

## High temperature, low-power quad voltage comparators

Datasheet – production data

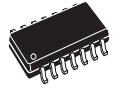
### Features

- Wide single supply voltage range or dual supplies for all devices: +2 V to +36 V or  $\pm 1$  V to  $\pm 18$  V
- Very low supply current (1.1 mA) independent of supply voltage (1.4 mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current:  $\pm 5$  nA typ.
- Input common-mode voltage range includes ground
- Low output saturation voltage: 250 mV typ. ( $I_O = 4$  mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs


### Description

This device consists of four independent precision voltage comparators. All these comparators are designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage.

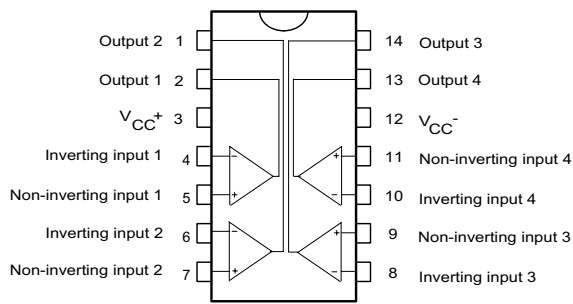


**D**  
**SO-14**  
(Plastic micropackage)



Wafer form

**Pin connections (top view)**



The diagram shows a top view of the 14-pin package with the following connections:

- Pin 1: Output 2
- Pin 2: Output 1
- Pin 3:  $V_{CC}^+$
- Pin 4: Inverting input 1
- Pin 5: Non-inverting input 1
- Pin 6: Inverting input 2
- Pin 7: Non-inverting input 2
- Pin 8: Inverting input 3
- Pin 9: Non-inverting input 3
- Pin 10: Inverting input 4
- Pin 11: Non-inverting input 4
- Pin 12:  $V_{CC}^-$
- Pin 13: Output 4
- Pin 14: Output 3

# 1 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings (AMR)**

| Symbol     | Parameter  | Value          | Unit |
|------------|--|----------------|------|
| $V_{CC}$   | Supply voltage   | $\pm 18$ or 36 | V    |
| $V_{ID}$   | Differential input voltage                                       | $\pm 36$       | V    |
| $V_{in}$   | Input voltage  | -0.3 to +36    | V    |
|            | Output short-circuit to ground <sup>(1)</sup>                    | 20             | mA   |
| $R_{thja}$ | Thermal resistance junction to ambient <sup>(2)</sup><br>(SO-14) | 105            | °C/W |
| $R_{thjc}$ | Thermal resistance junction to case <sup>(2)</sup><br>(SO-14)    | 31             | °C/W |
| $T_j$      | Maximum junction temperature                                     | 160            | °C   |
| ESD        | HBM: human body model <sup>(3)</sup>                             | 500            | V    |
|            | MM: machine model <sup>(4)</sup>                                 | 100            |      |
|            | CDM: charged device model <sup>(5)</sup>                         | 1500           |      |
| $T_{stg}$  | Storage temperature range  | -65 to +150    | °C   |

- Short-circuit from the output to  $V_{CC}^+$  can cause excessive heating and eventual destruction. The maximum output current is approximately 20 mA, independent of the magnitude of  $V_{CC}^+$
- Short-circuits can cause excessive heating and destructive dissipation. Values are typical.
- Human body model: A 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
- Machine model: A 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
- Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

**Table 2. Operating conditions**

| Symbol     | Parameter  | Value  | Unit |
|------------|--|--|------|
| $V_{CC}^+$ | Supply voltage   | 2 to 36                                      | V    |
| $T_{oper}$ | Operating free-air temperature range   | -40 to +150                                  | °C   |
| $V_{icm}$  | Input common mode voltage range ( $V_{CC} = 30 V$ ) <sup>(1)</sup><br>$T_{amb} = +25^\circ C$<br>$T_{min} \leq T_{amb} \leq T_{max}$ | 0 to $V_{CC}^+ - 1.5$<br>0 to $V_{CC}^+ - 2$ | V    |

- The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC}^+ - 1.5 V$ , but either or both inputs can go to +30 V without damage.

## 2 Circuit schematics

Figure 1. Schematic diagram (1/4 LM2901)

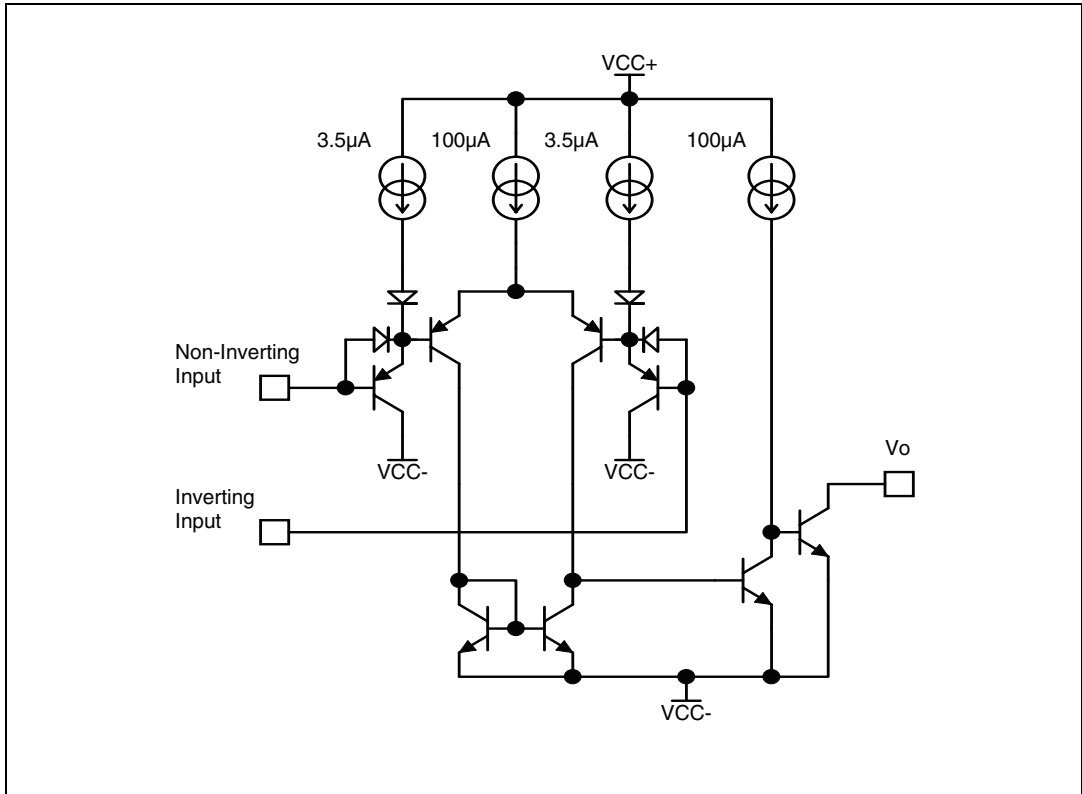
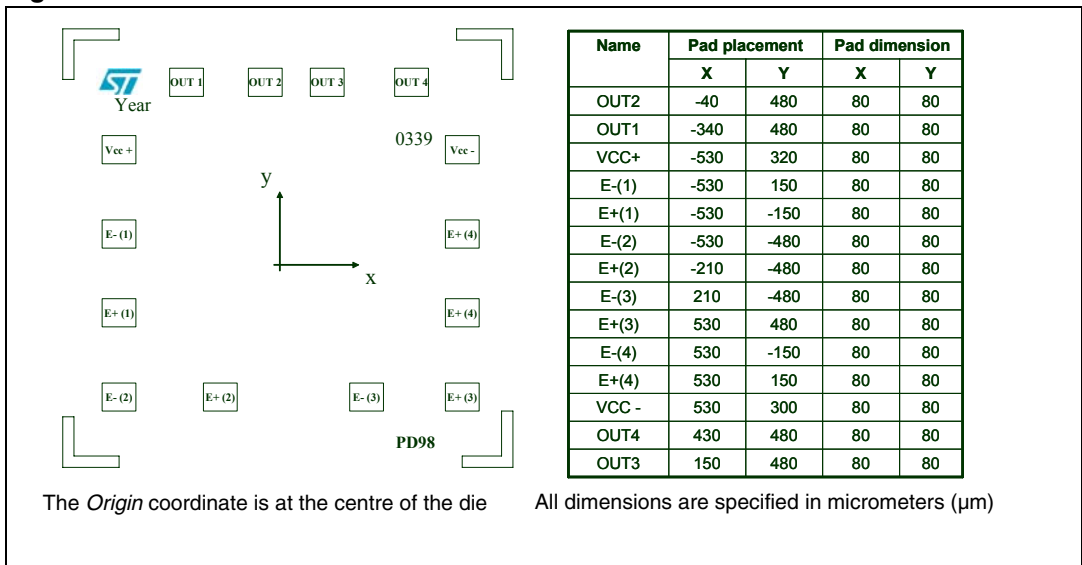


Figure 2. Pad locations



### 3 Electrical characteristics

**Table 3.**  $V_{CC}^+ = 5V$ ,  $V_{CC}^- = GND$ ,  $T_{amb} = 25^\circ C$  (unless otherwise specified)

| Symbol     | Parameter  | Min.   | Typ.       | Max.       | Unit          |
|------------|--|--------|------------|------------|---------------|
| $V_{io}$   | Input offset voltage <sup>(1)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$   |        | 1          | 7<br>15    | mV            |
| $I_{io}$   | Input offset current<br>$T_{min} \leq T_{amb} \leq T_{max}$  |        | 5          | 50<br>150  | nA            |
| $I_{ib}$   | Input bias current ( $I_{I^+}$ or $I_{I^-}$ ) <sup>(2)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$  |        | 25         | 250<br>400 | nA            |
| $A_{VD}$   | Large signal voltage gain<br>$V_{CC}=15V$ , $R=15k\Omega$ , $V_o=1$ to $11V$   | 25     | 200        |            | V/mV          |
| $I_{CC}$   | Supply current (all comparators)<br>$V_{CC} = +5V$ , no load<br>$V_{CC} = +30V$ , no load  |        | 1.1<br>1.3 | 2<br>2.5   | mA            |
| $V_{ID}$   | Differential input voltage <sup>(3)</sup>  |        |            | $V_{CC}^+$ | V             |
| $V_{OL}$   | Low level output voltage<br>$V_{id} = -1V$ , $I_{sink} = 4mA$<br>$T_{min} \leq T_{amb} \leq T_{max}$   |        | 250        | 400<br>700 | mV            |
| $I_{OH}$   | High level output current<br>$V_{CC} = V_o = 30V$ , $V_{id} = 1V$<br>$T_{min} \leq T_{amb} \leq T_{max}$   |        | 0.1        | 1          | nA<br>$\mu A$ |
| $I_{sink}$ | Output sink current<br>$V_{id} = -1V$ , $V_o = 1.5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$  | 6<br>2 | 16         |            | mA            |
| $t_{re}$   | Small signal response time <sup>(4)</sup><br>$R_L = 5.1k\Omega$ connected to $V_{CC}^+$  |        | 1.3        |            | $\mu s$       |
| $t_{rel}$  | Large signal response time <sup>(5)</sup><br>TTL input, $V_{ref} = +1.4V$ , $R_L = 5.1k\Omega$ to $V_{CC}^+$<br>– Output signal at 50% of final value<br>– Output signal at 95% of final value |        |            | 500<br>1   | ns<br>$\mu s$ |

1. At output switch point,  $V_o \approx 1.4V$ ,  $R_S = 0$  with  $V_{CC}^+$  from 5V to 30V, and over the full input common-mode range (0V to  $V_{CC}^+ - 1.5V$ ).
2. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so there is no load on the reference of input lines
3. The response time specified is for a 100 mV input step with 5 mV overdrive.
4. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than  $-0.3V$  (or 0.3V below the negative power supply, if used).
5. Maximum values are guaranteed by design.

Figure 3. Supply current vs. supply voltage

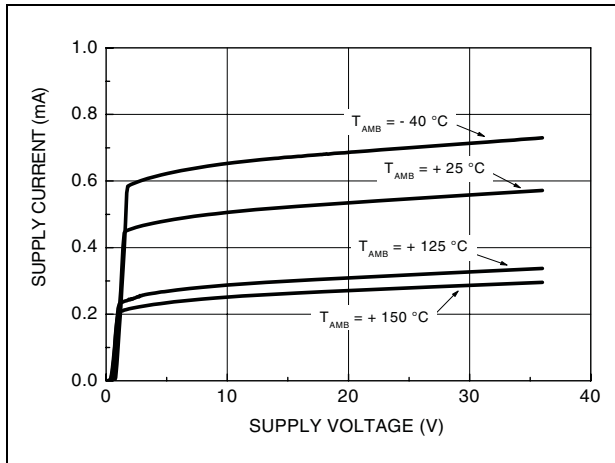


Figure 4. Input current vs. supply voltage

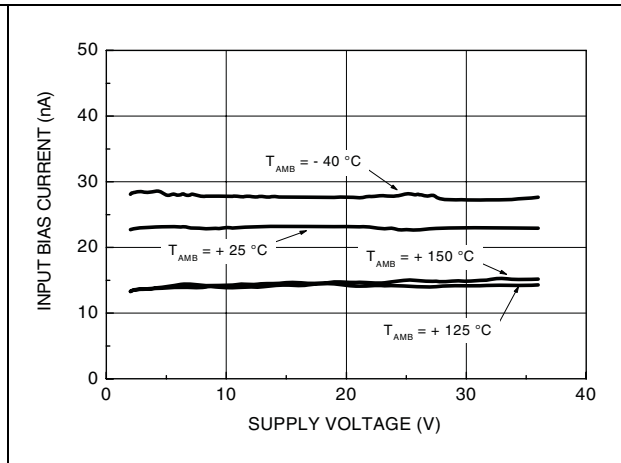


Figure 5. Output saturation voltage vs. output current ( $V_{CC} = 5\text{ V}$ )

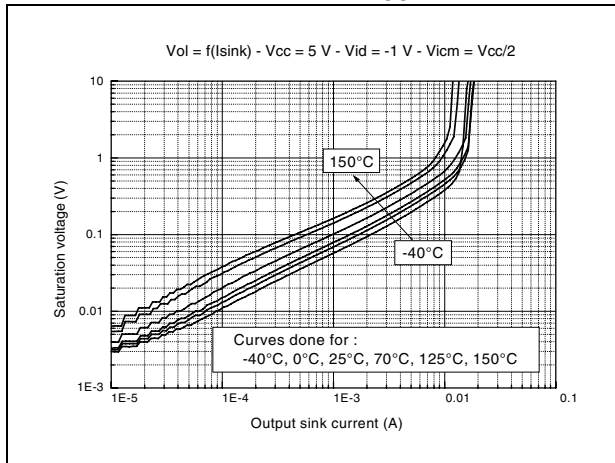


Figure 6. Output saturation voltage vs. output current ( $V_{CC} = 30\text{ V}$ )

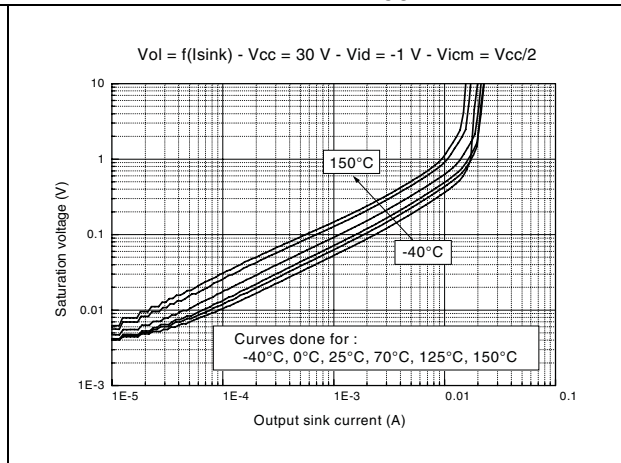


Figure 7. Response time for various input overdrives - positive transition

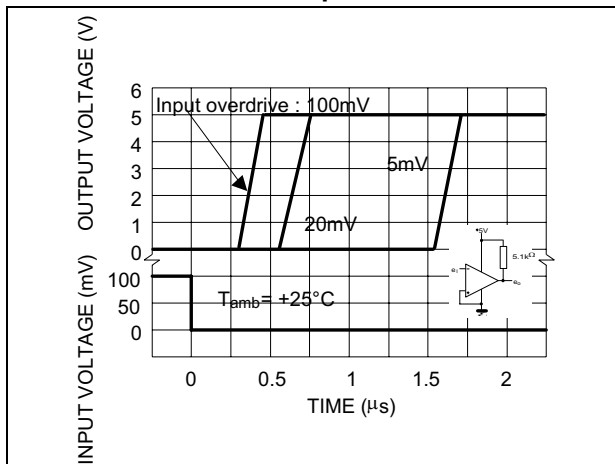
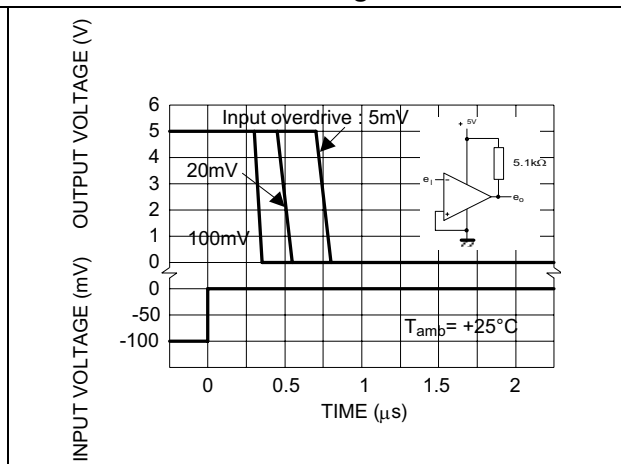


Figure 8. Response time for various input overdrives - negative transition



## 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<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 9. SO-14 package mechanical drawing

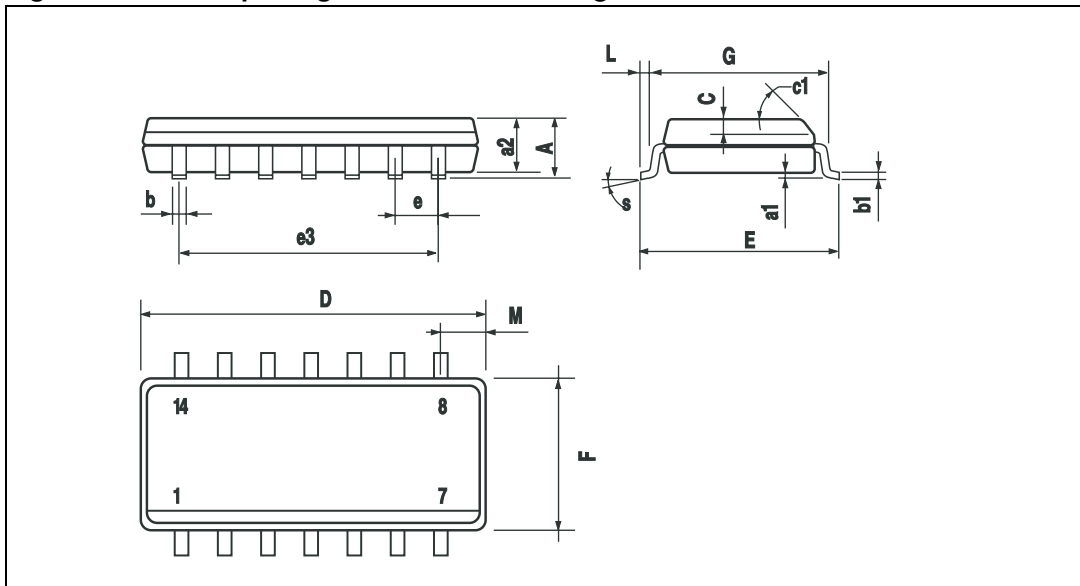


Table 4. SO-14 package mechanical data

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | 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.)   |      |      |        |       |       |

## 5 Ordering information

**Table 5. Order codes**

| Order code                | Temperature range | Package                     | Packing                | Marking |
|---------------------------|-------------------|-----------------------------|------------------------|---------|
| JLM2901H- I6D1            | -40°C, +150°C     | Wafer                       |                        |         |
| LM2901HD<br>LM2901HDT     |                   | SO-14                       | Tube or<br>Tape & reel | 2901H   |
| LM2901HYDT <sup>(1)</sup> |                   | SO-14<br>(Automotive grade) | Tape & reel            | 2901HY  |

1. Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.



## 6 Revision history

**Table 6. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 25-Sep-2003 | 1        | Initial release.   |
| 07-Jul-2005 | 2        | PPAP references inserted in the datasheet, see Order codes table.  |
| 08-Nov-2005 | 3        | Table data reformatted for easier use in <i>Electrical characteristics</i> .<br>Curves added in <i>Electrical characteristics</i> section.                                 |
| 08-Apr-2008 | 4        | Added ESD parameters in AMR table.<br>Added operating conditions table.<br>Added footnotes for automotive grade order codes in order codes table.<br>Reformatted document. |
| 12-Mar-2012 | 5        | Changed value of $T_J$ in <i>Table 1: Absolute maximum ratings (AMR)</i> .<br>Removed LM2901HYD order code from <i>Table 5</i> .   |

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