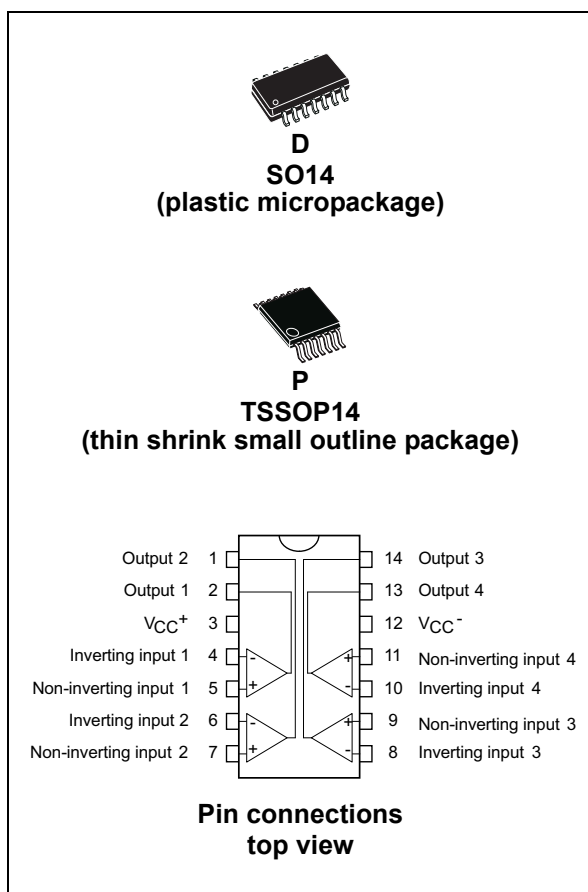


## Micropower quad CMOS voltage comparator

Datasheet - production data



### Features

- Extremely low supply current: 9  $\mu$ A typ./comparator
- Wide single supply range 2.7 V to 16 V or dual supplies ( $\pm 1.35$  V to  $\pm 8$  V)
- Extremely low input bias current: 1 pA typ.
- Extremely low input offset current: 1 pA typ.
- Input common-mode voltage range includes GND
- High input impedance:  $10^{12}$   $\Omega$  typ.
- Fast response time: 1.5  $\mu$ s typ. for 5 mV overdrive
- Pin-to-pin and functionally compatible with bipolar LM339 device

### Description

The TS339 device is a micro-power, CMOS, quad voltage comparator with extremely low consumption of 9  $\mu$ A typ./comparator (20 times less than the bipolar LM339). Similar performances are offered by the quad micro-power comparator TS3704 with a push-pull CMOS output. Thus response times remain similar to the LM339 device.

**Table 1. Device summary**

| Order code  | Temperature range | Package | Packaging             | Marking |
|-------------|-------------------|---------|-----------------------|---------|
| TS339CD/CDT | 0 °C, 70 °C       | SO14    | Tube or tape and reel | S339C   |
| TS339IDT    | -40 °C, 125 °C    |         |                       | TSSOP14 |
| TS339IPT    |                   |         |                       |         |

# Contents

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# 1 Absolute maximum ratings

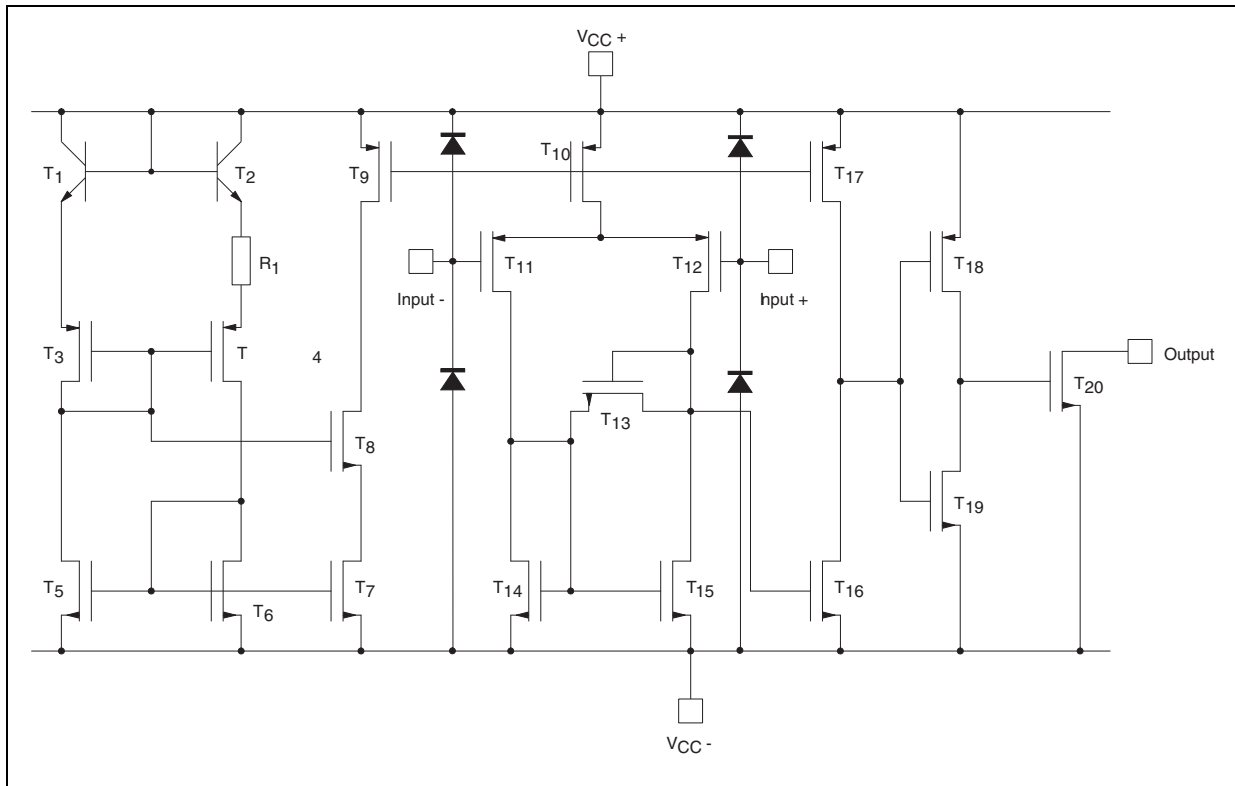
**Table 2. Key parameters and their absolute maximum ratings**

| Symbol     | Parameter   | Value       | Unit |
|------------|---|-------------|------|
| $V_{CC}^+$ | Supply voltage <sup>(1)</sup>                                     | 18          | V    |
| $V_{id}$   | Differential input voltage <sup>(2)</sup>                         | ±18         |      |
| $V_i$      | Input voltage <sup>(3)</sup>                                      | 18          |      |
| $V_o$      | Output voltage  | 18          |      |
| $I_o$      | Output current  | 20          | mA   |
| $I_F$      | Forward current in ESD protection diodes on inputs <sup>(4)</sup> | 50          |      |
| $P_d$      | Power dissipation <sup>(5)</sup>                                  |             | mW   |
|            | SO14<br>TSSOP14   | 830<br>710  |      |
| $T_{stg}$  | Storage temperature range   | -65 to +150 | °C   |
| ESD        | HBM: human body model <sup>(6)</sup>                              | 50          | V    |
|            | MM: machine model <sup>(7)</sup>                                  | 40          |      |
|            | CDM: charged device model   | 800         |      |

- All voltage values, except the differential voltage, are with respect to network ground terminal.
- Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- Excursions of input voltages may exceed the power supply level. As long as the common mode voltage [ $V_{icm}=(V_{in}^+ + V_{in}^-)/2$ ] remains within the specified range, the comparator will provide a stable output state. However, the maximum current through the ESD diodes ( $I_F$ ) of the input stage must strictly be observed.
- Guaranteed by design.
- $P_d$  is calculated with  $T_{amb} = +25\text{ °C}$ ,  $T_j = +150\text{ °C}$  and  
 $R_{thja} = 150\text{ °C/W}$  for SO14 package  
 $R_{thja} = 175\text{ °C/W}$  for TSSOP14 package.
- Human body model, 100pF discharged through a 1.5 kΩ resistor into pin of device.
- Machine model ESD, a 200 pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5 Ω), into pin to pin of device.

## 2 Typical application schematics

Figure 1. Schematic diagram (for 1/4 TS339)



### 3 Electrical characteristics

Table 3.  $V_{CC}^+ = 3\text{ V}$ ,  $V_{CC}^- = 0\text{ V}$ ,  $T_{amb} = 25\text{ °C}$  (unless otherwise specified)

| Symbol    | Parameter   | Min.   | Typ.        | Max.                                 | Unit          |
|-----------|---|--------|-------------|--------------------------------------|---------------|
| $V_{io}$  | Input offset voltage <sup>(1)</sup><br>$V_{ic} = 1.5\text{ V}$<br>$T_{min} \leq T_{amb} \leq T_{max}$ .   |        |             | 5<br>6.5                             | mV            |
| $I_{io}$  | Input offset current <sup>(2)</sup><br>$V_{ic} = 1.5\text{ V}$<br>$T_{min} \leq T_{amb} \leq T_{max}$ .   |        | 1           | 300                                  | pA            |
| $I_{ib}$  | Input bias current <sup>(2)</sup><br>$V_{ic} = 1.5\text{ V}$<br>$T_{min} \leq T_{amb} \leq T_{max}$ .   |        | 1           | 600                                  |               |
| $V_{icm}$ | 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>$V_{ic} = V_{icm\ min}$ .  |        | 70          |                                      | dB            |
| SVR       | Supply voltage rejection ratio<br>$V_{CC}^+ = 3\text{ V to }5\text{ V}$   |        | 70          |                                      |               |
| $I_{OH}$  | High level output current<br>$V_{id} = +1\text{ V}$ , $V_{OH} = 3\text{ V}$<br>$T_{min} \leq T_{amb} \leq T_{max}$ .  |        | 2           | 40<br>1000                           | nA            |
| $V_{OL}$  | Low level output voltage<br>$V_{id} = -1\text{ V}$ , $I_{OL} = +6\text{ mA}$<br>$T_{min} \leq T_{amb} \leq T_{max}$ .   |        | 400         | 550<br>800                           | 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                             | $\mu\text{A}$ |
| $t_{PLH}$ | Response time low to high<br>$V_{ic} = 0\text{ V}$ , $f = 10\text{ kHz}$ , $T_{min} \leq T_{amb} \leq T_{max}$ , $C_L = 50\text{ pF}$ , overdrive = 5 mV<br>TTL input |        | 1.5<br>0.7  |                                      | $\mu\text{s}$ |
| $t_{PHL}$ | Response time high to low<br>$V_{ic} = 0\text{ V}$ , $f = 10\text{ kHz}$ , $R_L = 5.1\text{ k}\Omega$ , $C_L = 50\text{ pF}$ , overdrive = 5 mV<br>TTL input          |        | 2.5<br>0.08 |                                      |               |

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

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

Table 4.  $V_{CC}^+ = 5\text{ V}$ ,  $V_{CC}^- = 0\text{ V}$ ,  $T_{amb} = 25\text{ }^\circ\text{C}$  (unless otherwise specified)

| Symbol    | Parameter   | Min.   | Typ.                             | Max.                                 | Unit          |
|-----------|---|--------|----------------------------------|--------------------------------------|---------------|
| $V_{io}$  | Input offset voltage <sup>(1)</sup><br>$V_{ic} = 2.5\text{ V}$ , $V_{CC}^+ = 5\text{ V to } 10\text{ V}$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$   |        | 1.4                              | 5<br>6.5                             | mV            |
| $I_{io}$  | Input offset current <sup>(2)</sup><br>$V_{ic} = 2.5\text{ V}$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$   |        | 1                                | 300                                  | pA            |
| $I_{ib}$  | Input bias current <sup>(2)</sup><br>$V_{ic} = 2.5\text{ V}$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$   |        | 1                                | 600                                  |               |
| $V_{icm}$ | 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>$V_{ic} = 0\text{ V}$  |        | 75                               |                                      | dB            |
| SVR       | Supply voltage rejection ratio<br>$V_{CC}^+ = +5\text{ V to } +10\text{ V}$   |        | 85                               |                                      |               |
| $I_{OH}$  | High level output voltage<br>$V_{id} = 1\text{ V}$ , $V_{OH} = +5\text{ V}$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$  |        | 27                               | 40<br>1000                           | nA            |
| $V_{OL}$  | Low level output voltage<br>$V_{id} = -1\text{ V}$ , $I_{OL} = 6\text{ mA}$<br>$T_{min.} \leq T_{amb} \leq T_{max.}$  |        | 260                              | 400<br>650                           | mV            |
| $I_{CC}$  | Supply current (each comparator)<br>No load - outputs low<br>$T_{min.} \leq T_{amb} \leq T_{max.}$  |        | 10                               | 20<br>25                             | $\mu\text{A}$ |
| $t_{PLH}$ | Response time low to high<br>$V_{ic} = 0\text{ V}$ , $f = 10\text{ kHz}$ , $R_L = 5.1\text{ k}\Omega$ , $C_L = 15\text{ pF}$ , overdrive = 5 mV<br>Overdrive = 10 mV<br>Overdrive = 20 mV<br>Overdrive = 40 mV<br>TTL input |        | 1.5<br>1.2<br>1.1<br>0.9<br>0.8  |                                      | $\mu\text{s}$ |
| $t_{PHL}$ | Response time high to low<br>$V_{ic} = 0\text{ V}$ , $f = 10\text{ kHz}$ , $R_L = 5.1\text{ k}\Omega$ , $C_L = 15\text{ pF}$ , overdrive = 5 mV<br>Overdrive = 10 mV<br>Overdrive = 20 mV<br>Overdrive = 40 mV<br>TTL input |        | 2.5<br>1.9<br>1.2<br>0.8<br>0.08 |                                      |               |
| $t_f$     | Fall time<br>$f = 10\text{ kHz}$ , $C_L = 50\text{ pF}$ , $R_L = 5.1\text{ k}\Omega$ , overdrive 50 mV  |        | 30                               |                                      | ns            |

1. The specified offset voltage is the maximum value required to drive the output up to 4.5 V or down to 0.3 V.
2. Maximum values including unavoidable inaccuracies of the industrial test.

## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 SO14 package information

Figure 2. SO14 package outline

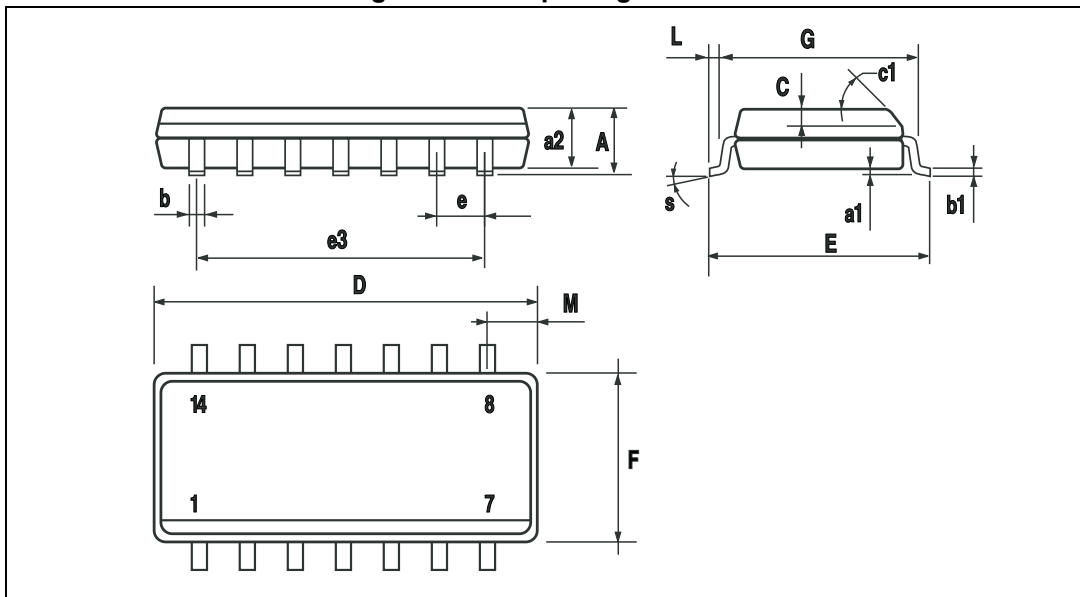


Table 5. SO14 package mechanical data

| Symbol | Dimensions |      |      |       |       |       |
|--------|------------|------|------|-------|-------|-------|
|        | mm         |      |      | inch  |       |       |
|        | Min.       | Typ. | Max. | Min.  | Typ.  | Max.  |
| A      |            |      | 1.75 |       |       | 0.068 |
| a1     | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2     |            |      | 1.65 |       |       | 0.064 |
| b      | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1     | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C      |            | 0.5  |      |       | 0.019 |       |
| c1     | 45° (typ.) |      |      |       |       |       |
| D      | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E      | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e      |            | 1.27 |      |       | 0.050 |       |
| e3     |            | 7.62 |      |       | 0.300 |       |
| F      | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G      | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L      | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M      |            |      | 0.68 |       |       | 0.026 |
| S      | 8° (max.)  |      |      |       |       |       |



## 4.2 TSSOP14 package information

Figure 3. TSSOP14 package outline

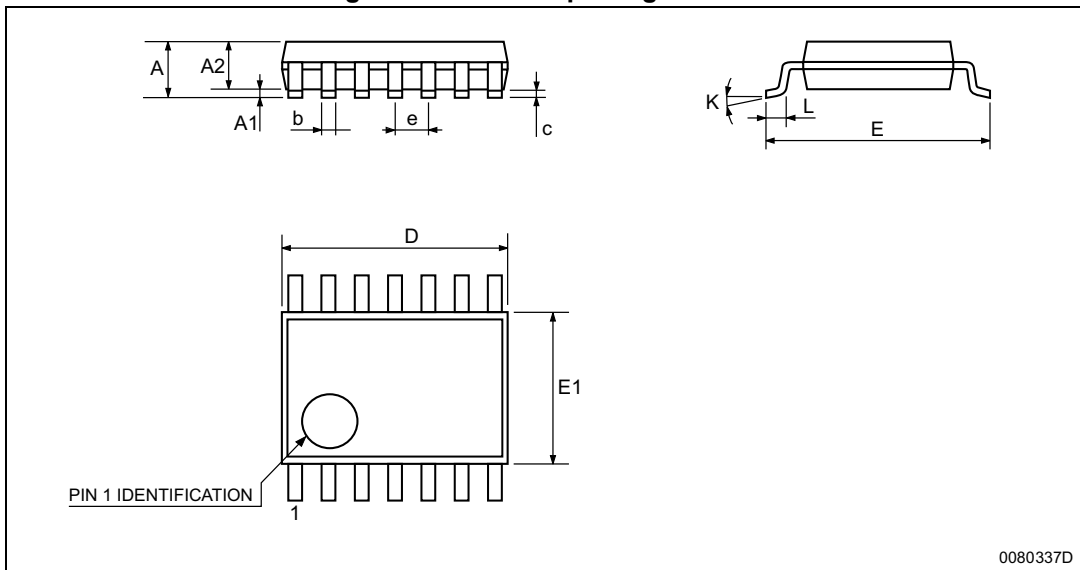


Table 6. TSSOP14 package mechanical data

| Symbol | Dimensions |          |      |       |            |        |
|--------|------------|----------|------|-------|------------|--------|
|        | mm.        |          |      | inch  |            |        |
|        | Min.       | Typ.     | Max. | Min.  | Typ.       | Max.   |
| A      |            |          | 1.2  |       |            | 0.047  |
| A1     | 0.05       |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2     | 0.8        | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b      | 0.19       |          | 0.30 | 0.007 |            | 0.012  |
| c      | 0.09       |          | 0.20 | 0.004 |            | 0.0089 |
| D      | 4.9        | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E      | 6.2        | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1     | 4.3        | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e      |            | 0.65 BSC |      |       | 0.0256 BSC |        |
| K      | 0°         |          | 8°   | 0°    |            | 8°     |
| L      | 0.45       | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |

## 5 Revision history

Table 7. Document revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| Jan. 2003   | 1        | Initial release.  |
| Aug. 2005   | 2        | 1 - PPAP references inserted in the datasheet see <a href="#">Table 1: Order codes on page 1</a> .<br>2 - ESD protection inserted in <a href="#">Table 2 Key parameters and their absolute maximum ratings on page 2</a> .                |
| 04-Sep-2012 | 3        | Updated <a href="#">Features, Table 1</a> , removed TS339IYD and TS339IYDT from <a href="#">Table 1</a> .<br>Updated ECOPACK text, reformatted <a href="#">Section 4: Package information</a> .<br>Minor corrections throughout document. |
| 21-Feb-2014 | 4        | Removed DIP package<br><a href="#">Features</a> : updated fast response time<br><a href="#">Device summary</a> : removed order codes TS339CN, TS339IN, and TS339ID; added temperature range for order codes TS339IDT and TS339IPT         |

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