



**QUAD PRECISION CMOS VOLTAGE COMPARATOR WITH OPEN DRAIN DRIVER**

**GENERAL DESCRIPTION**

The ALD4301A/ALD4301 is a monolithic high performance quad voltage comparator built with advanced silicon gate CMOS technology. It features very high typical input impedance of  $10^{12}\Omega$ ; low input bias current of 10pA; fast response time of 300ns; very low power dissipation of 55µA per comparator; high output drive and single (+5V) or dual ( $\pm 5V$ ) power supply operation.

The input voltage range includes ground, making this comparator ideal for low level signal detection with high source impedance. The outputs are open-drain configuration, allowing maximum application flexibility. The outputs can be connected to a higher external voltage than V+ 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+. The ALD4301A/ALD4301 is ideal for a great variety of voltage comparator applications, especially detection circuits requiring very low input currents and low standby power, yet retaining high output current capability.

**FEATURES**

- Fanout of 30LS TTL loads
- Low supply current of 55µA/comparator typical
- Pinout/Functional equivalent to LM393 types
- Extremely low input bias currents -- typically 10pA
- Virtually eliminates source impedance effects
- Low operating supply voltage of 3V to 10V
- Single (+5V) and dual supply ( $\pm 5V$ ) operation
- High speed for both large signal and low level signals -- 300ns typical for TTL inputs
- CMOS, NMOS and TTL compatible
- Wired-OR open drain outputs
- High output sinking current -- typically 60mA
- Low supply current spikes
- High gain

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

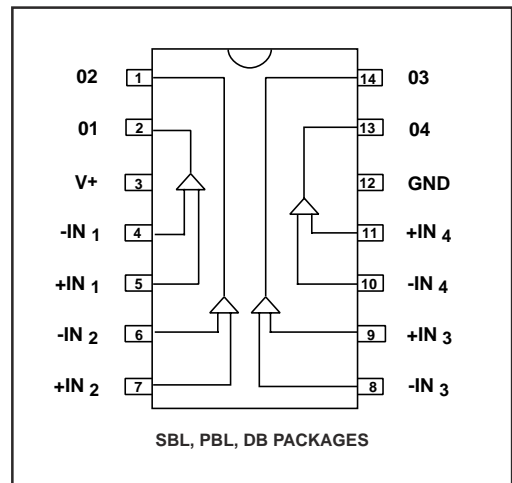
| Operating Temperature Range *             |                                  |                             |
|---|----------------------------------|-----------------------------|
| 0°C to +70°C                              | 0°C to +70°C                     | -55°C to +125°C             |
| 14-Pin<br>Small Outline<br>Package (SOIC) | 14-Pin<br>Plastic Dip<br>Package | 14-Pin<br>CERDIP<br>Package |
| ALD4301ASBL<br>ALD4301SBL                 | ALD4301APBL<br>ALD4301PBL        | ALD4301ADB<br>ALD4301DB     |

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

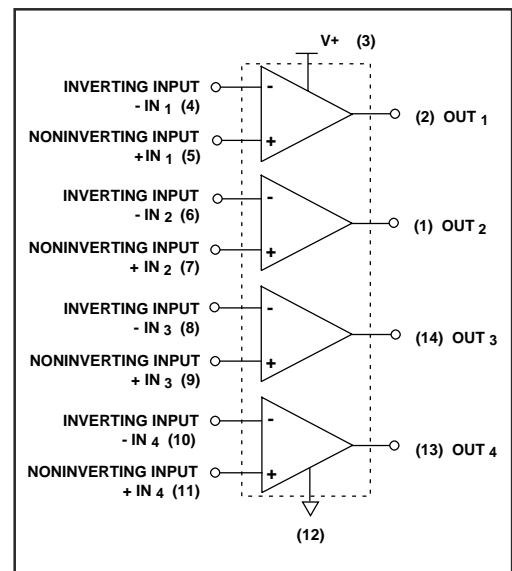
**APPLICATIONS**

- High source impedance voltage comparison circuits
- Dual/Quad limit window comparator
- Power supply voltage monitor
- Photo-detector sensor circuit
- Relay or LED driver
- Oscillators
- Battery operated instruments
- Remote signal detection

**PIN CONFIGURATION**



**BLOCK DIAGRAM**



## ABSOLUTE MAXIMUM RATINGS

Supply voltage, V<sub>+</sub> \_\_\_\_\_ 10.6V  
 Differential input voltage range \_\_\_\_\_ -0.3V to V<sub>+</sub> +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

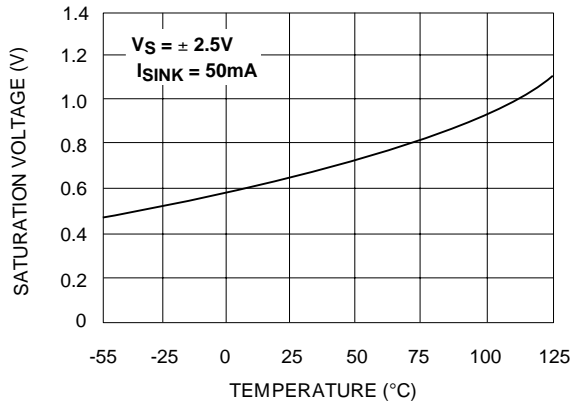
## OPERATING ELECTRICAL CHARACTERISTICS T<sub>A</sub> = 25°C V<sub>+</sub> = +5V unless otherwise specified

| Parameter                                    | Symbol                           | 4301A     |      |                     | 4301      |      |                     | Unit   | Test Conditions   |
|--|----------------------------------|-----------|------|---------------------|-----------|------|---------------------|--------|---|
|  |                                  | Min       | Typ  | Max                 | Min       | Typ  | Max                 |        |   |
| Supply Voltage                               | V <sub>S</sub><br>V <sub>+</sub> | ±1.5<br>3 |      | ±5<br>10            | ±1.5<br>3 |      | ±5<br>10            | V<br>V | Dual Supply<br>Single Supply  |
| Supply Current                               | I <sub>S</sub>                   |           | 220  | 350                 |           | 220  | 350                 | μA     | No load   |
| Voltage Gain                                 | A <sub>VD</sub>                  | 50        | 150  |                     | 50        | 150  |                     | V/mV   | R <sub>LOAD</sub> ≥ 15KΩ  |
| Input Offset Voltage                         | V <sub>OS</sub>                  |           |      | 5                   |           |      | 10                  | mV     | R <sub>LOAD</sub> ≥ 1.5KΩ   |
| Input Offset Current <sup>1</sup>            | I <sub>OS</sub>                  |           | 0.1  | 30                  |           | 0.1  | 30                  | pA     |   |
| Input Bias Current <sup>1</sup>              | I <sub>B</sub>                   |           | 0.1  | 30                  |           | 0.1  | 30                  | pA     |   |
| Common Mode Input Voltage Range <sup>2</sup> | V <sub>ICR</sub>                 | -0.3      |      | V <sub>+</sub> -1.5 | -0.3      |      | V <sub>+</sub> -1.5 | V      |   |
| Low Level Output Voltage                     | V <sub>OL</sub>                  |           | 0.15 | 0.4                 |           | 0.15 | 0.4                 | V      | I <sub>SINK</sub> = 12mA<br>V <sub>INPUT</sub> = 1V<br>Differential               |
| Low Level Output Current                     | I <sub>OL</sub>                  | 24        | 60   |                     | 24        | 60   |                     | mA     | V <sub>OL</sub> = 1.0V  |
| High Level Leakage Current                   | I <sub>LH</sub>                  |           | 0.1  | 20                  |           | 0.1  | 20                  | nA     | V <sub>OH</sub> = 5.0 V   |
| Response Time <sup>2</sup>                   | t <sub>RP</sub>                  |           | 650  |                     |           | 650  |                     | ns     | R <sub>L</sub> = 5.1KΩ<br>C <sub>L</sub> = 15pF<br>100mV Input Step/5mV Overdrive |
|  |                                  |           | 300  |                     |           | 300  |                     | ns     | R <sub>L</sub> = 5.1KΩ<br>C <sub>L</sub> = 15pF<br>TTL- Level Input Step          |

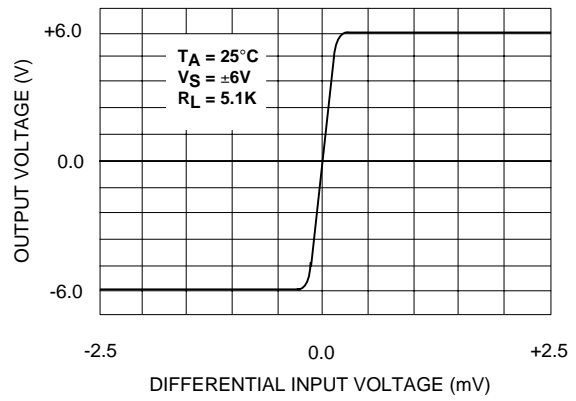
Notes: <sup>1</sup> Consists of junction leakage currents  
<sup>2</sup> Sample tested parameters

# TYPICAL PERFORMANCE CHARACTERISTICS

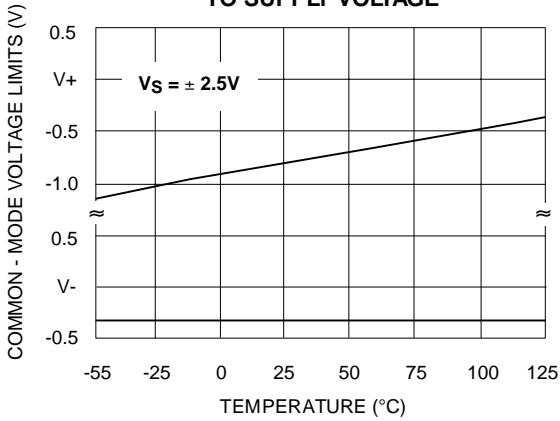
### SATURATION VOLTAGE vs. TEMPERATURE



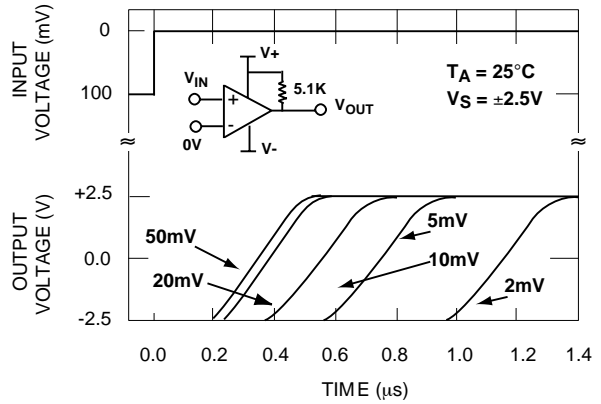
### TRANSFER FUNCTION



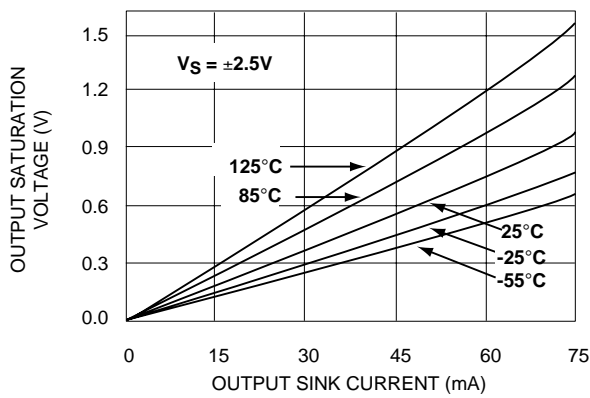
### COMMON - MODE VOLTAGE REFERRED TO SUPPLY VOLTAGE



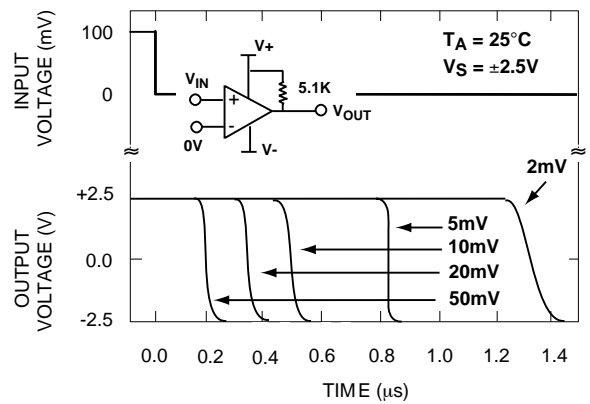
### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



### SATURATION VOLTAGE vs. SINK CURRENT

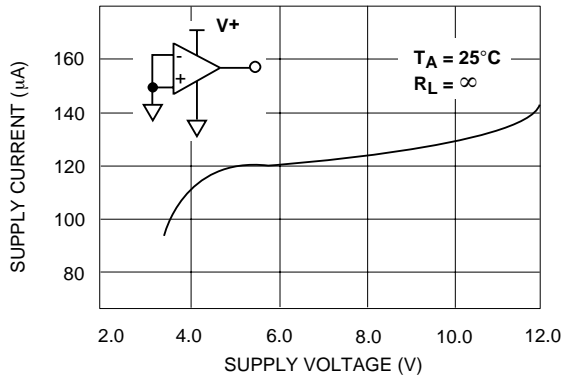


### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES

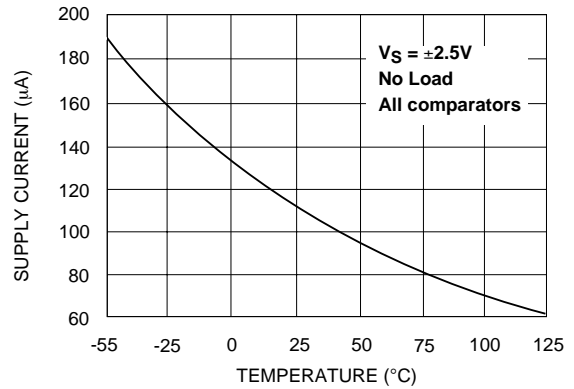


## TYPICAL PERFORMANCE CHARACTERISTICS (cont'd)

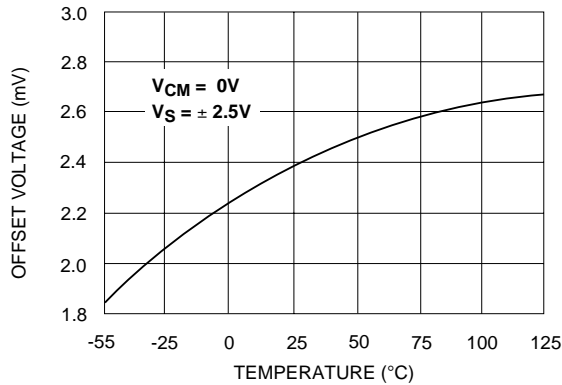
**TOTAL SUPPLY CURRENT vs. TOTAL SUPPLY VOLTAGE**



**SUPPLY CURRENT vs. TEMPERATURE**

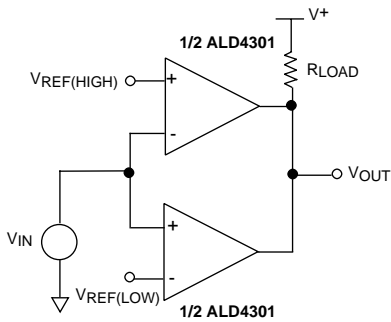


**INPUT OFFSET VOLTAGE vs. TEMPERATURE**



## TYPICAL APPLICATIONS

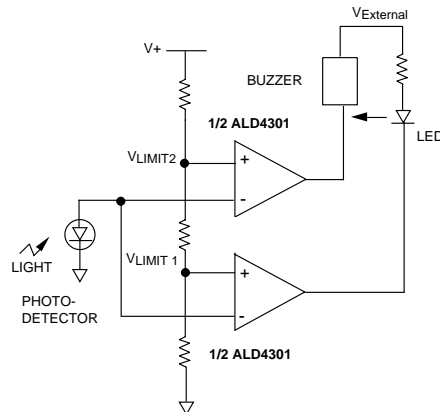
**QUAD LIMIT WINDOW COMPARATOR**



MINIMUM  $R_{LOAD} = 1.5\text{k}\Omega$

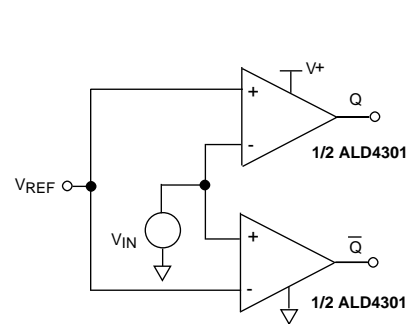
OUTPUT HIGH FOR  $V_{IN} < V_{REF(HIGH)}$   
AND  $V_{IN} > V_{REF(LOW)}$

**QUAD LIMIT PHOTO-DETECTOR MONITOR**



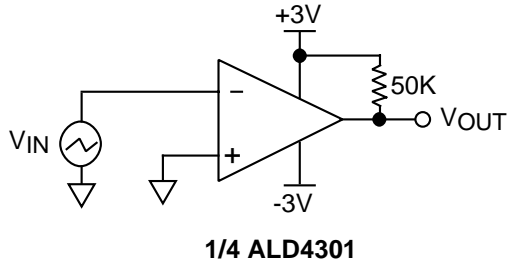
LED turns on as photo-detector voltage reaches  $V_{LIMIT1}$ . Both LED and horn turns on as photo-detector voltage reaches  $V_{LIMIT2}$ .  
 $V_{EXTERNAL} = +12\text{V}$   $V_+ = +5\text{V}$ .

**VOLTAGE COMPARATOR WITH COMPLEMENTARY OUTPUTS**

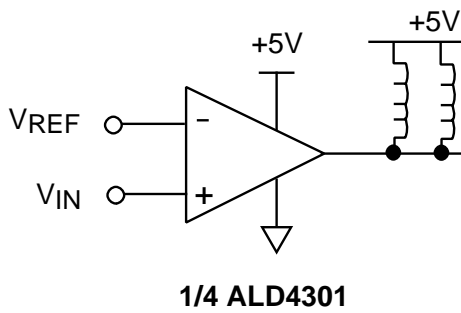


## TYPICAL APPLICATIONS (cont'd)

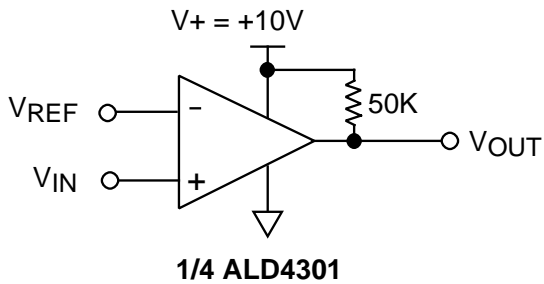
ZERO CROSSING DETECTOR



MULTIPLE RELAY DRIVE



VOLTAGE LEVEL TRANSLATOR

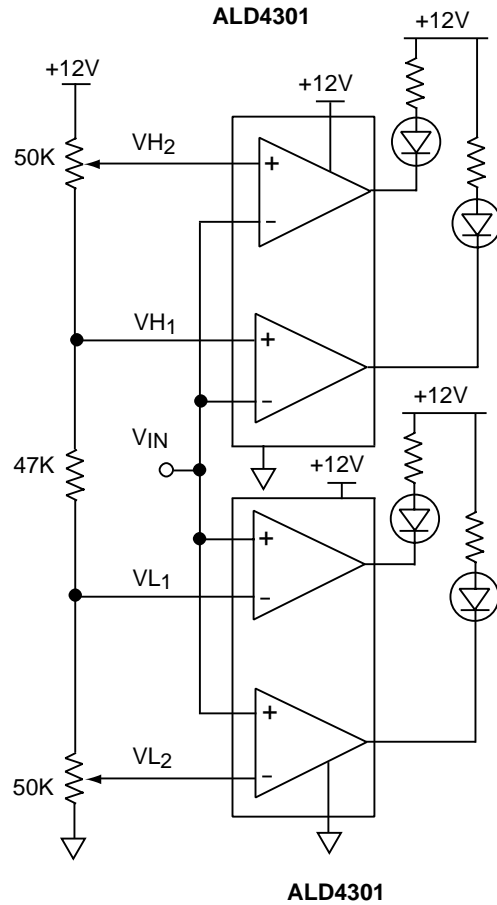


$V_{REF} = 1.4V$  for TTL input

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

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

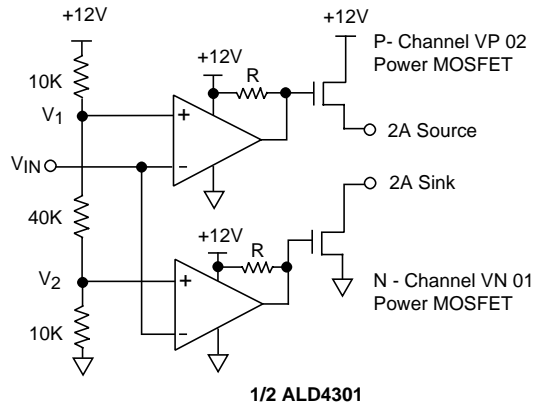
DOUBLE DUAL LIMIT WINDOW COMPARATOR



$V_{L1}$  and  $V_{H1}$  first limit window send warning.  
 $V_{L2}$  and  $V_{H2}$  second limit window execute system cutoff.

## TYPICAL APPLICATIONS (cont'd)

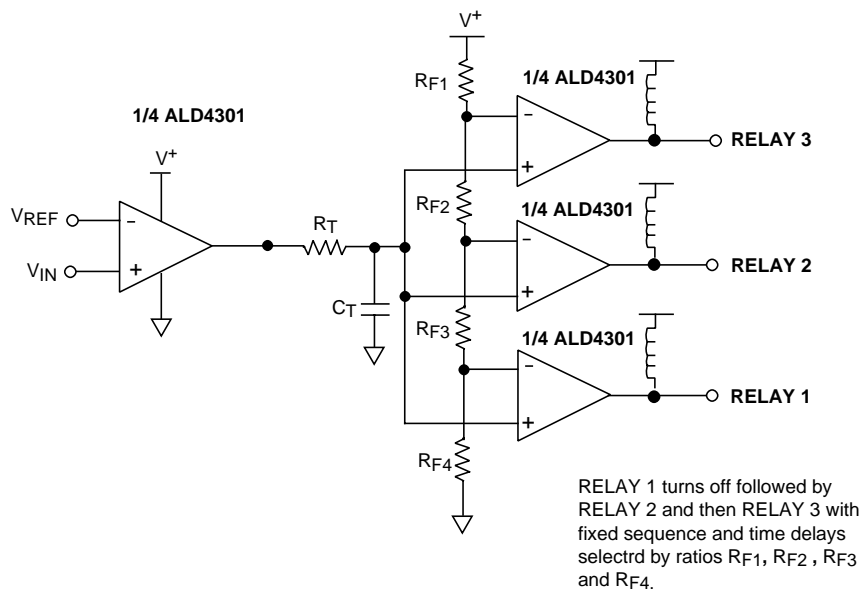
### PUSH-PULL COMPLEMENTARY POWER MOSFET DRIVER



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

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

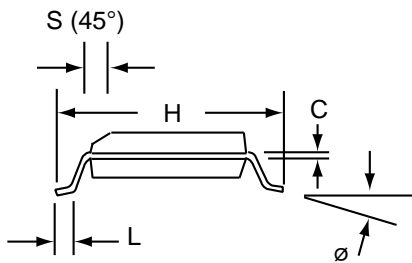
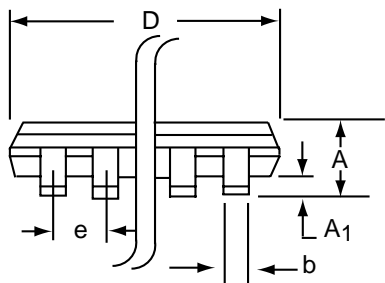
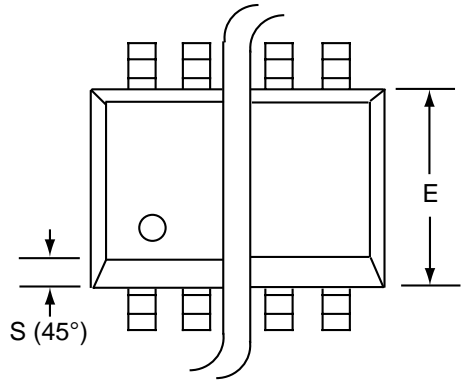


#### Design & Operating Notes:

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

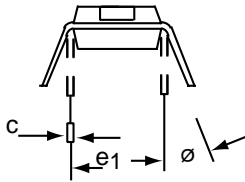
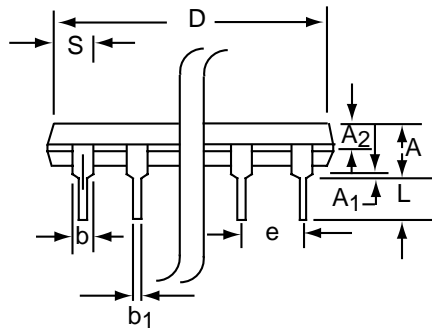
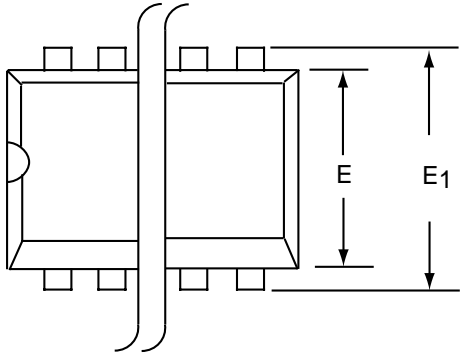
## 14 Pin Plastic SOIC Package



| 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

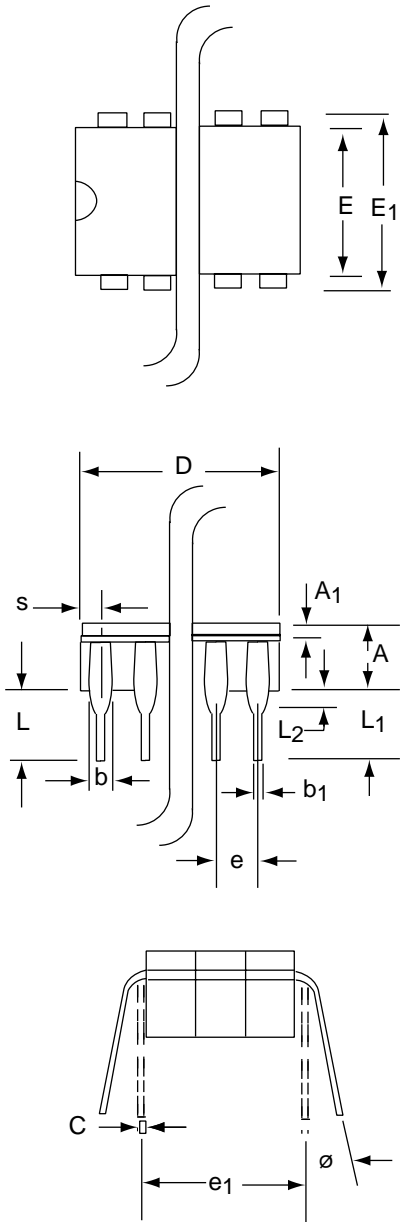


| Dim            | Millimeters |       | Inches |       |
|----------------|-------------|-------|--------|-------|
|                | Min         | Max   | Min    | Max   |
| A              | 3.81        | 5.08  | 0.105  | 0.200 |
| A <sub>1</sub> | 0.38        | 1.27  | 0.015  | 0.050 |
| A <sub>2</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 |
| ∅              | 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°   |