

### FEATURES

- 2.25 V to 5.5 V operating voltage range
- Low power consumption (4  $\mu$ A)
- High voltage (22 V) tolerance on inputs
- Output stages
  - ADCMP370: open-drain, high voltage (22 V tolerance)
  - ADCMP371: push-pull
- 50 nA input bias current
- 150 nA input offset current
- 9 mV input offset voltage
- Rail-to-rail, common-mode input range
- Specified over  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  temperature range
- 5-lead SC70 packaging

### APPLICATIONS

- Voltage detectors
- Battery management systems
- Analog-to-digital converters
- Low voltage applications
- Battery-powered electronics
- Portable equipment

### GENERAL DESCRIPTION

The ADCMP370/ADCMP371 are general-purpose comparators with input offset voltages of 9 mV (maximum) and low power consumption, which make them ideal for battery-powered, portable equipment.

The ADCMP371 has a push-pull output stage, while the ADCMP370 has an open-drain output. The inputs on both parts and the output on the ADCMP370 can tolerate voltages up to 22 V, making them suitable for use as voltage detectors in portable equipment.

The devices are available in space-efficient, 5-lead SC70 packaging.

### FUNCTIONAL BLOCK DIAGRAMS

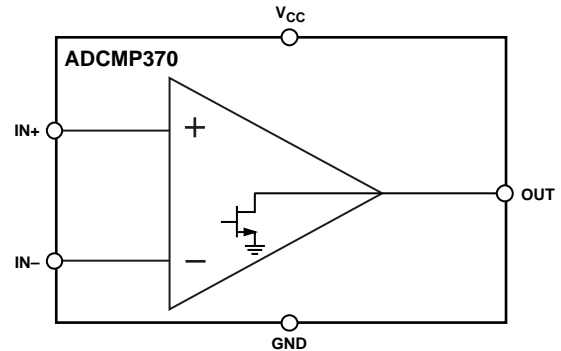


Figure 1.

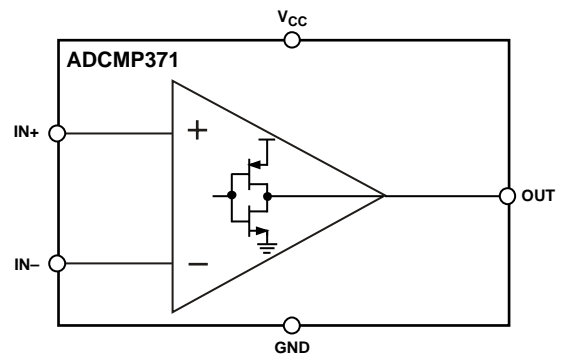


Figure 2.

#### Rev. A

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

## TABLE OF CONTENTS

|                                |   |  |    |
|--------------------------------|---|--|----|
| Features .....                 | 1 | Pin Configuration and Function Descriptions..... | 5  |
| Applications.....              | 1 | Typical Performance Characteristics .....        | 6  |
| General Description .....      | 1 | Applications.....                                | 9  |
| Functional Block Diagrams..... | 1 | Basic Comparator .....                           | 9  |
| Revision History .....         | 2 | Adding Hysteresis.....                           | 9  |
| Specifications.....            | 3 | Outline Dimensions .....                         | 11 |
| Absolute Maximum Ratings.....  | 4 | Ordering Guide .....                             | 11 |
| ESD Caution.....               | 4 |  |    |

## REVISION HISTORY

### 1/06—Rev. 0 to Rev. A

|                                   |    |
|-----------------------------------|----|
| Changes to Features.....          | 1  |
| Changes to Figure 19.....         | 9  |
| Changes to Figure 20 Caption..... | 10 |
| Updated Outline Dimensions .....  | 11 |

### 10/04—Revision 0: Initial Version

## SPECIFICATIONS

$V_{CC}$  = full operating range,  $T_A$  =  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , unless otherwise noted.

Table 1.

| Parameter                          | Min          | Typ | Max      | Unit                           | Test Conditions/Comments                   |
|------------------------------------|--------------|-----|----------|--------------------------------|--|
| SUPPLY                             |              |     |          |                                |  |
| $V_{CC}$ Operating Voltage Range   | 2.25         |     | 5.5      | V                              |  |
| Supply Current                     |              | 4   | 7        | $\mu\text{A}$                  |  |
| COMMON-MODE INPUT RANGE            | 0            |     | $V_{CC}$ | V                              |  |
| INPUT OFFSET VOLTAGE               |              |     | 9        | mV                             | $V_{IN} = V_{CC} / 2$                      |
| INPUT OFFSET VOLTAGE AVERAGE DRIFT |              | 5   |          | $\mu\text{V}/^{\circ}\text{C}$ | $V_{CM} = 0\text{ V}$                      |
| INPUT BIAS CURRENT                 |              |     | 50       | nA                             | $V_{IN} = V_{CC} / 2$                      |
| INPUT OFFSET CURRENT               |              |     | 150      | nA                             | $V_{IN} = V_{CC} / 2$                      |
| OUT VOLTAGE LOW                    |              |     | 0.4      | V                              | $IN+ < IN-, I_{SINK} = 1.2\text{ mA}$      |
| OUT VOLTAGE HIGH (ADCMP371)        | $0.8 V_{CC}$ |     |          | V                              | $IN+ > IN-, I_{SOURCE} = 500\ \mu\text{A}$ |
| OUT LEAKAGE CURRENT (ADCMP370)     |              |     | 1        | $\mu\text{A}$                  | $IN+ > IN-, OUT = 22\text{ V}$             |
| Output Rise Time                   |              | 30  |          | ns                             | $C_{OUT} = 15\text{ pF}$                   |
| Output Fall Time                   |              | 45  |          | ns                             | $C_{OUT} = 15\text{ pF}$                   |
| TIMING                             |              |     |          |                                |  |
| Propagation Delay                  |              | 5   |          | $\mu\text{s}$                  | Input overdrive = 10 mV                    |
|                                    |              | 2   |          | $\mu\text{s}$                  | Input overdrive = 100 mV                   |

# ADCMP370/ADCMP371

## ABSOLUTE MAXIMUM RATINGS

T<sub>A</sub> = 25°C, unless otherwise noted.

Table 2.

| Parameter                               | Rating                            |
|---|-----------------------------------|
| V <sub>CC</sub>                         | -0.3 V to +6 V                    |
| IN+, IN-                                | -0.3 V to +25 V                   |
| OUT (ADCMP370)                          | -0.3 V to +25 V                   |
| OUT (ADCMP371)                          | -0.3 V to V <sub>CC</sub> + 0.3 V |
| Operating Temperature Range             | -40°C to +85°C                    |
| Storage Temperature Range               | -65°C to +150°C                   |
| θ <sub>JA</sub> Thermal Impedance, SC70 | 146°C/W                           |
| Lead Temperature                        |                                   |
| Soldering (10 sec)                      | 300°C                             |
| Vapor Phase (60 sec)                    | 215°C                             |
| Infrared (15 sec)                       | 220°C                             |

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.

## ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



# PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

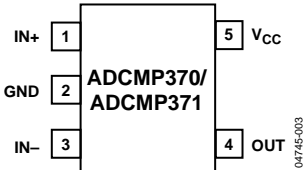


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

| Pin No. | Mnemonic        | Description   |
|---------|-----------------|---|
| 1       | IN+             | Noninverting Input.   |
| 2       | GND             | Ground.   |
| 3       | IN-             | Inverting Input.  |
| 4       | OUT             | Comparator Output. Open drain for ADCMP370. Push-pull for ADCMP371. |
| 5       | V <sub>CC</sub> | Power Supply.   |

## TYPICAL PERFORMANCE CHARACTERISTICS

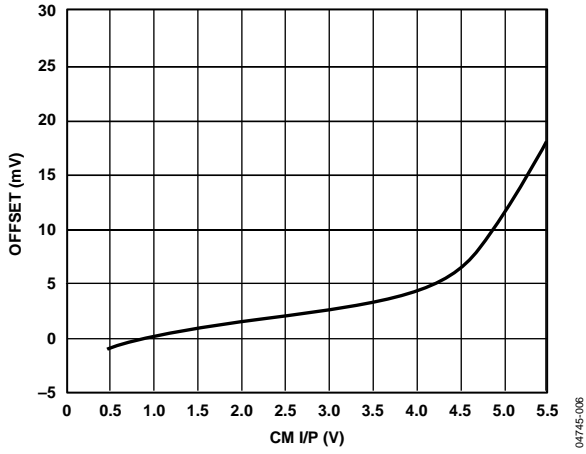


Figure 4. Input Offset vs. Common-Mode Input Voltage

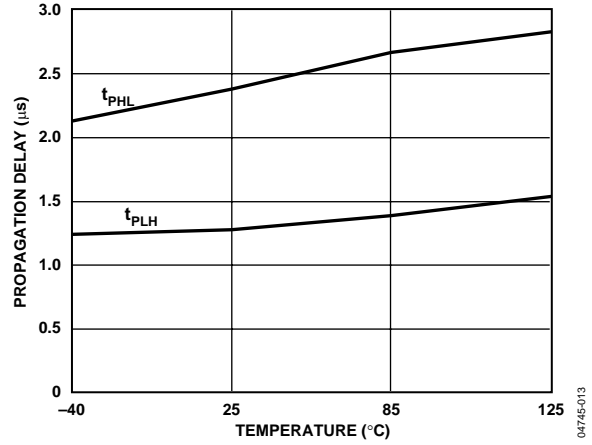


Figure 7. Propagation Delay vs. Temperature

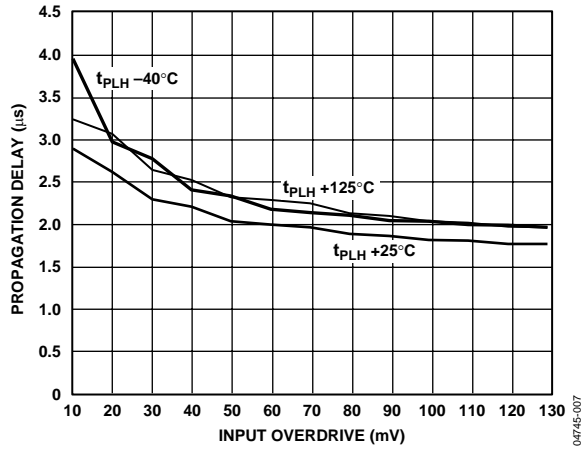


Figure 5. Propagation Delay vs. Input Overdrive (Low to High)

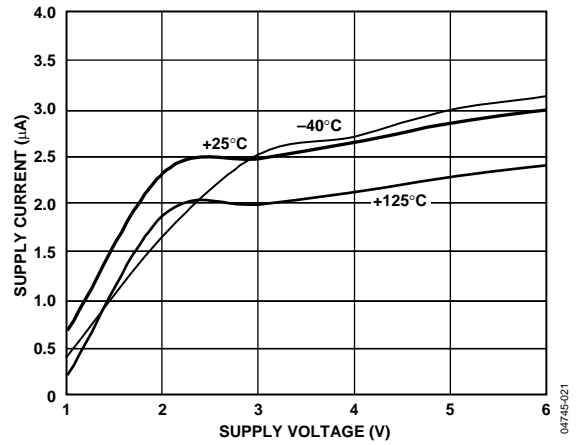


Figure 8. Supply Current vs. Supply Voltage (Output Low)

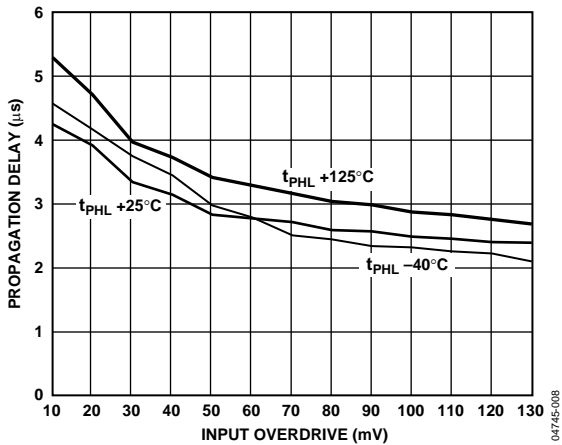


Figure 6. Propagation Delay vs. Input Overdrive (High to Low)

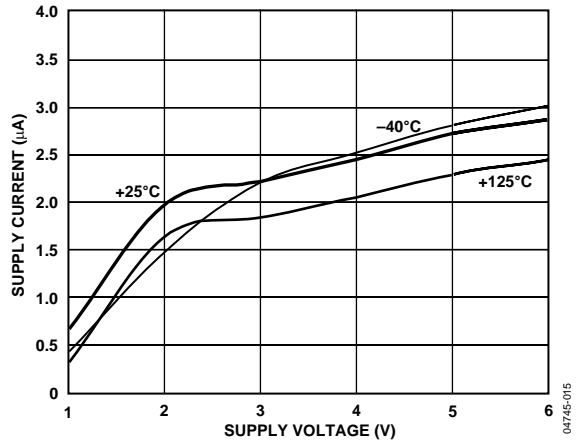


Figure 9. Supply Current vs. Supply Voltage (Output High)

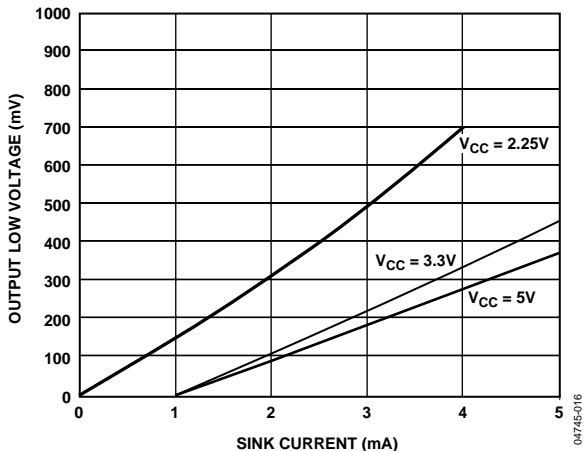


Figure 10. Output Low Voltage vs. Sink Current

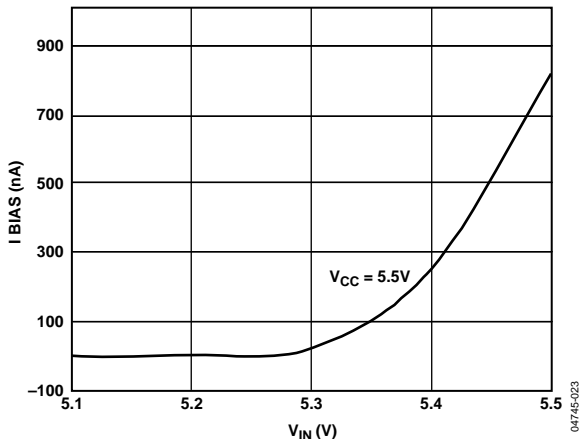


Figure 13. Input Bias Current vs. Input Voltage

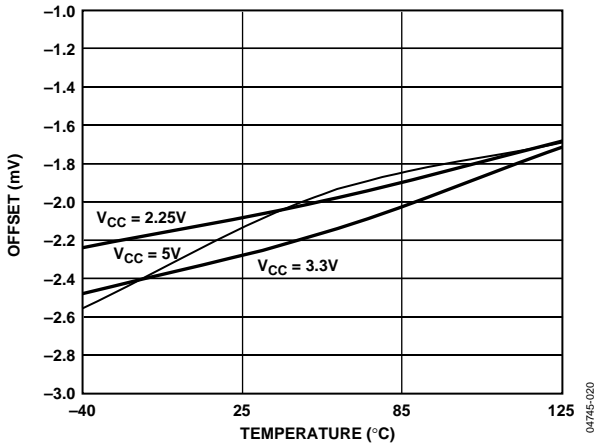


Figure 11. Input Offset vs. Temperature

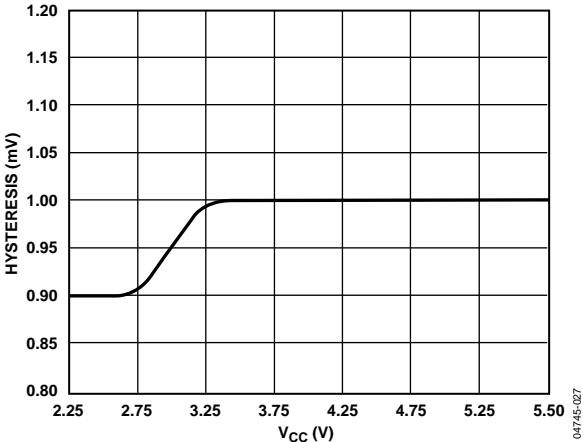


Figure 14. Hysteresis vs. Supply Voltage

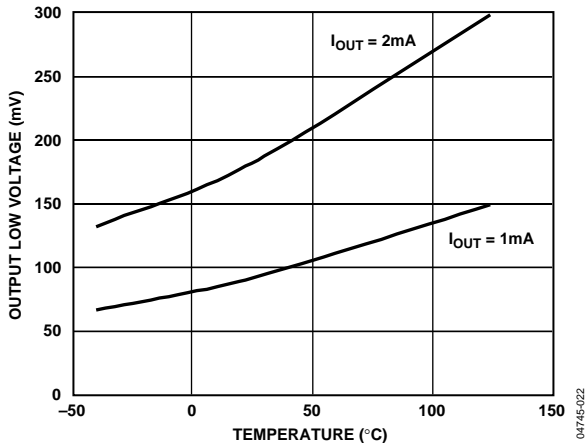


Figure 12. Output Low Voltage vs. Temperature

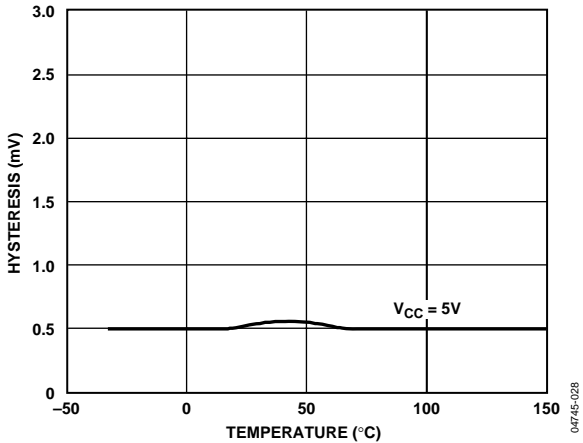


Figure 15. Hysteresis vs. Temperature

# ADCMP370/ADCMP371

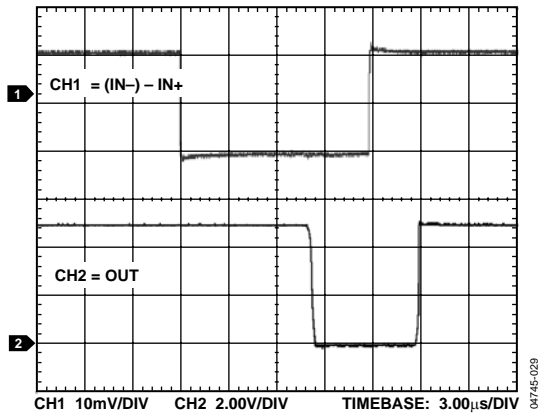


Figure 16. Propagation Delay Timing 10 mV Overdrive

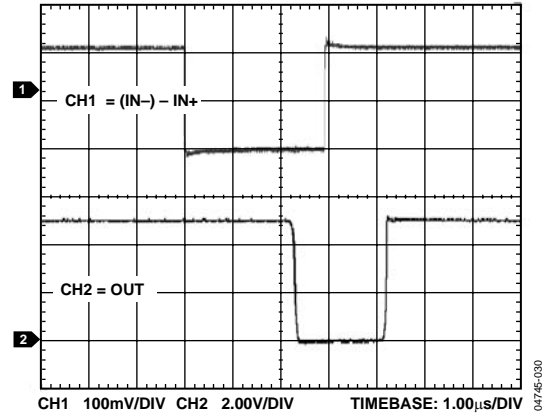


Figure 17. Propagation Delay Timing 100 mV Overdrive



## APPLICATIONS

### BASIC COMPARATOR

In its most basic configuration, a comparator can be used to convert an analog input signal to a digital output signal. The analog signal on IN+ is compared to the voltage on IN–, and the voltage at OUT is either high or low, depending on whether IN+ is at a higher or lower potential than IN–, respectively.

The ADCMP370 and ADCMP371 have different digital output structures. The ADCMP370 has an open-drain output stage that requires an external resistor to pull OUT to the logic high voltage level when the output transistor is switched off. This voltage level can be as high as 22 V. The same 22 V tolerance also applies to the inputs of the comparators. The pull-up resistor should be large enough to avoid excessive power dissipation but small enough to switch logic levels reasonably quickly when the comparator output is connected to other digital circuitry. A suitable value is between 1 kΩ and 10 kΩ. The ADCMP371 has a push-pull output stage, which has an internal PMOS pull-up and, therefore, does not require an external resistor. Faster switching speeds between low and high rails are possible, but the logic high level is limited to V<sub>CC</sub>.

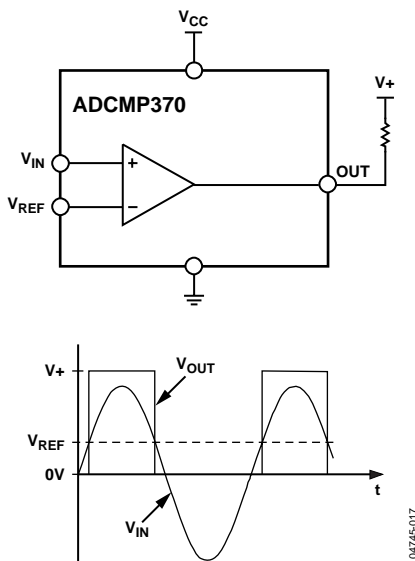


Figure 18. Basic Comparator and Input and Output Signals

### ADDING HYSTERESIS

To prevent oscillations at the output caused by noise or slowly moving signals passing the switching threshold, positive feedback can be used to add hysteresis to the differential input.

For the noninverting configuration, shown in Figure 19, 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 V<sub>REF</sub>, and when it is decreasing, the threshold is below V<sub>REF</sub>.

The upper input threshold level is given by

$$V_{IN\_HI} = \frac{V_{REF}(R1 + R2) - V_{CC}R1}{R2}$$

The lower input threshold level is given by

$$V_{IN\_LO} = \frac{V_{REF}(R1 + R2)}{R2}$$

The hysteresis is the difference between these voltage levels

$$\Delta V_{IN} = \frac{V_{CC}R1}{R2}$$

In the example in Figure 19, Resistor R1 and Resistor R2 are chosen to give 1 V hysteresis about the reference of 2.5 V, with V<sub>CC</sub> = 5 V.

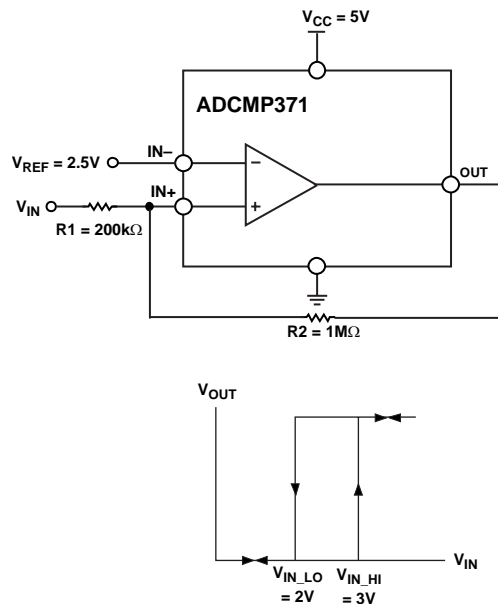


Figure 19. Noninverting Comparator Configuration with Hysteresis

With the inverting configuration, the upper and lower switching thresholds are

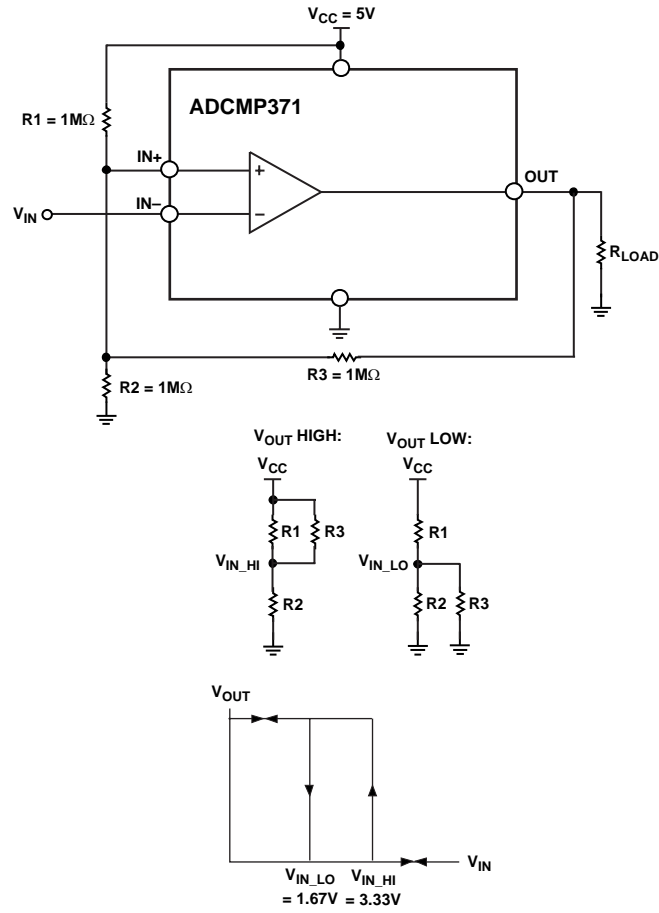
$$V_{IN\_HI} = \frac{V_{CC}R2}{(R1 \parallel R3) + R2}$$

$$V_{IN\_HI} = \frac{V_{CC} \times R2(R1 + R3)}{(R1 \times R3) + (R2 \times R1) + (R2 \times R3)}$$

$$V_{IN\_LO} = \frac{V_{CC}(R2 \parallel R3)}{R1 + (R2 \parallel R3)}$$

$$V_{IN\_LO} = \frac{V_{CC} \times R2 \times R3}{(R1 \times R3) + (R2 \times R1) + (R2 \times R3)}$$

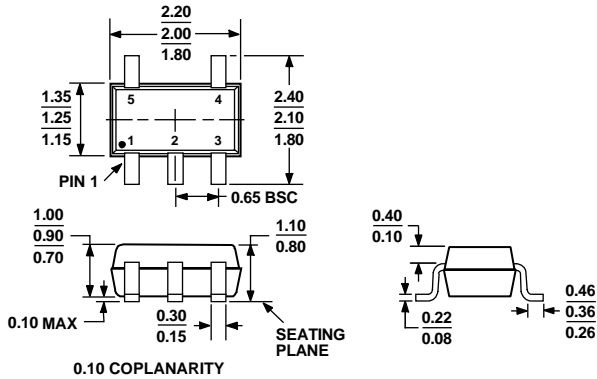
# ADCMP370/ADCMP371



04745-018

Figure 20. Inverting Comparator Configuration with Hysteresis

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-203-AA  
 Figure 21. 5-Lead Thin Shrink Small Outline Transistor Package [SC70] (KS-5)  
 Dimensions shown in millimeters

ORDERING GUIDE

| Model                           | Temperature Range | Package Description | Package Option | Branding |
|---------------------------------|-------------------|---------------------|----------------|----------|
| ADCMP370AKS-REEL                | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M1F      |
| ADCMP370AKS-REEL7               | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M1F      |
| ADCMP370AKSZ-REEL <sup>1</sup>  | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M8P      |
| ADCMP370AKSZ-REEL7 <sup>1</sup> | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M8P      |
| ADCMP371AKS-REEL                | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M1G      |
| ADCMP371AKS-REEL7               | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M1G      |
| ADCMP371AKSZ-REEL7 <sup>1</sup> | -40°C to +85°C    | 5-Lead SC70         | KS-5           | M8W      |

<sup>1</sup> Z = Pb-free part.

**NOTES**