GENERAL DESCRIPTION

The ALD2331A/ALD2331B/ALD2331 is a monolithic high performance dual precision voltage comparator built with advanced silicon gate EPAD® CMOS technology intended for high precision analog applications. The ALD2331A/ALD2331B/ALD2331 offers ultra-low input offset voltages and currents at its input pre-amplifier, precision voltage comparator and high-current output driver integrated on-chip, in one industry standard pinout 8 Lead PDIP or SOIC package. Primary features include: very high typical input impedance of $10^{12} \Omega$; low input bias current of $10pA$; fast response time of 750ns with only 10mV input step signal; very low power dissipation of $55\mu A$ per comparator; and single (+5V) or dual (±5V) power supply operation; and 50mA open drain output drivers.

The input voltage range includes ground, making this comparator ideal for low level signal detection with high source impedance. The outputs are open-drain configurations, allowing maximum application flexibility, such as wired-OR connection and various different output loads. An external pull-up resistor is required for each output, although the value of the pull-up resistor can vary over a wide range in order to suit the application needs. The outputs can be connected to a higher external voltage than $V^+$. The ALD2331A/ALD2331B/ALD2331 is ideal for a great variety of precision analog voltage comparator applications, especially low level signal detection circuits requiring low standby power, yet retaining high output current capability as needed.

FEATURES

- Fanout of 30LS TTL loads
- Guaranteed to drive 200Ω loads
- Low supply current of $55\mu A$ typical
- Pinout of LM193 industry standard voltage comparators
- 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 (±5V) operation
- High speed for both large and small level signals -- 300ns typical for TTL inputs
- CMOS, NMOS and TTL compatible
- Wired-OR open drain outputs
- High output sink current -- typically 50mA
- Low supply current spike

APPLICATIONS

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

BENEFITS

- Simple precision reference voltage setting
- On-chip input pre-amplifier and output buffers
- Precision voltage comparison without pre-amplifier
- Eliminates need for second power supply
- Wide range of pull-up resistor values

PIN CONFIGURATION

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

<table>
<thead>
<tr>
<th></th>
<th>8-Pin Small</th>
<th>8-Pin Plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outline Package (SOIC)</td>
<td>Dip Package</td>
</tr>
<tr>
<td>ALD2331ASAL</td>
<td>ALD2331APAL</td>
<td></td>
</tr>
<tr>
<td>ALD2331BSAL</td>
<td>ALD2331BPAL</td>
<td></td>
</tr>
<tr>
<td>ALD2331SAL</td>
<td>ALD2331PAL</td>
<td></td>
</tr>
</tbody>
</table>

* Contact factory for ledged (non-RoHS) or high temperature versions.
ABSOLUTE MAXIMUM RATINGS
Supply voltage, \( V^+ \)                     \(+10.6\) V
Differential input voltage range          \(-0.3\) V to \( V^+ + 0.3\) V
Power dissipation                         600 mW
Operating temperature range SAL, PAL packages \( 0°C \) to \(+70°C \)
Storage temperature range                 \(-65°C \) to \(+150°C \)
Lead temperature, 10 seconds              \(+260°C \)

OPERATING ELECTRICAL CHARACTERISTICS
\( TA = 25°C \) \( V^+ = +5V \) unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>2331A</th>
<th>2331B</th>
<th>2331</th>
<th>Unit</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>( V_S )</td>
<td>( V^+ )</td>
<td>( \pm 1.5 )</td>
<td>( 3 )</td>
<td>( \pm 5 )</td>
<td>( 10 )</td>
</tr>
<tr>
<td>Supply Current</td>
<td>( I_S )</td>
<td>110</td>
<td>180</td>
<td>110</td>
<td>180</td>
<td>110</td>
</tr>
<tr>
<td>Voltage Gain ( A_VD )</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>Input Offset Voltage ( V_{OS} )</td>
<td>0.2</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Input Offset Current ( I_{OS} )</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
</tr>
<tr>
<td>Input Bias Current ( I_B )</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
</tr>
<tr>
<td>Common Mode Input Voltage Range ( V_{ICR} )</td>
<td>-0.3</td>
<td>( V^+ - 1.5 )</td>
<td>-0.3</td>
<td>( V^+ - 1.5 )</td>
<td>-0.3</td>
<td>( V^+ - 1.5 )</td>
</tr>
<tr>
<td>Low Level Sink Output Voltage ( V_{OL} )</td>
<td>0.15</td>
<td>0.4</td>
<td>0.15</td>
<td>0.4</td>
<td>0.15</td>
<td>0.4</td>
</tr>
<tr>
<td>Low Level Sink Output Current ( I_{OL} )</td>
<td>24</td>
<td>50</td>
<td>24</td>
<td>50</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td>High Level Sink Output Leakage Current ( I_L )</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
</tr>
<tr>
<td>Response Time ( t_{RP} )</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>( \mu s )</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
<td>( \mu s )</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>600</td>
<td>600</td>
<td>ns</td>
<td>( R_L = 5.1K\Omega , C_L = 15pF ) ( 5mV\ Input\ Step/ 5mV\ Overdrive )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>ns</td>
<td>( R_L = 5.1K\Omega , C_L = 15pF ) ( 100mV\ Input\ Step/ 5mV\ Overdrive )</td>
<td></td>
</tr>
<tr>
<td>Common Mode Rejection Ratio ( CMRR )</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>dB</td>
<td>( V_{INPUT} = 0V ) to ( 2.5V )</td>
<td></td>
</tr>
<tr>
<td>Power Supply Rejection Ratio ( PSRR )</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>dB</td>
<td>( V^+ = 4V ) to ( 5V )</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1 Consists of junction leakage currents
2 Sample test parameter
TYPICAL PERFORMANCE CHARACTERISTICS

TRANSFER FUNCTION

COMMON - MODE VOLTAGE REFERRED TO SUPPLY VOLTAGE

SUPPLY CURRENT vs. TEMPERATURE

SUPPLY CURRENT vs. SUPPLY VOLTAGE

INPUT BIAS CURRENT vs. TEMPERATURE

LOW LEVEL OUTPUT VOLTAGE vs. TEMPERATURE
TYPICAL PERFORMANCE CHARACTERISTICS (cont’d)

**INPUT OFFSET VOLTAGE vs. TEMPERATURE**

![Graph showing input offset voltage vs. temperature for devices ALD2331A, ALD2331B, ALD2331.](image)

**COMMON MODE REJECTION RATIO vs. TEMPERATURE**

![Graph showing common mode rejection ratio vs. temperature for devices ALD2331A, ALD2331B, ALD2331.](image)

**SATURATION VOLTAGE vs. SINK CURRENT**

![Graph showing saturation voltage vs. sink current for devices ALD2331A, ALD2331B, ALD2331.](image)

**OUTPUT OFF-STATE VOLTAGE vs. OUTPUT LEAKAGE CURRENT**

![Graph showing output off-state voltage vs. output leakage current for devices ALD2331A, ALD2331B, ALD2331.](image)

**POWER SUPPLY REJECTION RATIO vs. TEMPERATURE**

![Graph showing power supply rejection ratio vs. temperature for devices ALD2331A, ALD2331B, ALD2331.](image)

**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES**

![Graph showing response time for various input overdrives for devices ALD2331A, ALD2331B, ALD2331.](image)
TYPICAL PERFORMANCE CHARACTERISTICS (cont'd)

RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES

- | OUTPUT VOLTAGE (V) |
- | 0.0 | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 |
---|---|---|---|---|---|---|---|---|---|---|---|
0.0 | 1mV |
20mV |
5mV |
50mV |
10mV |
2mV |

VOUT = +5V, TA = 25°C

OUTPUT LOW VOLTAGE vs. SUPPLY VOLTAGE

- | OUTPUT LOW VOLTAGE (V) |
- | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
---|---|---|---|---|---|---|---|
2 | 4 | 6 | 8 | 10 | 12 |

TA = 25°C
IOL = 12mA

TYPICAL APPLICATIONS

PRECISION SINGLE SUPPLY VOLTAGE COMPARATOR WITH DIRECT RELAY DRIVER

- | VIN |
- | +5VRELAY |
- | 5VRELAY |
- | Q |
- | Q |

VOLTAGE COMPARATOR WITH COMPLEMENTARY OUTPUTS

- | VREF |
- | VIN |
- | V+ |
- | V- |
- | Q |
- | Q |

VOLTAGE COMPARATOR WITH +/-5V SUPPLY AND +5V RELAY DRIVE

- | VIN' |
- | VIN+ |
- | +5VRELAY |
- | 1K |

VOLTAGE COMPARATOR WITH SINGLE SUPPLY AND OUTPUT LEVEL SHIFT

- | VA = 0V to +10V |
- | VOUT |
- | VOUT +10V |
- | 0 |
TYPICAL APPLICATIONS (cont’d)

VOLTAGE COMPARATOR WITH +/-5V SUPPLY AND OUTPUT LEVEL SHIFT

VOLTAGE COMPARATOR WITH OUTPUT LEVEL SHIFT AND HIGH CURRENT LOAD DRIVER

RESPONSE TIME MEASUREMENT CIRCUIT
Response time is defined as the interval between the application of an input step function and the instant when the output reaches 50% of its maximum value as measured by the following test circuit:

DUAL LIMIT WINDOW COMPARATOR

DUAL LIMIT PHOTO DETECTOR MONITOR

MINIMUM $R_{LOAD} = 1.5K\Omega$

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

LED turns on as photo-detector voltage reaches $V_{LIMIT1}$. Both LED and horn turn on as photo-detector voltage reaches $V_{LIMIT2}$.

$V_{EXTERNAL} = +10V$, $V_+ = +5V$
# SOIC-8 PACKAGE DRAWING

8 Pin Plastic SOIC Package

<table>
<thead>
<tr>
<th>Dim</th>
<th>Millimeters</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.35 - 1.75</td>
<td>0.053 - 0.069</td>
</tr>
<tr>
<td>A₁</td>
<td>0.10 - 0.25</td>
<td>0.004 - 0.010</td>
</tr>
<tr>
<td>b</td>
<td>0.35 - 0.45</td>
<td>0.014 - 0.018</td>
</tr>
<tr>
<td>C</td>
<td>0.18 - 0.25</td>
<td>0.007 - 0.010</td>
</tr>
<tr>
<td>D-8</td>
<td>4.69 - 5.00</td>
<td>0.185 - 0.196</td>
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<tr>
<td>E</td>
<td>3.50 - 4.05</td>
<td>0.140 - 0.160</td>
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<tr>
<td>e</td>
<td>1.27 BSC</td>
<td>0.050 BSC</td>
</tr>
<tr>
<td>H</td>
<td>5.70 - 6.30</td>
<td>0.224 - 0.248</td>
</tr>
<tr>
<td>L</td>
<td>0.60 - 0.937</td>
<td>0.024 - 0.037</td>
</tr>
<tr>
<td>Ø</td>
<td>0° - 8°</td>
<td>0° - 8°</td>
</tr>
<tr>
<td>S</td>
<td>0.25 - 0.50</td>
<td>0.010 - 0.020</td>
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</tbody>
</table>
8 Pin Plastic DIP Package

<table>
<thead>
<tr>
<th>Dim</th>
<th>Min (Millimeters)</th>
<th>Max (Millimeters)</th>
<th>Min (Inches)</th>
<th>Max (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.81</td>
<td>5.08</td>
<td>0.105</td>
<td>0.200</td>
</tr>
<tr>
<td>A1</td>
<td>0.38</td>
<td>1.27</td>
<td>0.015</td>
<td>0.050</td>
</tr>
<tr>
<td>A2</td>
<td>1.27</td>
<td>2.03</td>
<td>0.050</td>
<td>0.080</td>
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<tr>
<td>b</td>
<td>0.89</td>
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<td>0.035</td>
<td>0.065</td>
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<tr>
<td>b1</td>
<td>0.38</td>
<td>0.51</td>
<td>0.015</td>
<td>0.020</td>
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<tr>
<td>c</td>
<td>0.20</td>
<td>0.30</td>
<td>0.008</td>
<td>0.012</td>
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<tr>
<td>D-8</td>
<td>9.40</td>
<td>11.68</td>
<td>0.370</td>
<td>0.460</td>
</tr>
<tr>
<td>E</td>
<td>5.59</td>
<td>7.11</td>
<td>0.220</td>
<td>0.280</td>
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<tr>
<td>E1</td>
<td>7.62</td>
<td>8.26</td>
<td>0.300</td>
<td>0.325</td>
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<tr>
<td>e</td>
<td>2.29</td>
<td>2.79</td>
<td>0.090</td>
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<tr>
<td>e1</td>
<td>7.37</td>
<td>7.87</td>
<td>0.290</td>
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<td>2.79</td>
<td>3.81</td>
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<td>S-8</td>
<td>1.02</td>
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<td>0.040</td>
<td>0.080</td>
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<td>ø</td>
<td>0°</td>
<td>15°</td>
<td>0°</td>
<td>15°</td>
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