

# MC33269

## 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.  
2.85 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

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 |
| 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 |               |       |

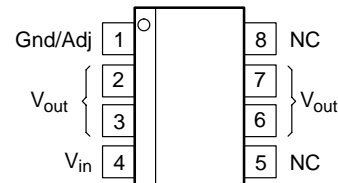


ON Semiconductor™

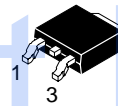
<http://onsemi.com>



SO–8  
D SUFFIX  
CASE 751

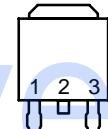


(Top View)



DPAK  
DT SUFFIX  
CASE 369A

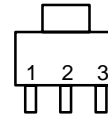
1. Gnd/Adj
2.  $V_{out}$
3.  $V_{in}$



(Top View)

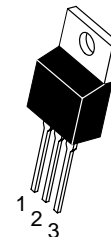


SOT–223  
ST SUFFIX  
CASE 318E



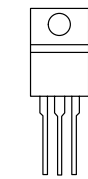
(Top View)

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



TO–220AB  
T SUFFIX  
CASE 221A

1. Gnd/Adj
2.  $V_{out}$
3.  $V_{in}$



(Top View)

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

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 8 of this data sheet.

## 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 | $\theta_{JA}$ | 156                | $^\circ\text{C/W}$ |
| 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.)

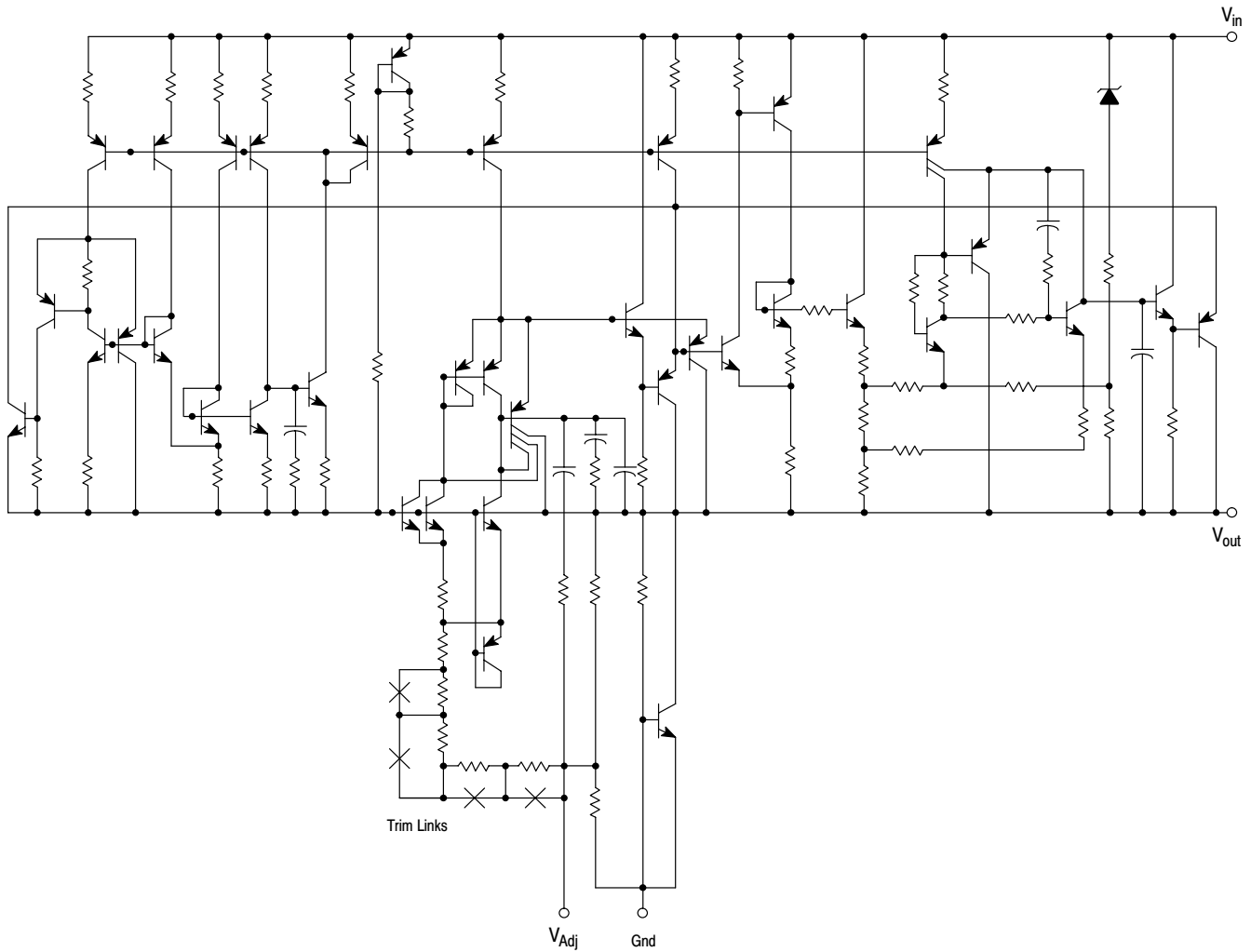
| Characteristic   | Symbol             | Min                   | Typ              | Max                   | Unit |
|--|--------------------|-----------------------|------------------|-----------------------|------|
| Output Voltage ( $I_{out} = 10 \text{ mA}$ , $T_J = 25^\circ\text{C}$ )<br>3.3 Suffix ( $V_{CC} = 5.3 \text{ V}$ )<br>5.0 Suffix ( $V_{CC} = 7.0 \text{ V}$ )<br>12 Suffix ( $V_{CC} = 14 \text{ V}$ )   | $V_O$              | 3.27<br>4.95<br>11.88 | 3.3<br>5.0<br>12 | 3.33<br>5.05<br>12.12 | V    |
| Output Voltage (Line, Load and Temperature) (Note 1.)<br>( $1.25 \text{ V} \leq V_{in} - V_{out} \leq 15 \text{ V}$ , $I_{out} = 500 \text{ mA}$ )<br>( $1.35 \text{ V} \leq V_{in} - V_{out} \leq 10 \text{ V}$ , $I_{out} = 800 \text{ mA}$ )<br>3.3 Suffix<br>5.0 Suffix<br>12 Suffix | $V_O$              | 3.23<br>4.9<br>11.76  | 3.3<br>5.0<br>12 | 3.37<br>5.1<br>12.24  | V    |
| Reference Voltage ( $I_{out} = 10 \text{ mA}$ , $V_{in} - V_{out} = 2.0 \text{ V}$ , $T_J = 25^\circ\text{C}$ )<br>for Adjustable Voltage  | $V_{ref}$          | 1.235                 | 1.25             | 1.265                 | V    |
| Reference Voltage (Line, Load and Temperature) (Note 1.)<br>( $1.25 \text{ V} \leq V_{in} - V_{out} \leq 15 \text{ V}$ , $I_{out} = 500 \text{ mA}$ )<br>( $1.35 \text{ V} \leq V_{in} - V_{out} \leq 10 \text{ V}$ , $I_{out} = 800 \text{ mA}$ )<br>for Adjustable Voltage             | $V_{ref}$          | 1.225                 | 1.25             | 1.275                 | V    |
| Line Regulation<br>( $I_{out} = 10 \text{ mA}$ , $V_{in} = [V_{out} + 1.5 \text{ V}]$ to $V_{in} = 20 \text{ V}$ , $T_J = 25^\circ\text{C}$ )  | $Reg_{line}$       | -                     | -                | 0.3                   | %    |
| Load Regulation ( $V_{in} = V_{out} + 3.0 \text{ V}$ , $I_{out} = 10 \text{ mA}$ to $800 \text{ mA}$ , $T_J = 25^\circ\text{C}$ )  | $Reg_{load}$       | -                     | -                | 0.5                   | %    |
| Dropout Voltage<br>( $I_{out} = 500 \text{ mA}$ )<br>( $I_{out} = 800 \text{ mA}$ )  | $V_{in} - V_{out}$ | -<br>-                | 1.0<br>1.1       | 1.25<br>1.35          | V    |
| Ripple Rejection<br>(10 Vpp, 120 Hz Sinewave; $I_{out} = 500 \text{ mA}$ )   | RR                 | 55                    | -                | -                     | dB   |
| Current Limit ( $V_{in} - V_{out} = 10 \text{ V}$ )  | $I_{Limit}$        | 800                   | -                | -                     | mA   |
| Quiescent Current (Fixed Output)<br>( $1.5 \text{ V} \leq V_{out} \leq 3.3 \text{ V}$ )<br>( $5 \text{ V} \leq V_{out} \leq 12 \text{ V}$ )  | $I_Q$              | -<br>-                | 5.5<br>-         | 8.0<br>20             | mA   |

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

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

| Characteristic                | Symbol            | Min | Typ | Max | Unit          |
|-------------------------------|-------------------|-----|-----|-----|---------------|
| Minimum Required Load Current | $I_{\text{Load}}$ | –   | –   | 0   | mA            |
| Fixed Output Voltage          |                   | 8.0 | –   | –   |               |
| Adjustable Voltage            |                   | –   | –   | –   |               |
| Adjustment Pin Current        | $I_{\text{Adj}}$  | –   | –   | 120 | $\mu\text{A}$ |



This device contains 38 active transistors.

**Figure 1. Internal Schematic**

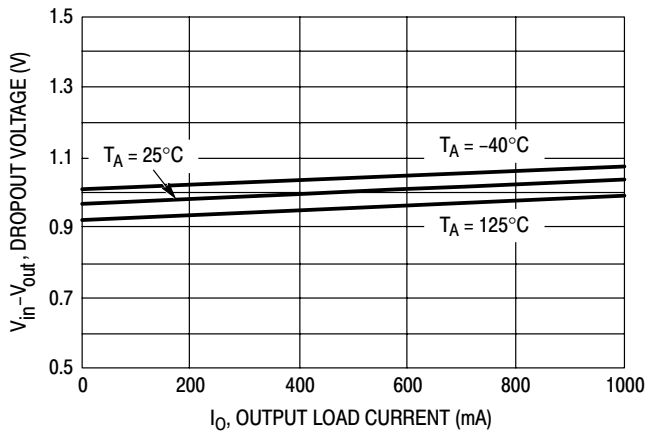


Figure 2. Dropout Voltage versus Output Load Current

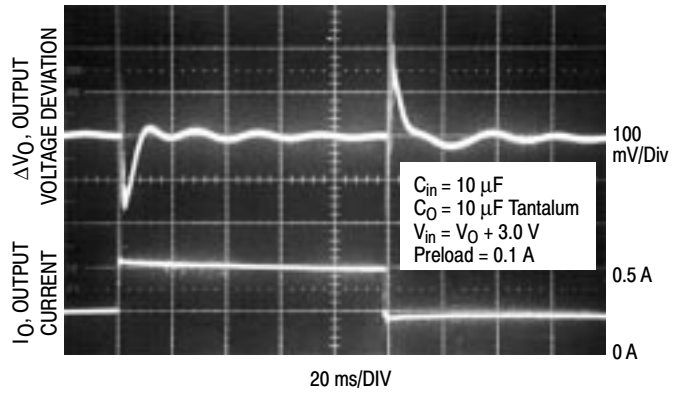


Figure 3. Transient Load Regulation

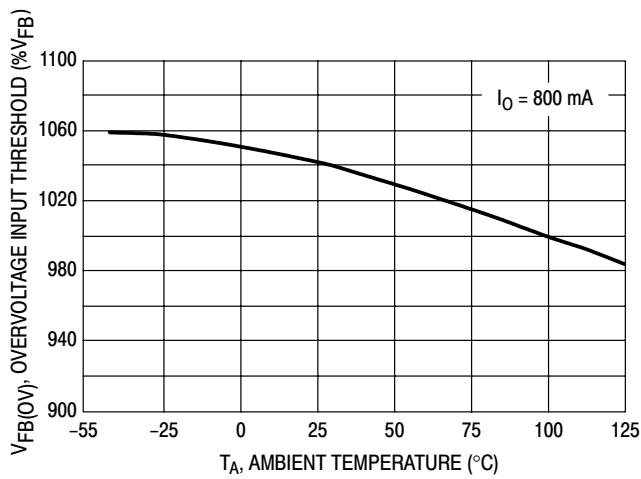


Figure 4. Dropout Voltage versus Temperature

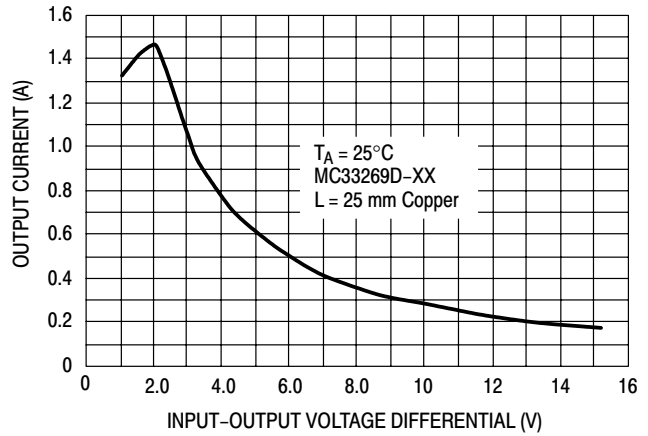


Figure 5. MC33269-XX Output DC Current versus Input-Output Differential Voltage

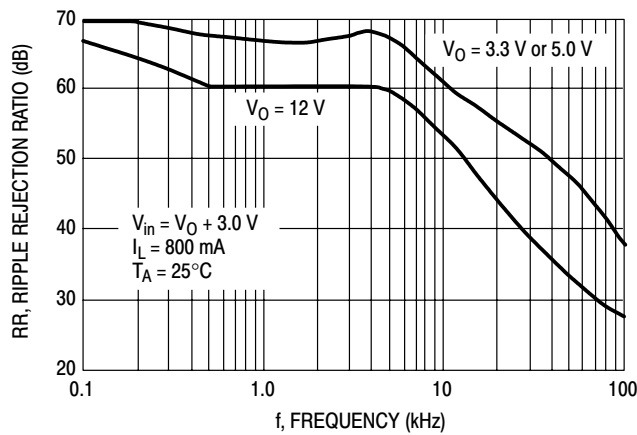


Figure 6. MC33269 Ripple Rejection versus Frequency

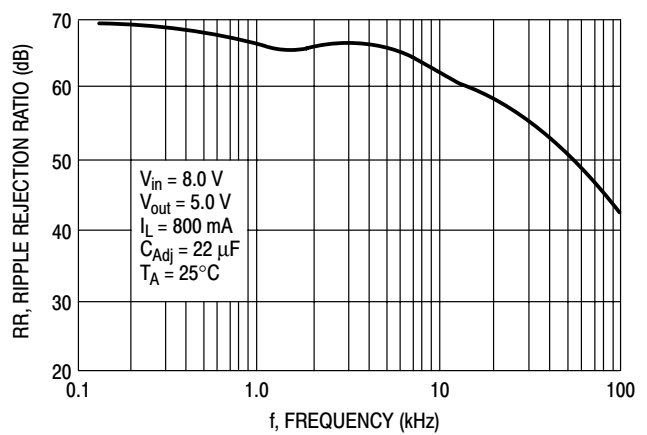


Figure 7. MC33269-ADJ Ripple Rejection versus Frequency

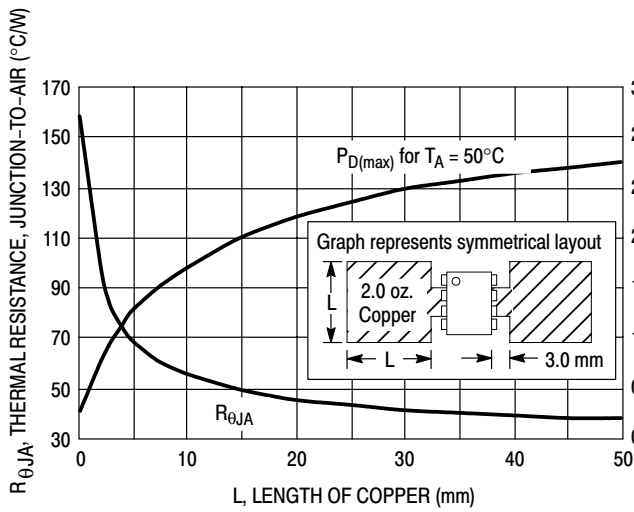


Figure 8. SOP-8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

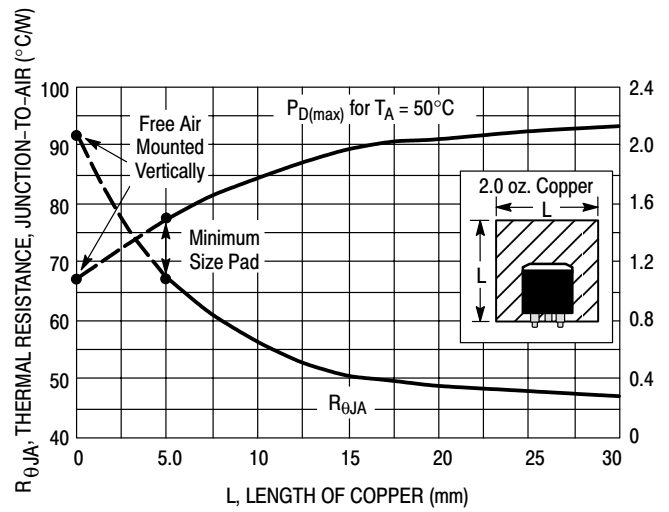


Figure 9. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

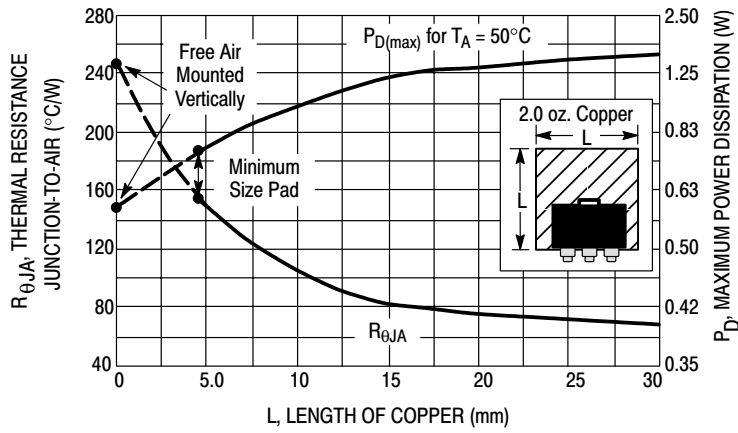


Figure 10. SOT-223 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

APPLICATIONS INFORMATION

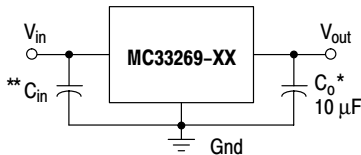
Figures 11 through 15 are typical application circuits. The output current capability of the regulator is in excess of 800 mA, with a typical dropout voltage of less than 1.0 V. Internal protective features include current and thermal limiting.

\* The MC33269 requires an external output capacitor for stability. The capacitor should be at least 10 μF with an equivalent series resistance (ESR) of less than 10 Ω but greater than 0.2 Ω 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. Also capacitance and ESR of a solid tantalum capacitor is more stable over temperature. The use of a low ESR ceramic capacitor placed within close proximity to the output of the device could cause instability.

\*\* An input bypass capacitor is recommended to improve transient response or if the regulator is connected to the

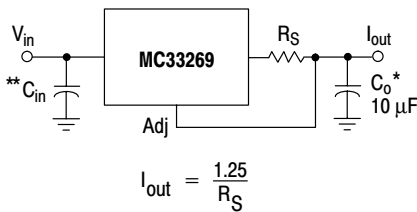
supply input filter with long wire lengths. This will reduce the circuit's sensitivity to the input line impedance at high frequencies. A 0.33 μF or larger tantalum, mylar, ceramic, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted 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.**



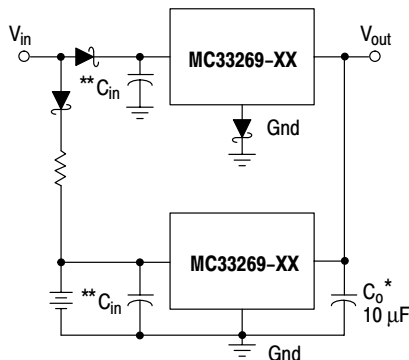
An input capacitor is not necessary for stability, however it will improve the overall performance.

Figure 11. Typical Fixed Output Application



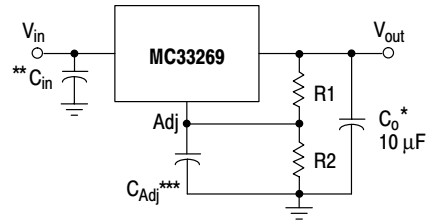
$$I_{out} = \frac{1.25}{R_s}$$

Figure 13. Current Regulator



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.

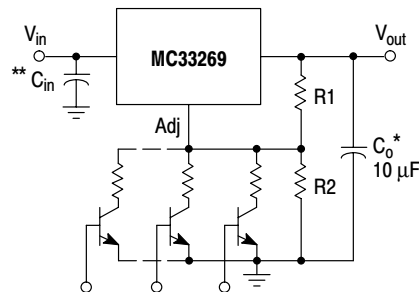
Figure 14. Battery Backed-Up Power Supply



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

\*\*\*C<sub>Adj</sub> is optional, however it will improve the ripple rejection. The MC34269 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 12. Typical Adjustable Output Application



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

Figure 15. Digitally Controlled Voltage Regulator

# MC33269

## ORDERING INFORMATION

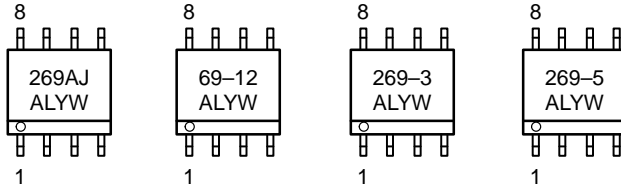
| Device          | Package | Shipping Information     |
|-----------------|---------|--------------------------|
| MC33269D        | SO-8    | 98 Units / Rail          |
| MC33269DR2      | SO-8    | 2500 Units / Tape & Reel |
| MC33269DT       | DPAK    | 75 Units / Rail          |
| MC33269DTRK     | DPAK    | 2500 Units / Tape & Reel |
| MC33269T        | TO-220  | 50 Units / Rail          |
| MC33269D-3.3    | SO-8    | 98 Units / Rail          |
| MC33269DR2-3.3  | SO-8    | 2500 Units / Tape & Reel |
| MC33269DT-3.3   | DPAK    | 75 Units / Rail          |
| MC33269DTRK-3.3 | DPAK    | 2500 Units / Tape & Reel |
| MC33269ST-3.3T3 | SOT-223 | 4000 Units / Tape & Reel |
| MC33269T-3.3    | TO-220  | 50 Units / Rail          |
| MC33269D-5.0    | SO-8    | 98 Units / Rail          |
| MC33269DR2-5.0  | SO-8    | 2500 Units / Tape & Reel |
| MC33269DT-5.0   | DPAK    | 75 Units / Rail          |
| MC33269DTRK-5.0 | DPAK    | 2500 Units / Tape & Reel |
| MC33269T-5.0    | TO-220  | 50 Units / Rail          |
| MC33269D-12     | SO-8    | 98 Units / Rail          |
| MC33269DR2-12   | SO-8    | 2500 Units / Tape & Reel |
| MC33269DT-12    | DPAK    | 75 Units / Rail          |
| MC33269DTRK-12  | DPAK    | 2500 Units / Tape & Reel |
| MC33269T-12     | TO-220  | 50 Units / Rail          |

# MC33269

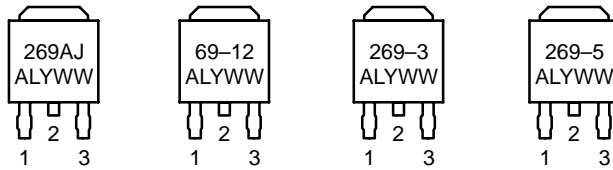
## MARKING DIAGRAMS

1

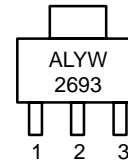
### SO-8 D SUFFIX CASE 751



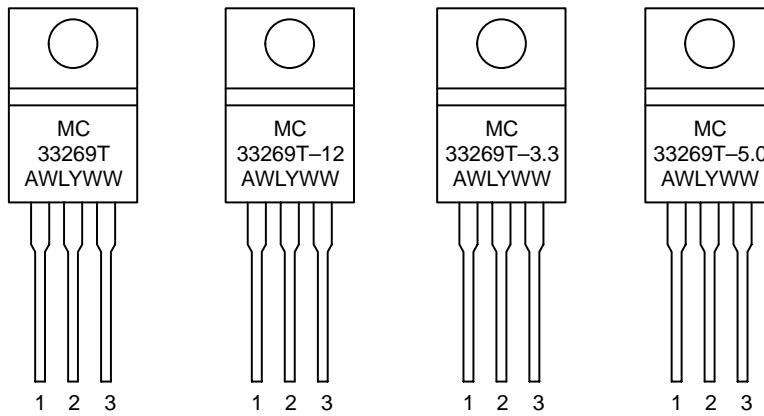
### DPAK DT SUFFIX CASE 369A



### SOT-223 ST SUFFIX CASE 318E



### TO-220AB T SUFFIX CASE 221A



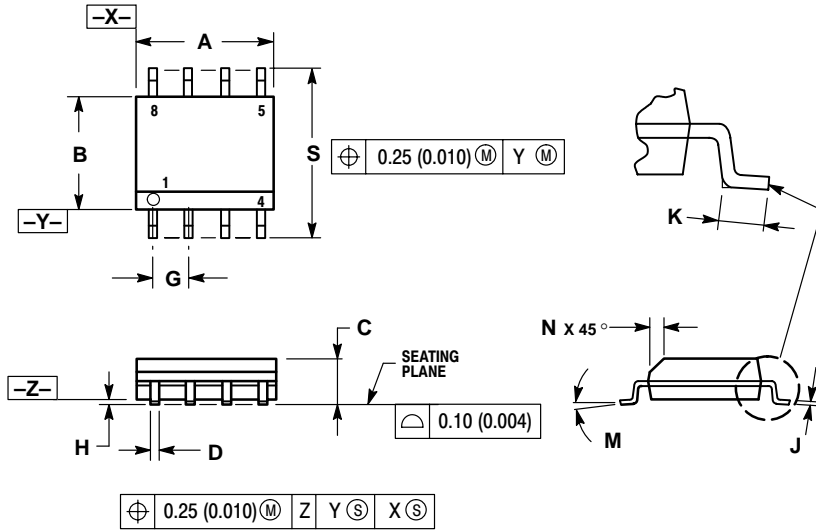
A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW, W = Work Week



# MC33269

## PACKAGE DIMENSIONS

SO-8  
D SUFFIX  
CASE 751-07  
ISSUE W

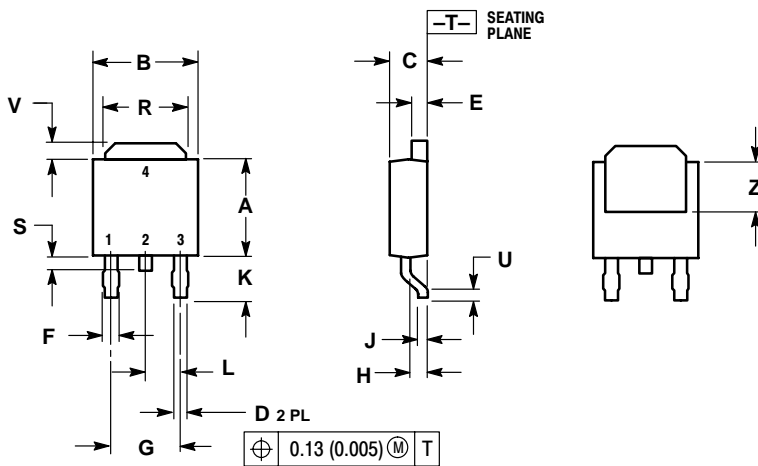


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0 °         | 8 °  | 0 °       | 8 °   |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

DPAK  
DT SUFFIX  
CASE 369A-13  
ISSUE Z



NOTES:

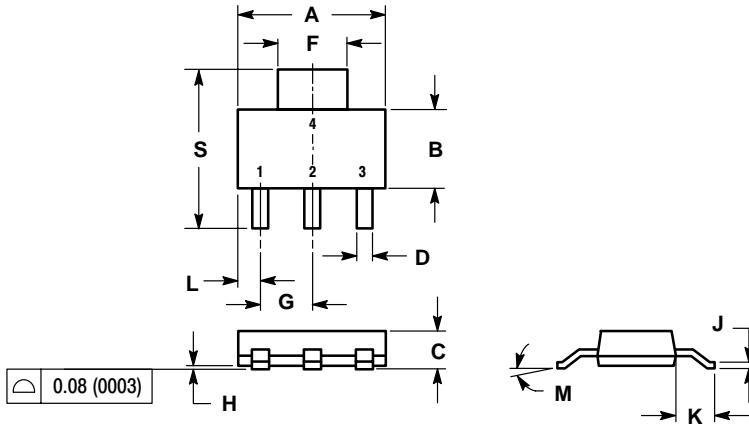
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| 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        | ---  |

# MC33269

## PACKAGE DIMENSIONS

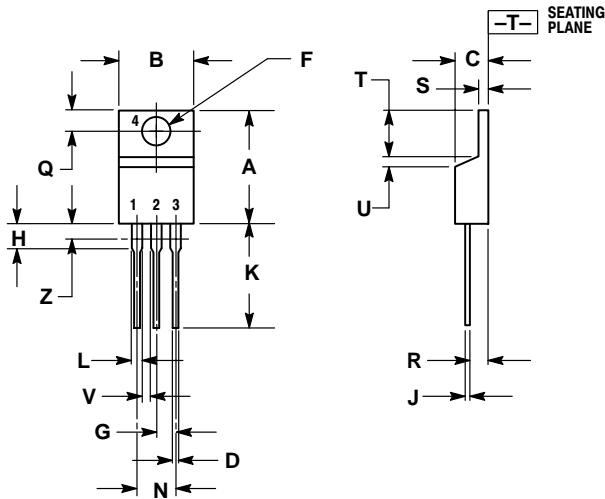
SOT-223  
ST SUFFIX  
CASE 318E-04  
ISSUE K



- 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  |
| F   | 0.115  | 0.126  | 2.90        | 3.20  |
| G   | 0.087  | 0.094  | 2.20        | 2.40  |
| H   | 0.0008 | 0.0040 | 0.020       | 0.100 |
| J   | 0.009  | 0.014  | 0.24        | 0.35  |
| K   | 0.060  | 0.078  | 1.50        | 2.00  |
| L   | 0.033  | 0.041  | 0.85        | 1.05  |
| M   | 0°     | 10°    | 0°          | 10°   |
| S   | 0.264  | 0.287  | 6.70        | 7.30  |

TO-220AB  
T SUFFIX  
CASE 221A-09  
ISSUE AA



- 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  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.018  | 0.025 | 0.46        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 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  |

**Notes**

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