

## LR3989

### Micropower 300mA Ultra Low-Dropout CMOS Voltage Regulator with Power Good

#### General Description

The LR3989 is a 300mA low dropout regulator designed specially to meet requirements of Portable battery applications.

The LR3989 is designed to work with space saving, small 1 $\mu$ F ceramic capacitor. The LR3989 features an Error Flag output that indicates a faulty output condition. The LR3989's performance is optimized for battery powered systems to deliver low noise, extremely low dropout voltage and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life.

Power supply rejection is better than 60 dB at low frequencies and starts to roll off at 10 kHz. High power supply rejection is maintained down to lower input voltage levels common to battery operated circuits.

The device is ideal for mobile phone and similar battery powered wireless applications. It provides up to 300 mA, from a 2.0V to 6.5V input, consuming less than 1 $\mu$ A in disable mode and has fast turn-on time less than 220 $\mu$ s.

The LR3989 is available SOT23(-3 -5) package and SC70(-3 -5) package. Performance is specified for -40 to +125 temperature range and is available in 1.5V~6.0V output voltages.

#### Key Specifications

- 2.0V to 6.5 V input range
- 300mA guaranteed output
- 30dB PSRR at 10kHz
- $\leq 1\mu$ A quiescent current when shut down
- Fast Turn-On time: 150  $\mu$ s (type.)
- 200 mV type dropout with 300mA load
- 40 to +125 junction temperature range for operation
- 1.5V~6.0V outputs

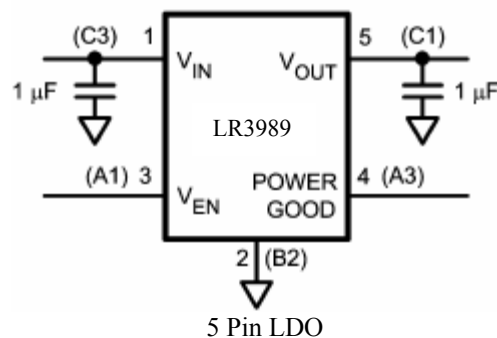
#### Features

- SOT23-3 SOT23-5 package
- SC70 SC70-5(SC88A) package
- Power-good flag output
- Logic controlled enable
- Stable with ceramic and high quality tantalum capacitors
- Fast turn-on
- Thermal shutdown and short-circuit current limit

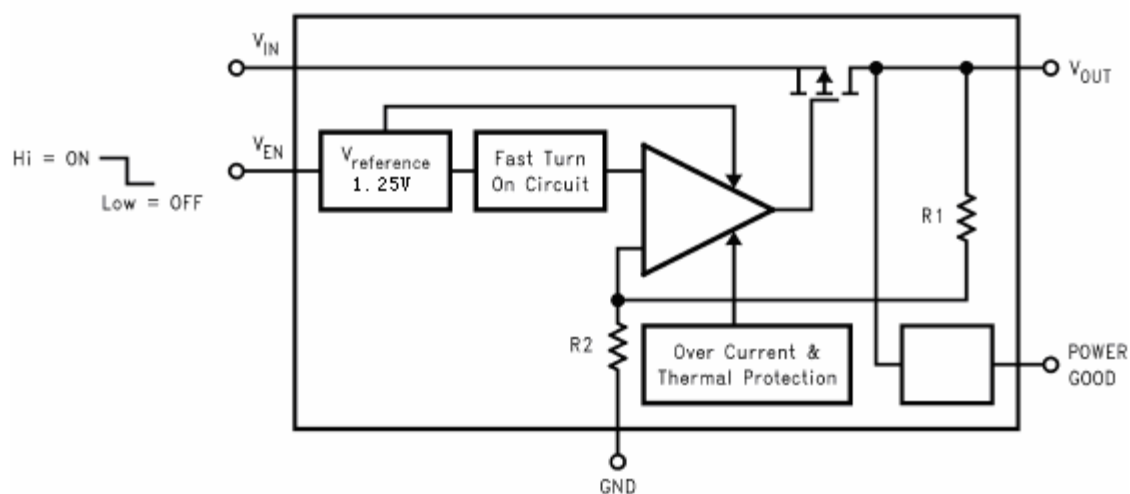
#### Applications

- CDMA cellular handsets
- Wideband CDMA cellular handsets
- GSM cellular handsets
- Portable information appliances
- Tiny 3.3V $\pm$  5% to 2.5V, 300mA converter

#### Typical Application Circuit



## Block Diagram

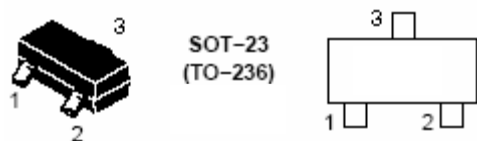


## Pin Descriptions

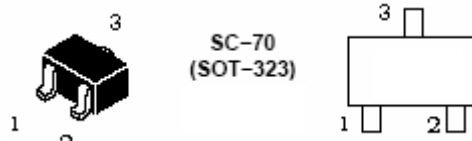
| Name             | SOT23<br>SC70 | SOT23-5<br>SC88A | Function                                                                                                                                                            |
|------------------|---------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>EN</sub>  |               | 3                | Enable Input Logic, Enable High                                                                                                                                     |
| GND              | 2             | 2                | Common Ground                                                                                                                                                       |
| V <sub>OUT</sub> | 3             | 5                | Output Voltage of the LDO                                                                                                                                           |
| V <sub>IN</sub>  | 1             | 1                | Input Voltage of the LDO                                                                                                                                            |
| Power Good       |               | 4                | Power Good Flag (output):<br>open-drain output, connected to an external pull-up<br>resistor. Active low indicates an output voltage out<br>of tolerance condition. |

## Connection Diagrams

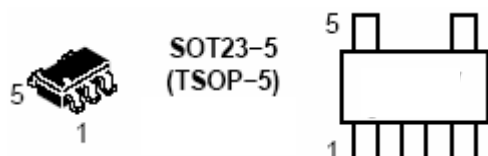
SOT23 package



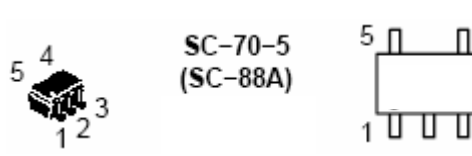
SC70 package



SOT23-5 package



SC88A package



## Absolute Maximum Ratings

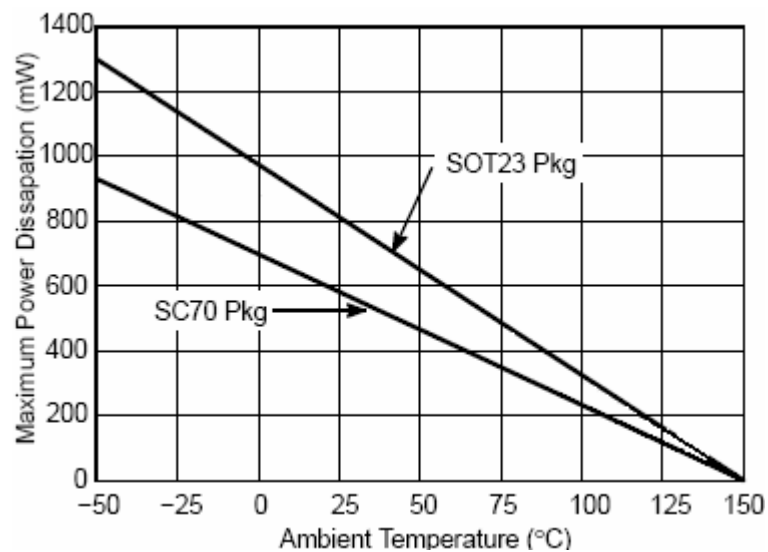
If Military/Aerospace specified devices are required, please contact the LRC Sales Office/Distributors for availability and specifications.

|                                  |                                         |
|----------------------------------|-----------------------------------------|
| $V_{IN}$                         | -0.3 to 7.0V                            |
| $V_{OUT}$ , $V_{EN}$ , PowerGood | -0.3V to ( $V_{IN}+0.3V$ ), with 6V max |
| Junction Temperature             | 150°C                                   |
| Storage Temperature              | -65°C to +150°C                         |
| Lead Temp, Pad Temp.             | 235°C                                   |
| ESD Rating                       |                                         |
| Human Body Model                 | 2kV                                     |
| Machine Model                    | 150V                                    |

## Operating Ratings

|                                                          |                 |
|----------------------------------------------------------|-----------------|
| $V_{IN}$ (note 1)                                        | 2.0V to 6.5V    |
| $V_{OUT}$ , $V_{EN}$                                     | 0 to $V_{IN}$   |
| Junction Temperature                                     | -40°C to +125°C |
| Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ) |                 |
| SOT23                                                    | 301°C /W        |
| SOT23-5                                                  | 220°C /W        |
| SC70                                                     | 314°C /W        |
| SC88A                                                    | 215°C /W        |

Maximum Power Dissipation (see graph)



### Electrical Characteristics

Unless otherwise specified:  $V_{EN} = 1.8V$ ,  $V_{IN} = V_{OUT} + 0.5V$ ,  $C_{IN} = 1\mu F$ ,  $I_{OUT} = 1mA$ ,  $C_{OUT} = 1\mu F$ . Typical values and limits appearing in standard typeface are for  $T_J = 25^\circ C$ . Limits appearing in **boldface type** apply over the entire junction temperature range for operation,  $-40^\circ C$  to  $+125^\circ C$ .

| Symbol                         | Parameter                    | Conditions                                                                     | Type  | Limit       |            | Units               |
|--------------------------------|------------------------------|--------------------------------------------------------------------------------|-------|-------------|------------|---------------------|
|                                |                              |                                                                                |       | Min         | Max        |                     |
| $V_{OUT}$                      | Output Voltage Tolerance     | $-20^\circ C \leq T_J \leq 125^\circ C$                                        |       | -2          | 2          | % of $V_{OUT(nom)}$ |
|                                |                              | $-40^\circ C \leq T_J \leq 125^\circ C$                                        |       | -3          | 3          |                     |
|                                |                              |                                                                                |       | <b>-3.5</b> | <b>3.5</b> |                     |
|                                | Line Regulation Error        | $V_{IN} = V_{OUT(nom)} + 0.5V$ to $6.0V$                                       |       | -0.1        | 0.1        | %/V                 |
|                                |                              |                                                                                |       | -0.2        | 0.2        |                     |
|                                | Load Regulation Error        | $I_{OUT} = 1mA$ to $300mA$                                                     |       |             | 0.01       | %/mA                |
|                                |                              |                                                                                |       |             |            |                     |
| PSRR                           | Power Supply Rejection Ratio | $V_{IN} = V_{OUT(nom)} + 1V$<br>$f = 1kHz$ ,<br>$I_{OUT} = 50mA$ (Figure 2)    | 60    |             |            | dB                  |
|                                |                              | $V_{IN} = V_{OUT(nom)} + 1V$ ,<br>$f = 10kHz$ ,<br>$I_{OUT} = 50mA$ (Figure 2) | 30    |             |            |                     |
| $I_Q$                          | Quiescent Current            | $V_{EN} = 1.4V$ , $I_{OUT} = 0mA$                                              | 90    |             | 250        | $\mu A$             |
|                                |                              | $V_{EN} = 1.4V$ , $I_{OUT} = 0$ to $300mA$                                     | 140   |             | 200        |                     |
|                                |                              | $V_{EN} = 0.4V$                                                                | 0.004 |             | 1.0        |                     |
|                                | Dropout Voltage              | $I_{OUT} = 1mA$                                                                | 1     |             | 5          | mV                  |
|                                |                              | $I_{OUT} = 200mA$                                                              | 120   |             | 230        |                     |
|                                |                              | $I_{OUT} = 300mA$                                                              | 200   |             |            |                     |
| $I_{SC}$                       | Short Circuit Current Limit  | Output Grounded(Steady State)                                                  | 450   |             |            | mA                  |
| $e_n$                          | Output Noise Voltage         | $BW = 10Hz$ to $100kHz$ ,<br>$C_{OUT} = 1\mu F$                                | 100   |             |            | $\mu V_rms$         |
| $C_{OUT}$                      | Output Capacitor             | Capacitance                                                                    |       | 1           | 10         | $\mu F$             |
|                                |                              | ESR                                                                            |       | 5           | 200        | m $\Omega$          |
| TSD                            | Thermal Shutdown Temperature |                                                                                | 150   |             |            | $^\circ C$          |
|                                | Thermal Shutdown Hysteresis  |                                                                                |       |             |            | $^\circ C$          |
| Enable Control Characteristics |                              |                                                                                |       |             |            |                     |
| $I_{EN}$                       | Maximum Input Current at EN  | $V_{EN} = 0$ and $V_{IN} = 5.5V$                                               |       |             | 0.1        | $\mu A$             |

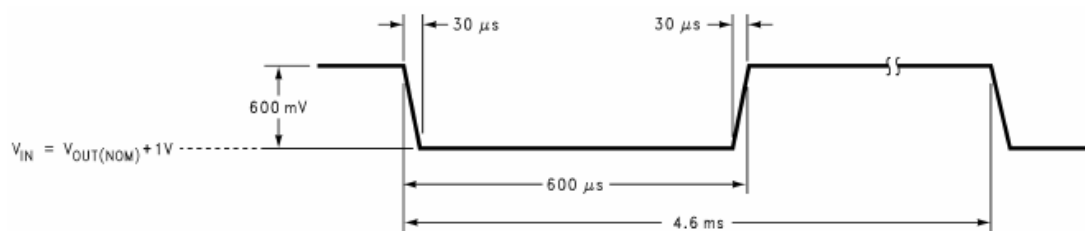
### Electrical Characteristics (Continued)

Unless otherwise specified:  $V_{EN} = 1.8V$ ,  $V_{IN} = V_{OUT} + 0.5V$ ,  $C_{IN} = 1\mu F$ ,  $I_{OUT} = 1mA$ ,  $C_{OUT} = 1\mu F$ . Typical values and limits appearing in standard typeface are for  $T_J = 25^\circ C$ . Limits appearing in **boldface type** apply over the entire junction temperature range for operation,  $-40^\circ C$  to  $+125^\circ C$ .

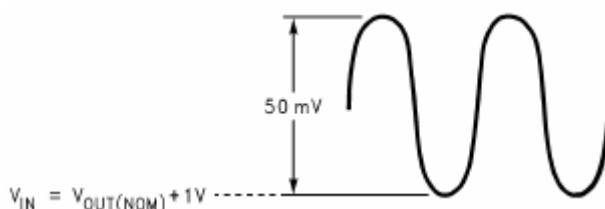
| Symbol                 | Parameter                                     | Conditions                                        | Type     | Limit    |          | Units   |
|------------------------|-----------------------------------------------|---------------------------------------------------|----------|----------|----------|---------|
|                        |                                               |                                                   |          | Min      | Max      |         |
| $V_{IL}$               | Logic Low Input threshold                     | $V_{IN} = 2.0V$ to $6.5V$                         |          |          | 0.5      | V       |
| $V_{IH}$               | Logic High Input threshold                    | $V_{IN} = 2.0V$ to $6.5V$                         |          | 1.2      |          | V       |
| <b>Power Good</b>      |                                               |                                                   |          |          |          |         |
| $V_{THL}$<br>$V_{THH}$ | Power Good<br>Low threshold<br>High Threshold | % of $V_{OUT}$ (PG ON)<br>% of $V_{OUT}$ (PG OFF) | 93<br>95 | 90<br>92 | 95<br>98 | %       |
| $V_{OL}$               | PG Output Logic Low Voltage                   | $I_{PULL-UP} = 100\mu A$ , fault condition        | 0.02     |          |          | V       |
| $I_{PGL}$              | PG Output Leakage Current                     | PG Off, $V_{PG} = 6V$                             | 0.02     |          |          | $\mu A$ |
| $T_{ON}$               | Power Good Turn On time                       | $V_{IN} = 4.2V$                                   | 10       |          |          | $\mu s$ |
| $T_{OFF}$              | Power Good Turn Off time                      | $V_{IN} = 4.2V$                                   | 10       |          |          | $\mu s$ |

**Note 1:** The minimum VIN is dependant on the device output option.

For  $V_{OUT(NOM)} < 2.5V$ ,  $V_{IN(MIN)}$  will equal 2.5V. For  $V_{OUT(NOM)} \geq 2.5V$ ,  $V_{IN(MIN)}$  will equal  $V_{OUT(NOM)} + 200mV$ .



**FIGURE 1. Line Transient response Input Perturbation**



**FIGURE 2. PSRR Input Perturbation**

## Ordering Information

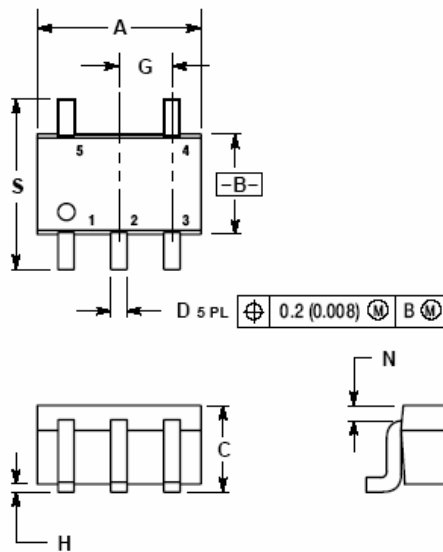
### SOT23-5 Package

| Output Voltage (V) | Grade | LR3988 Supplied as 3000 Units, Tape and Reel | LR3988 Supplied as 10000Units, Tape and Reel | Package Marking |
|--------------------|-------|----------------------------------------------|----------------------------------------------|-----------------|
| 1.5                | STD   | LR3989DW1T1G-1.5                             | LR3989DW1T3G-1.5                             |                 |
| 2.5                | STD   | LR3989DW1T1G-2.5                             | LR3989DW1T3G-2.5                             |                 |
| 2.6                | STD   | LR3989DW1T1G-2.6                             | LR3989DW1T3G-2.6                             |                 |
| 2.7                | STD   | LR3989DW1T1G-2.7                             | LR3989DW1T3G-2.7                             |                 |
| 2.8                | STD   | LR3989DW1T1G-2.8                             | LR3989DW1T3G-2.8                             |                 |
| 2.9                | STD   | LR3989DW1T1G-2.9                             | LR3989DW1T3G-2.9                             |                 |
| 3.0                | STD   | LR3989DW1T1G-3.0                             | LR3989DW1T3G-3.0                             |                 |
| 3.1                | STD   | LR3989DW1T1G-3.1                             | LR3989DW1T3G-3.1                             |                 |
| 3.2                | STD   | LR3989DW1T1G-3.2                             | LR3989DW1T3G-3.2                             |                 |
| 3.3                | STD   | LR3989DW1T1G-3.3                             | LR3989DW1T3G-3.3                             |                 |
| 4.2                | STD   | LR3989DW1T1G-4.2                             | LR3989DW1T3G-4.2                             |                 |
| 5.0                | STD   | LR3989DW1T1G-5.0                             | LR3989DW1T3G-5.0                             |                 |

## Physical Dimensions

### PACKAGE DIMENSIONS

#### SC-70-5 (SC-88A)

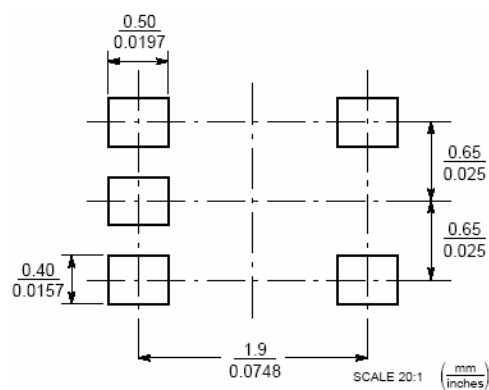


#### NOTES:

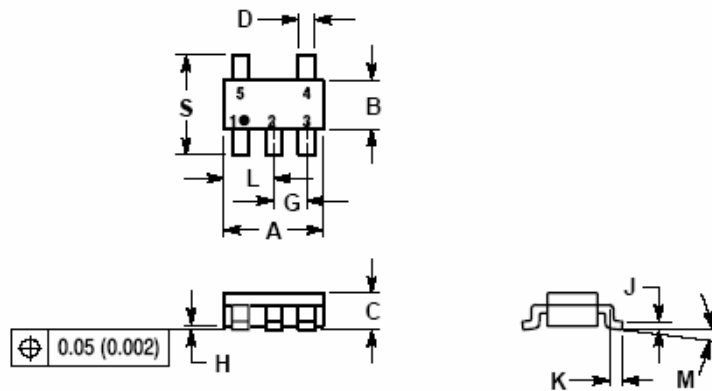
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418A-01 OBSOLETE. NEW STANDARD 418A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | MIN    | MAX   | MIN         | MAX  |
| A   | 0.071  | 0.087 | 1.80        | 2.20 |
| B   | 0.045  | 0.053 | 1.15        | 1.35 |
| C   | 0.031  | 0.043 | 0.80        | 1.10 |
| D   | 0.004  | 0.012 | 0.10        | 0.30 |
| G   | 0.026  | BSC   | 0.65        | BSC  |
| H   | ---    | 0.004 | ---         | 0.10 |
| J   | 0.004  | 0.010 | 0.10        | 0.25 |
| K   | 0.004  | 0.012 | 0.10        | 0.30 |
| N   | 0.008  | REF   | 0.20        | REF  |
| S   | 0.079  | 0.087 | 2.00        | 2.20 |

### SOLDERING FOOTPRINT\*



**SOT23-5 (TSOP-5)**

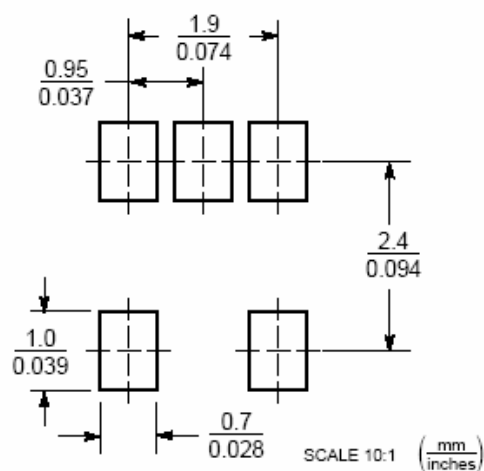


**NOTES:**

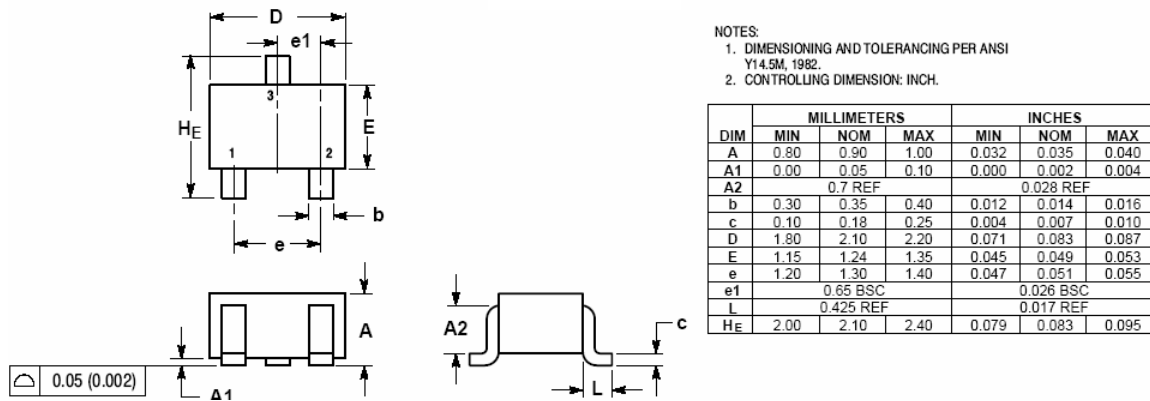
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. A AND B DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |       | INCHES |        |
|-----|-------------|-------|--------|--------|
|     | MIN         | MAX   | MIN    | MAX    |
| A   | 2.90        | 3.10  | 0.1142 | 0.1220 |
| B   | 1.30        | 1.70  | 0.0512 | 0.0669 |
| C   | 0.90        | 1.10  | 0.0354 | 0.0433 |
| D   | 0.25        | 0.50  | 0.0098 | 0.0197 |
| E   | 0.85        | 1.05  | 0.0335 | 0.0413 |
| F   | 0.013       | 0.100 | 0.0005 | 0.0040 |
| G   | 0.10        | 0.26  | 0.0040 | 0.0102 |
| H   | 0.20        | 0.80  | 0.0079 | 0.0315 |
| I   | 1.25        | 1.55  | 0.0493 | 0.0610 |
| J   | 0           | 10    | 0      | 10     |
| K   | 2.50        | 3.00  | 0.0985 | 0.1181 |

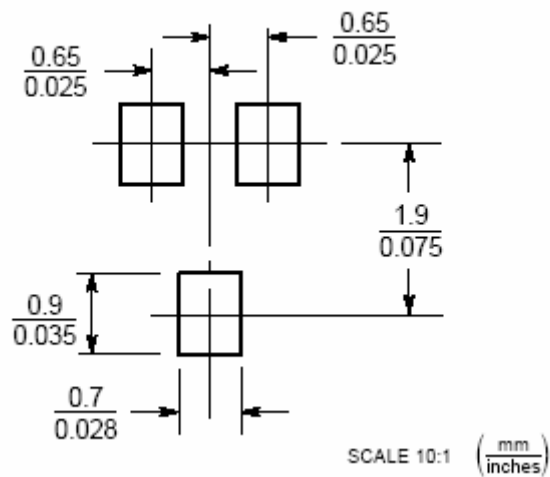
**SOLDERING FOOTPRINT\***

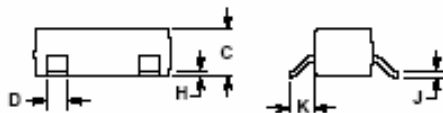
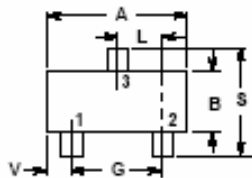


SC-70 (SOT-323)



SOLDERING FOOTPRINT\*

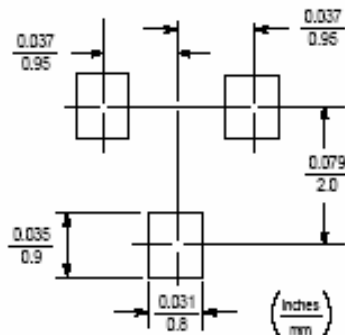


**SOT-23**

**NOTES:**

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

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.065       | 0.177 |
| K   | 0.0140 | 0.0285 | 0.35        | 0.69  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.1039 | 2.10        | 2.64  |
| V   | 0.0177 | 0.0236 | 0.45        | 0.60  |

PIN 1. BASE  
 2. EMITTER  
 3. COLLECTOR



Remark: These packages above are available for RoHS.