

# CMOS Micro-Power Comparator plus Voltage Follower

The MC14578 is an analog building block consisting of a very-high input impedance comparator. The voltage follower allows monitoring the noninverting input of the comparator without loading.

Four enhancement-mode MOSFETs are also included on chip. These FETs can be externally configured as open-drain or totem-pole outputs. The drains have on-chip static-protecting diodes. Therefore, the output voltage must be maintained between  $V_{SS}$  and  $V_{DD}$ .

The chip requires one external component. A  $3.9\text{ M}\Omega \pm 10\%$  resistor must be connected from the  $R_{bias}$  pin to  $V_{DD}$ . This circuit is designed to operate in smoke detector systems that comply with UL217 and UL268 specifications.

## Features

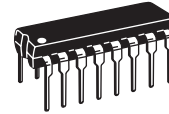
- Applications:
  - Pulse Shapers
  - Threshold Detectors
  - Low-Battery Detectors
  - Line-Powered Smoke Detectors
  - Liquid/Moisture Sensors
  - CO Detector and Micro Interface
- Operating Voltage Range: 3.5 to 14 V
- Operating Temperature Range:  $-30^{\circ}$  to  $70^{\circ}\text{C}$
- Input Current ( $I_{IN} + I_{Pin}$ ):  $\pm 1\text{ pA}$  @  $25^{\circ}\text{C}$  (DIP Only)
- Quiescent Current:  $10\text{ }\mu\text{A}$  @  $25^{\circ}\text{C}$
- Electrostatic Discharge (ESD) Protection Circuitry on All Pins

## ORDERING INFORMATION

Device	Temperature Range	Case No.	Package
MC14578P	$-30^{\circ}$ to $70^{\circ}\text{C}$	648-08	Plastic Dip

## MC14578

### CMOS MICRO-POWER COMPARATOR PLUS VOLTAGE FOLLOWER



P SUFFIX  
PLASTIC DIP  
CASE 648-08

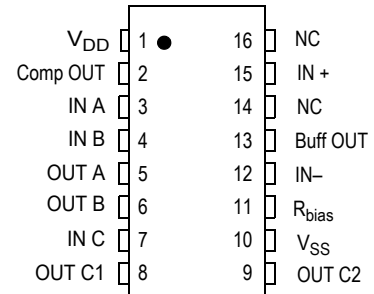


Figure 1. Pin Connections

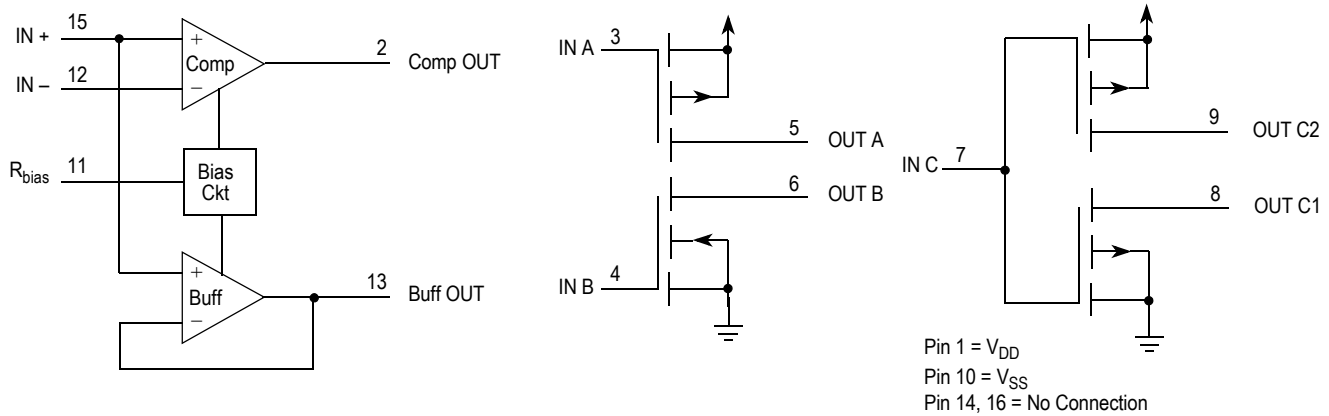


Figure 2. Block Diagram

**Table 1. Maximum Ratings<sup>(1)</sup>**  
 (Voltages Referenced to  $V_{SS}$ )

Rating	Symbol	Value	Unit
DC Supply Voltage	$V_{DD}$	-0.5 to +14	V
DC Input Voltage	$V_{in}$	-0.5 to $V_{DD} + 0.5$	V
DC Output Voltage	$V_{out}$	-0.5 to $V_{DD} + 0.5$	V
DC Input Current, Except IN +	$I_{in}$	$\pm 10$	mA
DC Output Current, IN +	$I_{in}$	$\pm 1.0$	mA
DC Output Current, per Pin	$I_{out}$	$\pm 25$	mA
DC Supply Current, $V_{DD}$ and $V_{SS}$ Pins	$I_{DD}$	$\pm 50$	mA
Power Dissipation, per Package	$P_D$	500	mW
Storage Temperature	$T_{stg}$	-65 to +150	$^{\circ}C$
Lead Temperature (10-Second Soldering)	$T_L$	260	$^{\circ}C$

1. Maximum Ratings are those values beyond which damage to the device may occur. This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

**Table 2. Electrical Characteristics**

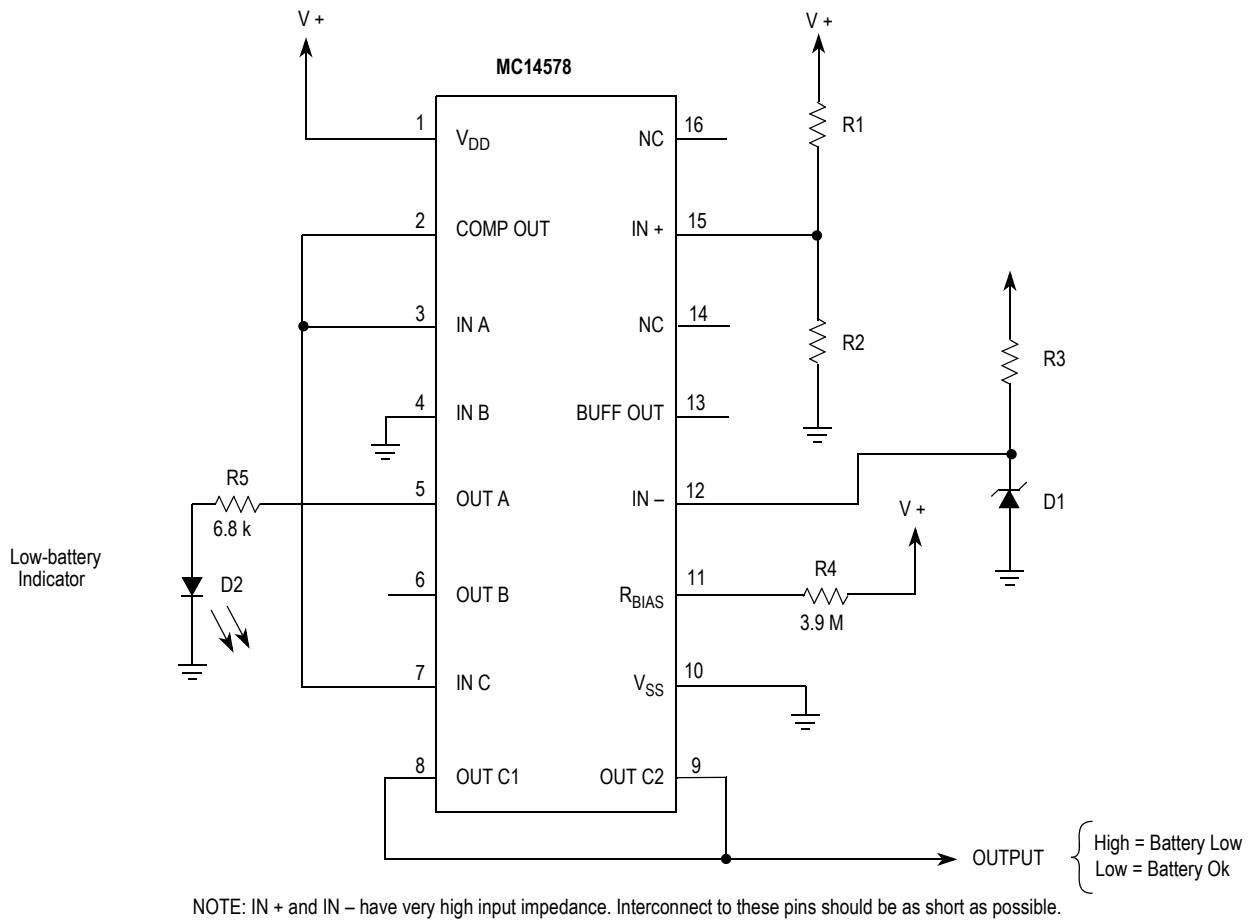
 (Voltages Referenced to  $V_{SS}$ ,  $R_{bias} = 3.9\text{ M}\Omega$  to  $V_{DD}$ ,  $T_A = -30^\circ$  to  $70^\circ\text{C}$  Unless Otherwise Indicated)

Characteristic	Symbol	Test Condition	$V_{DD}$ $V_{DC}$	Guaranteed Limit	Unit
Power Supply Voltage Range	$V_{DD}$		—	3.5 to 14.0	V
Maximum Low-Level Input Voltage, MOSFETs Wired as Inverters; i.e., IN A tied to IN B, OUT A to OUT B, OUT C1 to OUT C2	$V_{IL}$	$V_{out} = 9.0\text{ V}$ , $ I_{out}  < 1\text{ }\mu\text{A}$	10.0	2.0	V
Minimum High-Level Input voltage, MOSFETs Wired as Inverters; i.e., IN A tied to IN B, OUT A to OUT B, OUT C1 to OUT C2	$V_{IH}$	$V_{out} = 1.0\text{ V}$ , $ I_{out}  < 1\text{ }\mu\text{A}$	10.0	8.0	V
Comparator Input Offset Voltage	$V_{IO}$	$T_A = 25^\circ\text{C}$ , Over Common Mode Range	10.0	$\pm 50$	mV
		$T_A = 0^\circ$ to $50^\circ\text{C}$ , Over Common Mode Range	3.5 to 14.0	$\pm 75$	
Comparator Common Mode Voltage Range	$V_{CM}$		3.5 to 14.0	0.7 to $V_{DD} - 1.5$	V
Maximum Low-Level Comparator Output Voltage	$V_{OL}$	IN +: $V_{in} = V_{SS}$ , IN -: $V_{in} = V_{DD}$ , $I_{out} = 30\text{ }\mu\text{A}$	10.0	0.5	V
Minimum High-Level Comparator Output Voltage	$V_{OH}$	IN +: $V_{in} = V_{DD}$ , IN -: $V_{in} = V_{SS}$ , $I_{out} = -30\text{ }\mu\text{A}$	10.0	9.5	V
Buffer Amp Output Offset Voltage	$V_{OO}$	$R_{load} = 10\text{ M}\Omega$ to $V_{DD}$ or $V_{SS}$ , Over Common Mode Range	—	$\pm 100$	mV
Maximum Low-Level Input Voltage, MOSFETs Wired as Inverters; i.e., IN A tied to IN B, OUT A to OUT B, OUT C1 to OUT C2	$V_{OL}$	OUT C1, OUT C2, $I_{out} = 1.1\text{ mA}$	10.0	0.5	V
		OUT A, OUT B, $I_{out} = 270\text{ }\mu\text{A}$	10.0	0.5	V
Minimum High-Level Input Voltage, MOSFETs Wired as Inverters; i.e., IN A tied to IN B, OUT A to OUT B, OUT C1 to OUT C2	$V_{OH}$	OUT C1, OUT C2, $I_{out} = -1.1\text{ mA}$	10.0	9.5	V
		OUT A, OUT B, $I_{out} = 270\text{ }\mu\text{A}$	10.0	9.5	V
Maximum Input Leakage Current	$I_{in}$	IN + (DIP Only) $T_A = 25^\circ\text{C}$ , 40% R.H., $V_{in} = V_{SS}$ or $V_{DD}$	10.0	$\pm 1.0$	pA
		IN + (DIP Only) $T_A = 50^\circ\text{C}$ , $V_{in} = V_{SS}$ or $V_{DD}$	10.0	$\pm 6.0$	
		IN + (SOG), IN A, IN B, IN C, IN - $V_{in} = V_{SS}$ or $V_{DD}$	10.0	$\pm 40$	nA
Maximum Off-State MOSFET Leakage Current	$I_{OZ}$	IN A, IN C: $V_{in} = V_{DD}$ , OUT A, OUT C2: $V_{out} = V_{SS}$ or $V_{DD}$	10.0	$\pm 100$	nA
		IN B, IN C: $V_{in} = V_{SS}$ , OUT B, OUT C1: $V_{out} = V_{SS}$ or $V_{DD}$	10.0	$\pm 100$	
Maximum Quiescent Current	$I_{DD}$	$T_A = 25^\circ\text{C}$ IN A, IN B, IN C: $V_{in} = V_{SS}$ or $V_{DD}$ , $ V_{IN+} - V_{IN-}  = 100\text{ mV}$ $I_{out} = 0\text{ }\mu\text{A}$	10.0	10	$\mu\text{A}$
Maximum Input Capacitance	$C_{in}$	IN + Other Inputs $f = 1\text{ kHz}$	—	5.0	pF
			—	15	

## APPLICATIONS INFORMATION

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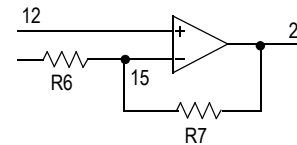
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**Figure 3. Low-Battery Detector**
**EXAMPLE VALUES**

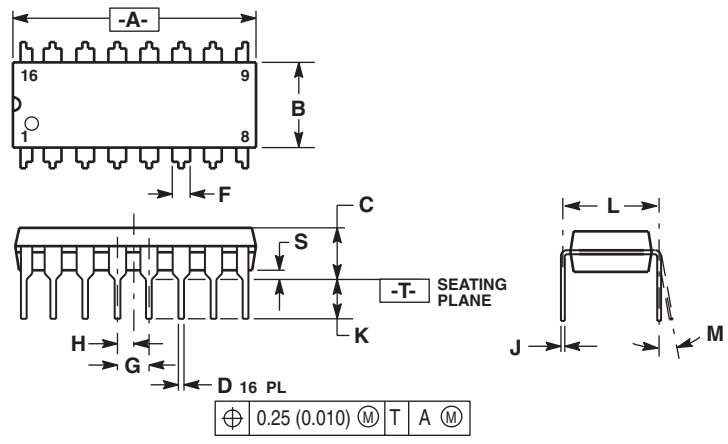
Near the switchpoint, the comparator output in the circuit of [Figure 3](#). may chatter or oscillate. This oscillation appears on the signal labelled OUTPUT. In some cases, the oscillation in the transition region will not cause problems. For example, an MPU reading OUTPUT could sample the signal two or three times to ensure a solid level is attained. But, in a low battery detector, this probably is not necessary.

To eliminate comparator chatter, hysteresis can be added as shown in [Figure 4](#). The circuit of [Figure 4](#). requires slightly more operating current than the [Figure 3](#). arrangement.

R1	R2	R3	Nominal Tip Point
470 kΩ	1.3 MΩ	20 kΩ	4.08 V
820 kΩ	1.2 MΩ	39 kΩ	5.05 V
1.2 MΩ	1.2 MΩ	62 kΩ	6.00 V


**Figure 4. Adding Hysteresis**

### PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0	10	0	10
S	0.020	0.040	0.51	1.01

- STYLE 1:  
 PIN 1: CATHODE  
 2: CATHODE  
 3: CATHODE  
 4: CATHODE  
 5: CATHODE  
 6: CATHODE  
 7: CATHODE  
 8: CATHODE  
 9: ANODE  
 10: ANODE  
 11: ANODE  
 12: ANODE  
 13: ANODE  
 14: ANODE  
 15: ANODE  
 16: ANODE
- STYLE 2:  
 PIN 1: COMMON DRAIN  
 2: COMMON DRAIN  
 3: COMMON DRAIN  
 4: COMMON DRAIN  
 5: COMMON DRAIN  
 6: COMMON DRAIN  
 7: COMMON DRAIN  
 8: COMMON DRAIN  
 9: GATE  
 10: SOURCE  
 11: GATE  
 12: SOURCE  
 13: GATE  
 14: SOURCE  
 15: GATE  
 16: SOURCE

**CASE 648-08  
 ISSUE R  
 16-LEAD PLASTIC DIP**

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**NOTES**

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