

ADCMP370/ADCMP371

FEATURES

- 2.25 V to 5.5 V operating voltage range
- Low power consumption (4 μ A)
- 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°C to $+85^{\circ}\text{C}$ temperature range
- 5-lead SC70 package

APPLICATIONS

- Voltage detectors
- Battery management systems
- A/D 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 (max) 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.

They are available in space-efficient 5-lead SC70 packaging.

FUNCTIONAL BLOCK DIAGRAMS

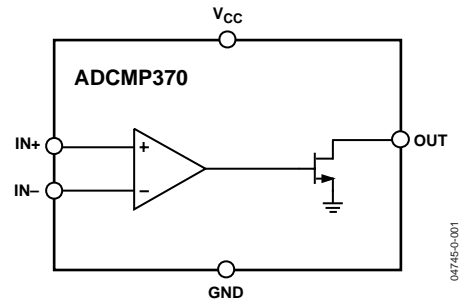


Figure 1.

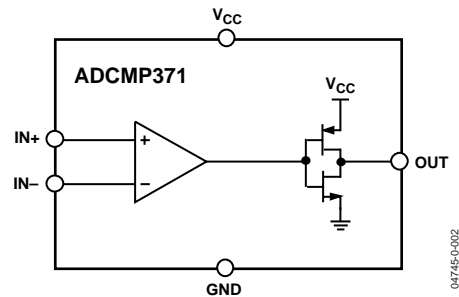


Figure 2.

Rev. 0

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REVISION HISTORY

10/04—Revision 0: Initial Version

SPECIFICATIONS

V_{CC} = Full Operating Range, T_A = -40°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	μA	
COMMON-MODE INPUT RANGE					
INPUT OFFSET VOLTAGE	0		V_{CC}	V	
INPUT OFFSET VOLTAGE AVERAGE DRIFT		5		$\mu\text{V}/^{\circ}\text{C}$	$V_{IN} = V_{CC}/2$
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)					
Output Rise Time		30	1	ns	$IN+ > IN-, OUT = 22 \text{ V}$ $C_{OUT} = 15 \text{ pF}$
Output Fall Time		45		ns	$C_{OUT} = 15 \text{ pF}$
TIMING					
Propagation Delay		5		μs	Input overdrive = 10 mV
		2		μs	Input overdrive = 100 mV

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ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Rating
V _{CC}	-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 _{CC} + 0.3 V
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
θ _{JA} 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 and 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

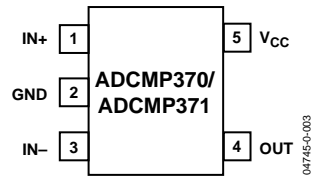


Figure 3. Pin Configuration

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 _{CC}	Power Supply.

TYPICAL PERFORMANCE CHARACTERISTICS

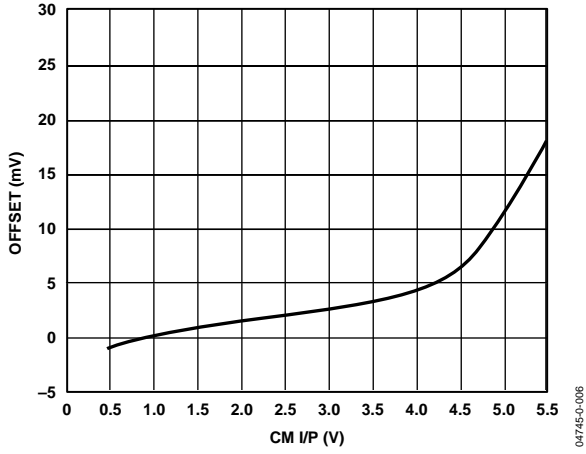


Figure 4. Input Offset vs. Common-Mode Input Voltage

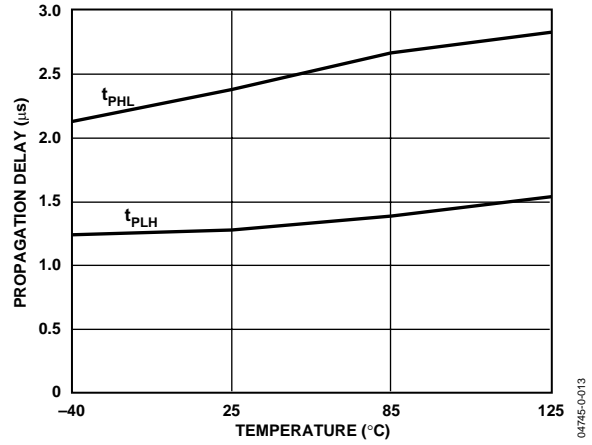


Figure 7. Propagation Delay vs. Temperature

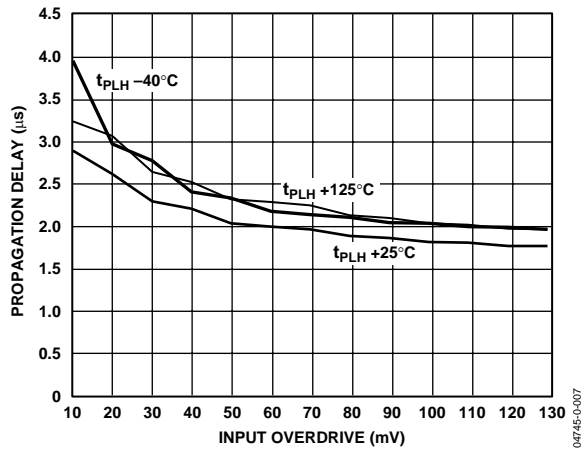


Figure 5. Propagation Delay vs. Input Overdrive (Low to High)

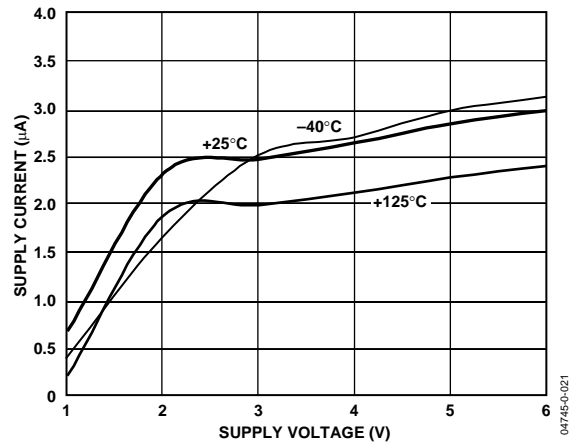


Figure 8. Supply Current vs. Supply Voltage (Output Low)

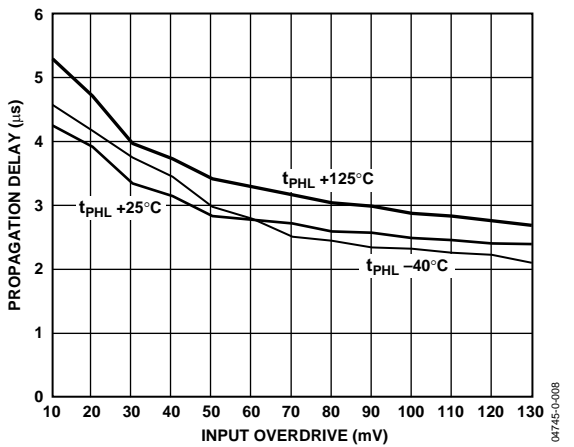


Figure 6. Propagation Delay vs. Input Overdrive (High to Low)

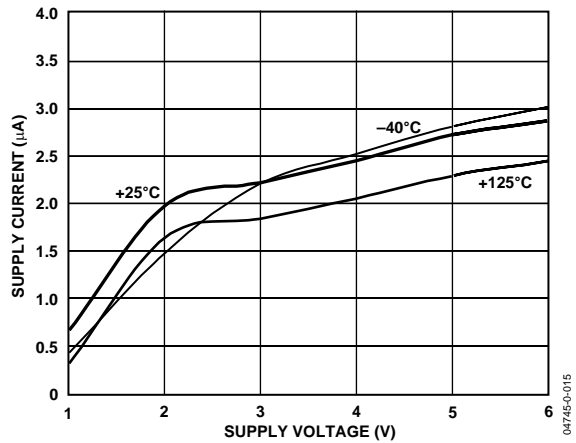


Figure 9. Supply Current vs. Supply Voltage (Output High)

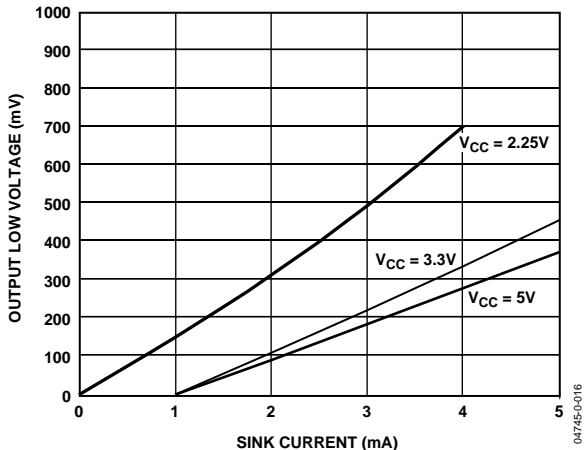


Figure 10. Output Low Voltage vs. Sink Current

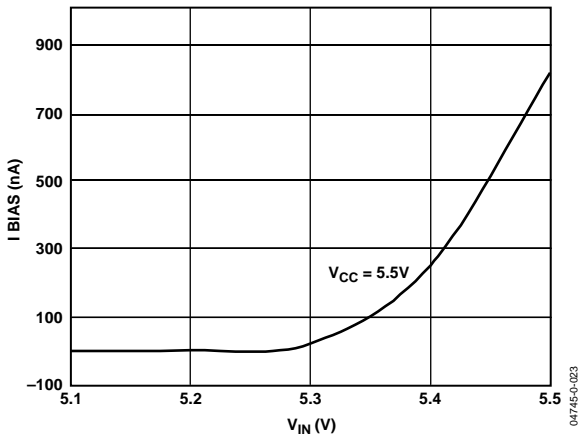


Figure 13. Input Bias Current vs. Input Voltage

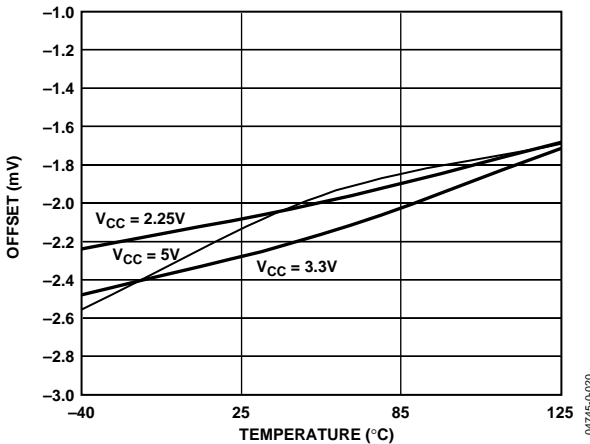


Figure 11. Input Offset vs. Temperature

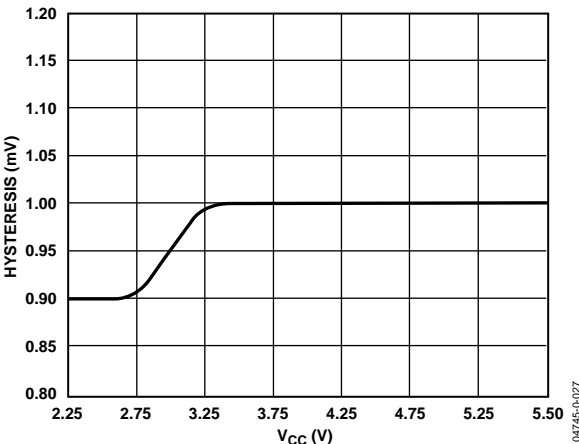


Figure 14. Hysteresis vs. Supply Voltage

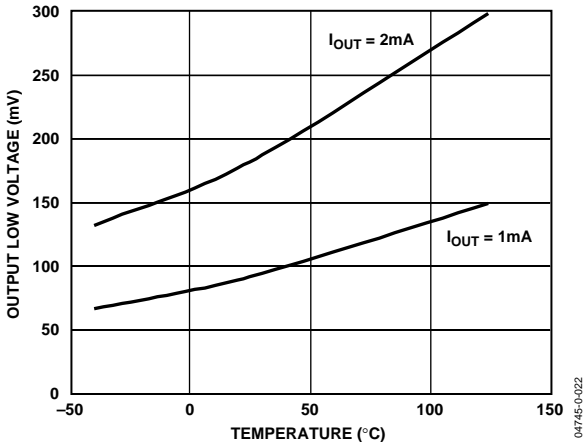


Figure 12. Output Low Voltage vs. Temperature

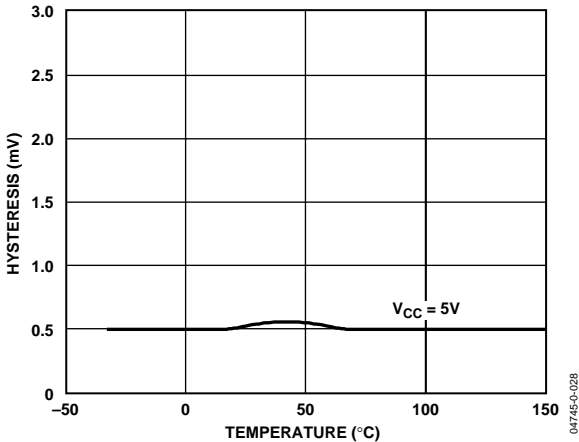


Figure 15. Hysteresis vs. Temperature

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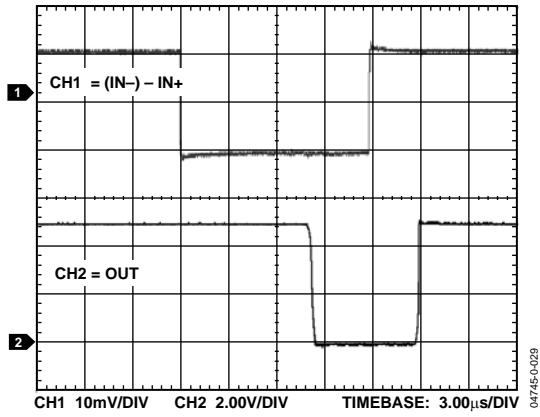


Figure 16. Propagation Delay Timing 10 mV Overdrive

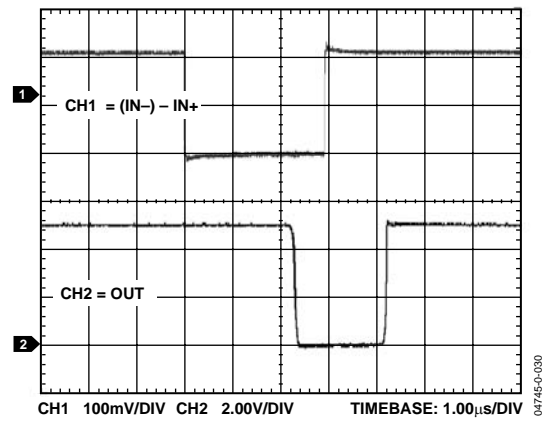


Figure 17. Propagation Delay Timing 100 mV Overdrive

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 which 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 applies also 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 would be between 1 kΩ and 10 kΩ. The ADCMP371 has a push-pull output stage, which has an internal PMOS pull-up and therefore doesn't require an external resistor. Faster switching speeds between low and high rails are possible, but the logic high level is limited to V_{CC}.

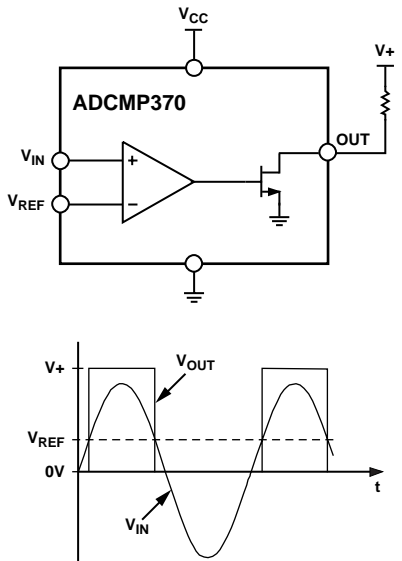


Figure 18. Basic Comparator and Input and Output Signals

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_{REF}; and when it's decreasing, the threshold is below V_{REF}.

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 and is given by

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

In the example in Figure 19, resistors R1 and R2 are chosen to give 1 V hysteresis about the reference of 2.5 V, with V_{CC} = 5 V. It's important that R_{PULL-UP} << R_{LOAD} so that the output high voltage isn't pulled below V_{CC}.

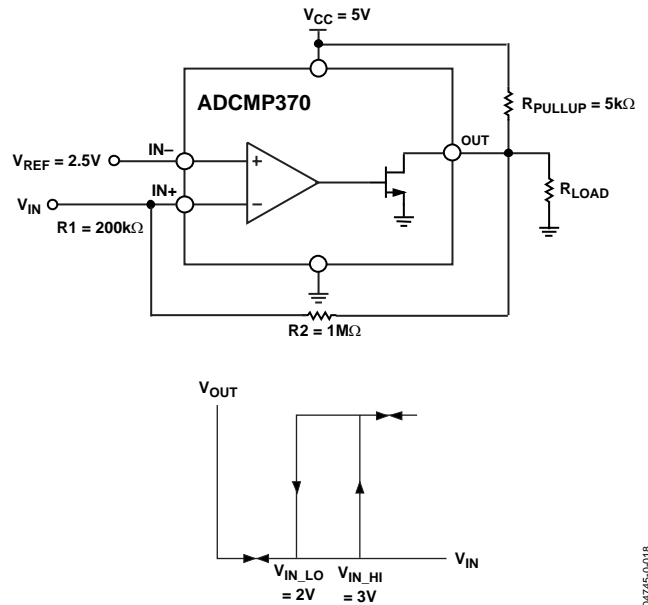


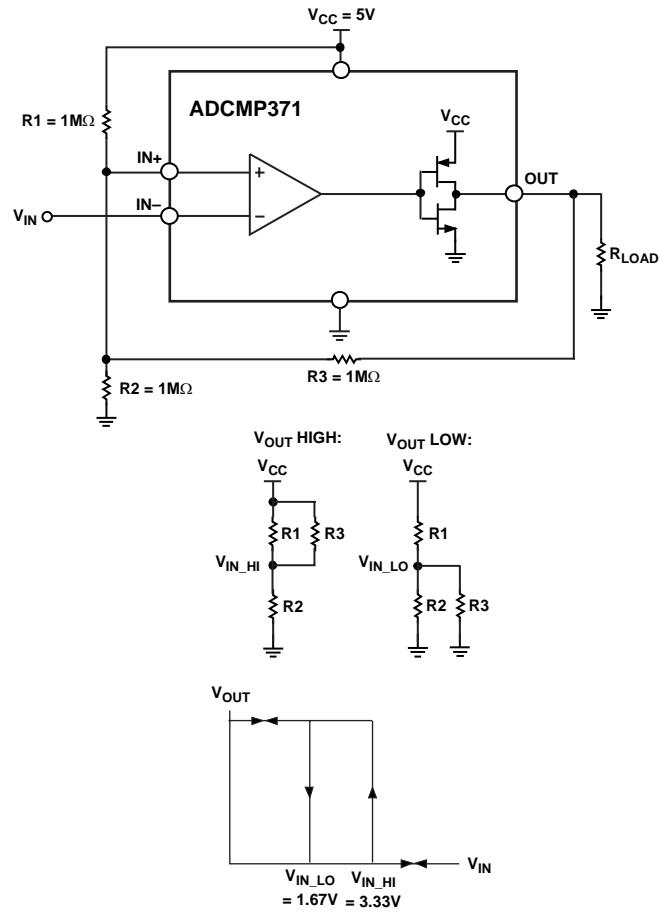
Figure 19. Noninverting Comparator Configuration with Hysteresis

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

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

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

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Figure 20. Noninverting Comparator Configuration with Hysteresis

OUTLINE DIMENSIONS

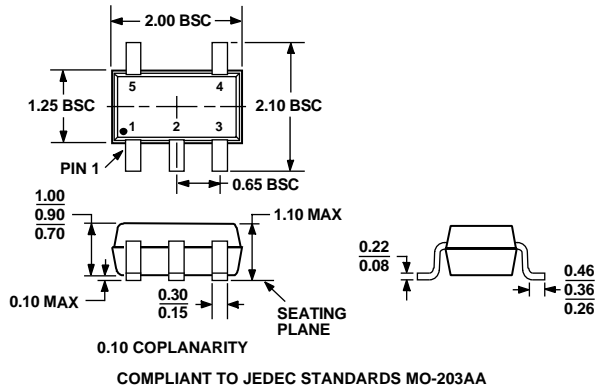


Figure 21. 5-Lead Thin Shrink Small Outline Transistor Package [SC70] (KS-5)
 Dimensions shown in millimeters

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
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

NOTES