



# Low Dropout Positive Fixed and Adjustable Voltage Regulators

The MC33269 series are low dropout, medium current, fixed and adjustable, positive voltage regulators specifically designed for use in low input voltage applications. These devices offer the circuit designer an economical solution for precision voltage regulation, while keeping power losses to a minimum.

The regulator consists of a 1.0 V dropout composite PNP-NPN pass transistor, current limiting, and thermal shutdown.

- 3.3 V, 5.0 V, 12 V and Adjustable Versions  
2.8 V version available as MC34268
- Space Saving DPAK, SOP-8 and SOT-223 Power Packages
- 1.0 V Dropout
- Output Current in Excess of 800 mA
- Thermal Protection
- Short Circuit Protection
- Output Trimmed to 1.0% Tolerance
- No Minimum Load Requirement for Fixed Voltage Output Devices
- Drop-in Replacement for National's LM1117, Linear Technology's LT1117 or Burr-Brown REG1117

## ORDERING INFORMATION

| Device        | Operating Temperature Range                       | Package         |
|---------------|---------------------------------------------------|-----------------|
| MC33269D      | $T_J = -40^\circ \text{ to } +125^\circ \text{C}$ | SOP-8           |
| MC33269DT     |                                                   | DPAK            |
| MC33269ST     |                                                   | SOT-223         |
| MC33269T      |                                                   | Insertion Mount |
| MC33269D-3.3  |                                                   | SOP-8           |
| MC33269DT-3.3 |                                                   | DPAK            |
| MC33269ST-3.3 |                                                   | SOT-223         |
| MC33269T-3.3  |                                                   | Insertion Mount |
| MC33269D-5.0  |                                                   | SOP-8           |
| MC33269DT-5.0 |                                                   | DPAK            |
| MC33269T-5.0  |                                                   | Insertion Mount |
| MC33269ST-5.0 |                                                   | SOT-223         |
| MC33269D-12   |                                                   | SOP-8           |
| MC33269DT-12  |                                                   | DPAK            |
| MC33269T-12   |                                                   | Insertion Mount |
| MC33269ST-12  |                                                   | SOT-223         |

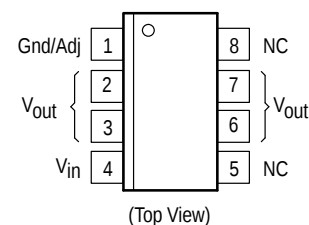
## DEVICE TYPE/NOMINAL OUTPUT VOLTAGE

|               |       |               |       |
|---------------|-------|---------------|-------|
| MC33269D      | Adj   | MC33269D-5.0  | 5.0 V |
| MC33269DT     | Adj   | MC33269DT-5.0 | 5.0 V |
| MC33269T      | Adj   | MC33269T-5.0  | 5.0 V |
| MC33269ST     | Adj   | MC33269ST-5.0 | 5.0 V |
| MC33269D-3.3  | 3.3 V | MC33269D-12   | 12 V  |
| MC33269DT-3.3 | 3.3 V | MC33269DT-12  | 12 V  |
| MC33269T-3.3  | 3.3 V | MC33269T-12   | 12 V  |
| MC33269ST-3.3 | 3.3 V | MC33269ST-12  | 12 V  |

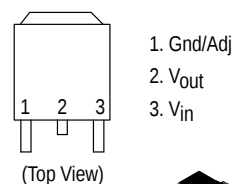
## MC33269

### 800 mA LOW DROPOUT THREE-TERMINAL VOLTAGE REGULATORS

**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SOP-8)

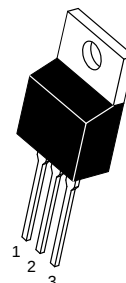


**DT SUFFIX**  
PLASTIC PACKAGE  
CASE 369A  
(DPAK)

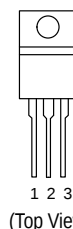


**ST SUFFIX**  
PLASTIC PACKAGE  
CASE 318E  
(SOT-223)

Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.



**T SUFFIX**  
PLASTIC PACKAGE  
CASE 221A



Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.

## MAXIMUM RATINGS

| Rating                                  | Symbol        | Value              | Unit               |
|-----------------------------------------|---------------|--------------------|--------------------|
| Power Supply Input Voltage              | $V_{in}$      | 20                 | V                  |
| Power Dissipation                       |               |                    |                    |
| Case 369A (DPAK)                        |               |                    |                    |
| $T_A = 25^\circ\text{C}$                | $P_D$         | Internally Limited | W                  |
| Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 92                 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 6.0                | $^\circ\text{C/W}$ |
| Case 751 (SOP-8)                        |               |                    |                    |
| $T_A = 25^\circ\text{C}$                | $P_D$         | Internally Limited | W                  |
| Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 160                | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 25                 | $^\circ\text{C/W}$ |
| Case 221A                               |               |                    |                    |
| $T_A = 25^\circ\text{C}$                | $P_D$         | Internally Limited | W                  |
| Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 65                 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 5.0                | $^\circ\text{C/W}$ |
| Case 318E                               |               |                    |                    |
| $T_A = 25^\circ\text{C}$                | $P_D$         | Internally Limited | W                  |
| Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 245                | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 15                 | $^\circ\text{C/W}$ |
| Operating Junction Temperature Range    | $T_J$         | -40 to +150        | $^\circ\text{C}$   |
| Storage Temperature                     | $T_{stg}$     | -55 to +150        | $^\circ\text{C}$   |

**NOTE:** ESD data available upon request.

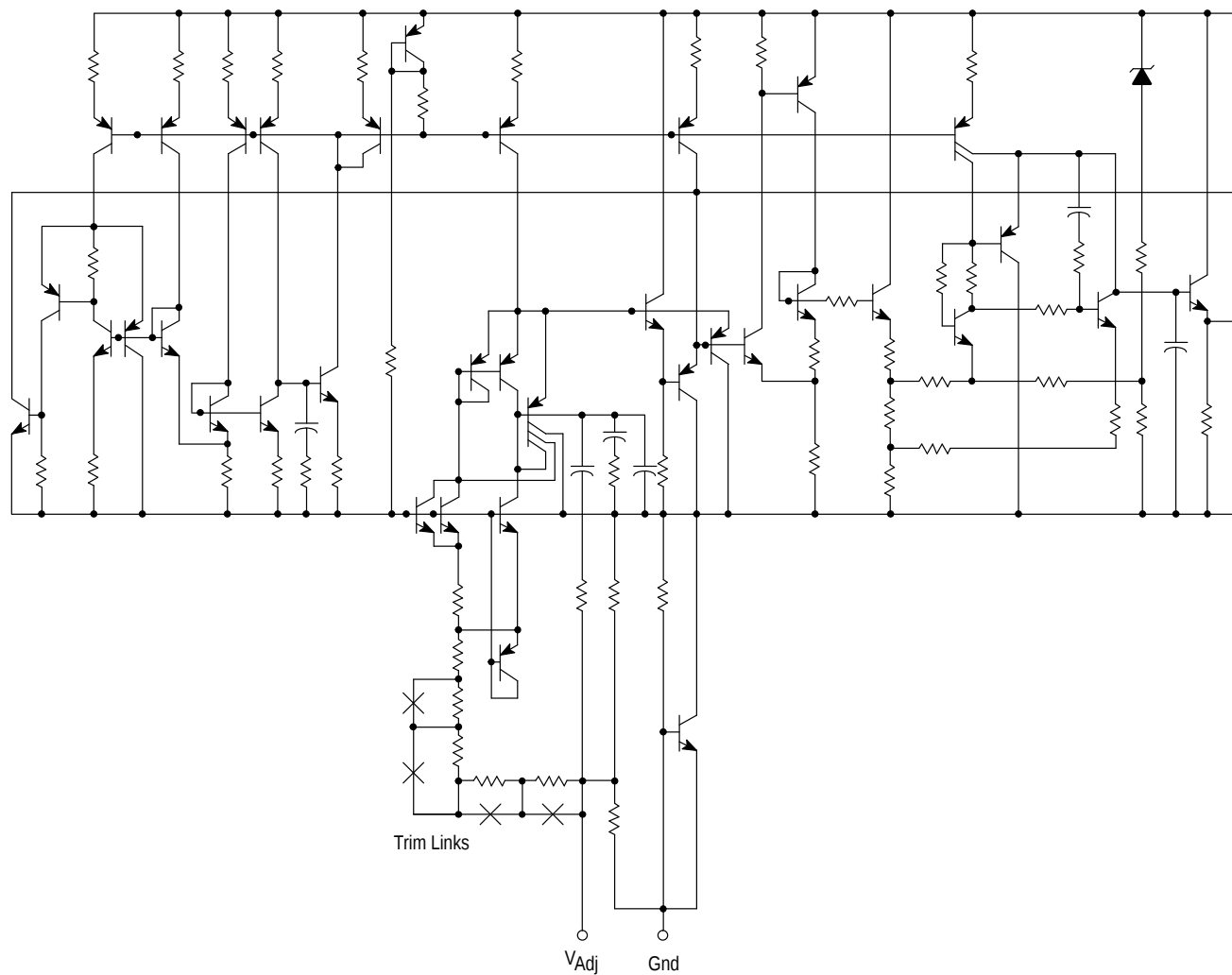
ELECTRICAL CHARACTERISTICS ( $C_O = 10\ \mu\text{F}$ ,  $T_A = 25^\circ\text{C}$ , for min/max values  $T_J = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.)

| Characteristic                                                                                                                    | Symbol              | Min   | Typ  | Max   | Unit          |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------------|-------|------|-------|---------------|
| Output Voltage ( $I_{out} = 10\ \text{mA}$ , $T_J = 25^\circ\text{C}$ )                                                           | $V_O$               |       |      |       | V             |
| 3.3 Suffix ( $V_{CC} = 5.3\ \text{V}$ )                                                                                           |                     | 3.27  | 3.3  | 3.33  |               |
| 5.0 Suffix ( $V_{CC} = 7.0\ \text{V}$ )                                                                                           |                     | 4.95  | 5.0  | 5.05  |               |
| 12 Suffix ( $V_{CC} = 14\ \text{V}$ )                                                                                             |                     | 11.88 | 12   | 12.12 |               |
| Output Voltage (Line, Load and Temperature) (Note 1)                                                                              | $V_O$               |       |      |       | V             |
| ( $1.25\ \text{V} \leq V_{in} - V_{out} \leq 15\ \text{V}$ , $I_{out} = 500\ \text{mA}$ )                                         |                     |       |      |       |               |
| ( $1.35\ \text{V} \leq V_{in} - V_{out} \leq 10\ \text{V}$ , $I_{out} = 800\ \text{mA}$ )                                         |                     |       |      |       |               |
| 3.3 Suffix                                                                                                                        |                     | 3.23  | 3.3  | 3.37  |               |
| 5.0 Suffix                                                                                                                        |                     | 4.9   | 5.0  | 5.1   |               |
| 12 Suffix                                                                                                                         |                     | 11.76 | 12   | 12.24 |               |
| Reference Voltage ( $I_{out} = 10\ \text{mA}$ , $V_{in} - V_{out} = 2.0\ \text{V}$ , $T_J = 25^\circ\text{C}$ )                   | $V_{ref}$           | 1.235 | 1.25 | 1.265 | V             |
| Adjustable                                                                                                                        |                     |       |      |       |               |
| Reference Voltage (Line, Load and Temperature) (Note 1)                                                                           | $V_{ref}$           | 1.225 | 1.25 | 1.275 | V             |
| ( $1.25\ \text{V} \leq V_{in} - V_{out} \leq 15\ \text{V}$ , $I_{out} = 500\ \text{mA}$ )                                         |                     |       |      |       |               |
| ( $1.35\ \text{V} \leq V_{in} - V_{out} \leq 10\ \text{V}$ , $I_{out} = 800\ \text{mA}$ )                                         |                     |       |      |       |               |
| Adjustable                                                                                                                        |                     |       |      |       |               |
| Line Regulation                                                                                                                   | $\text{Reg}_{line}$ | —     | —    | 0.3   | %             |
| ( $I_{out} = 10\ \text{mA}$ , $V_{in} = [V_{out} + 1.5\ \text{V}]$ to $V_{in} = 20\ \text{V}$ , $T_J = 25^\circ\text{C}$ )        |                     |       |      |       |               |
| Load Regulation ( $V_{in} = V_{out} + 3.0\ \text{V}$ , $I_{out} = 10\ \text{mA}$ to $800\ \text{mA}$ , $T_J = 25^\circ\text{C}$ ) | $\text{Reg}_{load}$ | —     | —    | 0.5   | %             |
| Dropout Voltage                                                                                                                   | $V_{in} - V_{out}$  |       |      |       | V             |
| ( $I_{out} = 500\ \text{mA}$ )                                                                                                    |                     | —     | 1.0  | 1.25  |               |
| ( $I_{out} = 800\ \text{mA}$ )                                                                                                    |                     | —     | 1.1  | 1.35  |               |
| Ripple Rejection                                                                                                                  | RR                  | 55    | —    | —     | dB            |
| (10 Vpp, 120 Hz Sinewave; $I_{out} = 500\ \text{mA}$ )                                                                            |                     |       |      |       |               |
| Current Limit ( $V_{in} - V_{out} = 10\ \text{V}$ )                                                                               | $I_{Limit}$         | 800   | —    | —     | mA            |
| Quiescent Current (Fixed Output)                                                                                                  | $I_Q$               | —     | 5.5  | 8.0   | mA            |
| Minimum Required Load Current                                                                                                     | $I_{Load}$          |       |      |       | mA            |
| Fixed Output                                                                                                                      |                     | —     | —    | 0     |               |
| Adjustable                                                                                                                        |                     | 8.0   | —    | —     |               |
| Adjustment Pin Current                                                                                                            | $I_{Adj}$           | —     | —    | 120   | $\mu\text{A}$ |

**NOTE 1:** The MC33269-12,  $V_{in} - V_{out}$  is limited to 8.0 V maximum, because of the 20 V maximum rating applied to  $V_{in}$ .

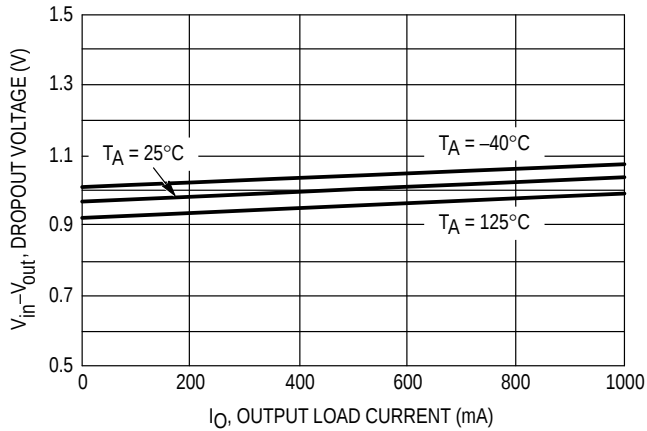
# MC33269

## Internal Schematic

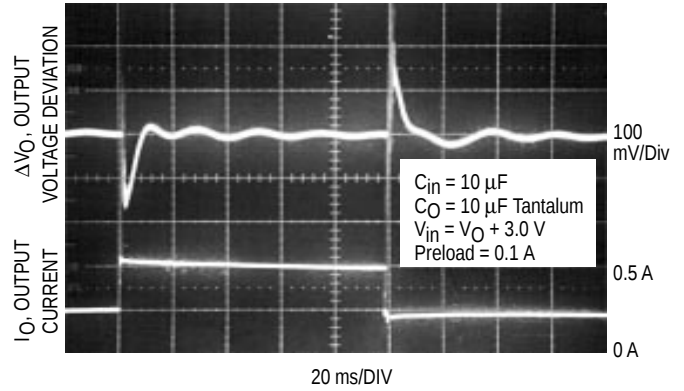


This device contains 38 active transistors.

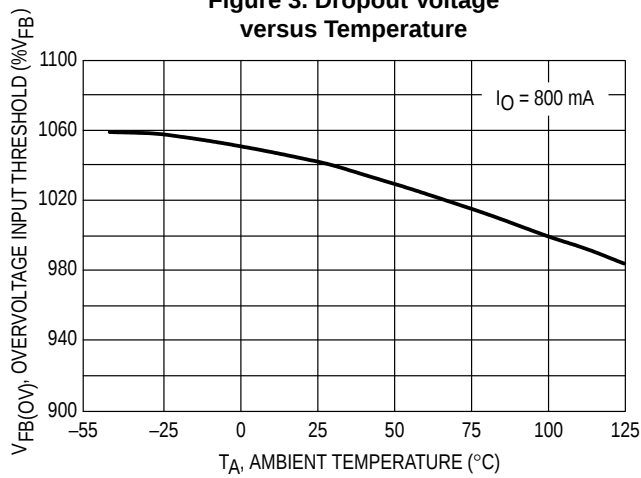
**Figure 1. Dropout Voltage versus Output Load Current**



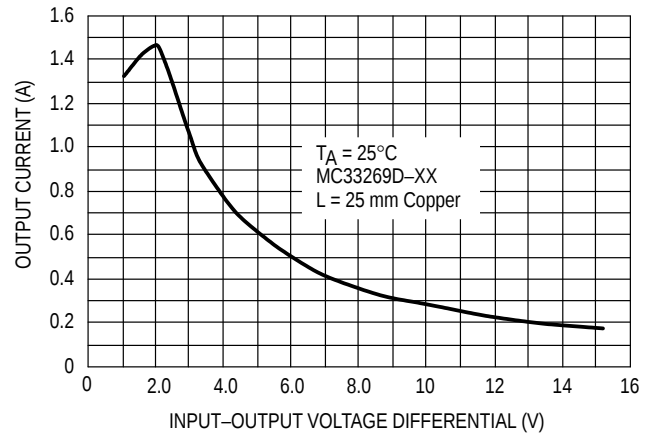
**Figure 2. Transient Load Regulation**



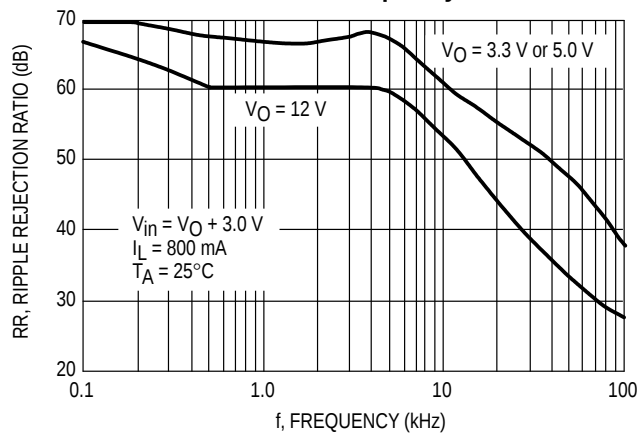
**Figure 3. Dropout Voltage versus Temperature**



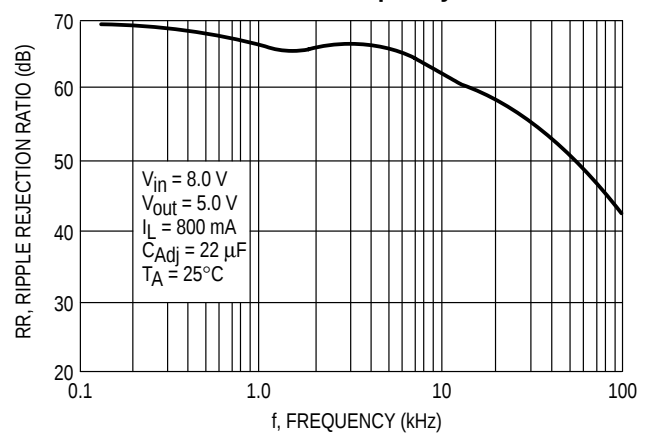
**Figure 4. MC33269-XX Output DC Current versus Input-Output Differential Voltage**



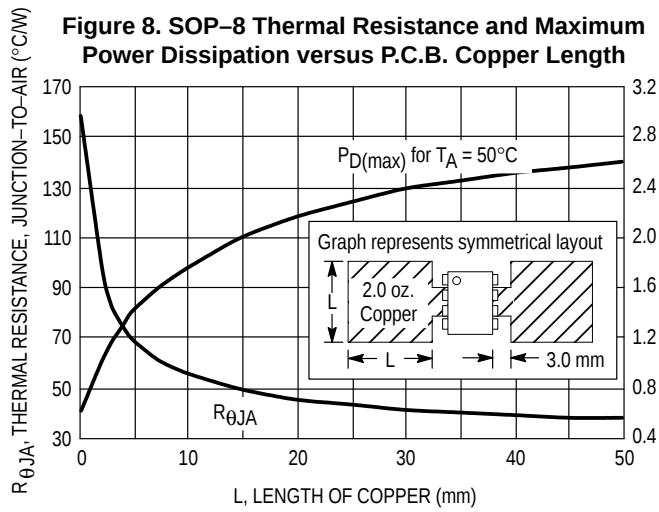
**Figure 5. MC33269 Ripple Rejection versus Frequency**



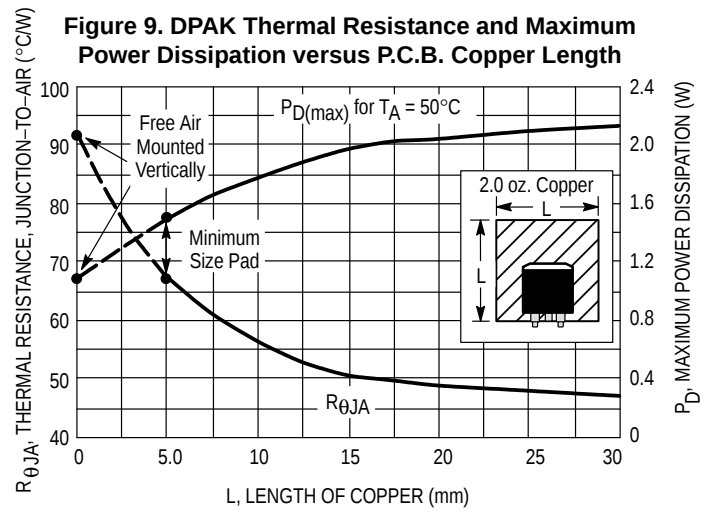
**Figure 6. MC33269-ADJ Ripple Rejection versus Frequency**



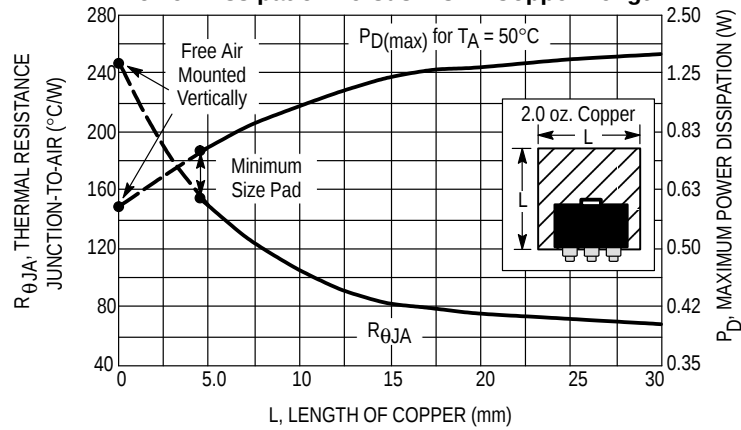
**Figure 8. SOP-8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



**Figure 9. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



**Figure 7. SOT-223 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



## APPLICATIONS INFORMATION

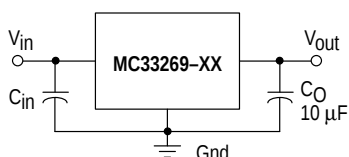
Figures 10 through 14 are typical application circuits. The output current capability of the regulator is in excess of 800 mA, with a typical dropout voltage of less than 1.0 V. Internal protective features include current and thermal limiting.

The MC33269 is not internally compensated and thus requires an external output capacitor for stability. The capacitor should be at least 10  $\mu\text{F}$  with an equivalent series resistance (ESR) of less than 10  $\Omega$  over the anticipated operating temperature range. With economical electrolytic capacitors, cold temperature operation can pose a problem. As temperature decreases, the capacitance also decreases and the ESR increases, which could cause the circuit to oscillate. Solid tantalum capacitors may be a better choice if small size is a requirement. Also capacitance and ESR of a solid tantalum capacitor is more stable over temperature. An input bypass capacitor is recommended to improve transient response or if the regulator is connected to the supply input

filter with long wire lengths. This will reduce the circuit's sensitivity to the input line impedance at high frequencies. A 0.33  $\mu\text{F}$  or larger tantalum, mylar, ceramic, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with shortest possible lead or track length directly across the regulator's input terminals. **Applications should be tested over all operating conditions to insure stability.**

Internal thermal limiting circuitry is provided to protect the integrated circuit in the event that the maximum junction temperature is exceeded. When activated, typically at 170°C, the output is disabled. There is no hysteresis built into the thermal limiting circuit. As a result, if the device is overheating, the output will appear to be oscillating. This feature is provided to prevent catastrophic failures from accidental device overheating. **It is not intended to be used as a substitute for proper heatsinking.**

Figure 10. Typical Fixed Output Application



An input capacitor is not necessary for stability, however it will improve the overall performance.

Figure 12. Current Regulator

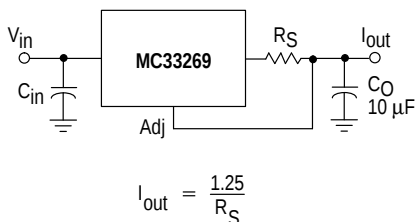
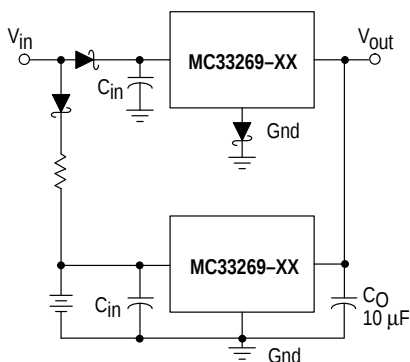
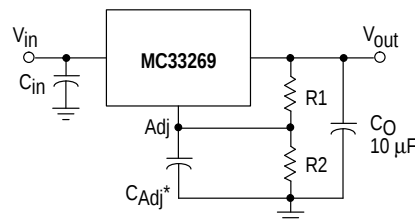


Figure 13. Battery Backed-Up Power Supply



The Schottky diode in series with the ground leg of the upper regulator shifts its output voltage higher by the forward voltage drop of the diode. This will cause the lower device to remain off until the input voltage is removed.

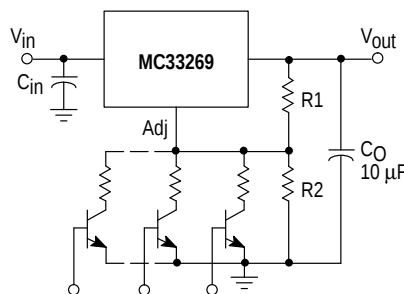
Figure 11. Typical Adjustable Output Application



$$V_{out} = 1.25 \left( 1 + \frac{R2}{R1} \right) + I_{Adj} R2$$

\*C<sub>Adj</sub> is optional, however it will improve the ripple rejection. The MC33269 develops a 1.25 V reference voltage between the output and the adjust terminal. Resistor R1, operates with constant current to flow through it and resistor R2. This current should be set such that the Adjust Pin current causes negligible drop across resistor R2. The total current with minimum load should be greater than 8.0 mA.

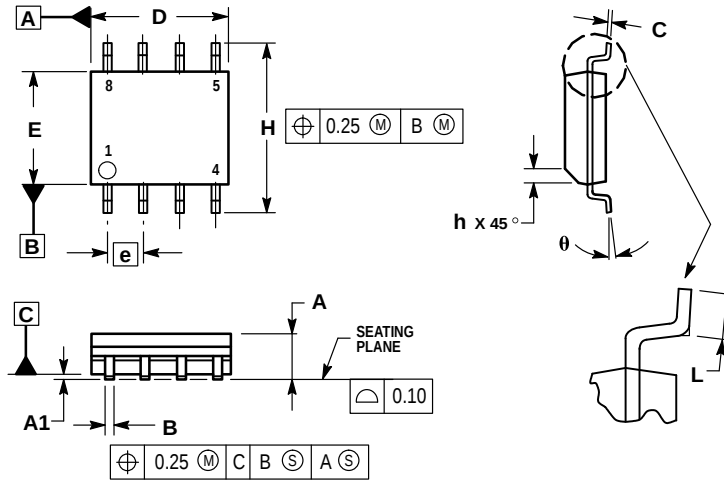
Figure 14. Digitally Controlled Voltage Regulator



R<sub>2</sub> sets the maximum output voltage. Each transistor reduces the output voltage when turned on.

## OUTLINE DIMENSIONS

**D SUFFIX**  
**PLASTIC PACKAGE**  
CASE 751-06  
(SOP-8)  
ISSUE T

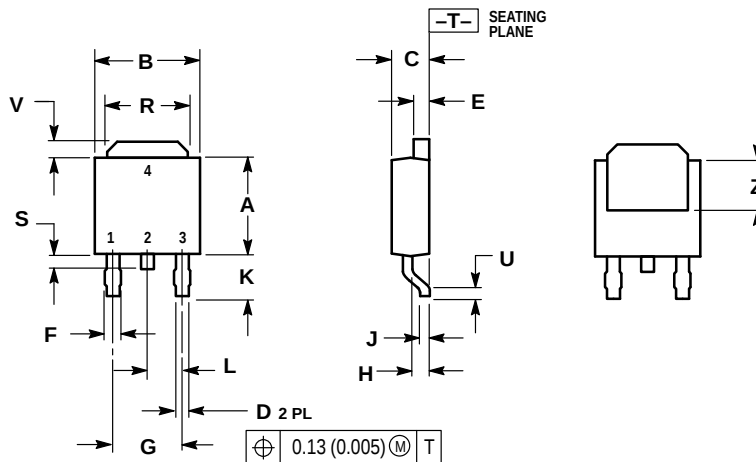


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 1.35        | 1.75 |
| A1  | 0.10        | 0.25 |
| B   | 0.35        | 0.49 |
| C   | 0.19        | 0.25 |
| D   | 4.80        | 5.00 |
| E   | 3.80        | 4.00 |
| e   | 1.27 BSC    |      |
| H   | 5.80        | 6.20 |
| h   | 0.25        | 0.50 |
| L   | 0.40        | 1.25 |
| θ   | 0°          | 7°   |

**DT SUFFIX**  
**PLASTIC PACKAGE**  
CASE 369A-13  
(DPAK)  
ISSUE Y

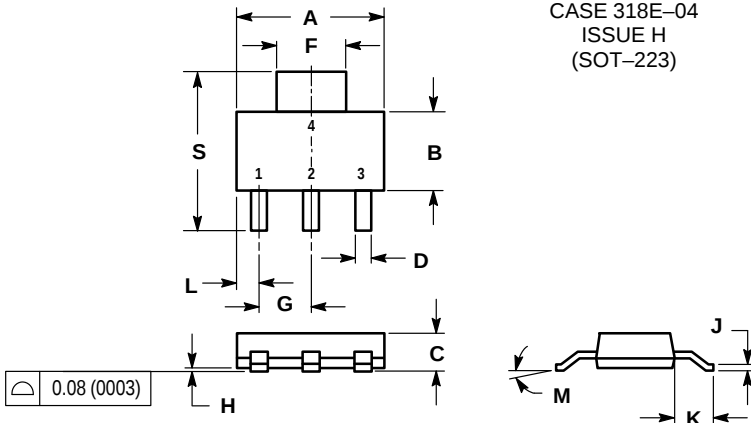


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

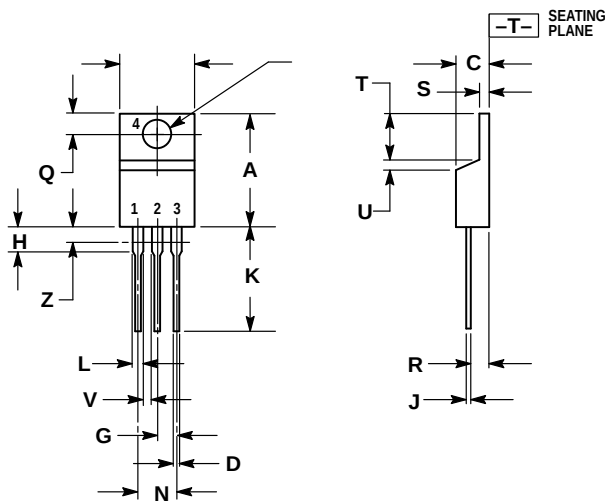
| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| G   | 0.180 BSC |       | 4.58 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.102     | 0.114 | 2.60        | 2.89 |
| L   | 0.090 BSC |       | 2.29 BSC    |      |
| R   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.020     | 0.050 | 0.51        | 1.27 |
| U   | 0.020     | —     | 0.51        | —    |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |
| Z   | 0.138     | —     | 3.51        | —    |

## OUTLINE DIMENSIONS

**ST SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 318E-04**  
**ISSUE H**  
**(SOT-223)**


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.249  | 0.263  | 6.30        | 6.70  |
| B   | 0.130  | 0.145  | 3.30        | 3.70  |
| C   | 0.060  | 0.068  | 1.50        | 1.75  |
| D   | 0.024  | 0.035  | 0.60        | 0.89  |
| E   | 0.115  | 0.126  | 2.90        | 3.20  |
| F   | 0.087  | 0.094  | 2.20        | 2.40  |
| G   | 0.0008 | 0.0040 | 0.020       | 0.100 |
| H   | 0.009  | 0.014  | 0.24        | 0.35  |
| J   | 0.060  | 0.078  | 1.50        | 2.00  |
| K   | 0.033  | 0.041  | 0.85        | 1.05  |
| L   | 0°     | 10°    | 0°          | 10°   |
| M   | 0.264  | 0.287  | 6.70        | 7.30  |

**T SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 221A-09**  
**ISSUE Z**


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| E   | 0.142  | 0.147 | 3.61        | 3.73  |
| F   | 0.095  | 0.105 | 2.42        | 2.66  |
| G   | 0.110  | 0.155 | 2.80        | 3.93  |
| H   | 0.018  | 0.025 | 0.46        | 0.64  |
| J   | 0.500  | 0.562 | 12.70       | 14.27 |
| K   | 0.045  | 0.060 | 1.15        | 1.52  |
| L   | 0.190  | 0.210 | 4.83        | 5.33  |
| M   | 0.100  | 0.120 | 2.54        | 3.04  |
| N   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | —     | 1.15        | —     |
| Z   | —      | 0.080 | —           | 2.04  |

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