FEATURES

400 mV ± 0.275% threshold
Supply range: 1.7 V to 5.5 V
Low quiescent current: 6.5 µA typical
Input range includes ground
Internal hysteresis: 9.3 mV typical
Low input bias current: ±5 nA maximum
Dual open-drain outputs
Small SOT-23 package
Qualified for automotive applications

APPLICATIONS

Li-Ion monitoring
Threshold detectors
Relay driving
Optoisolator driving
Industrial control systems
Handheld instruments

GENERAL DESCRIPTION

The ADCMP361 is a single low power, high accuracy comparator with a 400 mV reference in a 5-lead SOT-23 package. The internal 400 mV reference provides the ability to monitor low voltage supplies. The device operates on a supply voltage from 1.7 V to 5.5 V and only draws 6.5 µA typical, making it suitable for low power system monitoring and portable applications. Hysteresis is included in the comparators.

There are dual open-drain outputs to enable the comparator and reference circuit to be used in an inverting or noninverting configuration. The outputs can be pulled to any voltage up to a maximum of 5.5 V. The output stage is guaranteed to sink greater than 5 mA over temperature.

The device is suitable for portable, commercial, industrial, and automotive applications.
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REVISION HISTORY

5/14—Rev. A to Rev. B
Changes to Adding Hysteresis Section and Added Figure 32;
Renumbered Sequentially ..................................... 11

3/11—Rev. 0 to Rev. A
Changes to Features Section ................................1
Changes to Adding Hysteresis Section .................... 11
Added Figure 31, Renumbered Sequentially ............... 10
Updated Outline Dimensions ................................12
Changes to Ordering Guide .................................. 12
Added Automotive Products Section ..................... 12

2/07—Revision 0: Initial Version
### SPECIFICATIONS

$V_{DD} = 1.7 \text{ V to } 5.5 \text{ V, } -40^\circ C \leq T_A \leq +125^\circ C$, unless otherwise noted.

#### Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THRESHOLDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rising Input Threshold Voltage</td>
<td>399.3</td>
<td>400.4</td>
<td>401.5</td>
<td>mV</td>
<td>$V_{DD} = 3.3 \text{ V, } T_A = 25^\circ C$</td>
</tr>
<tr>
<td></td>
<td>391.2</td>
<td>400.4</td>
<td>401.7</td>
<td>mV</td>
<td>$V_{DD} = 1.7 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>393.1</td>
<td>400.4</td>
<td>405.9</td>
<td>mV</td>
<td>$V_{DD} = 3.3 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>393.1</td>
<td>400.4</td>
<td>405.8</td>
<td>mV</td>
<td>$V_{DD} = 5.5 \text{ V}$</td>
</tr>
<tr>
<td>Falling Input Threshold Voltage</td>
<td>381.1</td>
<td>391.1</td>
<td>400.9</td>
<td>mV</td>
<td>$V_{DD} = 1.7 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>381.2</td>
<td>391.1</td>
<td>398.4</td>
<td>mV</td>
<td>$V_{DD} = 3.3 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>381.0</td>
<td>391.1</td>
<td>398.2</td>
<td>mV</td>
<td>$V_{DD} = 5.5 \text{ V}$</td>
</tr>
<tr>
<td>Hysteresis = $V_{TH(R)} - V_{TH(F)}$</td>
<td>2</td>
<td>9.3</td>
<td>13.5</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>Threshold Voltage Accuracy</td>
<td>±0.275</td>
<td></td>
<td></td>
<td>%</td>
<td>$T_A = 25^\circ C, V_{DD} = 3.3 \text{ V}$</td>
</tr>
<tr>
<td>Threshold Voltage Temperature Coefficient</td>
<td>16</td>
<td></td>
<td></td>
<td>ppm/°C</td>
<td></td>
</tr>
<tr>
<td><strong>POWER SUPPLY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td>6.5</td>
<td>9</td>
<td></td>
<td>µA</td>
<td>$V_{DD} = 1.7 \text{ V}$</td>
</tr>
<tr>
<td></td>
<td>7.0</td>
<td>10</td>
<td></td>
<td>µA</td>
<td>$V_{DD} = 5.5 \text{ V}$</td>
</tr>
<tr>
<td><strong>INPUT CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>0.01</td>
<td>5</td>
<td></td>
<td>nA</td>
<td>$V_{DD} = 1.7 \text{ V, } V_{IN} = V_{DD}$</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>5</td>
<td></td>
<td>nA</td>
<td>$V_{DD} = 1.7 \text{ V, } V_{IN} = 0.1 \text{ V}$</td>
</tr>
<tr>
<td><strong>OPEN-DRAIN OUTPUTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Low Voltage</td>
<td>140</td>
<td>220</td>
<td></td>
<td>mV</td>
<td>$V_{DD} = 1.7 \text{ V, } I_{OUT} = 3 \text{ mA}$</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>220</td>
<td></td>
<td>mV</td>
<td>$V_{DD} = 5.5 \text{ V, } I_{OUT} = 5 \text{ mA}$</td>
</tr>
<tr>
<td>Output Leakage Current</td>
<td>0.01</td>
<td>1</td>
<td></td>
<td>µA</td>
<td>$V_{DD} = 1.7 \text{ V, } V_{OUT} = V_{DD}$</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>1</td>
<td></td>
<td>µA</td>
<td>$V_{DD} = 1.7 \text{ V, } V_{OUT} = 5.5 \text{ V}$</td>
</tr>
<tr>
<td><strong>DYNAMIC PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-to-Low Propagation Delay</td>
<td>10</td>
<td></td>
<td></td>
<td>µs</td>
<td>$V_{DD} = 5 \text{ V, } V_{OL} = 400 \text{ mV}$</td>
</tr>
<tr>
<td>Low-to-High Propagation Delay</td>
<td>8</td>
<td></td>
<td></td>
<td>µs</td>
<td>$V_{DD} = 5 \text{ V, } V_{OH} = 0.9 \times V_{DD}$</td>
</tr>
<tr>
<td>Output Rise time</td>
<td>0.5</td>
<td></td>
<td></td>
<td>µs</td>
<td>$V_{DD} = 5 \text{ V, } V_{OL} = (0.1 \text{ to } 0.9) \times V_{DD}$</td>
</tr>
<tr>
<td>Output Fall time</td>
<td>0.07</td>
<td></td>
<td></td>
<td>µs</td>
<td>$V_{DD} = 5 \text{ V, } V_{OL} = (0.1 \text{ to } 0.9) \times V_{DD}$</td>
</tr>
</tbody>
</table>

1 $R_L = 100 \text{ kΩ, } V_{OL} = 2 \text{ V swing.}$
2 10 mV input overdrive.
3 $V_{IN} = 40 \text{ mV overdrive.}$
4 $R_L = 10 \text{ kΩ.}$
ABSOLUTE MAXIMUM RATINGS

Table 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>−0.3 V to +6 V</td>
</tr>
<tr>
<td>IN</td>
<td>−0.3 V to +6 V</td>
</tr>
<tr>
<td>OUT, OUT</td>
<td>−0.3 V to +6 V</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>−40°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>−65°C to +150°C</td>
</tr>
<tr>
<td>Lead Temperature</td>
<td></td>
</tr>
<tr>
<td>Soldering (10 sec)</td>
<td>300°C</td>
</tr>
<tr>
<td>Vapor Phase (60 sec)</td>
<td>215°C</td>
</tr>
<tr>
<td>Infrared (15 sec)</td>
<td>220°C</td>
</tr>
</tbody>
</table>

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL CHARACTERISTICS

θJA is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 3. Thermal Resistance

<table>
<thead>
<tr>
<th>Package Type</th>
<th>θJA</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Lead SOT-23</td>
<td>240</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

![Figure 4. Pin Configuration](image)

Table 4. Pin Function Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUT</td>
<td>Noninverting Open-Drain Output.</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground.</td>
</tr>
<tr>
<td>3</td>
<td>IN</td>
<td>Monitors analog input voltage on comparator. The other input of the comparator is connected to a 400 mV reference.</td>
</tr>
<tr>
<td>4</td>
<td>VDD</td>
<td>Power Supply.</td>
</tr>
<tr>
<td>5</td>
<td>OUT</td>
<td>Inverting Open-Drain Output.</td>
</tr>
</tbody>
</table>
**TYPICAL PERFORMANCE CHARACTERISTICS**

*Figure 5. Distribution of Rising Input Threshold Voltage*

![Graph showing the distribution of rising input threshold voltage with labels for percent of units (%) and rising input threshold voltage (mV).]

*Figure 6. Distribution of Hysteresis*

![Graph showing the distribution of hysteresis with labels for percent of units (%) and hysteresis (mV).]

*Figure 7. Rising Input Threshold Voltage vs. Supply Voltage*

![Graph showing the rising input threshold voltage vs. supply voltage with labels for supply voltage (V) and temperature (°C).]

*Figure 8. Distribution of Falling Input Threshold Voltage*

![Graph showing the distribution of falling input threshold voltage with labels for percent of units (%) and falling input threshold voltage (mV).]

*Figure 9. Rising Input Threshold Voltage vs. Temperature*

![Graph showing the rising input threshold voltage vs. temperature with labels for temperature (°C) and rising input threshold voltage (mV).]

*Figure 10. Hysteresis vs. Temperature*

![Graph showing the hysteresis vs. temperature with labels for temperature (°C) and hysteresis (mV).]

*Figure 11. Four Typical Parts*

![Graph showing four typical parts with labels for supply voltage (V) and temperature (°C).]
Supply Current vs. Output Sink Current

Low Level Input Bias Current

Output Saturation Voltage vs. Output Sink Current

Below Ground Input Bias Current

High Level Input Bias Current
Figure 23. Output Saturation Voltage vs. Output Sink Current

Figure 24. Short-Circuit Current vs. Output Voltage

Figure 25. Propagation Delay vs. Input Overdrive

Figure 26. Short-Circuit Current vs. Output Voltage

Figure 27. Output Leakage Current vs. Output Voltage

Figure 28. Rise and Fall Times vs. Output Pull-Up Resistor
Figure 29. Noninverting and Inverting Comparators Propagation Delay
APPLICATION INFORMATION

The ADCMP361 is a low power comparator and reference circuit featuring a 400 mV reference that operates from 1.7 V to 5.5 V. The comparator is 0.275% accurate with a built-in hysteresis of 9.3 mV. There are two outputs, one the inverse of the other. This enables the ADCMP361 to be used as an inverting or a noninverting comparator circuit. These open-drain outputs are capable of sinking 40 mA.

COMPARATORS AND INTERNAL REFERENCE

The comparator has one input available externally; the other comparator input is connected internally to the 400 mV reference. The rising input threshold voltage of the comparators is designed to be equal to that of the reference.

POWER SUPPLY

The ADCMP361 is designed to operate from 1.7 V to 5.5 V. A 100 nF decoupling capacitor is recommended between VDD and GND.

INPUTS

The comparator input is limited to the maximum VDD voltage range. The voltage on these inputs can be above VDD but never above the maximum allowed VDD voltage. When adding a resistor string to the input, take care when choosing resistor values. This is due to the fact that the input bias current will be in parallel with the bottom resistor, R2, of the input resistor divider string. This bottom resistor must therefore be chosen carefully in order to reduce the error introduced by this bias current (see Figure 30).

OUTPUTS

The open-drain comparator outputs are limited to the maximum specified VDD voltage range, regardless of the VDD voltage. These outputs are capable of sinking up 40 mA.

ADDING HYSTERESIS

To prevent oscillations at the output caused by noise or slowly moving signals passing the switching threshold, each comparator has built-in hysteresis of approximately 9.3 mV. Positive feedback can be used to increase hysteresis.

For the configuration shown in Figure 31, two resistors are used to create different switching thresholds, depending on whether the input signal is increasing or decreasing in magnitude. When the input voltage is increasing, the threshold is above VREF, and when it is decreasing, the threshold is below VREF. VIN_HI is the high input threshold used to trigger the output low to high transmission. VIN_LO is the low input threshold used to trigger the output high to low transmission.

The upper input threshold level is given by

\[ V_{IN_HI} = \frac{V_{REF} (R1 + R2)}{R2} \]

assuming \( R_{LOAD} >> R2, R_{PULLUP} \) where \( V_{REF} = 0.4 \) V.

The lower input threshold level is given by

\[ V_{IN_LO} = \frac{V_{REF} (R1 + R2 + R_{PULLUP}) - VCC \cdot R1}{R2 + R_{PULLUP}} \]

The hysteresis is the difference between these voltage levels and is given by

\[ \Delta V_{IN} = \frac{VCC \cdot R1}{R2 + R_{PULLUP}} \]

![Figure 30. Input Bias Current Effect on Input Resistor String](image)

![Figure 31. Comparator Configuration with Added Hysteresis](image)

![Figure 32. Noninverting Comparator Configuration with Hysteresis](image)
OUTLINE DIMENSIONS

Figure 33. 5-Lead Small Outline Transistor Package [SOT-23] (RJ-5)

Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model 1, 2</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option</th>
<th>Branding</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADCMP361YRJZ-REEL7</td>
<td>–40°C to +125°C</td>
<td>5-Lead SOT-23</td>
<td>RJ-5</td>
<td>M99</td>
</tr>
<tr>
<td>ADCMP361WRJZ-RL7</td>
<td>–40°C to +125°C</td>
<td>5-Lead SOT-23</td>
<td>RJ-5</td>
<td>M99</td>
</tr>
</tbody>
</table>

1 Z = RoHS Compliant Part.
2 W = Qualified for Automotive Applications.

AUTOMOTIVE PRODUCTS

The ADCMP361W models are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models; therefore, designers should review the Specifications section of this data sheet carefully. Only the automotive grade products shown are available for use in automotive applications. Contact your local Analog Devices account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.