






# TS9000/TS9000A

## 300mA CMOS Low Dropout Voltage Regulator

| TO-92   | Pin assignment                             | SOT-89  | Pin assignment                             | SOT-23  | Pin assignment                             |
|---|--|---|--|---|--|
|  | TS9000<br>1. Gnd<br>2. Input<br>3. Output  |  | TS9000<br>1. Gnd<br>2. Input<br>3. Output  |  | TS9000<br>1. Input<br>2. Output<br>3. Gnd  |
|   | TS9000A<br>1. Input<br>2. Gnd<br>3. Output |   | TS9000A<br>1. Output<br>2. Gnd<br>3. Input |   | TS9000A<br>1. Gnd<br>2. Output<br>3. Input |

### General Description

The TS9000/TS9000A series is a positive voltage regulator developed utilizing CMOS technology featured low quiescent current, low dropout voltage and high output voltage accuracy. Built in low on-resistor provides low dropout voltage and large output current. A 2.2uF or greater can be used as an output capacitor.

The TS9000/TS9000A series are prevented device failure under the worst operation condition with both thermal shutdown and current fold-back. These series are recommended for configuring portable devices and large current application, respectively.

This series are offered in 3-pin TO-92, SOT-89 and SOT-23 package.

### Features

- ◇ Dropout voltage typically 0.4V @ $I_o=300mA$
- ◇ Output current up to 300mA
- ◇ Low quiescent current
- ◇ Output voltage trimmed before assembly
- ◇ Internal current limit
- ◇ Thermal shutdown protection

### Applications

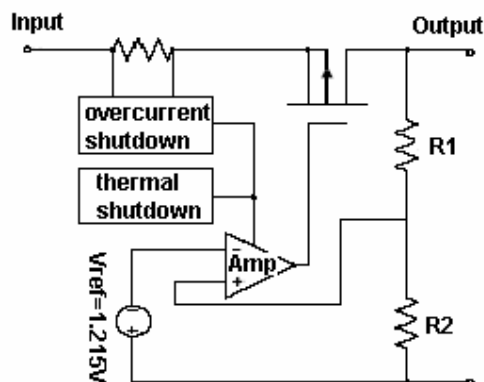
- ◇ Battery power equipment
- ◇ Personal communication devices
- ◇ Home electronic appliances
- ◇ PC peripherals
- ◇ CD-ROM
- ◇ Digital signal camera

### Ordering Information

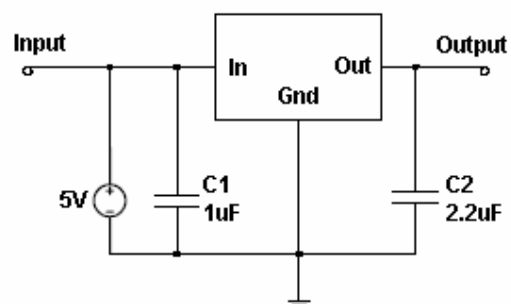
| Part No.   | Operating Temp. (Ambient) | Package |
|------------|---------------------------|---------|
| TS9000xCT  | -40 ~ +85 °C              | TO-92   |
| TS9000xCX  |                           | SOT-23  |
| TS9000xCY  |                           | SOT-89  |
| TS9000AxCT |                           | TO-92   |
| TS9000AxCX |                           | SOT-23  |
| TS9000AxCY |                           | SOT-89  |

Note: Where **x** denotes voltage option, available are  
**K**=2.5V, **M**=2.7V, **N**=2.8V, **P**=3.0V,  
**S**=3.3V, **U**=3.5V, **V**=3.6V, **X**=3.8V.  
 Contact factory for additional voltage options.

### Block Diagram



### Typical Application Circuit





## Absolute Maximum Rating

|                                      |                           |                        |                    |
|--------------------------------------|---------------------------|------------------------|--------------------|
| Input Supply Voltage                 | Vin                       | +7                     | V                  |
| Output Current                       | Io                        | $P_D / (V_{in} - V_o)$ | V                  |
| Power Dissipation                    | SOT-23<br>SOT-89<br>TO-92 | P <sub>D</sub>         | 0.3<br>0.5<br>0.65 |
| Thermal Resistance                   | SOT-23<br>SOT-89<br>TO-92 | θ <sub>ja</sub>        | 325<br>180<br>160  |
| Operating Junction Temperature Range | T <sub>j</sub>            | -40 ~ +150             | °C                 |
| Storage Temperature Range            | T <sub>STG</sub>          | -65 ~ +150             | °C                 |
| Lead Soldering Temperature (260 °C)  |                           | 10                     | S                  |

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

## Electrical Characteristics

T<sub>a</sub> = 25 °C unless otherwise specified.

| Parameter                              | Conditions  | Min                  | Typ  | Max                  | Unit              |
|--|---|----------------------|------|----------------------|-------------------|
| Output Voltage                         | V <sub>in</sub> =V <sub>o</sub> + 0.3V,<br>1mA ≤ I <sub>o</sub> ≤ 300mA,          | 0.985 V <sub>o</sub> |      | 1.015 V <sub>o</sub> |                   |
| Input Supply Voltage                   |   | V <sub>o</sub> +0.3V | --   | 7                    | V                 |
| Output Voltage Temperature Coefficient |   | --                   | 40   | --                   | ppm/°C            |
| Line Regulation                        | V <sub>o</sub> +1V ≤ V <sub>in</sub> ≤ V <sub>o</sub> +2V,<br>I <sub>o</sub> =5mA | --                   | 0.02 | 0.1                  | %                 |
| Load Regulation                        | 1mA ≤ I <sub>L</sub> ≤ 300mA  | --                   | 0.2  | 1.0                  | %                 |
| Dropout Voltage                        | I <sub>o</sub> =300mA, V <sub>o</sub> =V <sub>o</sub> -2%                         | --                   | --   | 400                  | mV                |
| Quiescent Current                      | V <sub>in</sub> =5V, I <sub>o</sub> =0A   | --                   | 30   | 50                   | μA                |
| Short Circuit Current                  | V <sub>out</sub> < 0.4V   | --                   | 300  | 400                  | mA                |
| Output Noise                           |   | --                   | 20   | --                   | μV <sub>rms</sub> |
| Power Supply Rejection Ratio           | At 1KHz   | --                   | 55   | --                   | dB                |

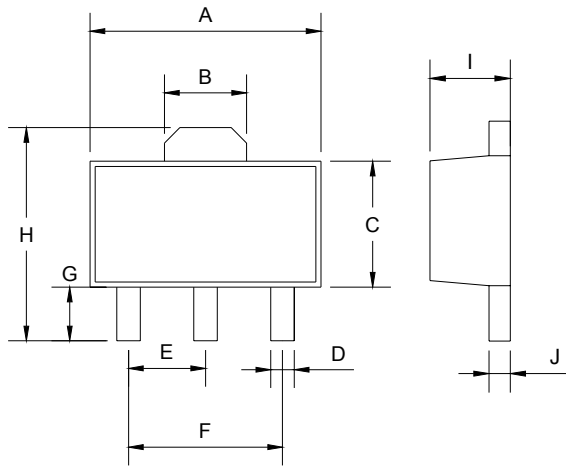
## Detail Description

The TS9000/TS9000A series of CMOS regulators contain a P-MOS pass transistor, voltage reference, error amplifier, over current protection and thermal shutdown.

The TS9000/TS9000A series switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over stress. The TS9000 also incorporates current fold-back to reduce power dissipation when the output is short circuit. This feature becomes active when the output drops below 0.8V, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8V.

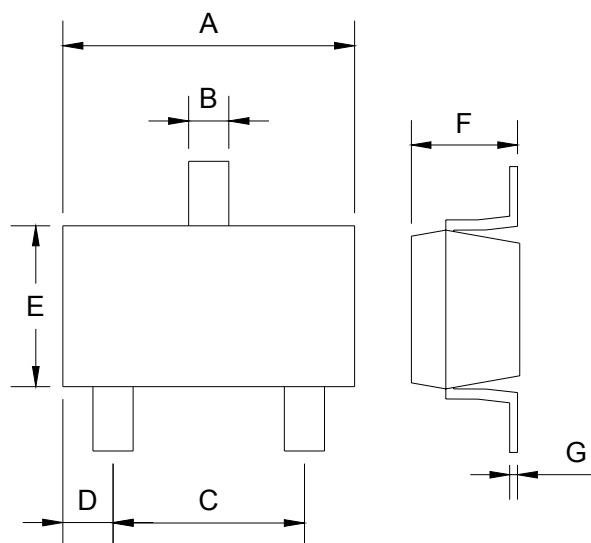
The internal P-channel pass transistor receives data from the error amplifier, over current shutdown and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over current and thermal shutdown circuits become active when the junction temperature exceeds 150 °C, or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 110 °C.

### SOT-89 Mechanical Drawing



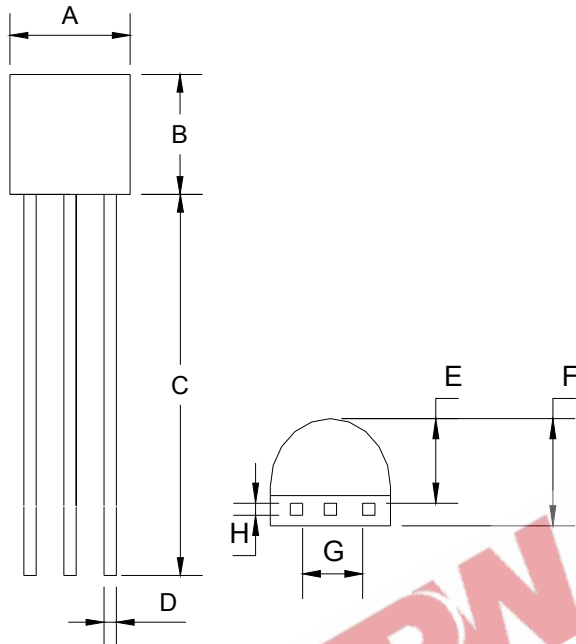
| DIM | SOT-89 DIMENSION |      |        |       |
|-----|------------------|------|--------|-------|
|     | MILLIMETERS      |      | INCHES |       |
|     | MIN              | MAX  | MIN    | MAX   |
| A   | 4.40             | 4.60 | 0.173  | 0.181 |
| B   | 1.50             | 1.7  | 0.059  | 0.070 |
| C   | 2.30             | 2.60 | 0.090  | 0.102 |
| D   | 0.40             | 0.52 | 0.016  | 0.020 |
| E   | 1.50             | 1.50 | 0.059  | 0.059 |
| F   | 3.00             | 3.00 | 0.118  | 0.118 |
| G   | 0.89             | 1.20 | 0.035  | 0.047 |
| H   | 4.05             | 4.25 | 0.159  | 0.167 |
| I   | 1.4              | 1.6  | 0.055  | 0.068 |
| J   | 0.35             | 0.44 | 0.014  | 0.017 |

### SOT-23 Mechanical Drawing



| DIM | SOT-23 DIMENSION |      |        |       |
|-----|------------------|------|--------|-------|
|     | MILLIMETERS      |      | INCHES |       |
|     | MIN              | MAX  | MIN    | MAX   |
| A   | 2.88             | 2.91 | 0.113  | 0.115 |
| B   | 0.39             | 0.42 | 0.015  | 0.017 |
| C   | 1.78             | 2.03 | 0.070  | 0.080 |
| D   | 0.51             | 0.61 | 0.020  | 0.024 |
| E   | 1.50             | 1.70 | 0.059  | 0.067 |
| F   | 1.04             | 1.08 | 0.041  | 0.043 |
| G   | 0.07             | 0.09 | 0.003  | 0.004 |

### TO-92 Mechanical Drawing



| TO-92 DIMENSION |             |      |            |       |
|-----------------|-------------|------|------------|-------|
| DIM             | MILLIMETERS |      | INCHES     |       |
|                 | MIN         | MAX  | MIN        | MAX   |
| A               | 4.30        | 4.70 | 0.169      | 0.185 |
| B               | 4.30        | 4.70 | 0.169      | 0.185 |
| C               | 14.30(typ)  |      | 0.563(typ) |       |
| D               | 0.43        | 0.49 | 0.017      | 0.019 |
| E               | 2.19        | 2.81 | 0.086      | 0.111 |
| F               | 3.30        | 3.70 | 0.130      | 0.146 |
| G               | 2.42        | 2.66 | 0.095      | 0.105 |
| H               | 0.37        | 0.43 | 0.015      | 0.017 |