# LM109
# LM209
# LM309



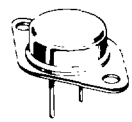
## POSITIVE THREE-TERMINAL FIXED VOLTAGE REGULATORS

A versatile positive fixed + 5.0-volt regulator designed for easy application as an on-card, local voltage regulator for digital logic systems. Current limiting and thermal shutdown are provided to make the units extremely rugged.

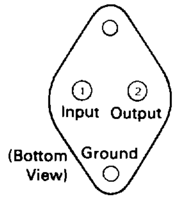
In most applications only one external component, a capacitor, is required in conjunction with the LM109 Series devices. Even this component may be omitted if the power-supply filter is not located an appreciable distance from the regulator.

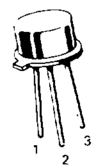
- High Maximum Output Current — Over 1.0 Ampere in K Suffix Package — Over 200 mA in H Suffix Package
- Minimum External Components Required
- Internal Short-Circuit Protection
- Internal Thermal Overload Protection
- Excellent Line and Load Transient Rejection
- Designed for Use with Popular MDTL and MTTL Logic

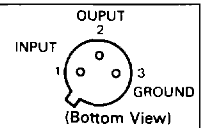
## POSITIVE VOLTAGE REGULATORS



**K SUFFIX**
METAL PACKAGE
CASE 1



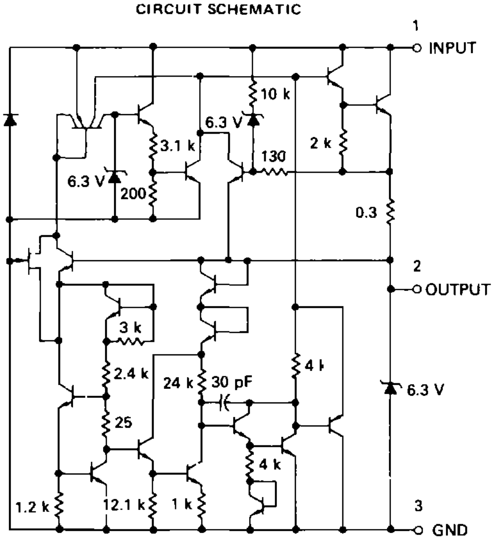

**H SUFFIX**
METAL PACKAGE
CASE 79

CASE IS GROUND

**ORDERING INFORMATION**

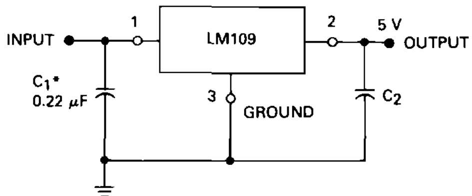
| Device | Tested Operating Temperature Range | Package |
|---|---|---|
| LM109H | $T_J$ = −55°C to +150°C | Metal Can |
| LM109K | $T_J$ = −55°C to +150°C | Metal Power |
| LM209H | $T_J$ = −25°C to +150°C | Metal Can |
| LM209K | $T_J$ = −25°C to +150°C | Metal Power |
| LM309H | $T_J$ = 0°C to +125°C | Metal Can |
| LM309K | $T_J$ = 0°C to +125°C | Metal Power |

CIRCUIT SCHEMATIC




TYPICAL APPLICATION

FIXED 5.0 V REGULATOR




*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.

## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Input Voltage | $V_{in}$ | 35 | Vdc |
| Power Dissipation | $P_D$ | Internally Limited | |
| Junction Temperature Range<br>LM109<br>LM209<br>LM309 | $T_J$ | <br>−55 to +150<br>−25 to +150<br>0 to +150 | °C |
| Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C |
| Lead Temperature (soldering, t − 60 s) | $T_S$ | 300 | °C |

## ELECTRICAL CHARACTERISTICS

| | | LM109/LM209[1] | | | LM309[2] | | | |
|---|---|---|---|---|---|---|---|---|
| Characteristic | Symbol | Min | Typ | Max | Min | Typ | Max | Unit |
| Output Voltage ($T_J$ = +25°C) | $V_O$ | 4.7 | 5.05 | 5.3 | 4.8 | 5.05 | 5.2 | Vdc |
| Input Regulation ($T_J$ = +25°C)<br>7.0 ≤ $V_{in}$ ≤ 25 V | $Reg_{line}$ | — | 4.0 | 50 | — | 4.0 | 50 | mV |
| Load Regulation ($T_J$ = +25°C)<br>Case 1-03 5.0 mA ≤ $I_O$ ≤ 1.5 A<br>Case 79-03 5.0 mA ≤ $I_O$ ≤ 0.5 A | $Reg_{load}$ | <br>—<br>— | <br>50<br>20 | <br>100<br>50 | <br>—<br>— | <br>50<br>20 | <br>100<br>50 | mV |
| Output Voltage Range<br>7.0 V ≤ $V_{in}$ ≤ 25 V<br>5.0 mA ≤ $I_O$ ≤ $I_{max}$, P ≤ $P_{max}$ | $V_O$ | 4.6 | — | 5.4 | 4.75 | — | 5.25 | Vdc |
| Quiescent Current (7.0 V ≤ $V_{in}$ ≤ 25 V)<br>Quiescent Current Change (7.0 V ≤ $V_{in}$ ≤ 25 V)<br>5.0 mA ≤ $I_O$ ≤ $I_{max}$ | $I_B$<br>$\Delta I_B$ | —<br>—<br>— | 5.2<br>—<br>— | 10<br>0.5<br>0.8 | —<br>—<br>— | 5.2<br>—<br>— | 10<br>0.5<br>0.8 | mAdc |
| Output Noise Voltage ($T_A$ = +25°C)<br>10 Hz ≤ f ≤ 100 kHz | $V_N$ | — | 40 | — | — | 40 | — | µV |
| Long Term Stability | S | — | — | 10 | — | — | 20 | mV |
| Thermal Resistance, Junction to Case[3]<br>Case 1-03<br>Case 79-03 | $\theta JC$ | <br>—<br>— | <br>3.0<br>15 | <br>—<br>— | <br>—<br>— | <br>3.0<br>15 | <br>—<br>— | °C/W |

NOTES:
1. Unless otherwise specified, these specifications apply for −55°C ≤ $T_J$ ≤ +150° (−25°C ≤ $T_J$ ≤ +150°C for the LM209). For Case 79-03 $V_{in}$ = 10 V, $I_O$ = 0.1 A, $I_{max}$ = 0.2 A and $P_{max}$ = 2.0 W. For Case 1-03 $V_{in}$ = 10 V, $I_O$ = 0.5 A, $I_{max}$ = 1.0 A and $P_{max}$ = 20 W.
2. Unless otherwise specified, these specifications apply for 0°C ≤ $T_J$ ≤ +125°C, $V_{in}$ = 10 V. For Case 79-03 $I_O$ = 0.1 A, $I_{max}$ = 0.2 A and $P_{max}$ = 2.0 W. For Case 1-03 $I_O$ = 0.5 A, $I_{max}$ = 1.0 A and $P_{max}$ = 20 W.
3. Without a heat sink, the thermal resistance of the Case 79-03 package is about 150°C/W, while that of the Case 1-03 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 heat sink.

## TYPICAL CHARACTERISTICS

($V_{in}$ = 10 V, $T_A$ = +25°C unless otherwise noted.)

FIGURE 1 — MAXIMUM AVERAGE POWER DISSIPATION (LM109K, LM209K)

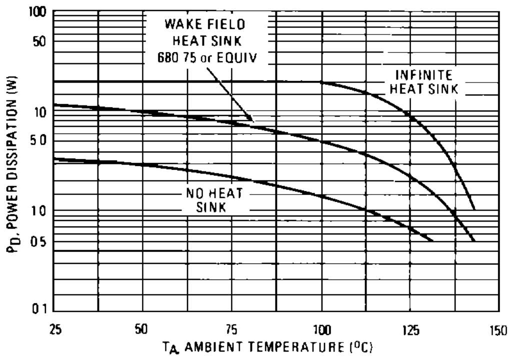
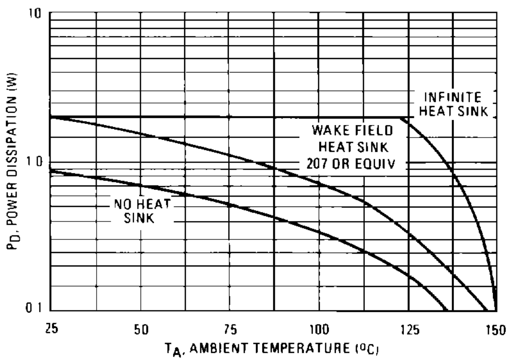



FIGURE 2 — MAXIMUM AVERAGE POWER DISSIPATION (LM109H, LM209H)



## TYPICAL CHARACTERISTICS (continued)

($V_{in}$ = 10 V, $T_A$ = +25°C unless otherwise noted)

FIGURE 3 – MAXIMUM AVERAGE POWER DISSIPATION (LM309K)

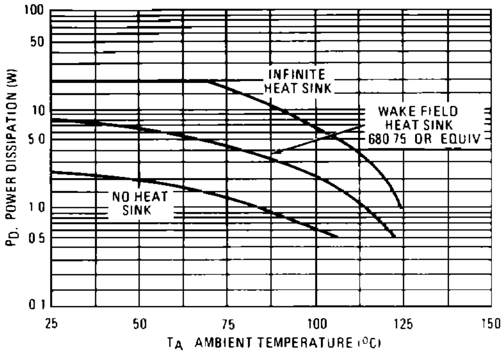



FIGURE 4 – MAXIMUM AVERAGE POWER DISSIPATION (LM309H)

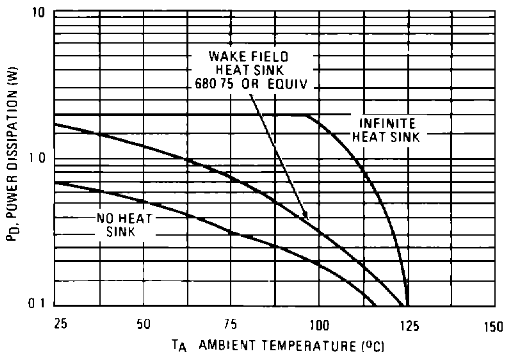



FIGURE 5 - OUTPUT IMPEDANCE versus FREQUENCY

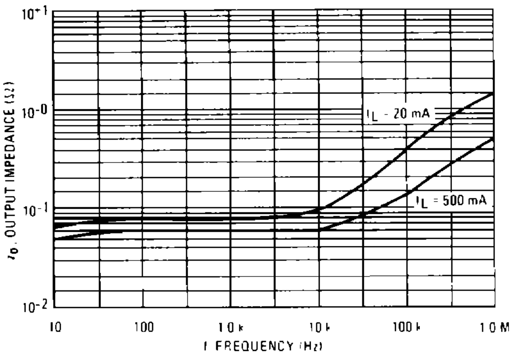



FIGURE 6 – PEAK OUTPUT CURRENT (K PACKAGE)

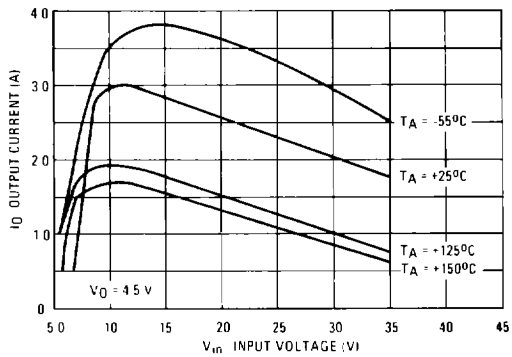



FIGURE 7 – PEAK OUTPUT CURRENT (H PACKAGE)

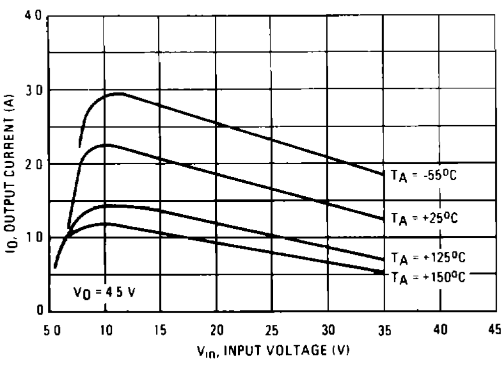
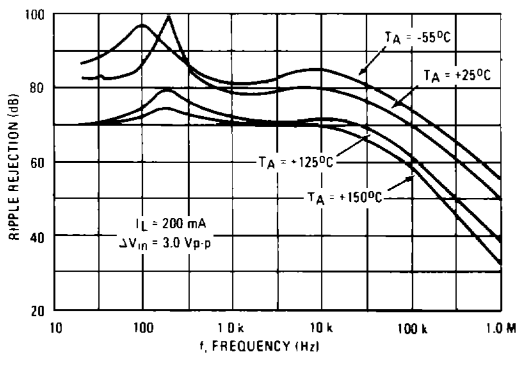



FIGURE 8 – RIPPLE REJECTION



## TYPICAL CHARACTERISTICS (continued)

FIGURE 9 – DROPOUT VOLTAGE

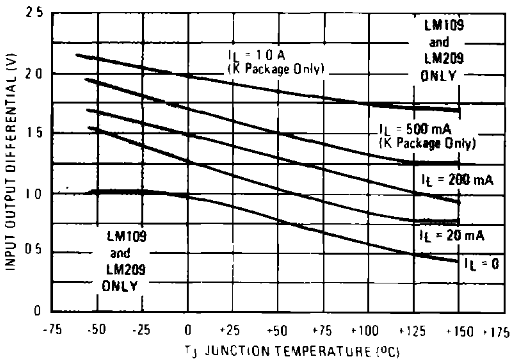



FIGURE 10 – DROPOUT CHARACTERISTIC (K PACKAGE)

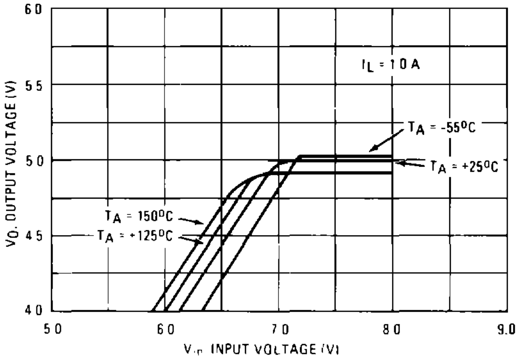



FIGURE 11 – OUTPUT VOLTAGE

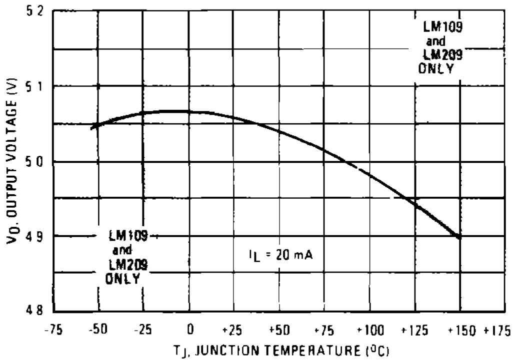



FIGURE 12 – OUTPUT NOISE VOLTAGE

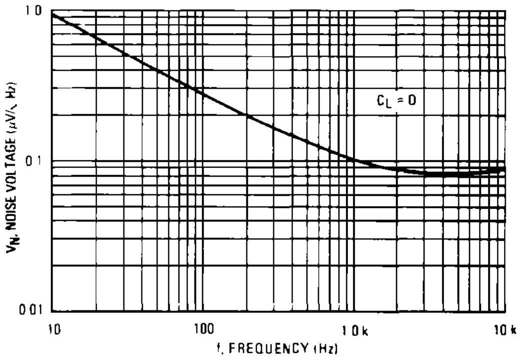



FIGURE 13 – QUIESCENT CURRENT

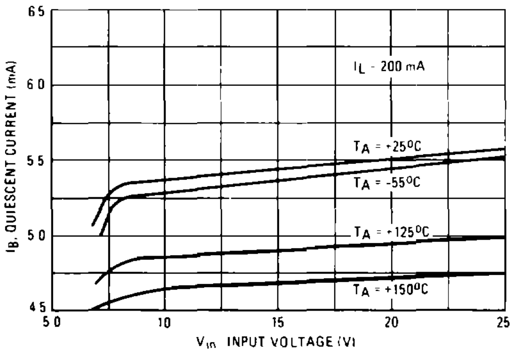
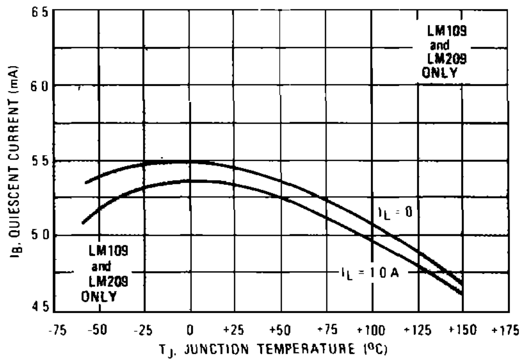



FIGURE 14 – QUIESCENT CURRENT



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## TYPICAL APPLICATIONS

**FIGURE 15 – ADJUSTABLE OUTPUT REGULATOR**

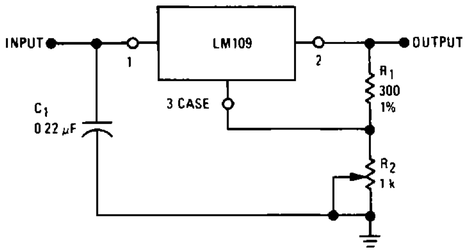
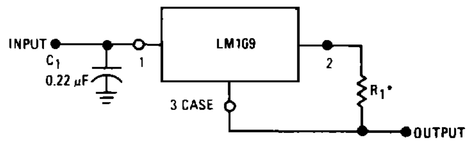



**FIGURE 16 – CURRENT REGULATOR**




*DETERMINES OUTPUT CURRENT

**FIGURE 17 – 5.0-VOLT, 3.0-AMPERE REGULATOR**
**(with plastic boost transistor)**

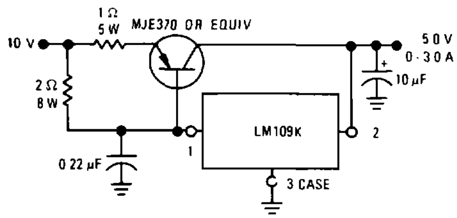



**FIGURE 18 – 5.0 VOLT, 4.0-AMPERE TRANSISTOR**
**(with plastic Darlington boost transistor)**

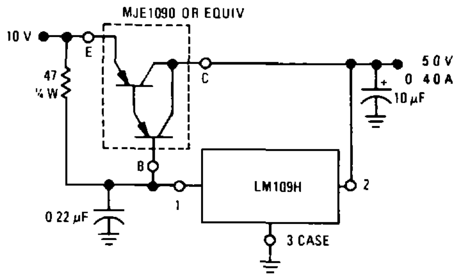



**FIGURE 19 – 5.0-VOLT, 10-AMPERE REGULATOR**

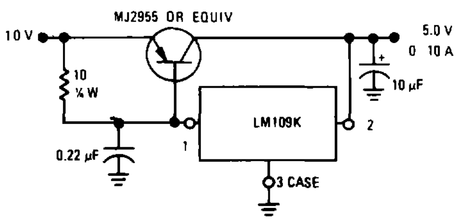



**FIGURE 20 – 5.0-VOLT, 10-AMPERE REGULATOR**
**(with Short-Circuit Current Limiting for Safe-Area Protection of pass transistors)**