



## QUAD PRECISION MICROPPOWER CMOS VOLTAGE COMPARATOR WITH DRIVER

### GENERAL DESCRIPTION

The ALD4303A/ALD4303 is a precision monolithic high performance quad voltage comparator with open drain output built with advanced silicon gate CMOS technology. It features very high typical input impedance of  $10^{12}\Omega$ ; low input bias current of 10pA; very low power dissipation of 7.5μA per comparator; micropower operation; high output drive and single (+5V) or dual (±5V) power supply operation.

The input voltage range includes ground, making this comparator ideal for single supply low level signal detection with high source impedance. The ALD4303A/ALD4303 can be used in connection with other voltage comparator circuits such as the ALD2301, ALD2302, and ALD4302 voltage comparators. The outputs can be connected to a higher external voltage than V<sup>+</sup> and used in a wired-OR connection with other open drain circuits such as the ALD2301 and ALD2303. They can also be used with push-pull output types such as the ALD2302 and ALD4302 voltage comparators simultaneously with open drain comparators using a common V<sup>+</sup>. The ALD4303A/ALD4303 is ideal for a great variety of voltage comparator applications, especially micropower detection circuits requiring very low input currents, high output currents and low standby power.

### FEATURES

- 3V, 5V and 10V supply
- Guaranteed to drive 200Ω loads
- Fanout of 30LS TTL loads
- Guaranteed maximum supply current of 22μA per comparator
- Industry standard pinout of LM393 type
- Extremely low input bias currents -- typically 10pA
- Virtually eliminates source impedance effects
- Single (+5V) and dual supply (±5V) operation
- CMOS, NMOS and TTL compatible
- Open drain wired-OR outputs
- Compatible with push-pull outputs
- High output sinking current -- typically 60mA
- Low supply current spikes
- High gain -- 100V/mV

### ORDERING INFORMATION ("L" suffix for lead free version)

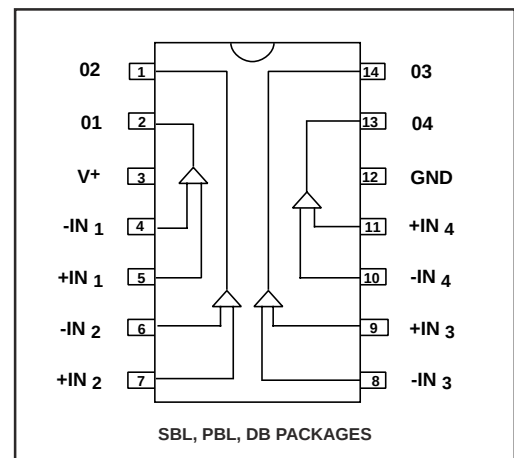
| Operating Temperature Range *             |                                  |                             |
|-------------------------------------------|----------------------------------|-----------------------------|
| 0°C to +70°C                              | 0°C to +70°C                     | -55°C to +125°C             |
| 14-Pin<br>Small Outline<br>Package (SOIC) | 14-Pin<br>Plastic Dip<br>Package | 14-Pin<br>CERDIP<br>Package |
| ALD4303ASBL<br>ALD4303SBL                 | ALD4303APBL<br>ALD4303PBL        | ALD4303ADB<br>ALD4303DB     |

\* Contact factory for leaded (non-RoHS) or high temperature versions.

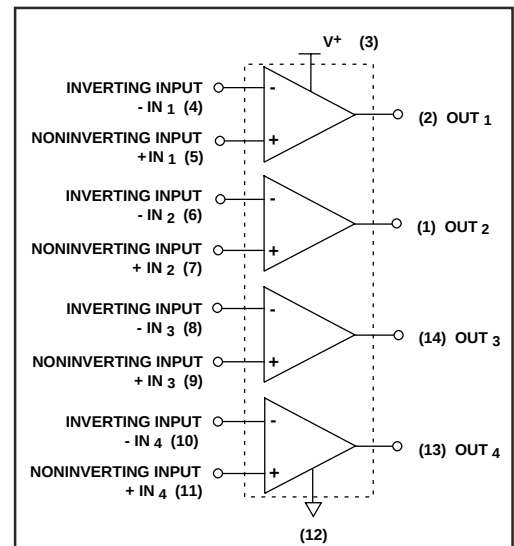
### APPLICATIONS

- Sensor detection circuits
- PCMCIA instruments
- MOSFET driver
- High source impedance voltage comparison circuits
- Multiple limit window comparator
- Power supply voltage monitor
- Photodetector sensor circuit
- High speed LED driver
- Oscillators
- Battery operated instruments
- Remote signal detection
- Multiple relay drivers

### PIN CONFIGURATION



### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Supply voltage,  $V^+$  \_\_\_\_\_ 10.6V  
Differential input voltage range \_\_\_\_\_ -0.3V to  $V^+ + 0.3V$   
Power dissipation \_\_\_\_\_ 600 mW  
Operating temperature range SBL, PBL packages \_\_\_\_\_ 0°C to +70°C  
DB package \_\_\_\_\_ -55°C to +125°C  
Storage temperature range \_\_\_\_\_ -65°C to +150°C  
Lead temperature, 10 seconds \_\_\_\_\_ +260°C

## OPERATING ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$   $V^+ = +5V$  unless otherwise specified

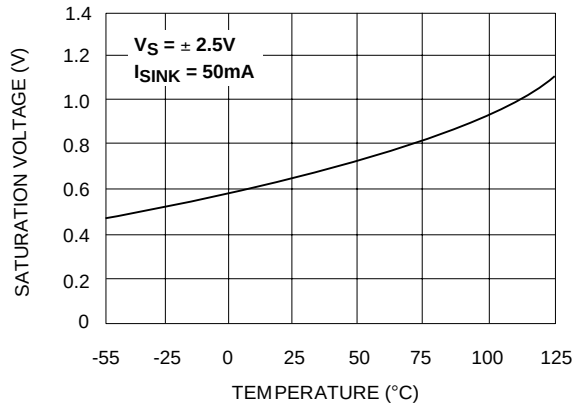
| Parameter                                    | Symbol         | 4303A          |      |               | 4303           |      |               | Unit          | Test Conditions                                                            |
|----------------------------------------------|----------------|----------------|------|---------------|----------------|------|---------------|---------------|----------------------------------------------------------------------------|
|                                              |                | Min            | Typ  | Max           | Min            | Typ  | Max           |               |                                                                            |
| Supply Voltage                               | $V_S$<br>$V^+$ | $\pm 1.5$<br>3 |      | $\pm 5$<br>10 | $\pm 1.5$<br>3 |      | $\pm 5$<br>10 | V<br>V        | Dual Supply<br>Single Supply                                               |
| Supply Current                               | $I_S$          |                | 50   | 90            |                | 50   | 90            | $\mu\text{A}$ | $R_{LOAD} = \infty$<br>4 comparators                                       |
| Voltage Gain                                 | $A_{VD}$       | 10             | 100  |               | 10             | 100  |               | V/mV          | $R_{LOAD} \geq 15K\Omega$                                                  |
| Input Offset Voltage                         | $V_{OS}$       |                | 2    | 5.0<br>7.0    |                | 4    | 10.0<br>12.0  | mV            | $R_{LOAD} = 1.5K\Omega$<br>0°C $\leq T_A \leq 70^\circ\text{C}$            |
| Input Offset Current <sup>1</sup>            | $I_{OS}$       |                | 0.1  | 30<br>800     |                | 0.1  | 30<br>800     | pA            | 0°C $\leq T_A \leq 70^\circ\text{C}$                                       |
| Input Bias Current <sup>1</sup>              | $I_B$          |                | 0.1  | 30<br>1000    |                | 0.1  | 30<br>1000    | pA            | 0°C $\leq T_A \leq 70^\circ\text{C}$                                       |
| Common Mode Input Voltage Range <sup>2</sup> | $V_{ICR}$      | -0.3           |      | $V^+ - 1.5$   | -0.3           |      | $V^+ - 1.5$   | V             |                                                                            |
| Low Level Output Voltage                     | $V_{OL}$       |                | 0.18 | 0.4           |                | 0.18 | 0.4           | V             | $I_{SINK} = 12\text{mA}$<br>$V_{INPUT} = 1V$<br>Differential               |
| Low Level Output Current                     | $I_{OL}$       | 24             | 60   |               | 24             | 60   |               | mA            | $V_{OL} = 1.0V$                                                            |
| High Level Leakage Current                   | $I_{LH}$       |                | 0.1  | 20            |                | 0.1  | 20            | nA            | $V_{OH} = 5.0V$                                                            |
| Response Time <sup>2</sup>                   | $t_{RP}$       |                | 6.5  |               |                | 6.5  |               | $\mu\text{s}$ | $R_L = 50K\Omega$<br>$C_L = 15\text{pF}$<br>10mV Input Step/10mV Overdrive |
|                                              |                |                | 5    |               |                | 5    |               | $\mu\text{s}$ | $R_L = 50K\Omega$<br>$C_L = 15\text{pF}$<br>TTL- Level Input Step          |

Notes: <sup>1</sup> Consists of junction leakage currents

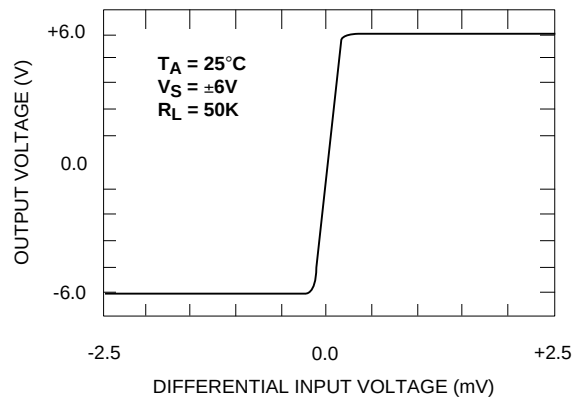
<sup>2</sup> Sample tested parameters

## TYPICAL PERFORMANCE CHARACTERISTICS

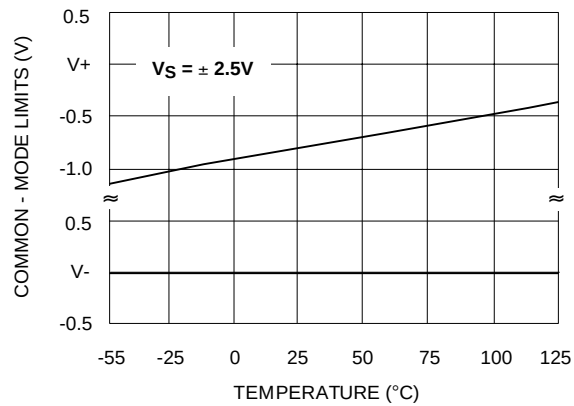
**SATURATION VOLTAGE  
vs. TEMPERATURE**



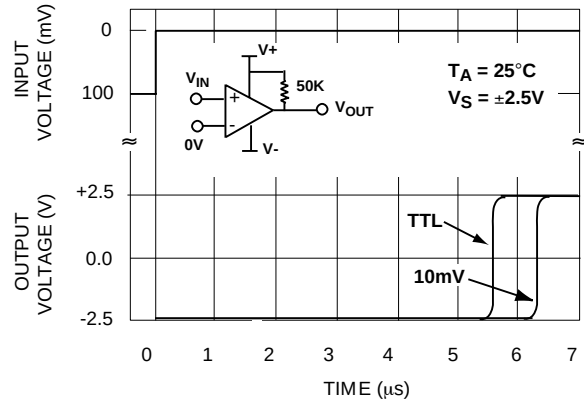
**TRANSFER FUNCTION**



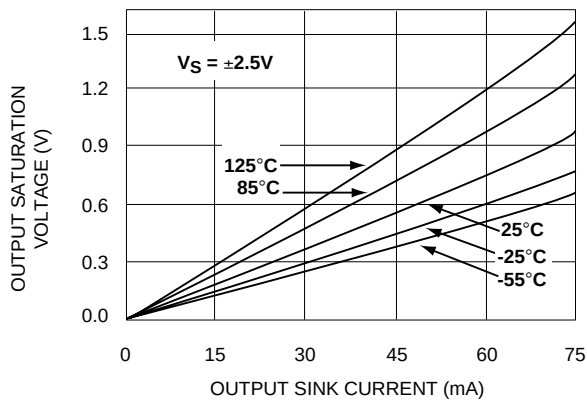
**COMMON - MODE VOLTAGE REFERRED  
TO SUPPLY VOLTAGE**



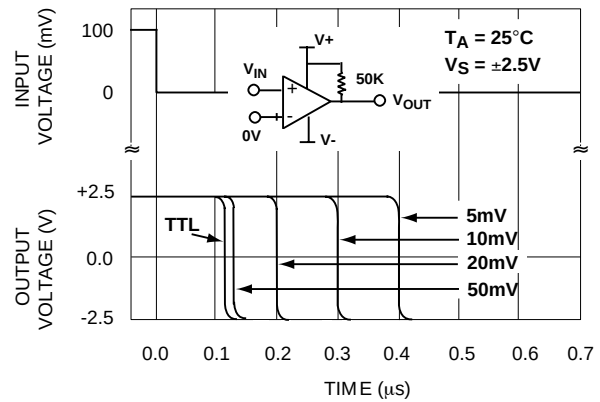
**RESPONSE TIME FOR VARIOUS  
INPUT OVERDRIVES**



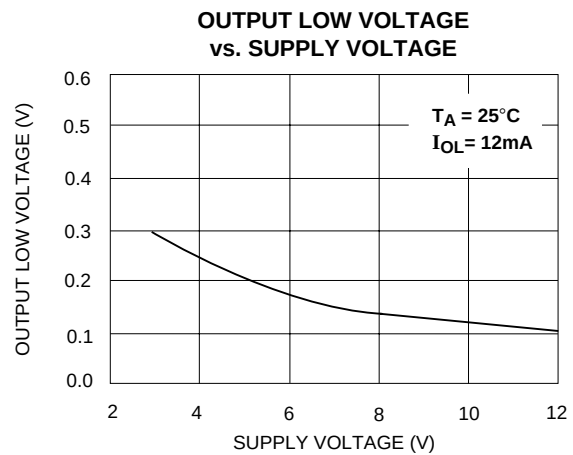
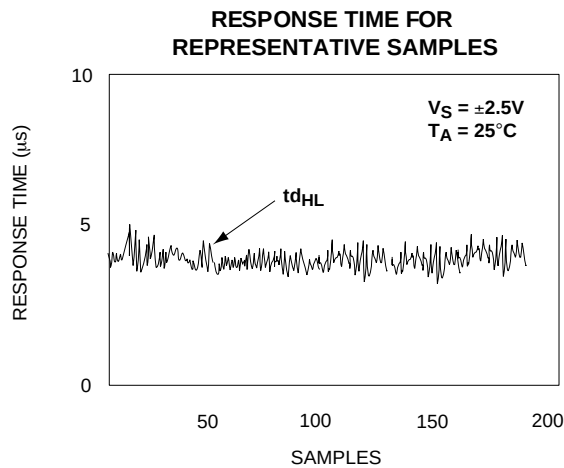
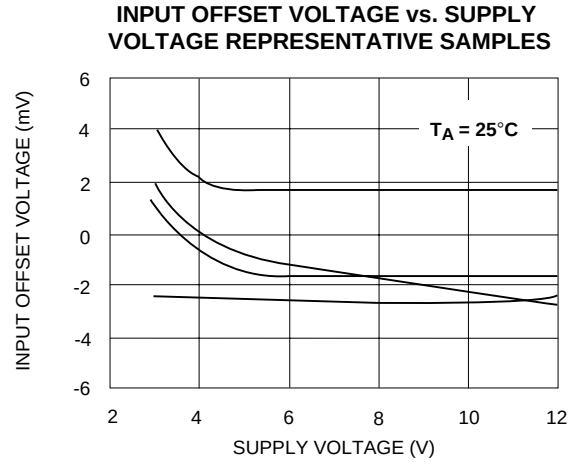
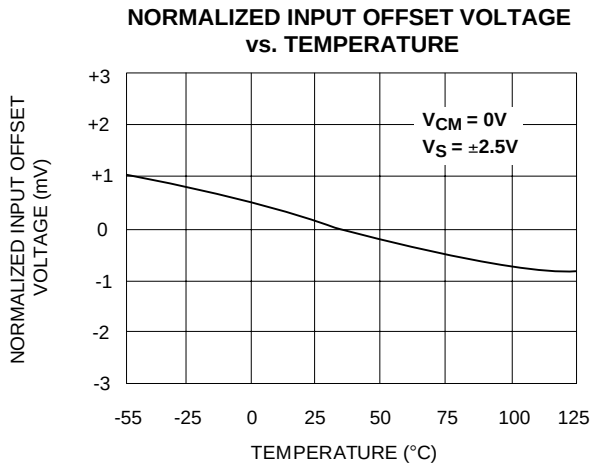
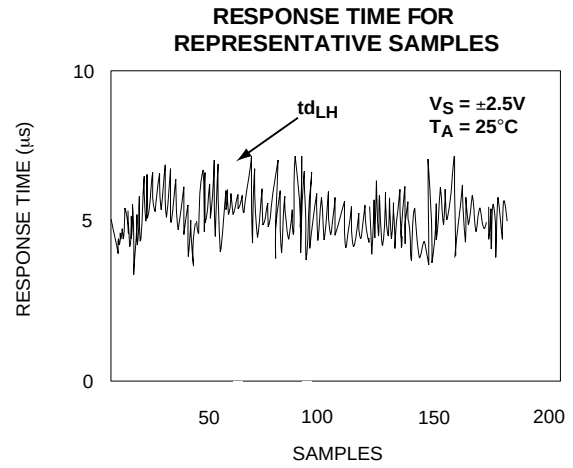
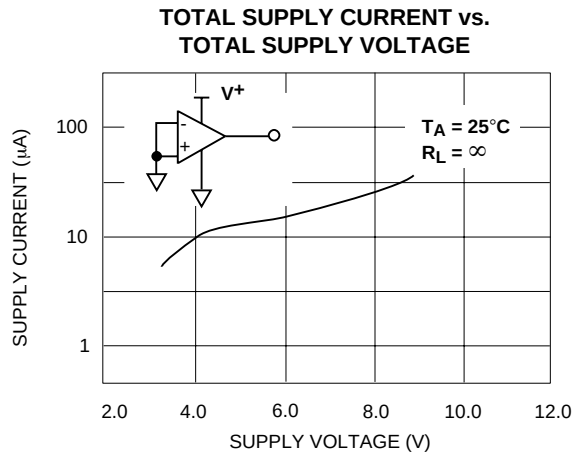
**SATURATION VOLTAGE vs.  
SINK CURRENT**



**RESPONSE TIME FOR VARIOUS  
INPUT OVERDRIVES**

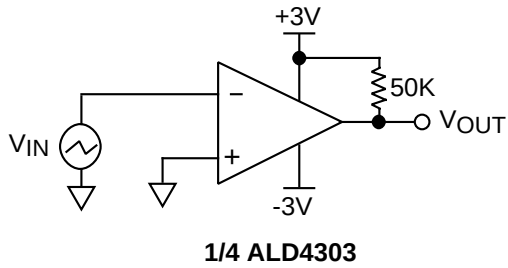


## TYPICAL PERFORMANCE CHARACTERISTICS (cont'd)

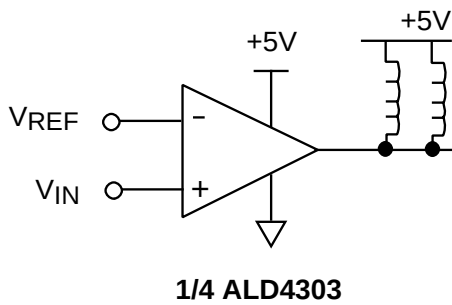


## TYPICAL APPLICATIONS

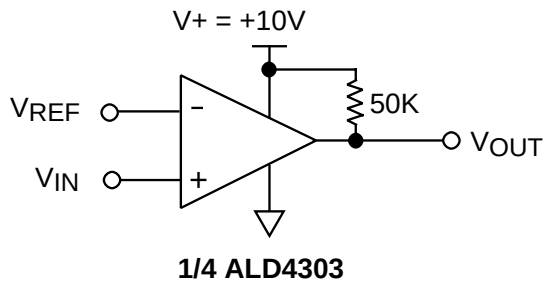
ZERO CROSSING DETECTOR



MULTIPLE RELAY DRIVE



VOLTAGE LEVEL TRANSLATOR

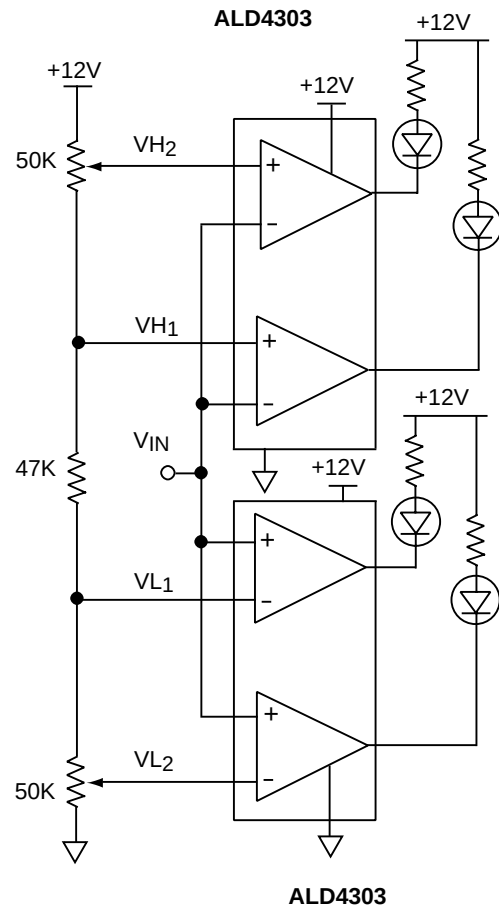


$V_{REF} = 1.4V$  for TTL input

$V_{REF} = \frac{V^+}{2}$  for CMOS input

Output  $V_{OUT}$  swings from rail-to-rail

DOUBLE QUAD LIMIT WINDOW COMPARATOR



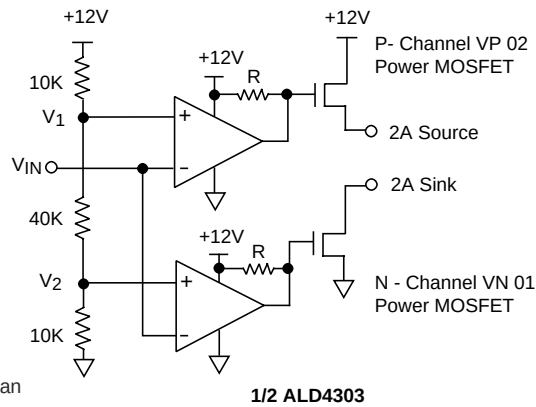
VL<sub>1</sub> and VH<sub>1</sub> first limit window send warning.  
VL<sub>2</sub> and VH<sub>2</sub> second limit window execute system cutoff.

## TYPICAL APPLICATIONS (cont'd)

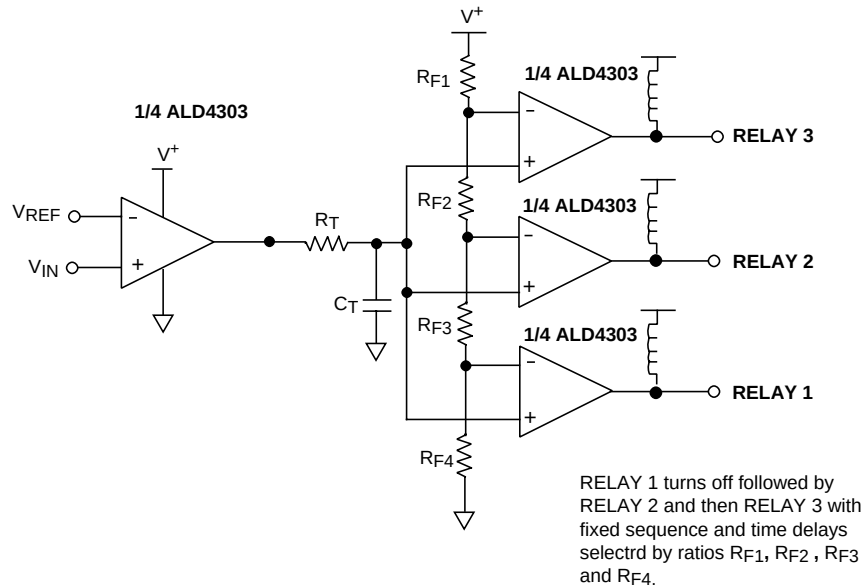
### PUSH-PULL COMPLEMENTARY POWER MOSFET DRIVER

$R \geq 50 \text{ K}\Omega$

This circuit eliminates crossover current in the complementary power transistors. The outputs can be used to source and sink different loads or tied together to provide push-pull drive of the same load.



### TIME DELAY GENERATOR

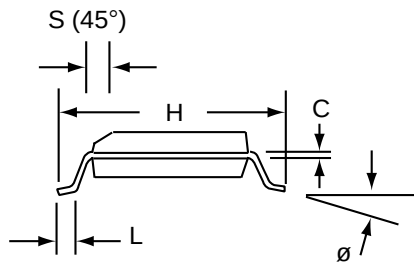
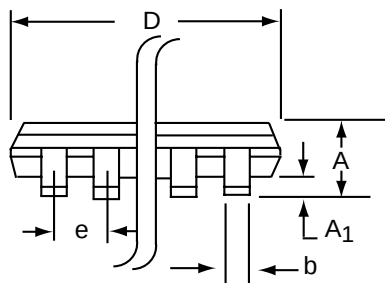
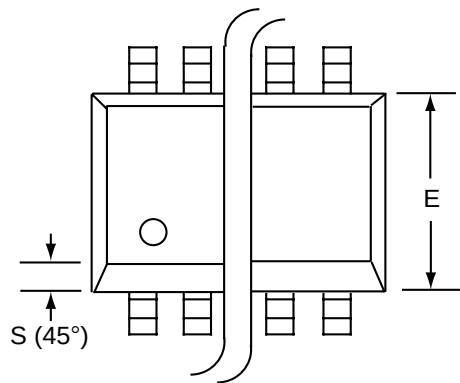


#### Design & Operating Notes:

1. In order to minimize stray oscillation, all unused inputs must be tied to ground.
2. The input bias and offset currents are essentially input protection diode reverse bias leakage currents, and are typically less than 1pA at room temperature. These currents are a function of ambient temperature, and would have to be considered in applications where very high source impedance or high accuracy are involved.
3. The high output sinking current of 60mA for each output offers flexibility in many applications, as a separate buffer or driver would not be necessary to drive the intended load. However, as the circuit normally operates close to ambient temperature due to its very low power consumption, thermal effects caused by large output current transients must be considered in certain applications.

# SOIC-14 PACKAGE DRAWING

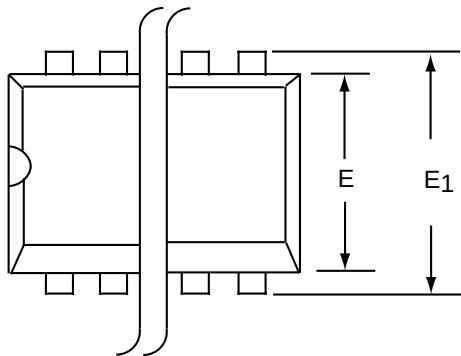
14 Pin Plastic SOIC Package



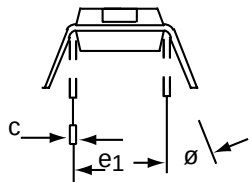
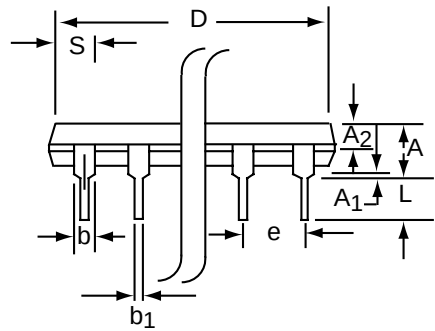
| Dim            | Millimeters |       | Inches    |       |
|----------------|-------------|-------|-----------|-------|
|                | Min         | Max   | Min       | Max   |
| A              | 1.35        | 1.75  | 0.053     | 0.069 |
| A <sub>1</sub> | 0.10        | 0.25  | 0.004     | 0.010 |
| b              | 0.35        | 0.45  | 0.014     | 0.018 |
| C              | 0.18        | 0.25  | 0.007     | 0.010 |
| D-14           | 8.55        | 8.75  | 0.336     | 0.345 |
| E              | 3.50        | 4.05  | 0.140     | 0.160 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| H              | 5.70        | 6.30  | 0.224     | 0.248 |
| L              | 0.60        | 0.937 | 0.024     | 0.037 |
| Ø              | 0°          | 8°    | 0°        | 8°    |
| S              | 0.25        | 0.50  | 0.010     | 0.020 |

PDIP-14 PACKAGE DRAWING

14 Pin Plastic DIP Package



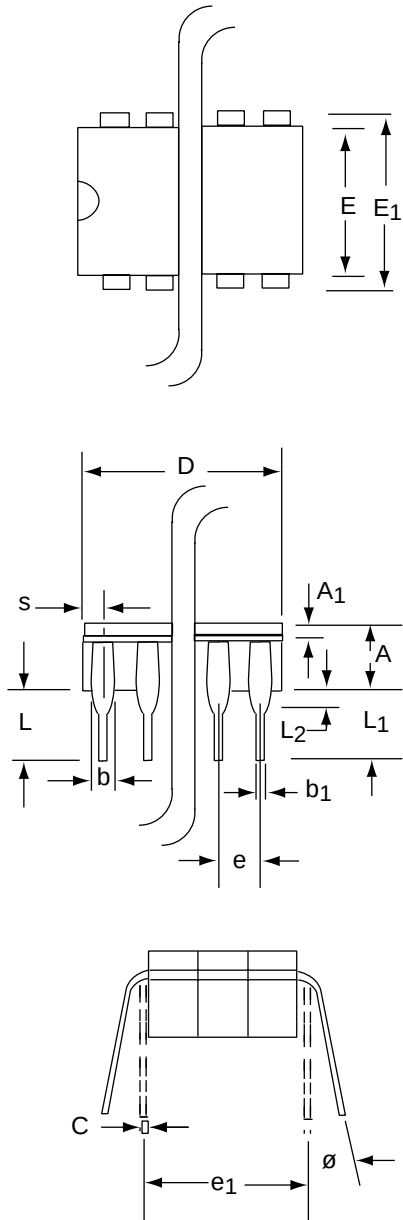
| Dim            | Millimeters |       | Inches |       |
|----------------|-------------|-------|--------|-------|
|                | Min         | Max   | Min    | Max   |
| A              | 3.81        | 5.08  | 0.105  | 0.200 |
| A <sub>1</sub> | 0.38        | 1.27  | 0.015  | 0.050 |
| A <sub>2</sub> | 1.27        | 2.03  | 0.050  | 0.080 |
| b              | 0.89        | 1.65  | 0.035  | 0.065 |
| b <sub>1</sub> | 0.38        | 0.51  | 0.015  | 0.020 |
| c              | 0.20        | 0.30  | 0.008  | 0.012 |
| D-14           | 17.27       | 19.30 | 0.680  | 0.760 |
| E              | 5.59        | 7.11  | 0.220  | 0.280 |
| E <sub>1</sub> | 7.62        | 8.26  | 0.300  | 0.325 |
| e              | 2.29        | 2.79  | 0.090  | 0.110 |
| e <sub>1</sub> | 7.37        | 7.87  | 0.290  | 0.310 |
| L              | 2.79        | 3.81  | 0.110  | 0.150 |
| S-14           | 1.02        | 2.03  | 0.040  | 0.080 |
| ø              | 0°          | 15°   | 0°     | 15°   |





# CERDIP-14 PACKAGE DRAWING

## 14 Pin CERDIP Package



| Dim                  | Millimeters |       | Inches    |       |
|----------------------|-------------|-------|-----------|-------|
|                      | Min         | Max   | Min       | Max   |
| <b>A</b>             | 3.55        | 5.08  | 0.140     | 0.200 |
| <b>A<sub>1</sub></b> | 1.27        | 2.16  | 0.050     | 0.085 |
| <b>b</b>             | 0.97        | 1.65  | 0.038     | 0.065 |
| <b>b<sub>1</sub></b> | 0.36        | 0.58  | 0.014     | 0.023 |
| <b>C</b>             | 0.20        | 0.38  | 0.008     | 0.015 |
| <b>D-14</b>          | --          | 19.94 | --        | 0.785 |
| <b>E</b>             | 5.59        | 7.87  | 0.220     | 0.310 |
| <b>E<sub>1</sub></b> | 7.73        | 8.26  | 0.290     | 0.325 |
| <b>e</b>             | 2.54 BSC    |       | 0.100 BSC |       |
| <b>e<sub>1</sub></b> | 7.62 BSC    |       | 0.300 BSC |       |
| <b>L</b>             | 3.81        | 5.08  | 0.150     | 0.200 |
| <b>L<sub>1</sub></b> | 3.18        | --    | 0.125     | --    |
| <b>L<sub>2</sub></b> | 0.38        | 1.78  | 0.015     | 0.070 |
| <b>S</b>             | --          | 2.49  | --        | 0.098 |
| <b>∅</b>             | 0°          | 15°   | 0°        | 15°   |