

# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## General Description

The MAX4373/MAX4374/MAX4375 low-cost, micropower, high-side current-sense supervisors contain a high-side current-sense amplifier, bandgap reference, and comparator with latching output. They feature a voltage output that eliminates the need for gain-setting resistors, making them ideal for today's notebook computers, cell phones, and other systems where battery/DC current monitoring is critical. High-side current monitoring is especially useful in battery-powered systems since it does not interfere with the ground path of the battery charger. The 0 to +28V input common-mode range is independent of the supply voltage, which ensures that the current-sense feedback remains viable even when connected to a battery pack in deep discharge.

The comparator output of the MAX4373/MAX4374/MAX4375 is latched to provide a turn-off flag that doesn't oscillate. In addition, the MAX4374/MAX4375 contain a second comparator for use in window-detection functions. The MAX4373/MAX4374/MAX4375 are available in three different gain versions (T = +20V/V, F = +50V/V, H = +100V/V) and use an external sense resistor to set the sensitivity of the input voltage to the load current. These features offer a high level of integration, resulting in a simple and compact current-sense solution.

The MAX4373/MAX4374/MAX4375 operate from a single +2.7V to +28V supply and consume 50µA. They are specified for the extended operating temperature range (-40°C to +85°C) and are available in 8-pin and 10-pin µMAX® packages.

## Applications

Notebook Computers  
Portable/Battery-Powered Systems  
Smart Battery Packs/Chargers  
Cell Phones  
Power-Management Systems  
General-System/Board-Level Current Monitoring  
Precision Current Sources

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Pin Configurations appear at end of data sheet.

## Features

- ◆ Current-Sense Amplifier plus Internal Comparator and Bandgap Reference with Improved Accuracy
- ◆ 50µA Supply Current
- ◆ Single +2.7V to +28V Operating Supply
- ◆ 1mV (max) Input Offset Voltage
- ◆ 2% (max) Full-Scale Accuracy
- ◆ Internal Bandgap Reference (±1.6% Accuracy)
- ◆ Latching Comparator Output
- ◆ Three Gain Versions Available (+20V/V, +50V/V, +100V/V)
- ◆ High Accuracy +2V to +28V Common-Mode Range, Functional Down to 0V, Independent of Supply Voltage

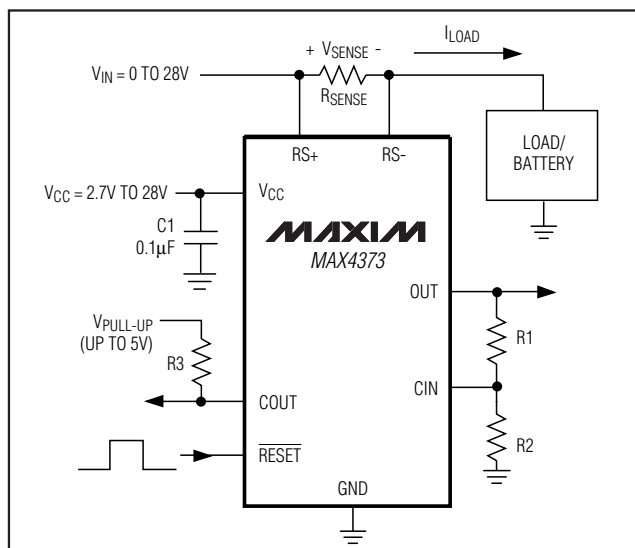
## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	GAIN (V/V)
MAX4373TEUA+	-40°C to +85°C	8 µMAX	+20
MAX4373TESA+	-40°C to +85°C	8 SO	+20
MAX4373FEUA+	-40°C to +85°C	8 µMAX	+50
MAX4373FESA+	-40°C to +85°C	8 SO	+50
MAX4373HEUA+	-40°C to +85°C	8 µMAX	+100
MAX4373HESA+	-40°C to +85°C	8 SO	+100

+Denotes a lead(Pb)-free/RoHS-compliant package.

Ordering Information continued at end of data sheet.

## Typical Operating Circuit



# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## ABSOLUTE MAXIMUM RATINGS

V <sub>CC</sub> , RS+, RS- to GND	-0.3V to +30V	8-Pin μMAX (derate 4.1mW/°C above +70°C)	0.330mW
OUT to GND	-0.3V to the lesser of (V <sub>CC</sub> + 0.3V) or +15V	8-Pin SO (derate 5.9mW/°C above +70°C)	0.471mW
CIN1, CIN2, RESET to GND	-0.3V to the lesser of (V <sub>CC</sub> + 0.3V) or +12V	10-Pin μMAX (derate 5.6mW/°C above +70°C)	0.444mW
Differential Input Voltage (V <sub>RS+</sub> - V <sub>RS-</sub> )	±0.3V	14-Pin SO (derate 8.3mW/°C above +70°C)	0.667mW
COU1, COU2 to GND	-0.3V to +6.0V	Operating Temperature Range	-40°C to +85°C
Current into Any Pin	±10mA	Junction Temperature	+150°C
		Storage Temperature Range	-65°C to +150°C
		Lead Temperature (soldering, 10s)	+300°C
		Soldering Temperature (Reflow)	+260°C

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = +2.7V to +28V, V<sub>RS+</sub> = 0 to +28V, V<sub>SENSE</sub> = 0V, V<sub>RESET</sub> = 0V, R<sub>LOAD</sub> = 1MΩ, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS	
Operating Voltage Range (Note 2)	V <sub>CC</sub>			2.7		28	V	
Common-Mode Input Range (Note 3)	V <sub>CMR</sub>			0		28	V	
Common-Mode Rejection	CMR	V <sub>RS+</sub> > 2V			85		dB	
Supply Current	I <sub>CC</sub>	V <sub>RS+</sub> > 2V, V <sub>SENSE</sub> = 5mV			50	100	μA	
Leakage Current	I <sub>RS+</sub> , I <sub>RS-</sub>	V <sub>CC</sub> = 0V			±0.015	±0.5	μA	
Input Bias Current	I <sub>RS+</sub>	V <sub>RS+</sub> > 2V		0		2.5	μA	
		V <sub>RS+</sub> ≤ 2V		-25		2.0		
	I <sub>RS-</sub>	V <sub>RS+</sub> > 2V		0		4		
		V <sub>RS+</sub> ≤ 2V		-50		4		
Full-Scale Sense Voltage (Note 4)	V <sub>SENSE</sub>	Gain = +20V/V, +50V/V		150	170		mV	
		Gain = +100V/V		100	120			
Input Offset Voltage	V <sub>OS</sub>	V <sub>CC</sub> = V <sub>RS+</sub> = 12V (Note 11)		T <sub>A</sub> = +25°C		0.1	1	mV
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			2	
Total OUT Voltage Error (Note 5)	V <sub>OUT</sub>	V <sub>SENSE</sub> = 100mV (Note 6)	V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V	T <sub>A</sub> = +25°C		±0.30	±2	%
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			±3	
			V <sub>CC</sub> = 28V, V <sub>RS+</sub> = 28V	T <sub>A</sub> = +25°C		±0.35	±2	
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>			±3	
		V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 0.1V				±5.0		
V <sub>SENSE</sub> = 6.25mV, V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V (Note 7)				±5.0				
OUT Voltage Low	V <sub>OUT</sub>	V <sub>CC</sub> = 2.7V		I <sub>OUT</sub> = 10μA		2.5	mV	
				I <sub>OUT</sub> = 100μA		8.5		65
OUT Voltage High	V <sub>CC</sub> - V <sub>OH</sub>	V <sub>CC</sub> = 2.7V, I <sub>OUT</sub> = -500μA				0.25	V	

# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

MAX4373/MAX4374/MAX4375

## ELECTRICAL CHARACTERISTICS (continued)

(V<sub>CC</sub> = +2.7V to +28V, V<sub>RS+</sub> = 0 to +28V, V<sub>SENSE</sub> = 0V, V<sub>RESET</sub> = 0V, R<sub>LOAD</sub> = 1MΩ, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS	
-3dB Bandwidth	BW	V <sub>RS+</sub> = 12V, V <sub>CC</sub> = 12V, C <sub>LOAD</sub> = 10pF	V <sub>SENSE</sub> = 100mV, Gain = +20V/V		200		kHz	
			V <sub>SENSE</sub> = 100mV, Gain = +50V/V		120			
			V <sub>SENSE</sub> = 100mV, Gain = +100V/V		110			
			V <sub>SENSE</sub> = 6.25mV		50			
Gain	A <sub>V</sub>	MAX437_T			+20		V/V	
		MAX437_F			+50			
		MAX437_H			+100			
Gain Accuracy	ΔA <sub>V</sub>	V <sub>SENSE</sub> = 20mV to 150mV; V <sub>CC</sub> = 12V; V <sub>RS+</sub> = 12V; Gain = 20, 50	T <sub>A</sub> = +25°C		±0.3	±1.7	%	
			T <sub>A</sub> = -40°C to +85°C					±2.7
		V <sub>SENSE</sub> = 20mV to 100mV, V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V, Gain = 100	T <sub>A</sub> = +25°C		±0.3	±1.7		
			T <sub>A</sub> = -40°C to +85°C					±2.7
OUT Settling Time to 1% of Final Value		Gain = +20V/V, V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V, C <sub>LOAD</sub> = 10pF	V <sub>SENSE</sub> = 6.25mV to 100mV		20		μs	
			V <sub>SENSE</sub> = 100mV to 6.25mV		20			
Capacitive Load Stability		No sustained oscillations			1000		pF	
OUT Output Resistance	R <sub>OUT</sub>	V <sub>SENSE</sub> = 100mV			1.5		Ω	
Power-Supply Rejection	PSR	V <sub>OUT</sub> = 2V, V <sub>RS+</sub> > 2V		72	87		dB	
Power-Up Time to 1% of Final Value		V <sub>SENSE</sub> = 100mV, C <sub>LOAD</sub> = 10pF, V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V			0.5		ms	
Saturation Recovery Time (Note 8)		V <sub>CC</sub> = 12V, V <sub>RS+</sub> = 12V, C <sub>LOAD</sub> = 10pF			0.1		ms	
<b>COMPARATOR</b> (Note 9)								
Comparator Threshold	V <sub>TH</sub>	T <sub>A</sub> = +25°C		590	600	610	mV	
		T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		586		614		
Comparator Hysteresis					-9		mV	
Input Bias Current	I <sub>B</sub>				±2.2	±15	nA	
Propagation Delay		C <sub>L</sub> = 10pF, R <sub>L</sub> = 10kΩ pull-up to 5V, 5mV of overdrive			4		μs	
Output Low Voltage	V <sub>OL</sub>	I <sub>SINK</sub> = 1mA				0.6	V	

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## ELECTRICAL CHARACTERISTICS (continued)

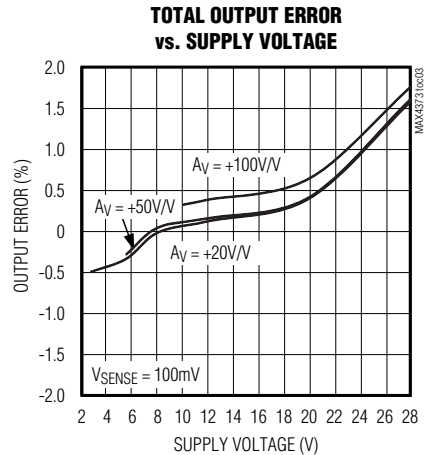
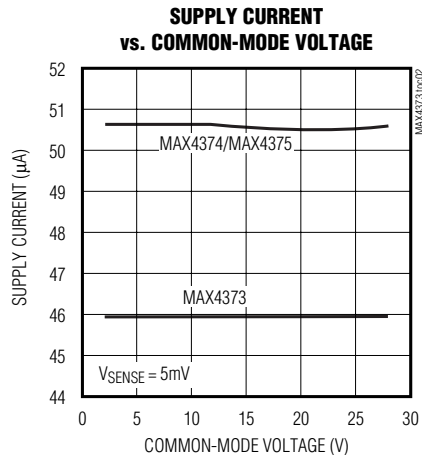
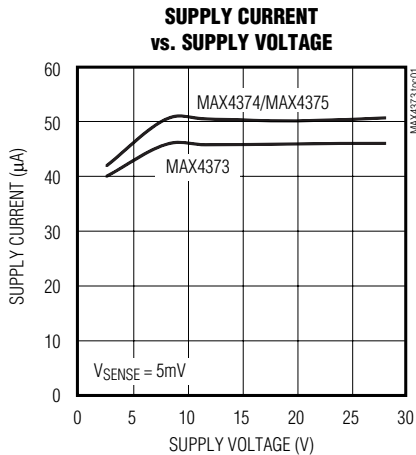
( $V_{CC} = +2.7V$  to  $+28V$ ,  $V_{RS+} = 0$  to  $+28V$ ,  $V_{SENSE} = 0V$ ,  $V_{RESET} = 0V$ ,  $R_{LOAD} = 1M\Omega$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Leakage Current		$V_{CC} = 28V$ , $V_{PULL-UP} = 5V$ (Note 10)			1	$\mu A$
$\overline{RESET}$ Input High Voltage	$V_{IH}$		2.0			V
$\overline{RESET}$ Input Low Voltage	$V_{IL}$				0.8	V
Logic Input Current	$I_{IL}$ , $I_{IH}$	$V_{IL} = 0$ , $V_{IH} = 5.5V$ , $V_{CC} = 28V$	-0.5		0.5	$\mu A$
Minimum $\overline{RESET}$ Pulse Width	$t_{RPW}$			1.5		$\mu s$
$\overline{RESET}$ Propagation Delay	$t_{RPD}$			3		$\mu s$

- Note 1:** All devices are 100% production tested at  $T_A = +25^\circ C$ . All temperature limits are guaranteed by design.
- Note 2:** Guaranteed by PSR test.
- Note 3:** Guaranteed by OUT Voltage Error test.
- Note 4:** Guaranteed by Gain Accuracy test. Output voltage is internally clamped not to exceed 12V.
- Note 5:** Total OUT Voltage Error and Full-Scale Accuracy are the sum of gain and offset voltage errors.
- Note 6:** Measured at  $I_{OUT} = -500\mu A$  ( $R_{LOAD} = 4k\Omega$  for gain of  $+20V/V$ ,  $R_{LOAD} = 10k\Omega$  for gain of  $+50V/V$ ,  $R_{LOAD} = 20k\Omega$  for gain of  $+100V/V$ ).
- Note 7:**  $+6.25mV = 1/16$  of  $+100mV$  full-scale voltage.
- Note 8:** The device will not experience phase reversal when overdriven.
- Note 9:** All comparator tests are done with  $V_{RS+} = +12V$ .
- Note 10:**  $V_{PULL-UP}$  is defined as an externally applied voltage through a resistor to pull up the comparator output.
- Note 11:**  $V_{OS}$  is extrapolated from the gain accuracy test.

## Typical Operating Characteristics

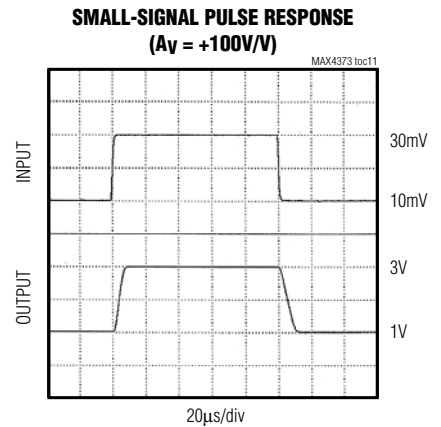
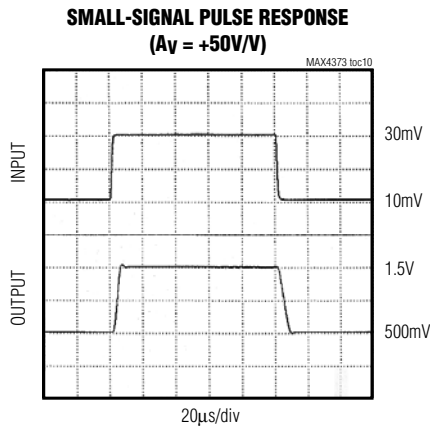
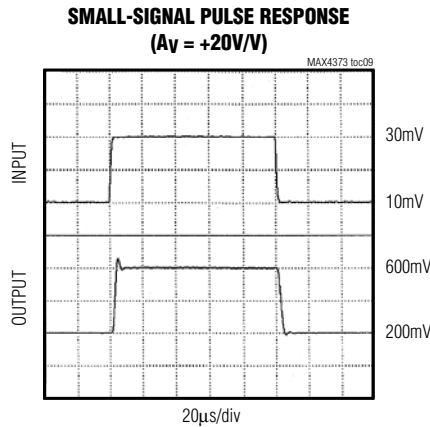
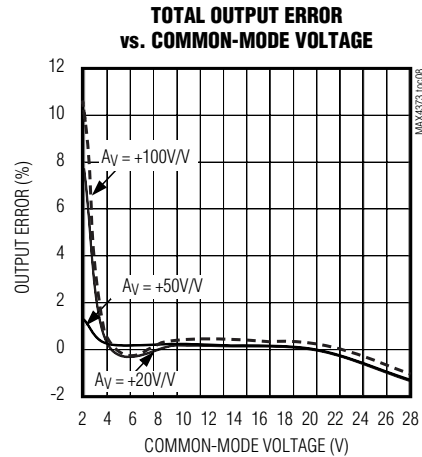
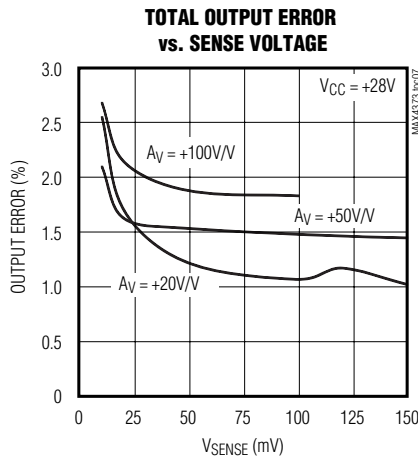
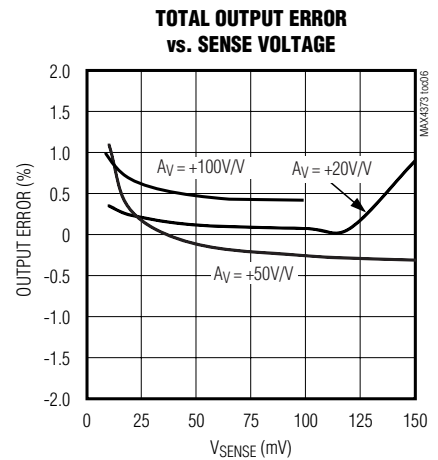
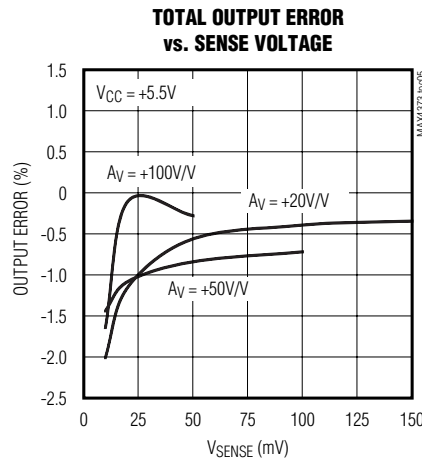
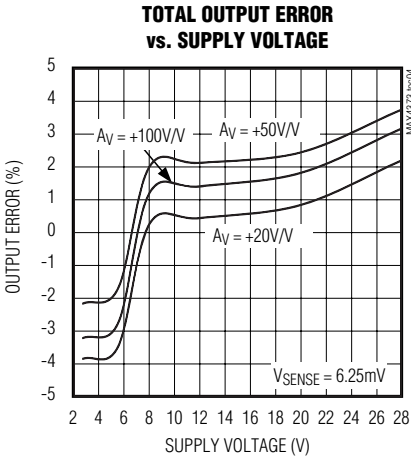
( $V_{RS+} = +12V$ ,  $V_{CC} = +12V$ ,  $R_{LOAD} = 1M\Omega$ ,  $V_{RESET} = 0V$ ,  $V_{SENSE} = 100mV$ ,  $V_{PULL-UP} = +5V$ ,  $R_{PULL-UP} = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## Typical Operating Characteristics (continued)

( $V_{RS+} = +12V$ ,  $V_{CC} = +12V$ ,  $R_{LOAD} = 1M\Omega$ ,  $V_{RESET} = 0V$ ,  $V_{SENSE} = 100mV$ ,  $V_{PULL-UP} = +5V$ ,  $R_{PULL-UP} = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



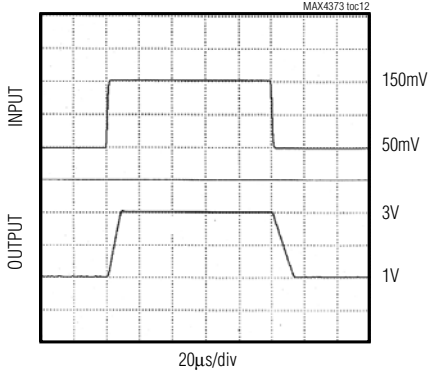
MAX4373/MAX4374/MAX4375

# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

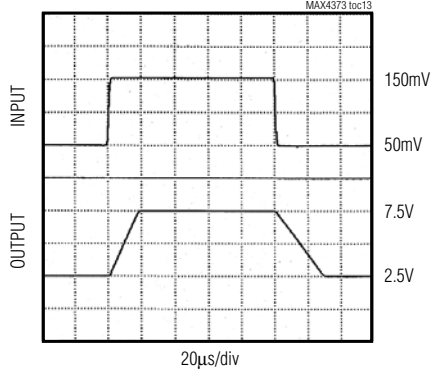
## Typical Operating Characteristics (continued)

( $V_{RS+} = +12V$ ,  $V_{CC} = +12V$ ,  $R_{LOAD} = 1M\Omega$ ,  $V_{RESET} = 0V$ ,  $V_{SENSE} = 100mV$ ,  $V_{PULL-UP} = +5V$ ,  $R_{PULL-UP} = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

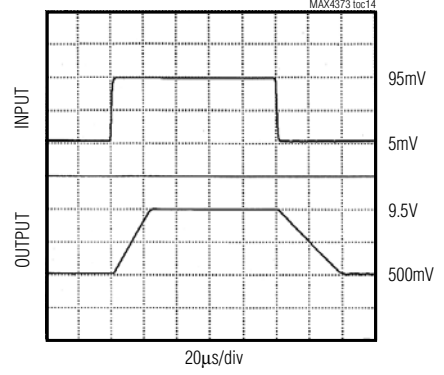
**LARGE-SIGNAL PULSE RESPONSE**  
( $A_V = +20V/V$ )



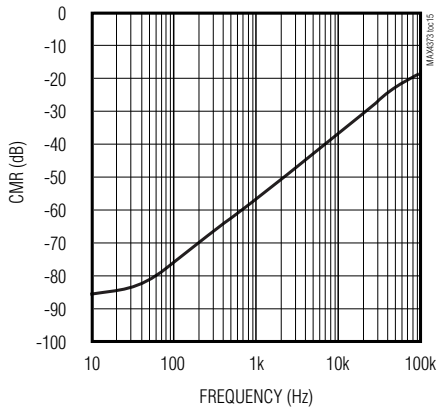
**LARGE-SIGNAL PULSE RESPONSE**  
( $A_V = +50V/V$ )



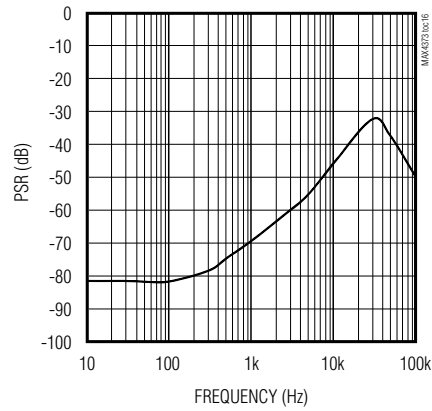
**LARGE-SIGNAL PULSE RESPONSE**  
( $A_V = +100V/V$ )



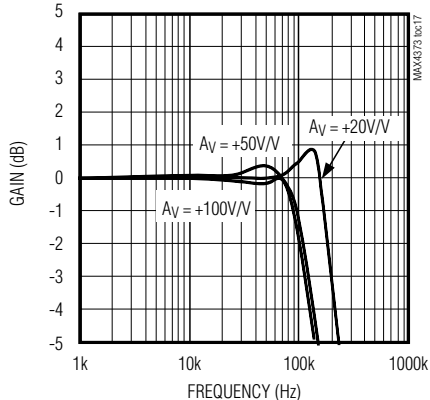
**COMMON-MODE REJECTION**  
vs. FREQUENCY



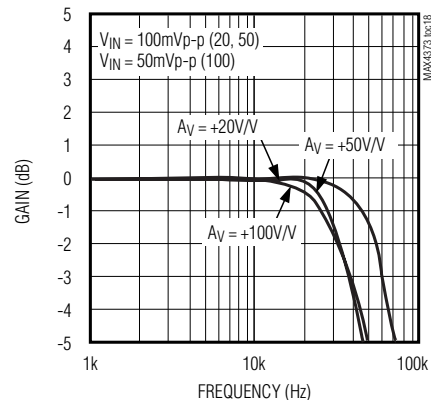
**POWER-SUPPLY REJECTION**  
vs. FREQUENCY



**SMALL-SIGNAL GAIN**  
vs. FREQUENCY



**LARGE-SIGNAL GAIN**  
vs. FREQUENCY

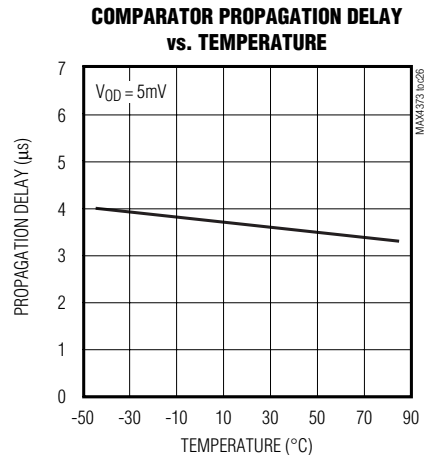
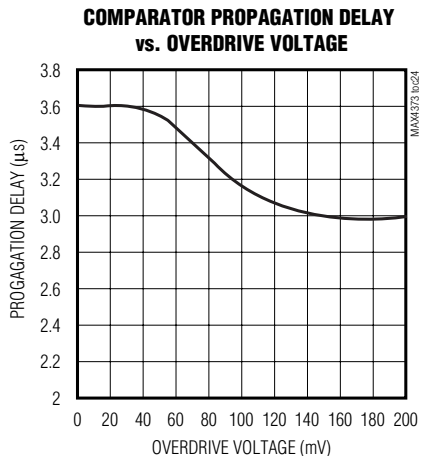
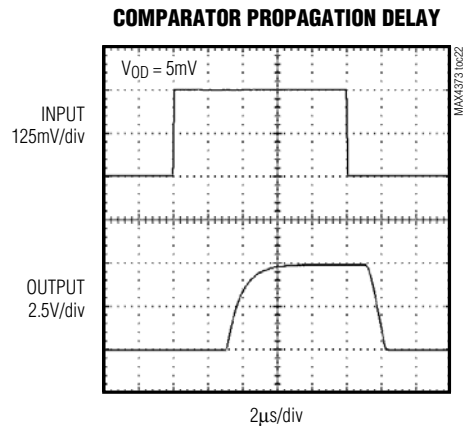
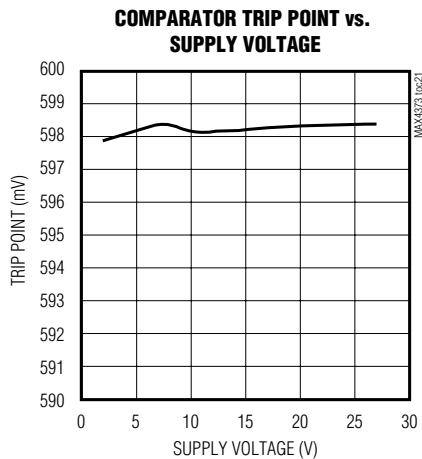
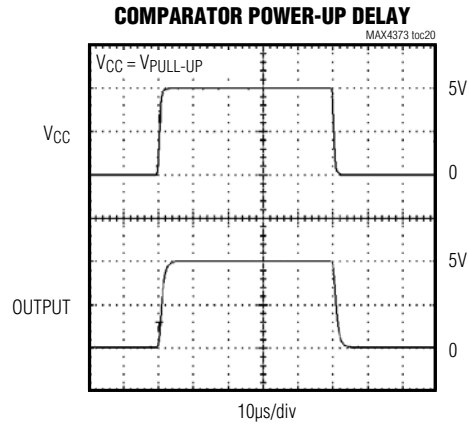
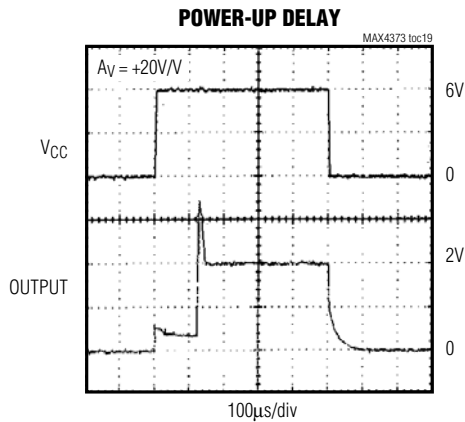


# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## Typical Operating Characteristics (continued)

( $V_{RS+} = +12V$ ,  $V_{CC} = +12V$ ,  $R_{LOAD} = 1M\Omega$ ,  $V_{RESET} = 0V$ ,  $V_{SENSE} = 100mV$ ,  $V_{PULL-UP} = +5V$ ,  $R_{PULL-UP} = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

MAX4373/MAX4374/MAX4375

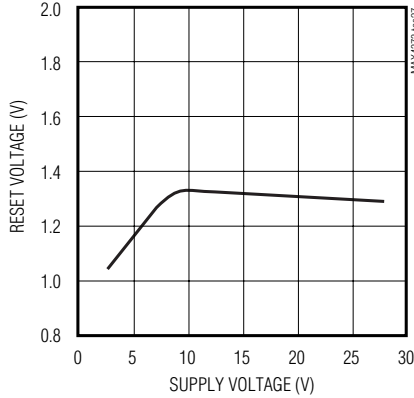


# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

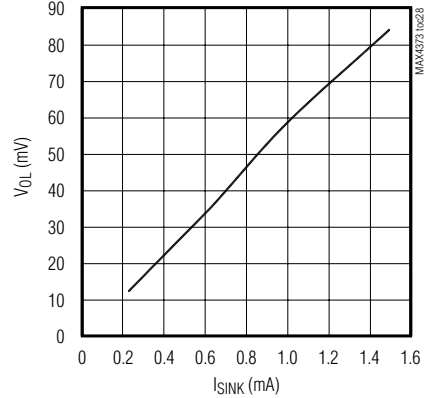
## Typical Operating Characteristics (continued)

( $V_{RS+} = +12V$ ,  $V_{CC} = +12V$ ,  $R_{LOAD} = 1M\Omega$ ,  $V_{RESET} = 0V$ ,  $V_{SENSE} = 100mV$ ,  $V_{PULL-UP} = +5V$ ,  $R_{PULL-UP} = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

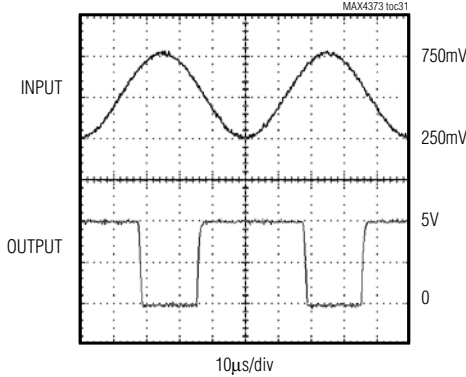
**COMPARATOR RESET VOLTAGE vs. SUPPLY VOLTAGE**



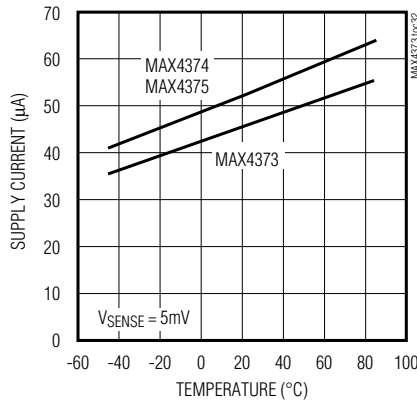
**COMPARATOR  $V_{OL}$  vs.  $I_{SINK}$**



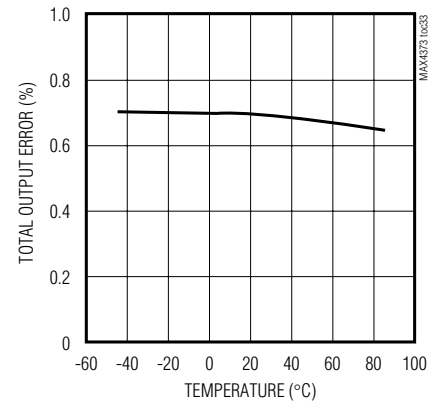
**COMPARATOR AC RESPONSE**



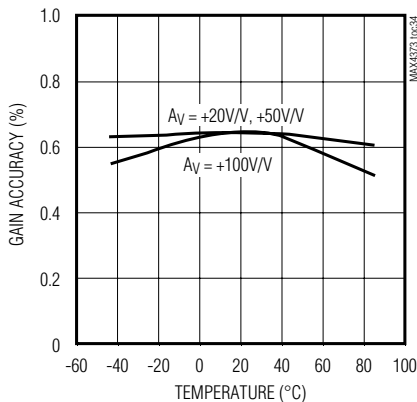
**SUPPLY CURRENT vs. TEMPERATURE**



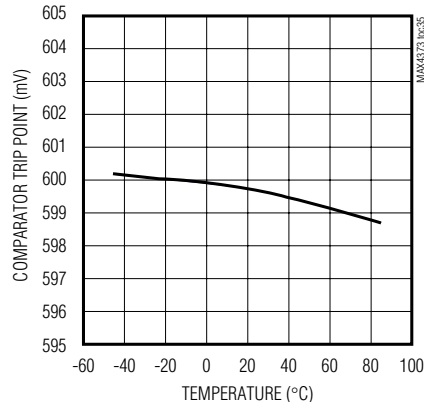
**TOTAL OUTPUT ERROR vs. TEMPERATURE**



**GAIN ACCURACY vs. TEMPERATURE**



**COMPARATOR TRIP POINT vs. TEMPERATURE**





# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## Pin Description

MAX4373/MAX4374/MAX4375

PIN			NAME	FUNCTION
MAX4373	MAX4374/MAX4375			
$\mu$ MAX/SO	$\mu$ MAX	SO		
1	1	1	V <sub>CC</sub>	Supply Voltage Input
2	2	2	OUT	Voltage Output. V <sub>OUT</sub> is proportional to V <sub>SENSE</sub> (V <sub>RS+</sub> - V <sub>RS-</sub> ).
3	3	4	CIN1	Comparator Input 1. Positive input of an internal comparator. The negative terminal is connected to a 0.6V internal reference.
—	4	5	CIN2	Comparator Input 2. Terminal of a second internal comparator. The positive terminal for the MAX4374 and the negative terminal for the MAX4375. The other terminal is connected to a 0.6V internal reference.
4	5	7	GND	Ground
5	6	8	RESET	Reset Input. Resets the output latch of the comparator at CIN1.
6	8	11	COU1	Open-Drain Comparator Output. Latching output of the comparator controlled by CIN1. Connect RESET to GND to disable the latch.
—	7	10	COU2	Open-Drain Comparator Output. Output of the second unlatched internal comparator.
7	9	13	RS-	Load-Side Connection for the External Sense Resistor
8	10	14	RS+	Power Connection to the External Sense Resistor
—	—	3, 6, 9, 12	N.C.	No Connection. Not internally connected.

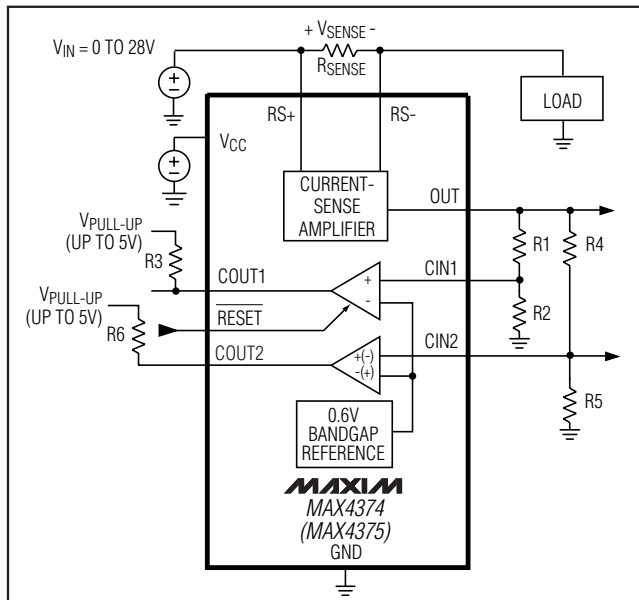


Figure 1. Functional Diagram

## Detailed Description

The MAX4373 high-side current-sense supervisor features a high-side current-sense amplifier, bandgap reference, and comparator with latching output to monitor a supply for an overcurrent condition (Figure 1). The latching output allows the comparator to shut down a power supply without oscillations. The MAX4374/MAX4375 offer an additional comparator to allow window detection of the current.

### Current-Sense Amplifier

The internal current-sense amplifier features a 0V to +28V input common-mode range that is independent of the supply voltage. With this feature, the device can monitor the output current of a battery in deep discharge and also high-side current-sensing voltages exceeding V<sub>CC</sub>.

The current-sense amplifier is also suitable for low-side current sensing. However, the total output voltage error will increase when V<sub>RS+</sub> falls below 2V, as shown in the *Electrical Characteristics* and *Typical Operating Characteristics*.

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## Internal Comparator(s)

The MAX4373/MAX4374/MAX4375 contain an open-drain output comparator for current limiting. The comparator's negative terminal is connected to the internal 600mV reference. The positive terminal is accessible at CIN1. When RESET is high, the internal latch is active, and once CIN1 rises above 600mV, the output latches into the open state. Pulsing RESET low for 1.5µs resets the latch, and holding RESET low makes the latch transparent. See *RESET at Power-Up* section

The MAX4374/MAX4375 contain an additional open-drain comparator. The negative terminal of the MAX4374's additional comparator and the positive terminal of the MAX4375's additional comparator are connected to the internal 600mV reference as shown in Figure 1. The positive terminal of the MAX4374's additional comparator and the negative terminal of the MAX4375's additional comparator are accessible at CIN2.

## Applications Information

### Recommended Component Values

Ideally, the maximum load current will develop the full-scale sense voltage across the current-sense resistor. Choose the gain version needed to yield the maximum output voltage required for the application:

$$V_{OUT} = V_{SENSE} \times A_V$$

where  $V_{SENSE}$  is the full-scale sense voltage, 150mV for gains of +20V/V and +50V/V or 100mV for a gain of +100V/V.  $A_V$  is the gain of the device. The minimum supply voltage is  $V_{OUT} + 0.25V$ . Note that the output for the gain of +100V/V is internally clamped at 12V. Calculate the maximum value for  $R_{SENSE}$  so that the differential voltage across  $RS+$  and  $RS-$  does not exceed the full-scale sense voltage:

$$R_{SENSE(MAX)} = \frac{V_{SENSE(MAX)}}{I_{LOAD}}$$

Choose the highest value resistance possible to maximize  $V_{SENSE}$  and thus minimize total output error.

In applications monitoring high current, ensure that  $R_{SENSE}$  is able to dissipate its own  $I^2R$  loss. If the resistor's power dissipation is exceeded, its value may drift or it may fail altogether, causing a differential voltage across the terminals in excess of the absolute maximum ratings. Use resistors specified for current-sensing applications.

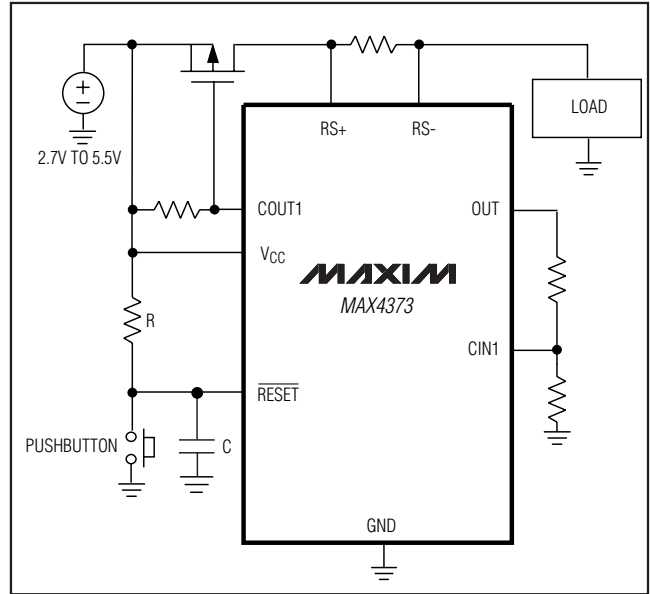


Figure 2. MAX4373 Overcurrent Protection Circuit

### Overcurrent Protection Circuit

The overcurrent protection circuit, shown in Figure 2, uses the MAX4373 to control an external P-channel MOSFET. The MOSFET controlled by the MAX4373 opens the current path under overload conditions. The latched output of the MAX4373's comparator prevents the circuit from oscillating, and the pushbutton resets the current path after an overcurrent condition.

### Window Detection Circuit

Figure 3 shows a simple circuit suitable for window detection. Let  $I_{OVER}$  be the minimum load current

$$I_{UNDER} = \frac{V_{REF}}{R_{SENSE} \times A_V} \left( \frac{R_4 + R_5}{R_5} \right)$$

and

$$I_{OVER} = \frac{V_{REF}}{R_{SENSE} \times A_V} \left( \frac{R_1 + R_2}{R_2} \right)$$

( $I_{LOAD}$ ) required to cause a low state at COUT2, and let  $I_{UNDER}$  be the maximum load current required to cause a high state at COUT1:

where  $A_V$  is the gain of the device and  $V_{REF}$  is the internal reference voltage (0.6V typ).

Connect COUT1 and COUT2; the resulting comparator output will be high when the current is inside the current window and low when the current is outside the window. The window is defined as load currents less than  $I_{OVER}$  and greater than  $I_{UNDER}$ .

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MAX4373/MAX4374/MAX4375

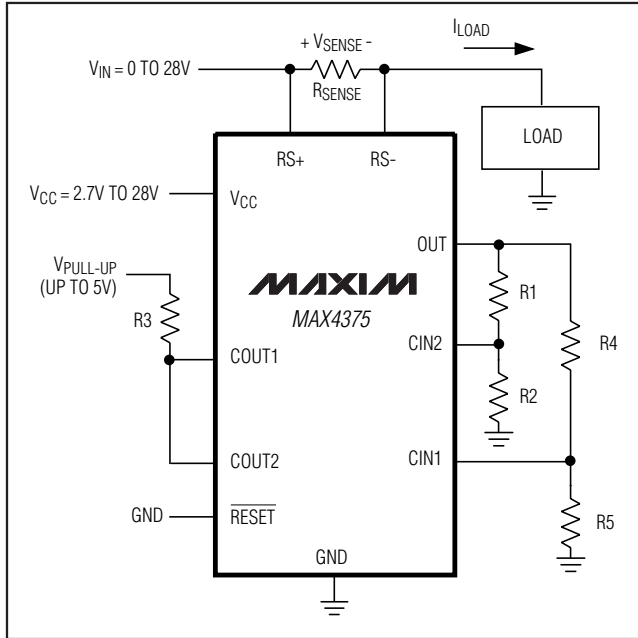


Figure 3. MAX4375 Window Detector

### Power-Supply Bypassing

It is recommended that VCC be bypassed to GND with at least a 0.1µF ceramic capacitor to isolate the IC from supply voltage transients. It is possible that plugging in/out a battery or AC adapter/charger could cause large, fast line transients (>5V/µs) at VCC. The simplest solution is to run VCC from a better regulated supply (+5V for example), since VCC and RS+ (or RS-) do not have to be connected together.

For high-speed VCC transients, another solution is to add a resistor in series with the VCC pin and a 0.1µF capacitor to create an RC time constant to slow the rise time of the transient. Since these current-sense amplifiers consume less than 100µA, even a 2.5kΩ resistor only drops an extra 250mV at VCC. For most applications with fast transients, 1kΩ in conjunction with a 0.1µF bypass capacitor works well.

### RESET at Power-Up

The RESET pin is used to control the latch function of comparator 1. Holding RESET low (<0.8V) makes the latch transparent and COUT1 will respond to changes at CIN1, above and below the internal 600mV reference threshold voltage. When RESET is high (>2.0V), once CIN1 rises above 600mV, COUT1 latches into the open-drain OFF state and remains in this state even if CIN1 drops below 600mV. Pulsing RESET low for at least 1.5µs resets the latch.

There is no internal circuitry to control the reset function during power-up. To prevent false latching, RESET must be held low until the VCC power has risen above the 2.7V minimum operating supply voltage. This is easily accomplished when RESET is driven under µC or logic gate control. However, if RESET is to be always connected high, add an RC between VCC, RESET and GND (see Figure 2). Note that RESET cannot exceed VCC + 0.3V or +12V, whichever is less.

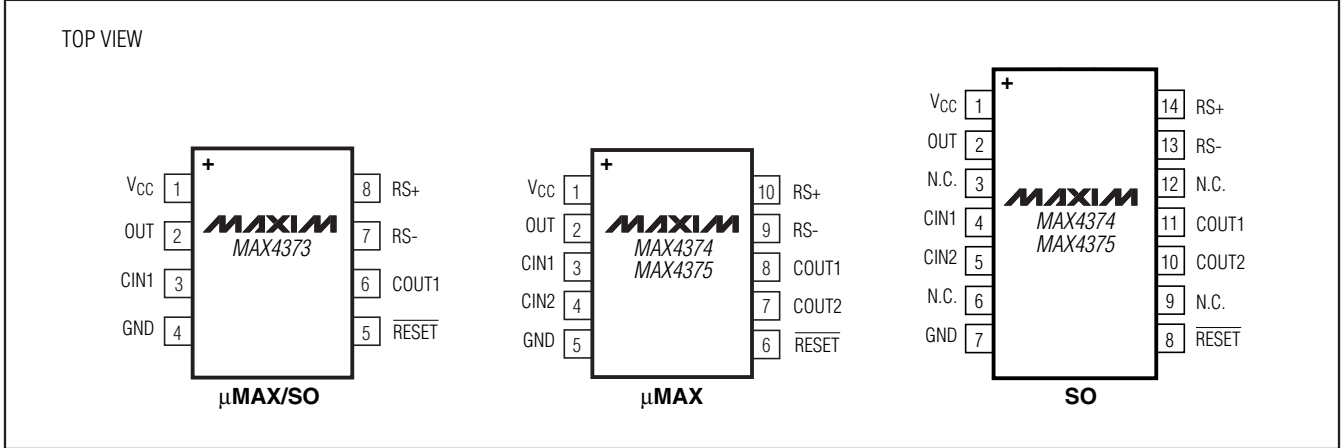
The following formula can be used to determine the appropriate RC value.

$$RC = \frac{T}{\ln(2.7V/(2.7V - 0.8V))} = \frac{T}{0.3514}$$

where T is the maximum time for VCC to reach 2.7V and 0.8V is the maximum RESET logic low voltage. For example, a 470kΩ resistor and 0.22µF capacitor will keep RESET low during a power-up time of up to 36ms. A faster power-up time is also safe with the calculated R and C since the capacitor will have even less time to charge.

# Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

## Pin Configurations



## Ordering Information (continued)

PART	TEMP RANGE	PIN-PACKAGE	GAIN (V/V)
MAX4374TEUB+	-40°C to +85°C	10 µMAX	+20
MAX4374TESD+	-40°C to +85°C	14 SO	+20
MAX4374FEUB+	-40°C to +85°C	10 µMAX	+50
MAX4374FESD+	-40°C to +85°C	14 SO	+50
MAX4374HEUB+	-40°C to +85°C	10 µMAX	+100
MAX4374HESD+	-40°C to +85°C	14 SO	+100
MAX4375TEUB+	-40°C to +85°C	10 µMAX	+20
MAX4375TESD+	-40°C to +85°C	14 SO	+20
MAX4375FEUB+	-40°C to +85°C	10 µMAX	+50
MAX4375FESD+	-40°C to +85°C	14 SO	+50
MAX4375HEUB+	-40°C to +85°C	10 µMAX	+100
MAX4375HESD+	-40°C to +85°C	14 SO	+100

+Denotes a lead(Pb)-free/RoHS-compliant package.

## Chip Information

SUBSTRATE CONNECTED TO GND

## Package Information

(For the latest package outline information and land patterns, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.)

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.	LAND PATTERN NO.
8 SOIC	S8+2	<a href="#">21-0041</a>	<a href="#">90-0096</a>
8 µMAX	U8+1	<a href="#">21-0036</a>	<a href="#">90-0092</a>
10 µMAX	U10+2	<a href="#">21-0061</a>	<a href="#">90-0330</a>
14 SOIC	S14+1	<a href="#">21-0041</a>	<a href="#">90-0096</a>

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## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
3	6/10	Clarified 0V to 2V is not a high-accuracy range for the device, added lead-free options and soldering temperature	1, 2, 12

MAX4373/MAX4374/MAX4375

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