DUAL PRECISION CMOS VOLTAGE COMPARATOR
WITH PUSH-PULL DRIVER

GENERAL DESCRIPTION
The ALD2332A/ALD2332B/ALD2332 is a monolithic high performance
dual precision voltage comparator built with advanced silicon gate
EPAD® CMOS technology intended for high precision analog applications.
The ALD2332A/ALD2332B/ALD2332 offers ultra-low input offset
voltages and currents at its input pre-amplifier, precision voltage com-
parator 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 1012Ω; low input bias current of
10pA; fast response time of 520ns with only 10mV input step signal; very
low power dissipation of 175µA per comparator; single (+5V) or dual
(±5V) power supply operation; and 50mA push-pull output drivers.

The input voltage range includes ground, which makes these comparators
ideal for single supply low level signal detection with high source
impedance. The outputs can source and sink current allowing for applica-
tion flexibility. They can be used in either wired-OR connection
without pull-up resistor or push-pull configuration. ALD2332A/ALD2332B/
ALD2332 can also be used in wired-OR connection with other open
drain circuits such as the ALD2331/ALD2303 voltage comparators.

The ALD2332A/ALD2332B/ALD2332 voltage comparators are ideal for
a great variety of precision analog voltage comparator applications,
especially in low level signal detection circuits which require low standby
power and high output current.

FEATURES
• Guaranteed to drive 200Ω loads
• Fanout of 30LS TTL loads
• Low supply current of 175µA each comparator
• Pinout of LM193 type industry standard voltage comparators
• Extremely low input bias currents -- typically 10pA
• Virtually eliminates source impedance effects
• Low operating supply voltage of 4V to 10V
• Single (+5V) and dual supply (±5V) operation
• High speed for both large and small signals --
  180ns for TTL inputs and 400ns for 20mV overdrive
• CMOS, NMOS and TTL compatible
• Push-pull outputs-current sourcing/ sinking
• High output sinking current -- typically 50mA
• Low supply current spikes
• High gain -- 100V/mV

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

<table>
<thead>
<tr>
<th>Operating Temperature Range *</th>
<th>0°C to +70°C</th>
<th>0°C to +70°C</th>
</tr>
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<tbody>
<tr>
<td>8-Pin Small Outline Package (SOIC)</td>
<td>ALD2332ASAL</td>
<td>ALD2332APAL</td>
</tr>
<tr>
<td>8-PinPlastic Dip Package</td>
<td>ALD2332BSAL</td>
<td>ALD2332BPAL</td>
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<tr>
<td>ALD2332SAL</td>
<td>ALD2332PAL</td>
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</table>

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

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

BENEFITS
• Simple precision reference voltage setting
• On-chip input pre-amplifier and output buffers
• Precision voltage comparison without
  pre-amplifier
• Eliminate need for second power supply
• Eliminate pull-up resistor

PIN CONFIGURATION

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<tr>
<th>OUT 1</th>
<th>1</th>
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<th>V+</th>
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<tr>
<td>-IN 1</td>
<td>2</td>
<td>7</td>
<td>OUT 2</td>
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<td>+IN 1</td>
<td>3</td>
<td>6</td>
<td>-IN 2</td>
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<tr>
<td>GND</td>
<td>4</td>
<td>5</td>
<td>+IN 2</td>
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</table>

SAL, PAL PACKAGES

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 PAL, SAL 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**

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<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
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<th>2332</th>
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<th>Unit</th>
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<td>Supply Voltage</td>
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<td>±5</td>
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<td>500</td>
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<td>Voltage Gain</td>
<td>AVD</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>150</td>
<td>50</td>
<td>150</td>
<td>V/mV</td>
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<td>Input Offset Voltage</td>
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<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
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<td>2.0</td>
<td>mV</td>
<td>RLOAD ≥ 1.5KΩ</td>
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<td>Input Offset Current(^1)</td>
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<td>20</td>
<td>0.01</td>
<td>20</td>
<td>0.01</td>
<td>20</td>
<td>pA</td>
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<td>20</td>
<td>0.01</td>
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<td>Common Mode Input Voltage Range(^2)</td>
<td>VCR</td>
<td>-0.3</td>
<td>V+ -1.5</td>
<td>-0.3</td>
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<td>V+ -1.5</td>
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<td>50</td>
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<td>24</td>
<td>50</td>
<td>mA</td>
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<td>High Level Source Output Voltage</td>
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<td>V</td>
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<td>5mV Input Step/50V Overdrive</td>
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<td>tRP</td>
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<td>1mV Input Step/1.5V Overdrive</td>
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<td>tRP</td>
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<td>100mV Input Step/20mV Overdrive</td>
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<td>tRP</td>
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<td>180</td>
<td>180</td>
<td>180</td>
<td>ns</td>
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<td>R(_L) = 5.1KΩ, C(_L) = 15pF</td>
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<td>TTL-Level Input Step</td>
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<td>Common Mode Rejection Ratio</td>
<td>CMRR</td>
<td>80</td>
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<td>80</td>
<td>80</td>
<td>dB</td>
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<td>VINPUT = 0V to 2.5V</td>
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<td>Power Supply Rejection Ratio</td>
<td>PSRR</td>
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<td>75</td>
<td>75</td>
<td>dB</td>
<td></td>
<td>V+ = 4V to 5V</td>
</tr>
</tbody>
</table>

Notes:

\(^1\) Consists of junction leakage currents

\(^2\) Sample test parameter
TYPICAL PERFORMANCE CHARACTERISTICS

TRANSFER FUNCTION

![Graph showing transfer function with $T_A = 25^\circ C$](image)

COMMON - MODE VOLTAGE REFERRED TO SUPPLY VOLTAGE

![Graph showing common-mode voltage referred to supply voltage](image)

TOTAL SUPPLY CURRENT vs. TOTAL SUPPLY VOLTAGE

![Graph showing total supply current vs. total supply voltage](image)

SUPPLY CURRENT vs. TEMPERATURE

![Graph showing supply current vs. temperature](image)

NORMALIZED INPUT OFFSET VOLTAGE vs. TEMPERATURE

![Graph showing normalized input offset voltage vs. temperature](image)

OUTPUT HIGH VOLTAGE vs. SUPPLY VOLTAGE

![Graph showing output high voltage vs. supply voltage](image)
TYPICAL PERFORMANCE CHARACTERISTICS (cont'd)

OUTPUT LOW VOLTAGE vs. SUPPLY VOLTAGE

INPUT BIAS CURRENT vs. TEMPERATURE

LOW LEVEL OUTPUT VOLTAGE vs. TEMPERATURE

SATURATION VOLTAGE vs. SINK CURRENT

HIGH LEVEL OUTPUT VOLTAGE vs. TEMPERATURE

INPUT OFFSET VOLTAGE vs. TEMPERATURE

SUPPLY VOLTAGE (V)

OUTPUT LOW VOLTAGE (V)

INPUT BIAS CURRENT (pA)

AMBIENT TEMPERATURE (°C)

OUTPUT SATURATION VOLTAGE (V)

OUTPUT SINK CURRENT (mA)

AMBIENT TEMPERATURE (°C)

HIGH LEVEL OUTPUT VOLTAGE (V)

INPUT OFFSET VOLTAGE (mV)

AMBIENT TEMPERATURE (°C)
TYPICAL PERFORMANCE CHARACTERISTICS (cont'd)

**COMMON MODE REJECTION RATIO vs. TEMPERATURE**

![Common Mode Rejection Ratio Graph](image)

**RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES**

![Response Time Graph](image)

**POWER SUPPLY REJECTION RATIO vs. TEMPERATURE**

![Power Supply Rejection Ratio Graph](image)
TYPICAL APPLICATIONS

PRECISION SINGLE SUPPLY VOLTAGE COMPARATOR WITH DIRECT RELAY DRIVER

ZERO CROSSING DETECTOR

MULTIPLE RELAY DRIVE

DOUBLE DUAL LIMIT WINDOW COMPARATOR

VL₁ and VH₁ first limit window send warning
VL₂ and VH₂ second limit window execute
system cutoff
TYPICAL APPLICATIONS (cont'd)

**VOLTAGE COMPARATOR WITH SINGLE SUPPLY AND OUTPUT LEVEL SHIFT**

![Diagram of Voltage Comparator](image1)

- $V_A = 0V$ to $+10V$
- $V_{IN}^+$, $V_{IN}^-$
- $V_{OUT}$
- $V_{OUT} = +10V$
- $0$

**DOUBLE DUAL PRECISION PHOTO DETECTOR MONITOR**

![Diagram of Double Dual Precision Photo Detector Monitor](image2)

- $V_{LIMIT 1}$
- $V_{LIMIT 2}$
- $V_+\rightarrow$ BUZZER
- $V_{EXTERNAL}$
- $LED$
- $LIGHT$
- $PHOTO-DETECTOR$

LED turns on as photo-detector voltage reaches $V_{LIMIT 1}$. Both LED and horn turns on as photo-detector voltage reaches $V_{LIMIT 2}$. $V_{EXTERNAL} = +10V$, $V_+ = +5V$.

**PRECISION VOLTAGE COMPARATOR WITH COMPLEMENTARY PUSH-PULL OUTPUTS**

![Diagram of Precision Voltage Comparator](image3)

- $V_{REF}$
- $V_{IN}$
- $V_{OUT}$
- $V_{OUT} = Q$

**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:

![Diagram of Response Time Measurement Circuit](image4)

- $10X\ INPUT\ STEP$
- $V_{IN}$
- $OUT$
- $+5V$
- $S1K\ Omega$
- $9K\ Omega$
- $1K\ Omega$
TYPICAL APPLICATIONS (cont’d)

PUSH-PULL COMPLEMENTARY POWER MOSFET DRIVER

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. As each output sources up to 10mA in the output high state, the output stage of a wired-OR low output circuit must be able to sink this current and still provide desired output voltage levels. For TTL output levels, this consideration limits the number to a maximum of three ALD2302 outputs wired-OR together.

2. In order to minimize stray oscillation, all unused inputs must be tied to ground.

3. The input bias and offset currents are essentially input protection diode reverse bias leakage currents, and are typically less than 1 pA at room temperature. The 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.

4. 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.
TYPICAL APPLICATIONS (cont'd)

**PRECISION DUAL LIMIT WINDOW COMPARATOAR**

- **Input:** VIN
- **Reference Voltage:** VREF(HIGH) and VREF(LOW)
- **Load Resistance:** RLOAD = 1.5KΩ
- **Output**
  - Output high if VIN < VREF(HIGH) and VIN > VREF(LOW)

**Voltage Level Translator**

- **Input:** VIN
- **Output:** VOUT
- **Reference Voltage:** VREF = 1.4V for TTL input, VREF = V+ / 2 for CMOS input
- **Output Swings:** VOUT swings from rail-to-rail

**Precision Voltage Comparator with +/-5V Supply and Output Level Shift**

- **Input:** VIN (TTL input)
- **Output:** VOUT
- **References:** VREF(HIGH) = V+ = +10V, VREF(LOW) = 0V
- **Circuit Components:**
  - 100KΩ resistors
  - 0.1µF capacitors
- **Output Voltage:** VOUT = 0V

**Precision Voltage Comparator with Output Level Shift and High Current Load Driver**

- **Input:** VIN
- **Output:** VOUT
- **References:** VREF(HIGH) = V+ = +10V, VREF(LOW) = 0V
- **Circuit Components:**
  - Resistors R1 = 15KΩ, R2 = 50Ω, RLoad = 200Ω
  - Capacitors 0.1µF
- **Output Voltage:** VOUT = 0.066V
### SOIC-8 PACKAGE DRAWING

8 Pin Plastic SOIC Package

<table>
<thead>
<tr>
<th>Dim</th>
<th>Millimeters</th>
<th>Inches</th>
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<tbody>
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<td>1.35 1.75</td>
<td>0.053 0.069</td>
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<tr>
<td>A₁</td>
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<tr>
<td>b</td>
<td>0.35 0.45</td>
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<tr>
<td>C</td>
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<td>D-8</td>
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<tr>
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PDIP-8 PACKAGE DRAWING

8 Pin Plastic DIP Package

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0° 15° 0° 15°