

## ■ General Description

The AME8845 family of linear regulators feature low quiescent current (100 $\mu$ A typ.) with low dropout voltage, making them ideal for battery applications. It is available in TO-252, SOT-223, TO-263 and TO-220 packages. The space-efficient TO-252, SOT-223 package is attractive for "Pocket" and "Hand Held" applications.

Output voltages are set at the factory and trimmed to 1.5% accuracy.

These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions.

The AME8845 is stable with an output capacitance of 2.2 $\mu$ F or greater.

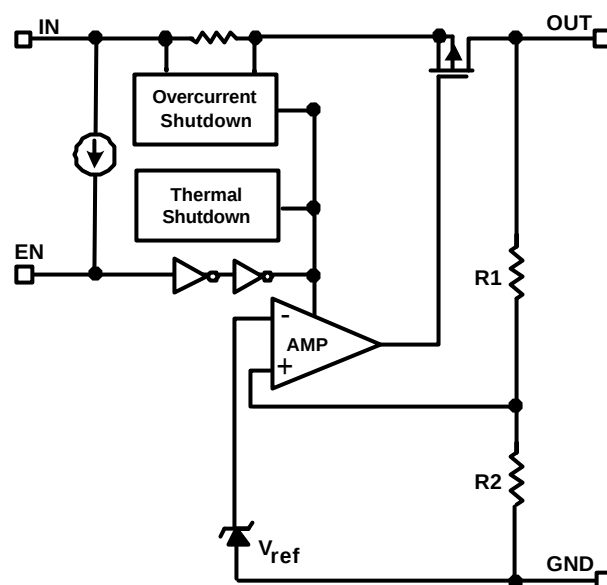
## ■ Features

- Very Low Dropout Voltage
- Guaranteed 3A Output
- Accurate to within 1.5%
- 100 $\mu$ A Quiescent Current Typically
- Over-Temperature Shutdown
- Current Limiting
- Short Circuit Current Fold-back
- Space-Saving TO-252, SOT-223, TO-263 and TO-220 Package
- Low Temperature Coefficient

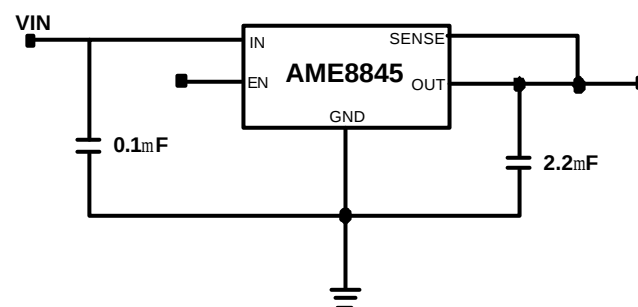
## ■ Applications

- Instrumentation
- Portable Electronics
- Wireless Devices
- PC Peripherals
- Battery Powered Widgets

## ■ Functional Block Diagram



## ■ Typical Application



## ■ Pin Configuration

**TO-252-2  
Top View**



**AME 8845AECSxxx**

1.  $V_{IN}$
2. GND (heat sink)
3.  $V_{OUT}$

**TO-252-2  
Top View**



**AME 8845BECSxxx**

1. GND
2.  $V_{OUT}$  (heat sink)
3.  $V_{IN}$

**SOT-223  
Top View**



**AME8845AEGTxxx**

1.  $V_{IN}$
2. GND
3.  $V_{OUT}$

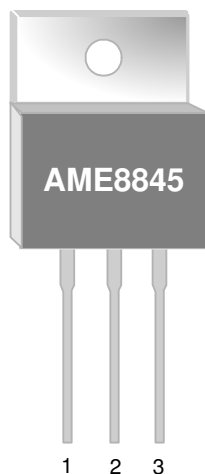
**SOT-223  
Top View**



**AME8845BEGTxxx**

1. GND
2.  $V_{OUT}$
3.  $V_{IN}$

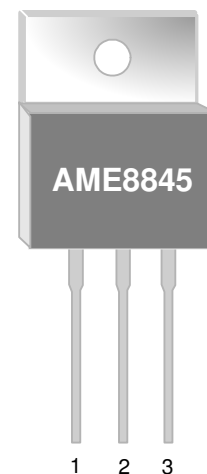
**TO-220  
Top View**



**AME 8845AEBTxxx**

1.  $V_{IN}$
2. GND (heat sink)
3.  $V_{OUT}$

**TO-220  
Top View**

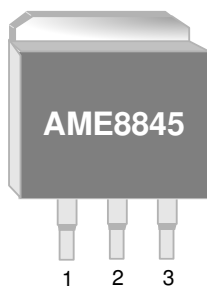


**AME 8845BEBTxxx**

1. GND
2.  $V_{OUT}$  (heat sink)
3.  $V_{IN}$

## ■ Pin Configuration

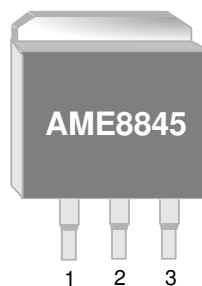
**TO-263-3L  
Top View**



**AME 8845AEDTxxx**

1.  $V_{IN}$
2. GND (heat sink)
3.  $V_{OUT}$

**TO-263-3L  
Top View**



**AME 8845BEDTxxx**

1. GND (heat sink)
2.  $V_{OUT}$
3.  $V_{IN}$

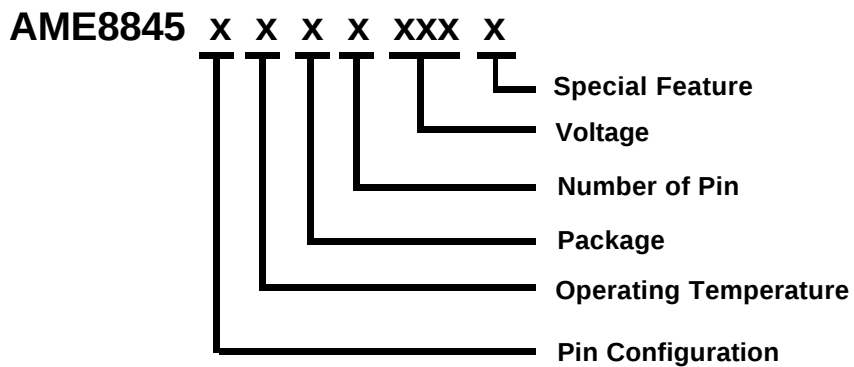
**TO-263-5L  
Top View**



**AME 8845AEDVxxx**

1.  $V_{IN}$
2. EN
3. GND (heat sink)
4. SENSE
5.  $V_{OUT}$

## ■ Ordering Information



| Pin Configuration                                                                        | Operating Temperature Range | Package Type                                      | Number of Pins       | Voltage                                                  | Special Feature |
|------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------|----------------------|----------------------------------------------------------|-----------------|
| A: 1. VIN<br>(TO-252) 2. GND<br>3. VOUT<br><br>B: 1. GND<br>2. VOUT<br>3. VIN            | E: -40°C to 85°C            | B: TO-220<br>C: TO-252<br>D: TO-263<br>G: SOT-223 | S: 2<br>T: 3<br>V: 5 | 150: V=1.5V<br>180: V=1.8V<br>250: V=2.5V<br>330: V=3.3V | Z: Lead Free    |
| A: 1. VIN<br>(TO-263-3) 2. GND<br>3. VOUT<br><br>B: 1. GND<br>2. VOUT<br>3. VIN          |                             |                                                   |                      |                                                          |                 |
| A: 1. VIN<br>(TO-263-5) 2. EN<br>3. GND<br>4. SENSE<br>5. VOUT                           |                             |                                                   |                      |                                                          |                 |
| A: 1. VIN<br>(TO-220) 2. GND<br>3. VOUT<br><br>B: 1. GND<br>2. VOUT<br>3. VIN            |                             |                                                   |                      |                                                          |                 |
| A: 1. VIN<br>(SOT-223) 2. GND<br>3. VOUT<br><br>B: 1. VIN<br>(SOT-223) 2. GND<br>3. VOUT |                             |                                                   |                      |                                                          |                 |
|                                                                                          |                             |                                                   |                      |                                                          |                 |
|                                                                                          |                             |                                                   |                      |                                                          |                 |
|                                                                                          |                             |                                                   |                      |                                                          |                 |

## ■ Ordering Information

| Part Number     | Marking*                   | Output Voltage | Package  | Operating Temp. Range |
|-----------------|----------------------------|----------------|----------|-----------------------|
| AME8845AEBT150  | AME8845<br>AEBT150<br>yyww | 1.50           | TO-220   | - 40°C to + 85°C      |
| AME8845AEBT150Z | AME8845<br>AEBT150<br>yyww | 1.50           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT150  | AME8845<br>BEBT150<br>yyww | 1.50           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT150Z | AME8845<br>BEBT150<br>yyww | 1.50           | TO-220   | - 40°C to + 85°C      |
| AME8845AEDT150  | AME8845<br>AEDT150<br>yyww | 1.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDT150Z | AME8845<br>AEDT150<br>yyww | 1.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT150  | AME8845<br>BEDT150<br>yyww | 1.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT150Z | AME8845<br>BEDT150<br>yyww | 1.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDV150  | AME8845<br>AEDV150<br>yyww | 1.50           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEDV150Z | AME8845<br>AEDV150<br>yyww | 1.50           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEBT180  | AME8845<br>AEBT180<br>yyww | 1.80           | TO-220   | - 40°C to + 85°C      |
| AME8845AEBT180Z | AME8845<br>AEBT180<br>yyww | 1.80           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT180  | AME8845<br>BEBT180<br>yyww | 1.80           | TO-220   | - 40°C to + 85°C      |

Note: yyww/ yww represents the date code

\* A line on top of the first letter represents lead free plating such as  $\overline{\text{AME8845}}$

Please consult AME sales office or authorized Rep./Distributor for output voltage and package type availability.

## ■ Ordering Information

| Part Number     | Marking*                   | Output Voltage | Package  | Operating Temp. Range |
|-----------------|----------------------------|----------------|----------|-----------------------|
| AME8845BEBT180Z | AME8845<br>BEBT180<br>yyww | 1.80           | TO-220   | - 40°C to + 85°C      |
| AME8845AEDT180  | AME8845<br>AEDT180<br>yyww | 1.80           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDT180Z | AME8845<br>AEDT180<br>yyww | 1.80           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT180  | AME8845<br>BEDT180<br>yyww | 1.80           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT180Z | AME8845<br>BEDT180<br>yyww | 1.80           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDV180  | AME8845<br>AEDV180<br>yyww | 1.80           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEDV180Z | AME8845<br>AEDV180<br>yyww | 1.80           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEGT180  | BAZyyww                    | 1.80           | SOT-223  | - 40°C to + 85°C      |
| AME8845AEGT180Z | BAZyyww                    | 1.80           | SOT-223  | - 40°C to + 85°C      |
| AME8845AEBT250  | AME8845<br>AEBT250<br>yyww | 2.50           | TO-220   | - 40°C to + 85°C      |
| AME8845AEBT250Z | AME8845<br>AEBT250<br>yyww | 2.50           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT250  | AME8845<br>BEBT250<br>yyww | 2.50           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT250Z | AME8845<br>BEBT250<br>yyww | 2.50           | TO-220   | - 40°C to + 85°C      |
| AME8845AEDT250  | AME8845<br>AEDT250<br>yyww | 2.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDT250Z | AME8845<br>AEDT250<br>yyww | 2.50           | TO-263-3 | - 40°C to + 85°C      |



## ■ Ordering Information

| Part Number     | Marking*                   | Output Voltage | Package  | Operating Temp. Range |
|-----------------|----------------------------|----------------|----------|-----------------------|
| AME8845BEDT250  | AME8845<br>BEDT250<br>yyww | 2.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT250Z | AME8845<br>BEDT250<br>yyww | 2.50           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDV250  | AME8845<br>AEDV250<br>yyww | 2.50           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEDV250Z | AME8845<br>AEDV250<br>yyww | 2.50           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEGT250  | AZSyww                     | 2.50           | SOT-223  | - 40°C to + 85°C      |
| AME8845AEGT250Z | AZSyww                     | 2.50           | SOT-223  | - 40°C to + 85°C      |
| AME8845AEBT330  | AME8845<br>AEBT330<br>yyww | 3.30           | TO-220   | - 40°C to + 85°C      |
| AME8845AEBT330Z | AME8845<br>AEBT330<br>yyww | 3.30           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT330  | AME8845<br>BEBT330<br>yyww | 3.30           | TO-220   | - 40°C to + 85°C      |
| AME8845BEBT330Z | AME8845<br>BEBT330<br>yyww | 3.30           | TO-220   | - 40°C to + 85°C      |
| AME8845AEDT330  | AME8845<br>AEDT330<br>yyww | 3.30           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDT330Z | AME8845<br>AEDT330<br>yyww | 3.30           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT330  | AME8845<br>BEDT330<br>yyww | 3.30           | TO-263-3 | - 40°C to + 85°C      |
| AME8845BEDT330Z | AME8845<br>BEDT150<br>yyww | 3.30           | TO-263-3 | - 40°C to + 85°C      |
| AME8845AEDV330Z | AME8845<br>AEDV330<br>yyww | 3.30           | TO-263-5 | - 40°C to + 85°C      |
| AME8845AEDV330Z | AME8845<br>AEDV330<br>yyww | 3.30           | TO-263-5 | - 40°C to + 85°C      |

**■ Absolute Maximum Ratings**

| Parameter          | Maximum                     | Unit |
|--------------------|-----------------------------|------|
| Input Voltage      | 7                           | V    |
| Output Current     | $P_D / (V_{IN} - V_O)$      | mA   |
| Output Voltage     | GND - 0.3 to $V_{IN} + 0.3$ | V    |
| ESD Classification | B                           |      |

Caution: Stress above the listed absolute maximum rating may cause permanent damage to the device

**■ Recommended Operating Conditions**

| Parameter                 | Rating        | Unit |
|---------------------------|---------------|------|
| Ambient Temperature Range | - 40 to + 85  | °C   |
| Junction Temperature      | - 40 to + 125 | °C   |

# **■ Thermal Information**

| Parameter                                                                    |         | Maximum        |    | Unit                          |
|------------------------------------------------------------------------------|---------|----------------|----|-------------------------------|
| Thermal Resistance ( $\theta_{ja}$ )                                         | TO-252  | 90             |    | $^{\circ}\text{C} / \text{W}$ |
|                                                                              | TO-263  | 60             |    |                               |
|                                                                              | TO-220  | 50             |    |                               |
|                                                                              | SOT-223 | 160            |    |                               |
| Thermal Resistance ( $\theta_{jc}$ )                                         | TO-252  | Conductive     | 7  | $^{\circ}\text{C} / \text{W}$ |
|                                                                              |         | Non-Conductive | 30 |                               |
|                                                                              | TO-263  | Conductive     | 7  |                               |
|                                                                              |         | Non-Conductive | 27 |                               |
|                                                                              | TO-220  | Conductive     | 7  |                               |
|                                                                              |         | Non-Conductive | 24 |                               |
|                                                                              | SOT-223 | Conductive     | 7  |                               |
|                                                                              |         | Non-Conductive | 31 |                               |
| Internal Power Dissipation ( $P_D$ )<br>( $\Delta T = 100^{\circ}\text{C}$ ) | TO-252  | 1200           |    | mW                            |
|                                                                              | TO-263  | 2800           |    |                               |
|                                                                              | TO-220  | 3000           |    |                               |
|                                                                              | SOT-223 | 625            |    |                               |
| Maximum Junction Temperature                                                 |         | 150            |    | $^{\circ}\text{C}$            |
| Maximum Lead Temperature (10 Sec)                                            |         | 300            |    | $^{\circ}\text{C}$            |

## ■ Electrical Specifications

$V_{IN} = V_{O(NOM)} + 1V$ ,  $C_{IN} = 0.1\mu F$ ,  $C_{OUT} = 2.2\mu F$ ,  $T_A = 25^\circ C$  unless otherwise noted

| Parameter                     | Symbol        | Test Condition                                |                                  | Min            | Typ  | Max      | Units           |
|-------------------------------|---------------|-----------------------------------------------|----------------------------------|----------------|------|----------|-----------------|
| Input Voltage                 | $V_{IN}$      |                                               |                                  | Note 1         |      | 6        | V               |
| Output Voltage Accuracy       | $V_O$         | $I_O = 1mA$                                   |                                  | -1.5           |      | 1.5      | %               |
| Dropout Voltage               | $V_{DROPOUT}$ | $I_O = 3A$<br>$V_O = V_{O(NOM)} - 2.0\%$      | $1.5V \leq V_{O(NOM)} \leq 1.8V$ |                |      | 1200     | mV              |
|                               |               |                                               | $1.8V < V_{O(NOM)} < 2.5V$       |                |      | 700      |                 |
|                               |               |                                               | $2.5V \leq V_{O(NOM)}$           |                | 300  | 450      |                 |
| Output Current                | $I_O$         | $V_O > 1.2V$                                  |                                  |                | 3000 |          | mA              |
| Current Limit                 | $I_{LIM}$     | $V_O > 1.2V$                                  |                                  |                | 3    |          | A               |
| Short Circuit Current         | $I_{SC}$      | $V_{IN} = V_{O(NOM)} + 1V$ , $V_O < 0.4V$     |                                  |                | 1.7  |          | A               |
| Quiescent Current             | $I_Q$         | $I_O = 0mA$                                   |                                  |                | 200  | 350      | $\mu A$         |
| Ground Pin Current            | $I_{GND}$     | $I_O = 1mA$ to $3A$                           |                                  |                | 300  |          | $\mu A$         |
| Line Regulation               | $REG_{LINE}$  | $I_O = 1mA$ , $V_{IN} = V_O + 1$ to $V_O + 2$ |                                  | -0.2           | 0.1  | 0.2      | %               |
| Load Regulation               | $REG_{LOAD}$  | $I_O = 1mA$ to $3A$                           |                                  | -1             |      | 1        | %               |
| Over Temperature Shutdown     | OTS           |                                               |                                  |                | 140  |          | $^\circ C$      |
| Over Temperature Hysteresis   | OTH           |                                               |                                  |                | 30   |          | $^\circ C$      |
| $V_O$ Temperature Coefficient | TC            |                                               |                                  |                | 30   |          | ppm/ $^\circ C$ |
| Power Supply Rejection        | PSRR          | $I_O = 100mA$<br>$C_O = 10\mu F$              | $f = 100Hz$                      |                | 70   |          | dB              |
|                               |               |                                               | $f = 1kHz$                       |                | 50   |          |                 |
| Output Voltage Noise          | eN            | $f = 10Hz$ to $100kHz$<br>$I_O = 10mA$        | $C_O = 2.2\mu F$                 |                | 30   |          | $\mu V_{rms}$   |
| EN Input Threshold            | $V_{EH}$      | $V_{IN} = V_{IN, MIN}$ to $V_{IN, MAX}$       |                                  | $V_{IN} * 0.8$ |      | $V_{IN}$ | V               |
|                               | $V_{EL}$      |                                               |                                  | 0              |      | 0.4      |                 |
| EN Input Leakage              | $I_{EH}$      | $V_{EN} = V_{IN} = 5V$                        |                                  |                |      | 2        | $\mu A$         |
|                               | $I_{EL}$      | $V_{EN} = 0V$ , $V_{IN} = 5V$                 |                                  |                |      | 2        |                 |
| Shutdown Current              | $I_{SD}$      | $V_{EN} = 0V$ , $V_{IN} = 5V$                 |                                  |                |      | 10       | $\mu A$         |

Note1:  $V_{IN(min)} = V_{OUT} + V_{DROPOUT}$

## ■ Detailed Description

The AME8845 family of CMOS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, and thermal shutdown.

The P-channel pass transistor receives data from the error amplifier, over-current shutdown, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and Thermal shutdown circuits become active when the junction temperature exceeds 140°C, or the current exceeds 4.5A. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 110°C.

The AME8845 behaves like a current source when the load reaches 4.5A. However, if the load impedance drops below 0.3 ohms, the current drops back to 600mA to prevent excessive power dissipation. Normal operation is restored when the load resistance exceeds 0.75 ohms.

## ■ External Capacitors

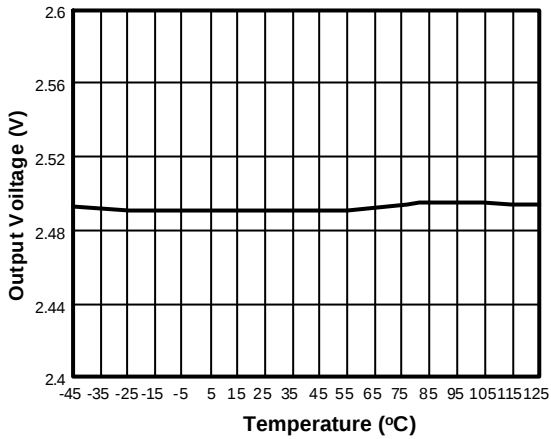
The AME8845 is stable with an output capacitor to ground of 2.2 $\mu$ F or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Electrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1 $\mu$ F ceramic capacitor with a 10 $\mu$ F Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost.

A second capacitor is recommended between the input and ground to stabilize  $V_{in}$ . The input capacitor should be at least 0.1 $\mu$ F to have a beneficial effect.

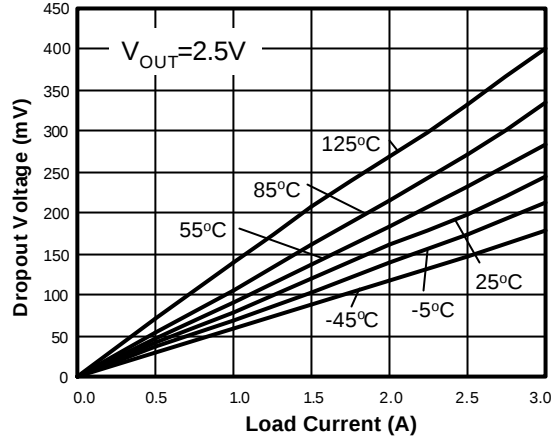
All capacitors should be placed in close proximity to the pins. A "Quiet" ground termination is desirable. This can be achieved with a "Star" connection.



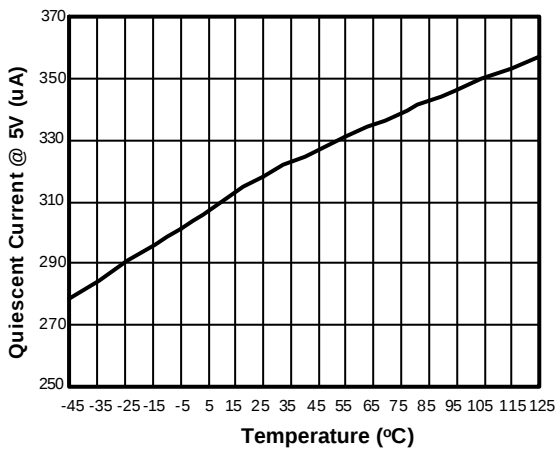
Temperature Stability



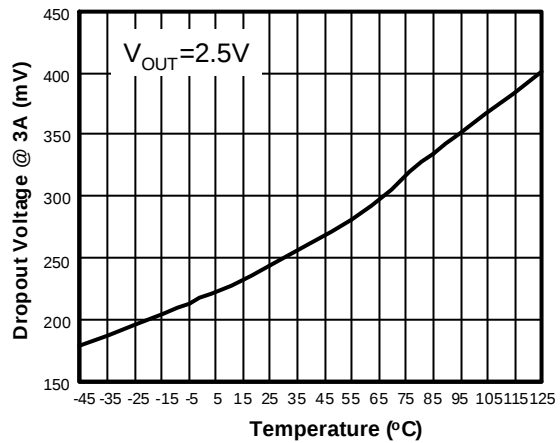
Dropout Voltage vs. Load Current



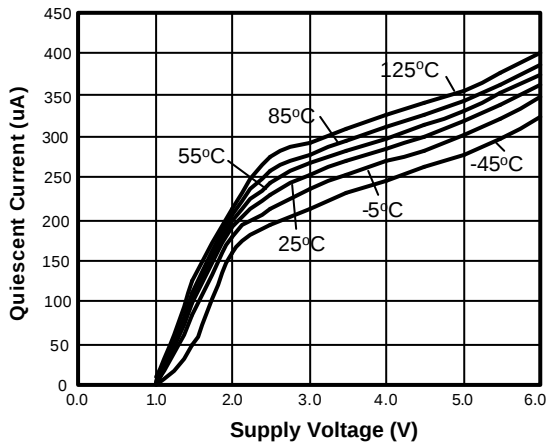
Quiescent Current vs. Temperature



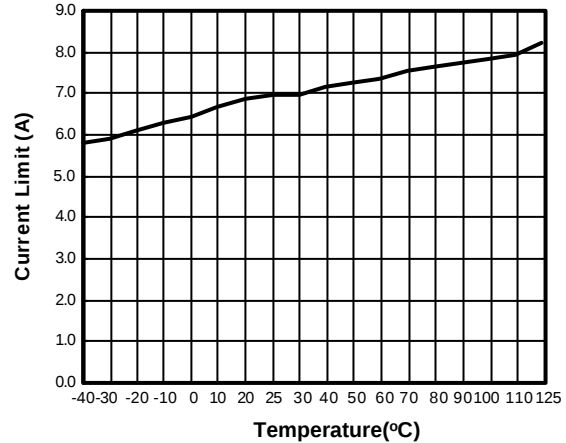
Dropout Voltage vs. Temperature



Quiescent Current vs. Supply Voltage

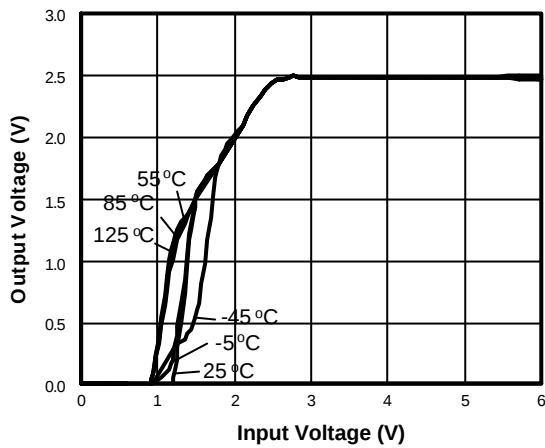


Current Limit vs. Temperature

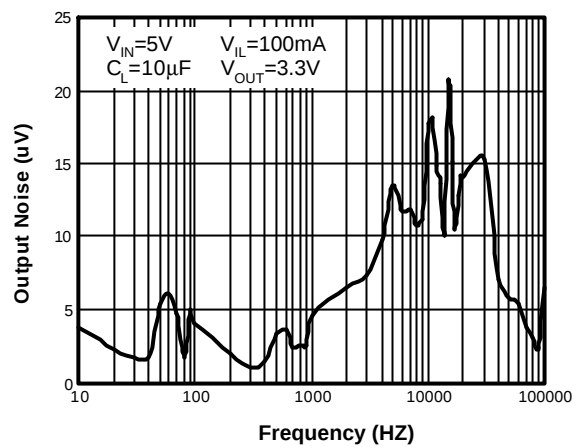




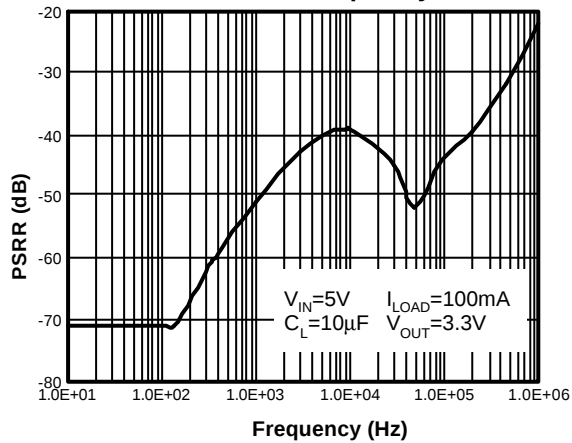
Output Voltage(2.5V) vs. Input Voltage



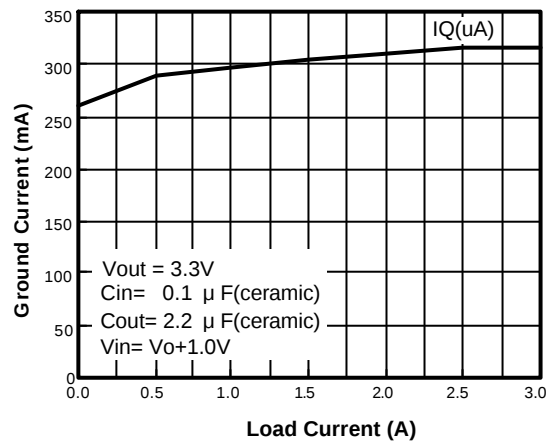
Output Noise vs. Frequency



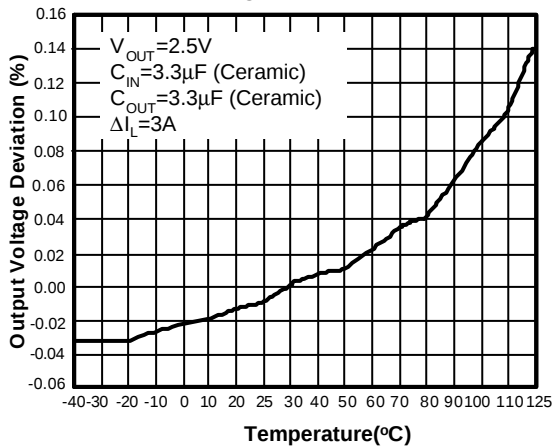
PSRR vs. Frequency



Ground Current vs. Load Current

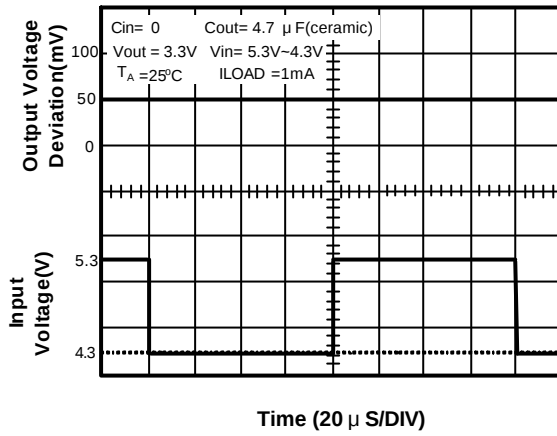


Load Regulation Deviation

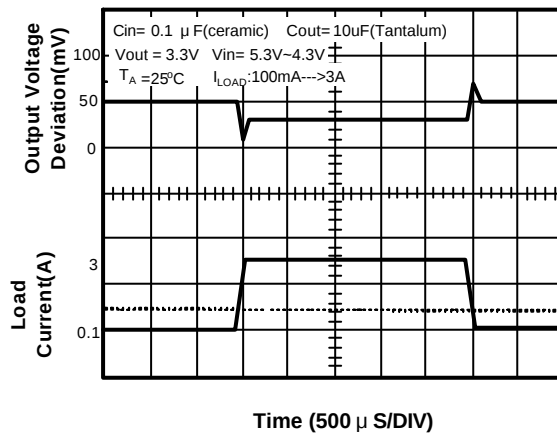




Line Transient Response

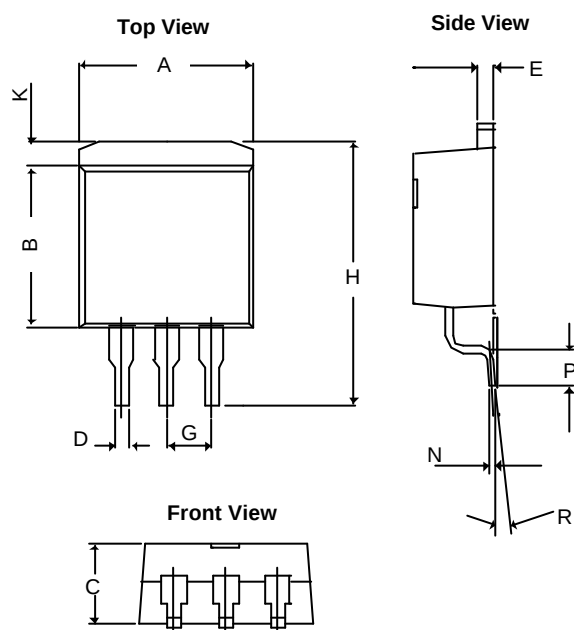


Load Transient Response



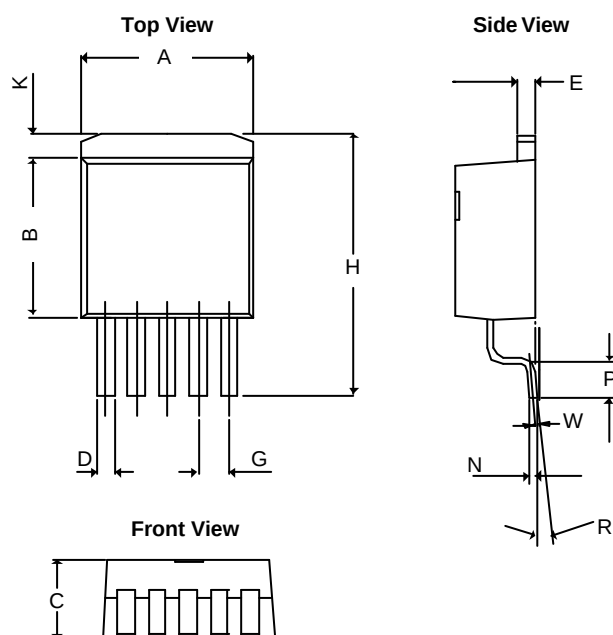
## ■ Package Dimension

### TO-263-3



| SYMBOLS | MILLIMETERS |       | INCHES   |         |
|---------|-------------|-------|----------|---------|
|         | MIN         | MAX   | MIN      | MAX     |
| A       | 9.65        | 10.42 | 0.380    | 0.410   |
| B       | 8.28        | 9.66  | 0.326    | 0.380   |
| C       | 4.06        | 4.83  | 0.160    | 0.190   |
| D       | 0.50        | 1.02  | 0.020    | 0.040   |
| E       | 1.14        | 1.40  | 0.045    | 0.055   |
| G       | *2.54       |       | *0.100   |         |
| H       | 14.60       | 15.60 | 0.5748   | 0.61417 |
| K       | 0.99        | 2.93  | 0.03898  | 0.11535 |
| N       | 0.381REF    |       | 0.015REF |         |
| P       | 2.28        | 2.80  | 0.08976  | 0.11024 |
| R       | 0°          | 8°    | 0°       | 8°      |

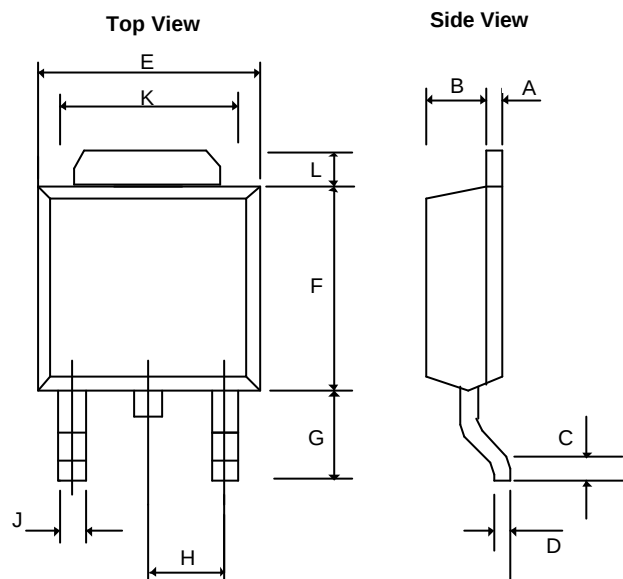
### TO-263-5



| SYMBOLS | MILLIMETERS |        | INCHES    |       |
|---------|-------------|--------|-----------|-------|
|         | MIN         | MAX    | MIN       | MAX   |
| A       | 10.050      | 10.668 | 0.396     | 0.420 |
| B       | 8.280       | 9.169  | 0.326     | 0.361 |
| C       | 4.310       | 4.597  | 0.170     | 0.181 |
| D       | 0.660       | 0.910  | 0.026     | 0.036 |
| E       | 1.140       | 1.400  | 0.045     | 0.055 |
| G       | 1.70REF     |        | 0.067 REF |       |
| H       | 14.605      | 15.875 | 0.575     | 0.625 |
| K       | 1.143       | 1.680  | 0.045     | 0.066 |
| L       | 0.000       | 0.305  | 0.000     | 0.012 |
| N       | 0.330       | 0.580  | 0.013     | 0.023 |
| P       | 2.280       | 2.800  | 0.090     | 0.110 |
| R       | 0°          | 8°     | 0°        | 8°    |
| W       | 0.25REF     |        | 0.01REF   |       |

## ■ Package Dimension

### TO-252(DPAK)-EIAJ



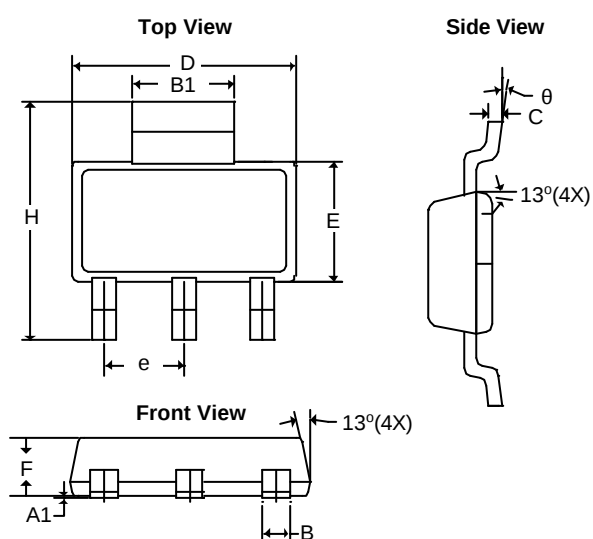
| SYMBOLS | MILLIMETERS |        | INCHES   |          |
|---------|-------------|--------|----------|----------|
|         | MIN         | MAX    | MIN      | MAX      |
| A       | 0.45        | 0.58   | 0.0177   | 0.0230   |
| B       | 1.60        | 1.95   | 0.0630   | 0.0768   |
| C       | 0.51        | 1.50   | 0.0201   | 0.0591   |
| D       | 0.45        | 0.60   | 0.0177   | 0.0236   |
| E       | 6.40        | 6.80   | 0.2520   | 0.2677   |
| F       | 5.40        | 7.20   | 0.2126   | 0.2835   |
| G       | 2.20        | 2.85   | 0.0866   | 0.1122   |
| H       | -           | * 2.30 | -        | * 0.0906 |
| J       | -           | 0.97   | -        | 0.0380   |
| K       | 5.20        | 5.50   | 0.2047   | 0.2165   |
| L       | 1.40REF     |        | 0.055REF |          |

\*: Typical Value

Notes:

1. Controlling dimension: Millimeters.
2. Maximum lead thickness includes lead finish thickness. Minimum lead thickness is the minimum thickness of base material.

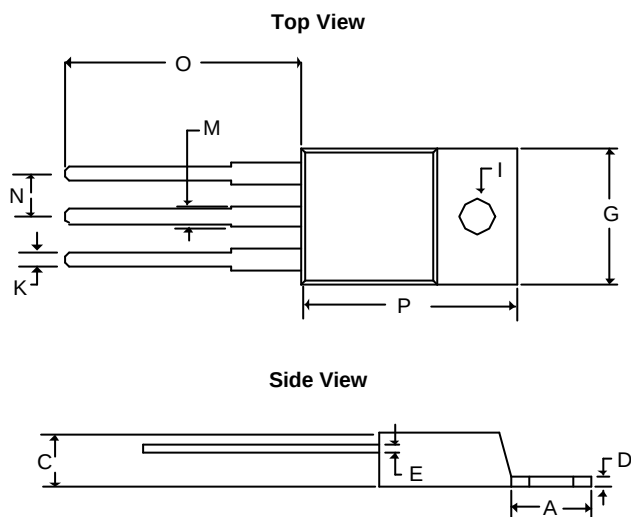
### SOT-223



| SYMBOLS        | MILLIMETERS |      | INCHES     |        |
|----------------|-------------|------|------------|--------|
|                | MIN         | MAX  | MIN        | MAX    |
| A <sub>1</sub> | 0.02        | 0.10 | 0.0008     | 0.0039 |
| B              | 0.60        | 0.84 | 0.0236     | 0.0330 |
| B <sub>1</sub> | 2.90        | 3.15 | 0.1140     | 0.1240 |
| C              | 0.24        | 0.38 | 0.0094     | 0.0150 |
| D              | 6.30        | 6.71 | 0.2480     | 0.2640 |
| E              | 3.30        | 3.71 | 0.1299     | 0.1460 |
| e              | 2.30 BSC    |      | 0.0906 BSC |        |
| H              | 6.70        | 7.30 | 0.2638     | 0.2874 |
| ?              | 0°          | 10°  | 0°         | 10°    |
| F              | 1.40        | 1.80 | 0.0560     | 0.0702 |

## **■ Package Dimension**

### **TO-220**



| SYMBOLS  | MILLIMETERS |       | INCHES |        |
|----------|-------------|-------|--------|--------|
|          | MIN         | MAX   | MIN    | MAX    |
| <b>A</b> | 5.58        | 7.49  | 0.2197 | 0.2949 |
| <b>C</b> | 3.55        | 4.83  | 0.1398 | 0.1900 |
| <b>D</b> | 0.50        | 1.40  | 0.0197 | 0.0550 |
| <b>E</b> | 0.30        | 1.15  | 0.0118 | 0.0453 |
| <b>G</b> | 9.65        | 10.67 | 0.3799 | 0.4200 |
| <b>I</b> | 3.53        | 4.09  | 0.1390 | 0.1610 |
| <b>K</b> | 0.50        | 1.15  | 0.0197 | 0.0453 |
| <b>M</b> | 1.14        | 1.78  | 0.0449 | 0.0700 |
| <b>N</b> | 2.28        | 2.80  | 0.0898 | 0.1102 |
| <b>O</b> | 12.70       | 14.74 | 0.5000 | 0.5803 |
| <b>P</b> | 14.22       | 16.51 | 0.5600 | 0.6500 |



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**E-Mail:Longman@rccn.com.cn**

Address:Room 2101, No.2 Building Yulan garden, No.50 Puhuitang Rd,Shanghai,PRC  
zip:200030

Tel : 86-21-64285731/32 ext:8033

Sales Manager:Longman Xu

Fax: 86-21-64393342