

## 1.5A Low Dropout Positive Voltage Regulator

TO-220



TO-263 (D<sup>2</sup>PAK)



TO-252 (DPAK)



SOT-223



**Pin Definition:**

- 1. Fixed / Adj
  - 2. Output
  - 3. Input
- Pin 2 connect to heat sink

### General Description

TS1086 are high performance positive voltage regulators are designed for use in applications requiring low dropout performance at full rated current, Additionally, TS1086 provides excellent regulation over variations due to changes in line, load and temperature. Outstanding features include low dropout performance at rated current, fast transient response, internal current limiting and thermal shutdown protection of the output device. TS1086 are three terminal regulators with fixed and adjustable voltage options available in popular packages.

### Features

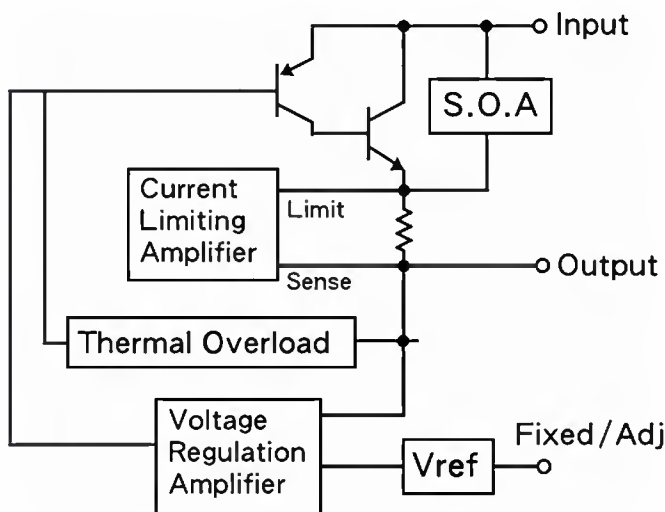
- Low Dropout Performance 1.5V max.
- Full Current Rating Over Line and Temperature
- Fast Transient Response
- ±2% Total Output Regulation Over Line, Load and Temperature
- Adjust Pin Current max 90uA Over Temperature
- Line Regulation Typical 0.015%
- Load Regulation Typical 0.2%
- Fixed / Adjustable Output Voltage
- TO-220, TO-263, TO-252 and SOT-223 Package

### Ordering Information

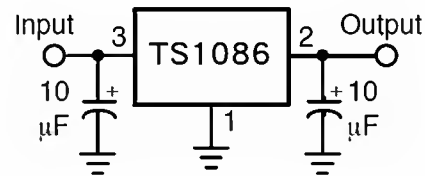
| Part No.      | Package | Packing            |
|---------------|---------|--------------------|
| TS1086CZxx C0 | TO-220  | 50pcs / Tube       |
| TS1086CMxx RN | TO-263  | 800pcs / 13" Reel  |
| TS1086CPxx RO | TO-252  | 2.5Kpcs / 13" Reel |
| TS1086CWxx RP | SOT-223 | 2.5Kpcs / 13" Reel |

Note: Where **xx** denotes voltage option, available are 5.0V, 3.3V, 2.5V, 1.8V and 1.5V. Leave blank for adjustable version. Contact factory for additional voltage options.

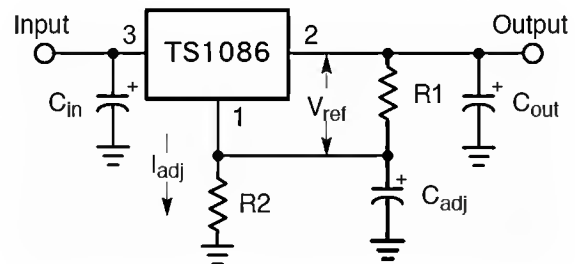
### Block Diagram



### Typical Application Circuit



#### Fixed Output Voltage Version



$$V_{OUT} = V_{REF}(1+R2/R1) + I_{adj} R2$$

**Adjustable Output Voltage Version**

## 1.5A Low Dropout Positive Voltage Regulator

### Absolute Maximum Rating (Note 1)

| Parameter                                 | Symbol               | Limit            | Unit |
|---|----------------------|------------------|------|
| Input Supply Voltage                      | $V_{IN}$             | 15               | V    |
| Operation Input Supply Voltage            | $V_{IN}$ (Opr. Typ.) | 12               | V    |
| Power Dissipation (Note 2)                | $P_D$                | Internal limited |      |
| Thermal Resistance<br>Junction to Ambient | TO-220               | 80               | °C/W |
|   | TO-263               | 85               |      |
|   | TO-252               | 105              |      |
|   | SOT-223              | 130              |      |
| Operating Junction Temperature Range      | $T_J$                | 0 ~+125          | °C   |
| Storage Temperature Range                 | $T_{STG}$            | -65 ~ +150       | °C   |
| Lead Soldering Temperature (260°C)        | TO-220 / TO-263      | 10               | S    |
|   | TO-252 / SOT-223     | 5                |      |

### Electrical Specification ( $T_a = 25^\circ\text{C}$ , unless otherwise specified.)

| Parameter                   | Conditions   | Min   | Typ   | Max   | Unit |
|-----------------------------|--|-------|-------|-------|------|
| Reference Voltage           | $V_{IN} = 2.75$ , $I_o = 1.5\text{A}$  | 1.225 | 1.25  | 1.275 | V    |
| Output Voltage (Note 4)     | $V_{IN} = 3.3\text{V} \sim 7\text{V}$ , $I_o = 1.5\text{A}$  | 1.764 | 1.8   | 1.836 | V    |
|                             | $V_{IN} = 4\text{V} \sim 7\text{V}$ , $I_o = 1.5\text{A}$  | 2.450 | 2.5   | 2.550 | V    |
|                             | $V_{IN} = 4.8\text{V} \sim 7\text{V}$ , $I_o = 1.5\text{A}$  | 3.235 | 3.3   | 3.366 | V    |
|                             | $V_{IN} = 6.5\text{V} \sim 7\text{V}$ , $I_o = 1.5\text{A}$  | 4.900 | 5.0   | 5.100 | V    |
| Line Regulation             | $V_o + 1.5\text{V} \leq V_{IN} \leq 7\text{V}$ , $I_o = 10\text{mA}$                                   | --    | 0.015 | 0.2   | %    |
| Load Regulation<br>(Note 2) | Adj<br>( $V_{IN} - V_{OUT} = 3\text{V}$ , $I_o = 10\text{mA} \sim 1.5\text{A}$ )                       | --    | 0.2   | 0.4   | %    |
|                             | Fixed<br>$V_{IN} = V_{OUT} + 1.5\text{V}$ , $I_o = 10\text{mA} \sim 1.5\text{A}$                       | --    | 0.2   | 1.0   |      |
| Dropout Voltage             | $I_o = 1\text{A}$ , $\Delta V_{OUT} = 1\% V_{OUT}$   | --    | 1.3   | 1.5   | V    |
| Quiescent Current           | $V_{IN} = 5\text{V}$   | --    | 8     | 10    | mA   |
| Adjustable Pin Current      |  | --    | 90    | --    | uA   |
| Output Current Limit        | $V_{IN} - V_{OUT} = 3\text{V}$   | 2.0   | --    | --    | A    |
| Temperature Stability       | $I_o = 10\text{mA}$ ,  | --    | 0.5   | --    | %    |
| Ripple Rejection            | $F = 120\text{Hz}$ , $I_o = 1\text{A}$ , $C_{OUT} = 25\mu\text{F}$ ,<br>$V_{IN} = V_{out} + 3\text{V}$ | --    | 60    | 70    | dB   |

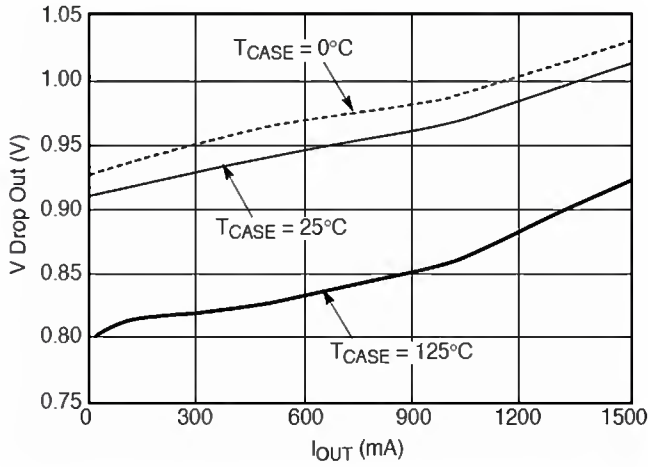
Note 1: See thermal regulation specification for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead = 1/18" from the package.

Note 2: Line and load regulation are guaranteed up to the maximum power dissipation of 15W. Power dissipation is determined by the input / output voltage difference and the output current. Guaranteed maximum power dissipation will not be available over the full input / output voltage range.

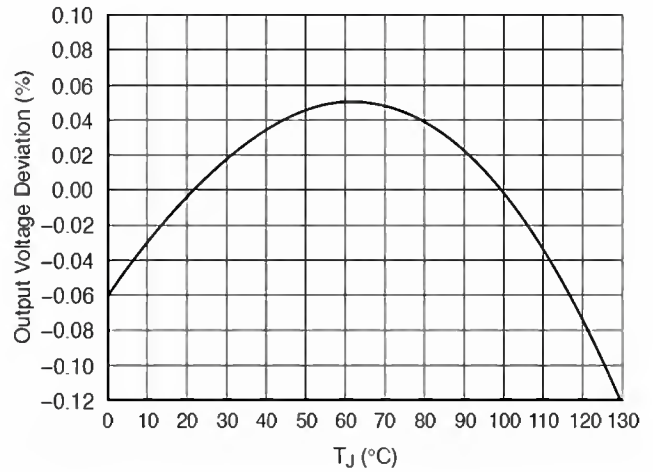
Note 3: Quiescent current is defined as the minimum output current required to maintain the regulation.

Note 4: The Output Capacitor does not have a theoretical upper limit and increasing its value will increase stability  $C_{OUT} = 100\mu\text{F}$  or more is typical for high current regulator design.

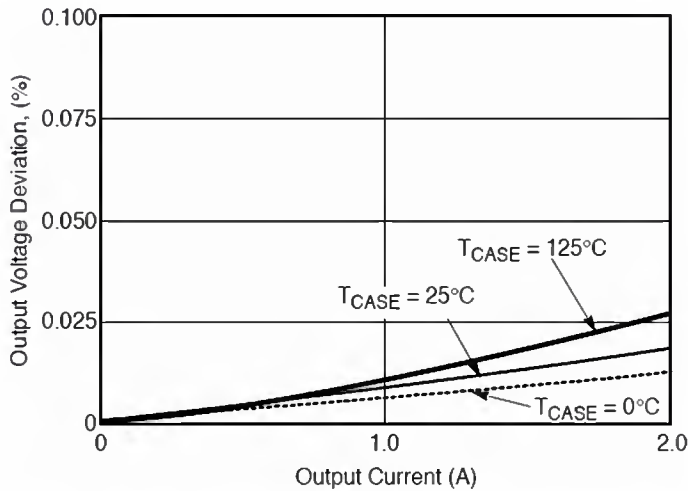
**Electrical Characteristics Curve**



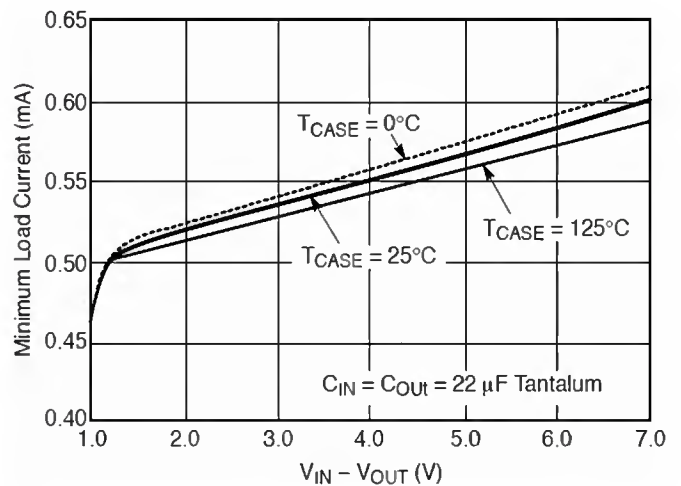
**Figure 1. Vdrop vs. Output Current**



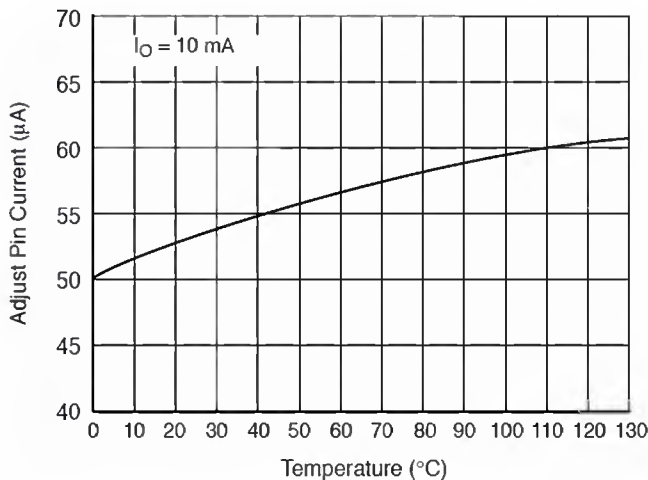
**Figure 2. Reference Voltage vs. Temperature**



**Figure 3. Load Regulation vs. Output Current**

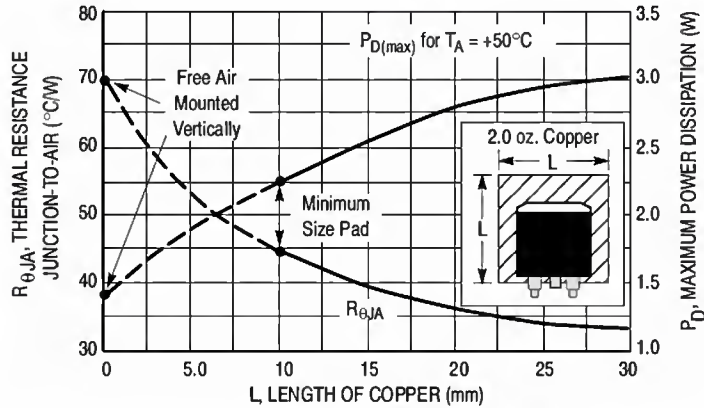


**Figure 4. Minimum Load Current**

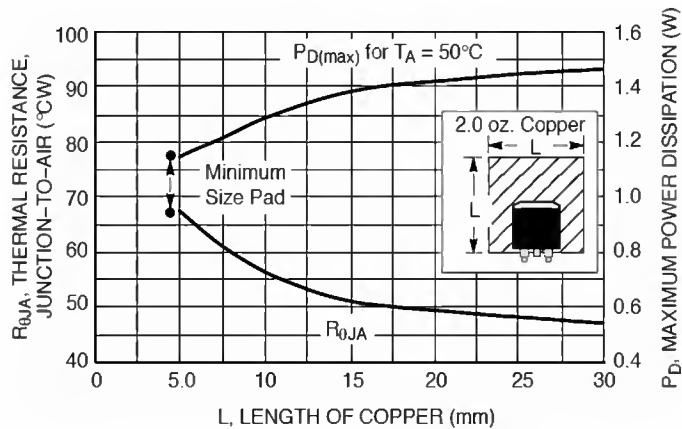


**Figure 5. Iadj Pin vs. Temperature**

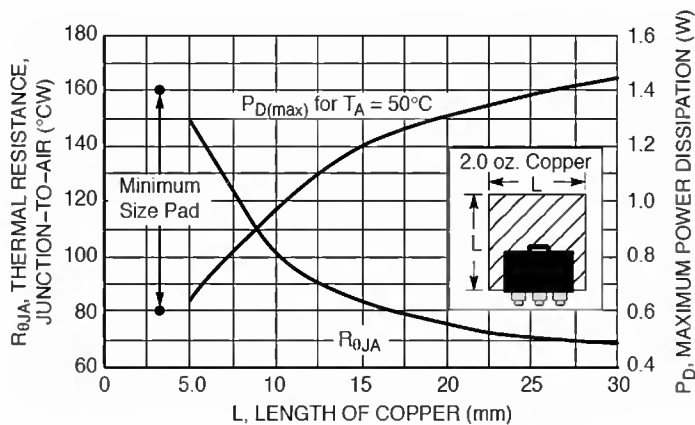
**Application Information**



**Figure 6. D<sup>2</sup>PAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length**

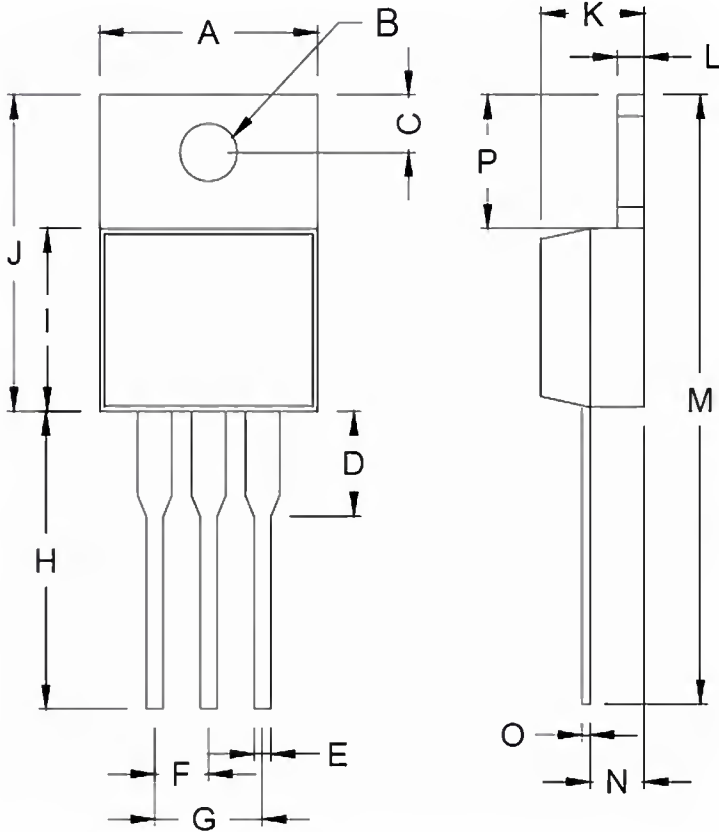


**Figure 7. DPAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length**



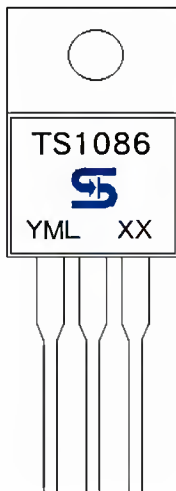
**Figure 8. SOT-223 Thermal Resistance and Maximum Power Dissipation vs. P.C.B Copper Length**

**TO-220 Mechanical Drawing**



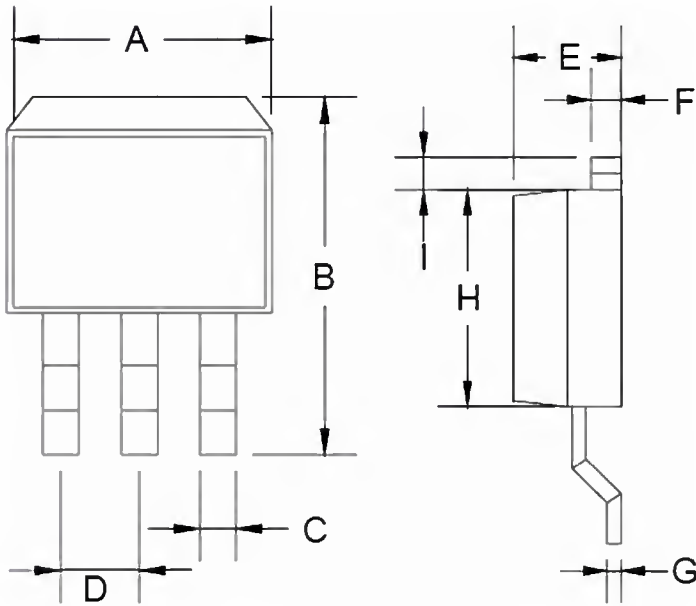
| TO-220 DIMENSION |             |        |        |       |
|------------------|-------------|--------|--------|-------|
| DIM              | MILLIMETERS |        | INCHES |       |
|                  | MIN         | MAX    | MIN    | MAX   |
| A                | 10.000      | 10.500 | 0.394  | 0.413 |
| B                | 3.740       | 3.910  | 0.147  | 0.154 |
| C                | 2.440       | 2.940  | 0.096  | 0.116 |
| D                | -           | 6.350  | -      | 0.250 |
| E                | 0.381       | 1.106  | 0.015  | 0.040 |
| F                | 2.345       | 2.715  | 0.092  | 0.058 |
| G                | 4.690       | 5.430  | 0.092  | 0.107 |
| H                | 12.700      | 14.732 | 0.500  | 0.581 |
| I                | 8.382       | 9.017  | 0.330  | 0.355 |
| J                | 14.224      | 16.510 | 0.560  | 0.650 |
| K                | 3.556       | 4.826  | 0.140  | 0.190 |
| L                | 0.508       | 1.397  | 0.020  | 0.055 |
| M                | 27.700      | 29.620 | 1.060  | 1.230 |
| N                | 2.032       | 2.921  | 0.080  | 0.115 |
| O                | 0.255       | 0.610  | 0.010  | 0.024 |
| P                | 5.842       | 6.858  | 0.230  | 0.270 |

**Marking Diagram**



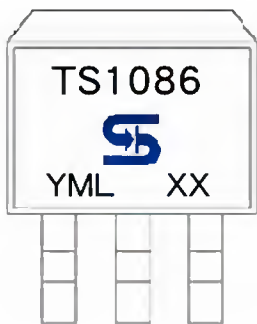
- Y** = Year Code
- M** = Month Code  
(A=Jan, B=Feb, C=Mar, D=Apr, E=May, F=Jun, G=Jul, H=Aug, I=Sep, J=Oct, K=Nov, L=Dec)
- L** = Lot Code
- XX** = Voltage Code  
(1.5=1.5V, 1.8=1.8V, 2.5=2.5V, 3.3=3.3V, 5.0=5V)
- = Package Code for Adjustable type  
(CZ = TO-220)

**TO-263 Mechanical Drawing**



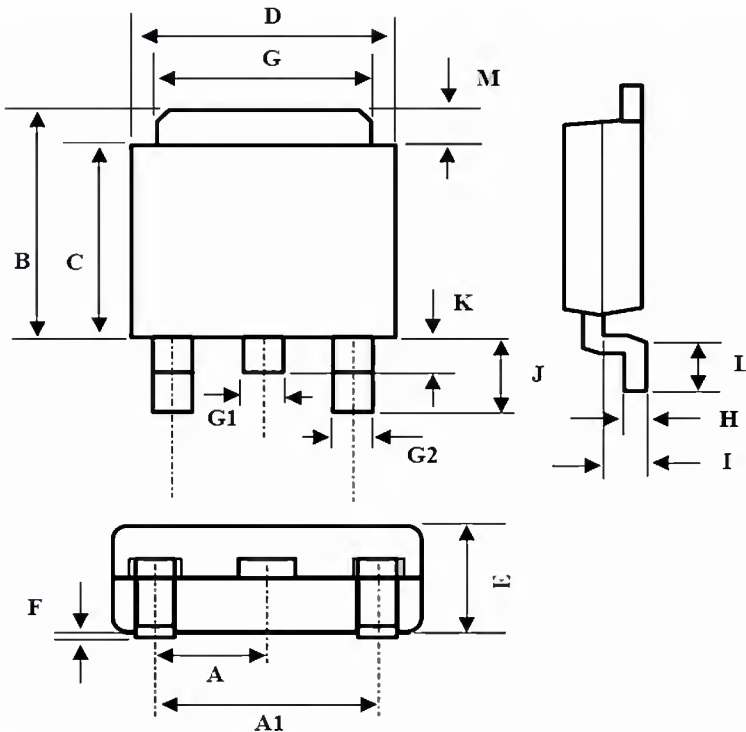
| DIM | TO-263 DIMENSION |        |        |       |
|-----|------------------|--------|--------|-------|
|     | MILLIMETERS      |        | INCHES |       |
|     | MIN              | MAX    | MIN    | MAX   |
| A   | 10.000           | 10.500 | 0.394  | 0.413 |
| B   | 14.605           | 15.875 | 0.575  | 0.625 |
| C   | 0.508            | 0.991  | 0.020  | 0.039 |
| D   | 2.420            | 2.660  | 0.095  | 0.105 |
| E   | 4.064            | 4.830  | 0.160  | 0.190 |
| F   | 1.118            | 1.400  | 0.045  | 0.055 |
| G   | 0.450            | 0.730  | 0.018  | 0.029 |
| H   | 8.280            | 8.800  | 0.325  | 0.346 |
| I   | 1.140            | 1.400  | 0.044  | 0.055 |
| J   | 1.480            | 1.520  | 0.058  | 0.060 |

**Marking Diagram**



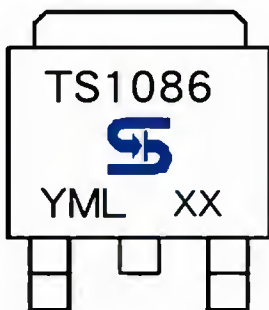
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- L** = Lot Code
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(1.5=1.5V, 1.8=1.8V, 2.5=2.5V, 3.3=3.3V, 5.0=5V)  
= Package Code for Adjustable type  
(CM = TO-263)

**TO-252 Mechanical Drawing**



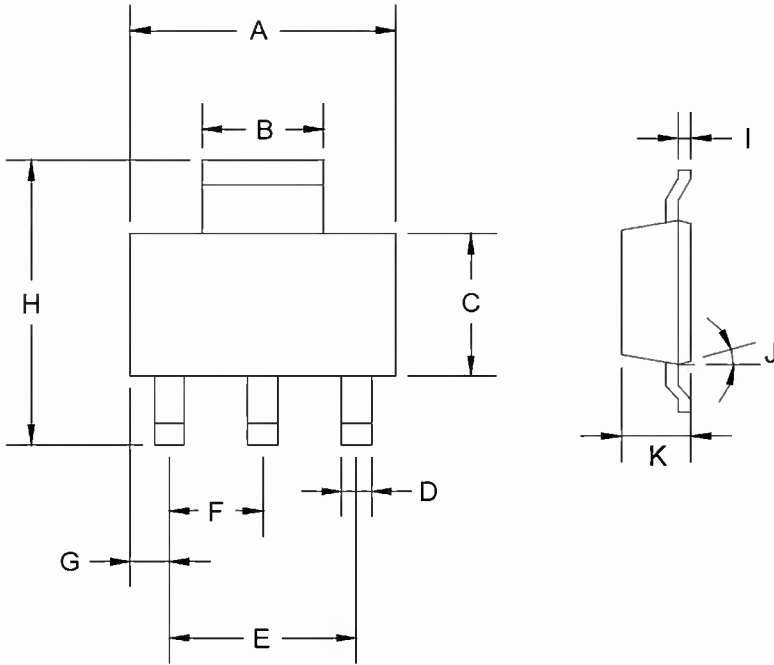
| TO-252 DIMENSION |             |      |         |       |
|------------------|-------------|------|---------|-------|
| DIM              | MILLIMETERS |      | INCHES  |       |
|                  | MIN         | MAX  | MIN     | MAX   |
| A                | 2.3BSC      |      | 0.09BSC |       |
| A1               | 4.6BSC      |      | 0.18BSC |       |
| B                | 6.80        | 7.20 | 0.268   | 0.283 |
| C                | 5.40        | 5.60 | 0.213   | 0.220 |
| D                | 6.40        | 6.65 | 0.252   | 0.262 |
| E                | 2.20        | 2.40 | 0.087   | 0.094 |
| F                | 0.00        | 0.20 | 0.000   | 0.008 |
| G                | 5.20        | 5.40 | 0.205   | 0.213 |
| G1               | 0.75        | 0.85 | 0.030   | 0.033 |
| G2               | 0.55        | 0.65 | 0.022   | 0.026 |
| H                | 0.35        | 0.65 | 0.014   | 0.026 |
| I                | 0.90        | 1.50 | 0.035   | 0.059 |
| J                | 2.20        | 2.80 | 0.087   | 0.110 |
| K                | 0.50        | 1.10 | 0.020   | 0.043 |
| L                | 0.90        | 1.50 | 0.035   | 0.059 |
| M                | 1.30        | 1.70 | 0.051   | 0.67  |

**Marking Diagram**



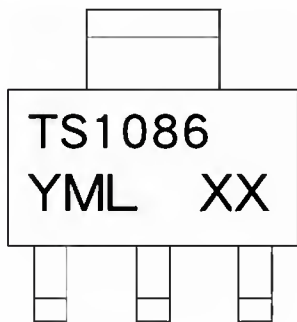
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(1.5=1.5V, 1.8=1.8V, 2.5=2.5V, 3.3=3.3V, 5.0=5V)  
= Package Code for Adjustable type  
(CP = TO-252)

**SOT-223 Mechanical Drawing**



| SOT-223 DIMENSION |             |       |        |       |
|-------------------|-------------|-------|--------|-------|
| DIM               | MILLIMETERS |       | INCHES |       |
|                   | MIN         | MAX   | MIN    | MAX   |
| A                 | 6.350       | 6.850 | 0.250  | 0.270 |
| B                 | 2.900       | 3.100 | 0.114  | 0.122 |
| C                 | 3.450       | 3.750 | 0.136  | 0.148 |
| D                 | 0.595       | 0.635 | 0.023  | 0.025 |
| E                 | 4.550       | 4.650 | 0.179  | 0.183 |
| F                 | 2.250       | 2.350 | 0.088  | 0.093 |
| G                 | 0.835       | 1.035 | 0.032  | 0.041 |
| H                 | 6.700       | 7.300 | 0.263  | 0.287 |
| I                 | 0.250       | 0.355 | 0.010  | 0.014 |
| J                 | 10°         | 16°   | 10°    | 16°   |
| K                 | 1.550       | 1.800 | 0.061  | 0.071 |

**Marking Diagram**



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- L** = Lot Code
- XX** = Voltage Code  
(1.5=1.5V, 1.8=1.8V, 2.5=2.5V, 3.3=3.3V, 5.0=5V)
- = Package Code for Adjustable type  
(CW = SOT-223)



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