



# TS3702C,I,M

## MICROPOWER DUAL CMOS VOLTAGE COMPARATORS

- PUSH-PULL CMOS OUTPUT (NO EXTERNAL PULL-UP RESISTOR REQUIRED)
- EXTREMELY LOW SUPPLY CURRENT : **9 $\mu$ A typ / comparator**
- WIDE SINGLE SUPPLY RANGE **2.7V TO 16V** OR DUAL SUPPLIES ( $\pm 1.35V$  TO  $\pm 8V$ )
- EXTREMELY LOW INPUT BIAS CURRENT : **1pA typ**
- EXTREMELY LOW INPUT OFFSET CURRENTS : **1pA typ**
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GND
- HIGH INPUT IMPEDANCE :  $10^{12}\Omega$  typ
- FAST RESPONSE TIME : 2 $\mu$ s typ for 5mV overdrive
- PIN-TO-PIN AND FUNCTIONALLY COMPATIBLE WITH BIPOLAR LM393

### DESCRIPTION

The TS3702 is a micropower CMOS dual voltage comparator with extremely low consumption of 9 $\mu$ A typ / comparator (20 times less than bipolar LM393). The push-pull CMOS output stage allows power and space saving by eliminating the external pull-up resistor required by usual open-collector output comparators.

Thus response times remain similar to the LM393.

### ORDER CODE

| Part Number | Temperature Range | Package |   |   |
|-------------|-------------------|---------|---|---|
|             |                   | N       | D | P |
| TS3702C     | 0°C, +70°C        | •       | • | • |
| TS3702I     | -40°C, +125°C     | •       | • | • |
| TS3702M     | -55°C, +125°C     | •       | • | • |

N = Dual in Line Package (DIP)  
D = Small Outline Package (SO) - also available in Tape & Reel (DT)  
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)



**N**  
**DIP8**  
(Plastic Package)

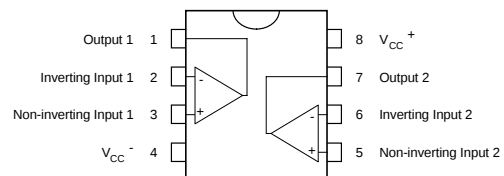


**D**  
**SO8**  
(Plastic Micropackage)

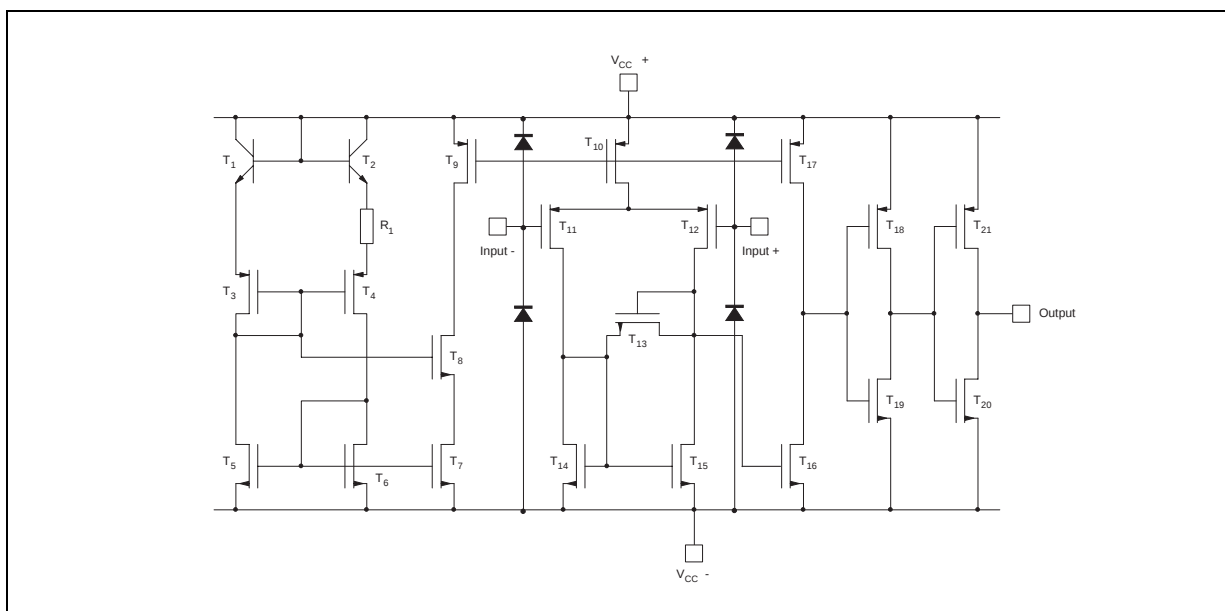


**P**  
**TSSOP8**  
(Thin Shrink Small Outline Package)

### PIN CONNECTIONS (top view)



## SCHEMATIC DIAGRAM (for 1/2 TS3702)



## ABSOLUTE MAXIMUM RATINGS

| Symbol       | Parameter                                                       | Value                 | Unit               |
|--------------|-----------------------------------------------------------------|-----------------------|--------------------|
| $V_{CC}^{+}$ | Supply Voltage <sup>1)</sup>                                    | 18                    | V                  |
| $V_{id}$     | Differential Input Voltage <sup>2)</sup>                        | $\pm 18$              | V                  |
| $V_i$        | Input Voltage <sup>3)</sup>                                     | 18                    | V                  |
| $V_o$        | Output Voltage                                                  | 18                    | V                  |
| $I_o$        | Output Current                                                  | 20                    | mA                 |
| $I_F$        | Forward Current in ESD Protection Diodes on Input <sup>4)</sup> | 50                    | mA                 |
| $P_d$        | Power Dissipation <sup>5)</sup>                                 | DIP8<br>SO8<br>TSSOP8 | 1250<br>710<br>625 |
| $T_{stg}$    | Storage Temperature Range                                       | -65 to +150           | °C                 |

1. All voltage values, except differential voltage, are with respect to network ground terminal.

2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.

3. The magnitude of the input and the output voltages must never exceed the magnitude of the positive supply voltage.

4. Guaranteed by design.

5.  $P_d$  is calculated with  $T_{amb} = +25^{\circ}\text{C}$ ,  $T_j = +150^{\circ}\text{C}$  and  $R_{thja} = 100^{\circ}\text{C/W}$  for DIP8 package  
 $= 175^{\circ}\text{C/W}$  for SO8 package  
 $= 200^{\circ}\text{C/W}$  for TSSOP8 package

## OPERATING CONDITIONS

| Symbol       | Parameter                                                             | Value                                  | Unit |
|--------------|-----------------------------------------------------------------------|----------------------------------------|------|
| $V_{CC}^{+}$ | Supply Voltage<br>TS3702C,I<br>TS3702M                                | 2.7 to 16<br>4 to 16                   | V    |
| $V_{icm}$    | Common Mode Input Voltage Range                                       | 0 to $V_{CC}^{+} - 1.5$                | V    |
| $T_{oper}$   | Operating Free-Air Temperature range<br>TS3702C<br>TS3702I<br>TS3702M | 0 to +70<br>-40 to +125<br>-55 to +125 | °C   |

**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = 3V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

| Symbol    | Parameter                                                                                                 | Min.     | Typ.        | Max.                                 | Unit    |
|-----------|-----------------------------------------------------------------------------------------------------------|----------|-------------|--------------------------------------|---------|
| $V_{io}$  | Input Offset Voltage <sup>1)</sup><br>$V_{ic} = 1.5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$              |          |             | 5<br>6.5                             | mV      |
| $I_{io}$  | Input Offset Current <sup>2)</sup><br>$V_{ic} = 1.5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$              |          | 1           | 300                                  | pA      |
| $I_{ib}$  | Input Bias Current <sup>2)</sup><br>$V_{ic} = 1.5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$                |          | 1           | 600                                  | pA      |
| $V_{icm}$ | Input Common Mode Voltage Range<br>$T_{min} \leq T_{amb} \leq T_{max}$                                    | 0<br>0   |             | $V_{CC}^+ - 1.2$<br>$V_{CC}^+ - 1.5$ | V       |
| CMR       | Common-mode Rejection Ratio<br>$V_{ic} = V_{icm\ min}$                                                    |          | 80          |                                      | dB      |
| SVR       | Supply Voltage Rejection Ratio<br>$V_{CC}^+ = 3V$ to $5V$                                                 |          | 75          |                                      | dB      |
| $V_{OH}$  | High Level Output Voltage<br>$V_{id} = 1V$ , $I_{OH} = -4mA$<br>$T_{min} \leq T_{amb} \leq T_{max}$       | 2<br>1.8 | 2.4         |                                      | V       |
| $V_{OL}$  | Low Level Output Voltage<br>$V_{id} = -1V$ , $I_{OL} = 4mA$<br>$T_{min} \leq T_{amb} \leq T_{max}$        |          | 300         | 400<br>450                           | mV      |
| $I_{CC}$  | Supply Current (each comparator)<br>No load - Outputs low<br>$T_{min} \leq T_{amb} \leq T_{max}$          |          | 7           | 20<br>25                             | $\mu A$ |
| $t_{PLH}$ | Response Time Low to High<br>$V_{ic} = 0V$ , $f = 10kHz$ , $C_L = 50pF$ ,<br>Overdrive = 5mV<br>TTL Input |          | 1.5<br>0.7  |                                      | $\mu s$ |
| $t_{PHL}$ | Response Time High to Low<br>$V_{ic} = 0V$ , $f = 10kHz$ , $C_L = 50pF$ ,<br>Overdrive = 5mV<br>TTL Input |          | 2.2<br>0.15 |                                      | $\mu s$ |

1. The specified offset voltage is the maximum value required to drive the output up to 2.5V or down to 0.3V.

2. Maximum values including unavoidable inaccuracies of the industrial test.

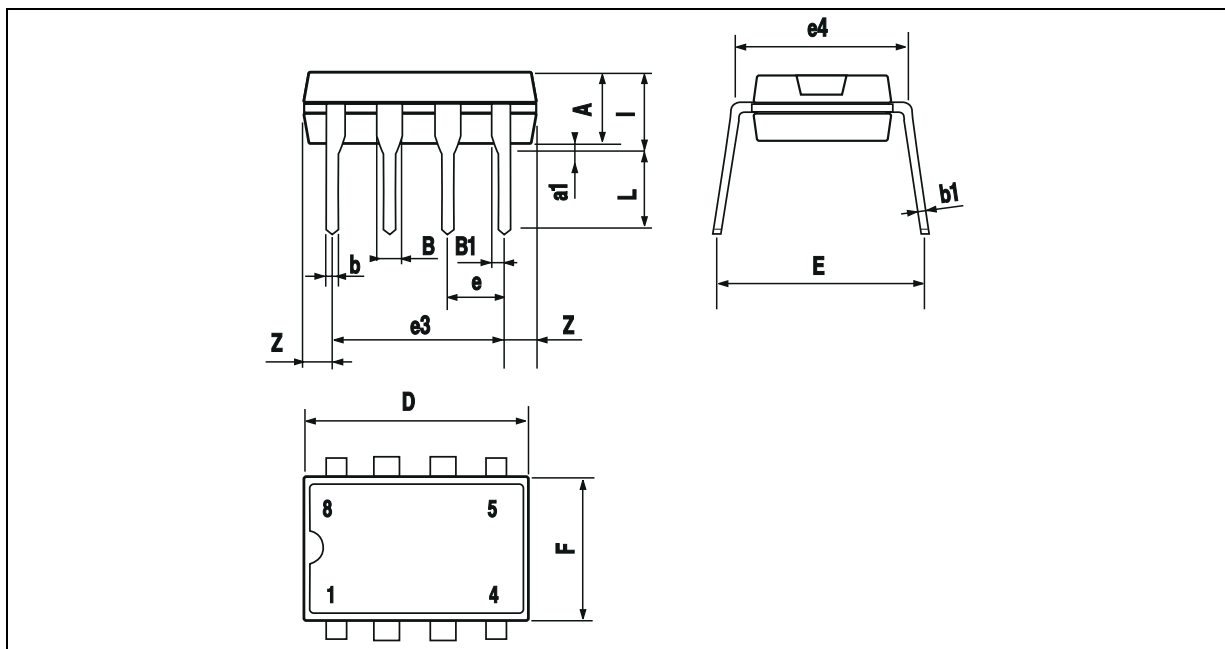
**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = 5V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

| Symbol    | Parameter                                                                                                                                                             | Min.       | Typ.                              | Max.                                 | Unit    |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------|--------------------------------------|---------|
| $V_{io}$  | Input Offset Voltage<br>$V_{ic} = V_{icm\ min.}$ , $V_{CC}^+ = 5V$ to $10V$ <sup>1)</sup><br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                    |            | 1.2                               | 5<br>6.5                             | mV      |
| $I_{io}$  | Input Offset Current <sup>2)</sup><br>$V_{ic} = 2.5V$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                        |            | 1                                 | 300                                  | pA      |
| $I_{ib}$  | Input Bias Current <sup>2)</sup><br>$V_{ic} = 2.5V$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                          |            | 1                                 | 600                                  | pA      |
| $V_{icm}$ | Input Common Mode Voltage Range<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                                              | 0<br>0     |                                   | $V_{CC}^+ - 1.2$<br>$V_{CC}^+ - 1.5$ | V       |
| CMR       | Common-mode Rejection Ratio<br>$V_{ic} = V_{icm\ min.}$                                                                                                               |            | 82                                |                                      | dB      |
| SVR       | Supply Voltage Rejection Ratio<br>$V_{CC}^+ = +5V$ to $+10V$                                                                                                          |            | 90                                |                                      | dB      |
| $V_{OH}$  | High Level Output Voltage<br>$V_{id} = 1V$ , $I_{OH} = -4mA$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                 | 4.5<br>4.3 | 4.7                               |                                      | V       |
| $V_{OL}$  | Low Level Output Voltage<br>$V_{id} = -1V$ , $I_{OL} = 4mA$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                  |            | 200                               | 300<br>375                           | mV      |
| $I_{CC}$  | Supply Current (each comparator)<br>No load - Outputs low<br>$T_{min.} \leq T_{amb} \leq T_{max.}$                                                                    |            | 9                                 | 20<br>25                             | $\mu A$ |
| $t_{PLH}$ | Response Time Low to High<br>$V_{ic} = 0V$ , $f = 10kHz$ , $C_L = 50pF$ ,<br>Overdrive = 5mV<br>Overdrive = 10mV<br>Overdrive = 20mV<br>Overdrive = 40mV<br>TTL Input |            | 1.5<br>1.1<br>0.9<br>0.7<br>0.6   |                                      | $\mu s$ |
| $t_{PHL}$ | Response Time High to Low<br>$V_{ic} = 0V$ , $f = 10kHz$ , $C_L = 50pF$ ,<br>Overdrive = 5mV<br>Overdrive = 10mV<br>Overdrive = 20mV<br>Overdrive = 40mV<br>TTL Input |            | 2.2<br>1.6<br>1.1<br>0.75<br>0.17 |                                      | $\mu s$ |
| $t_f$     | Fall time<br>$f = 10kHz$ , $C_L = 50pF$ , Overdrive 50mV                                                                                                              |            | 30                                |                                      | ns      |

1. The specified offset voltage is the maximum value required to drive the output up to 4.5V or down to 0.3V.

2. Maximum values including unavoidable inaccuracies of the industrial test.

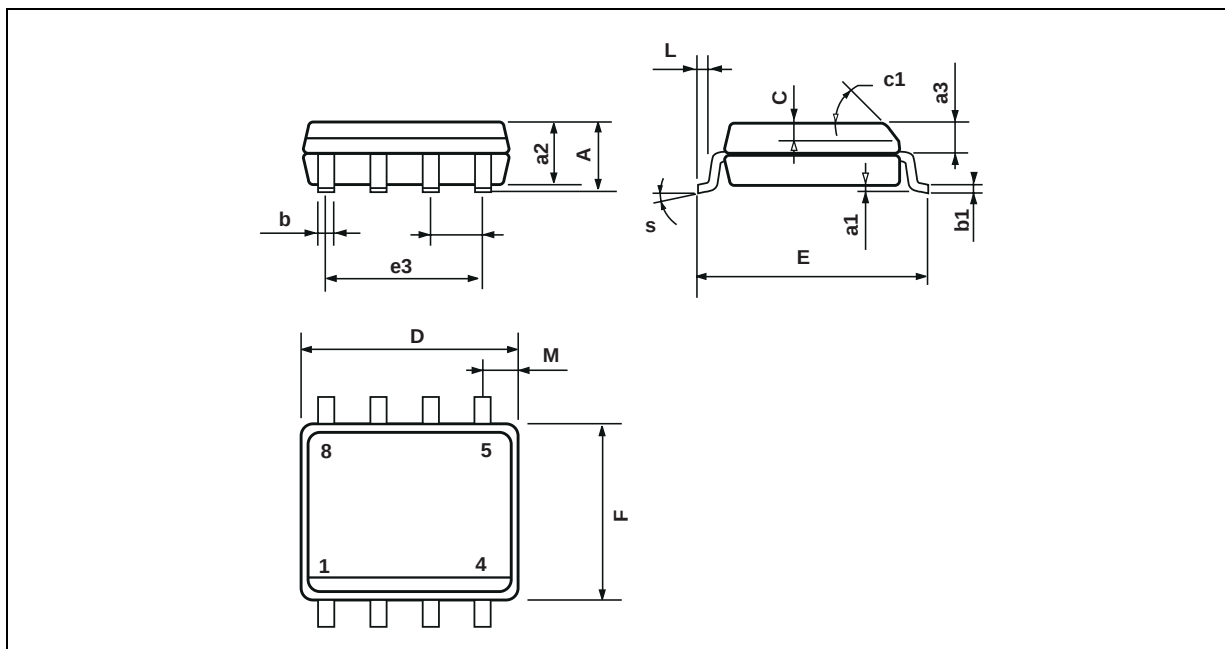
**PACKAGE MECHANICAL DATA**  
**8 PINS - PLASTIC DIP**



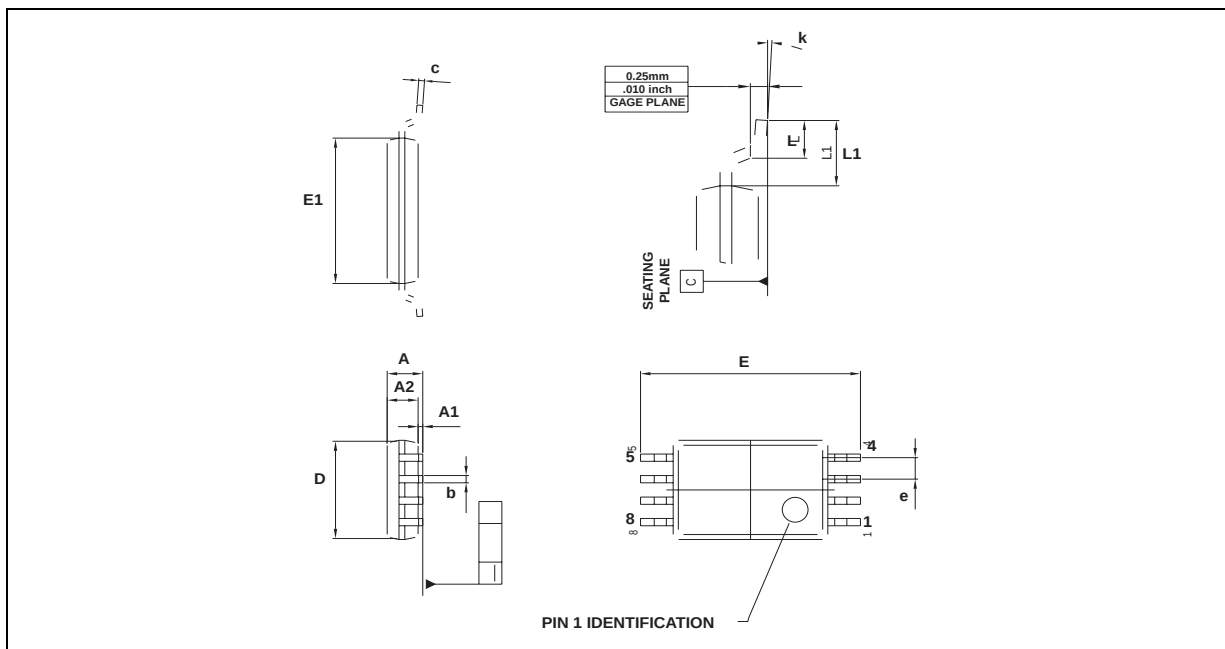
| Dimensions | Millimeters |      |       | Inches |       |       |
|------------|-------------|------|-------|--------|-------|-------|
|            | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A          |             | 3.32 |       |        | 0.131 |       |
| a1         | 0.51        |      |       | 0.020  |       |       |
| B          | 1.15        |      | 1.65  | 0.045  |       | 0.065 |
| b          | 0.356       |      | 0.55  | 0.014  |       | 0.022 |
| b1         | 0.204       |      | 0.304 | 0.008  |       | 0.012 |
| D          |             |      | 10.92 |        |       | 0.430 |
| E          | 7.95        |      | 9.75  | 0.313  |       | 0.384 |
| e          |             | 2.54 |       |        | 0.100 |       |
| e3         |             | 7.62 |       |        | 0.300 |       |
| e4         |             | 7.62 |       |        | 0.300 |       |
| F          |             |      | 6.6   |        |       | 0.260 |
| i          |             |      | 5.08  |        |       | 0.200 |
| L          | 3.18        |      | 3.81  | 0.125  |       | 0.150 |
| Z          |             |      | 1.52  |        |       | 0.060 |

**PACKAGE MECHANICAL DATA**

8 PINS - PLASTIC MICROPACKAGE (SO)



| Dimensions | Millimeters |      |      | Inches |       |       |
|------------|-------------|------|------|--------|-------|-------|
|            | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A          |             |      | 1.75 |        |       | 0.069 |
| a1         | 0.1         |      | 0.25 | 0.004  |       | 0.010 |
| a2         |             |      | 1.65 |        |       | 0.065 |
| a3         | 0.65        |      | 0.85 | 0.026  |       | 0.033 |
| b          | 0.35        |      | 0.48 | 0.014  |       | 0.019 |
| b1         | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C          | 0.25        |      | 0.5  | 0.010  |       | 0.020 |
| c1         | 45° (typ.)  |      |      |        |       |       |
| D          | 4.8         |      | 5.0  | 0.189  |       | 0.197 |
| E          | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e          |             | 1.27 |      |        | 0.050 |       |
| e3         |             | 3.81 |      |        | 0.150 |       |
| F          | 3.8         |      | 4.0  | 0.150  |       | 0.157 |
| L          | 0.4         |      | 1.27 | 0.016  |       | 0.050 |
| M          |             |      | 0.6  |        |       | 0.024 |
| S          | 8° (max.)   |      |      |        |       |       |

**PACKAGE MECHANICAL DATA****8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)**

| Dimensions | Millimeters |       |      | Inches |        |       |
|------------|-------------|-------|------|--------|--------|-------|
|            | Min.        | Typ.  | Max. | Min.   | Typ.   | Max.  |
| A          |             |       | 1.20 |        |        | 0.05  |
| A1         | 0.05        |       | 0.15 | 0.01   |        | 0.006 |
| A2         | 0.80        | 1.00  | 1.05 | 0.031  | 0.039  | 0.041 |
| b          | 0.19        |       | 0.30 | 0.007  |        | 0.15  |
| c          | 0.09        |       | 0.20 | 0.003  |        | 0.012 |
| D          | 2.90        | 3.00  | 3.10 | 0.114  | 0.118  | 0.122 |
| E          |             | 6.40  |      |        | 0.252  |       |
| E1         | 4.30        | 4.40  | 4.50 | 0.169  | 0.173  | 0.177 |
| e          |             | 0.65  |      |        | 0.025  |       |
| k          | 0°          |       | 8°   | 0°     |        | 8°    |
| l          | 0.50        | 0.60  | 0.75 | 0.09   | 0.0236 | 0.030 |
| L          | 0.45        | 0.600 | 0.75 | 0.018  | 0.024  | 0.030 |
| L1         |             | 1.000 |      |        | 0.039  |       |

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2003 STMicroelectronics - Printed in Italy - All Rights Reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia  
Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States

© <http://www.st.com>