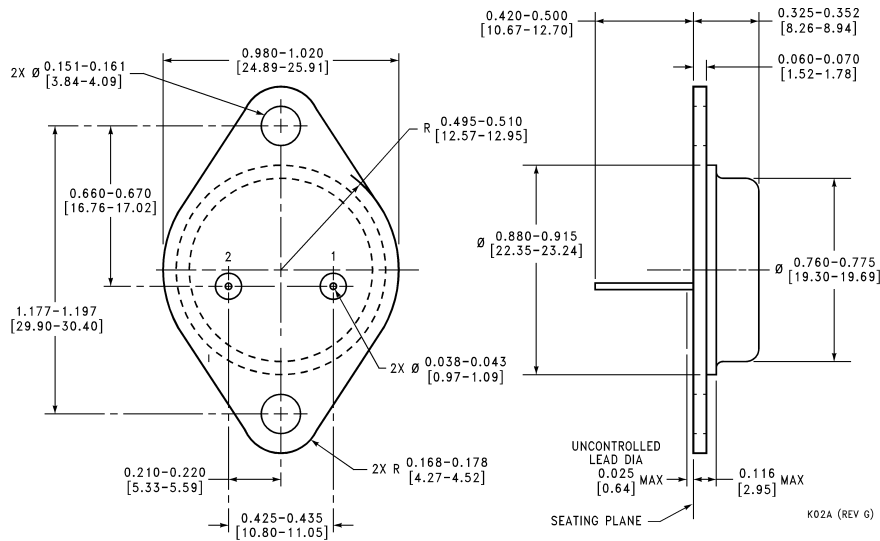
Order Number LM109K STEEL or
LM309K STEEL
See NS Package Number K02A
Order Number LM109K/883
See NS Package Number K02C

Physical Dimensions inches (millimeters) unless otherwise noted



H03A (REV B)

Metal Can Package (H)
 Order Number LM109H, LM109H/883 or LM309H
 NS Package Number H03A



Metal Can Package (K)
 Order Number LM109K STEEL, LM309K STEEL
 NS Package Number K02A