

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

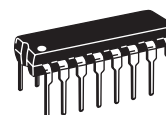
- Applications:
 - Pulse Shapers
 - Threshold Detectors
 - Low-Battery Detectors
 - Line-Powered Smoke Detectors
 - Liquid/Moisture Sensors
 - CO Detector and Micro Interface
- Operating Voltage Range: 3.5 to 14 V
- Operating Temperature Range: -30° to 70°C
- Input Current ($I_N + I_{Pin}$): $\pm 1\text{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

ORDERING INFORMATION

| Device | Temperature Range | Case No. | Package |
|----------|---------------------------------------|----------|-------------|
| MC14578P | -30° to 70°C | 648-08 | Plastic Dip |

MC14578

**CMOS
MICRO-POWER COMPARATOR
PLUS VOLTAGE FOLLOWER**



**P SUFFIX
PLASTIC DIP
CASE 648-08**

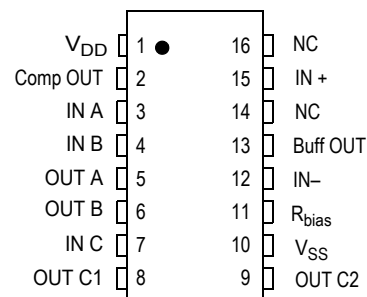


Figure 1. Pin Connections

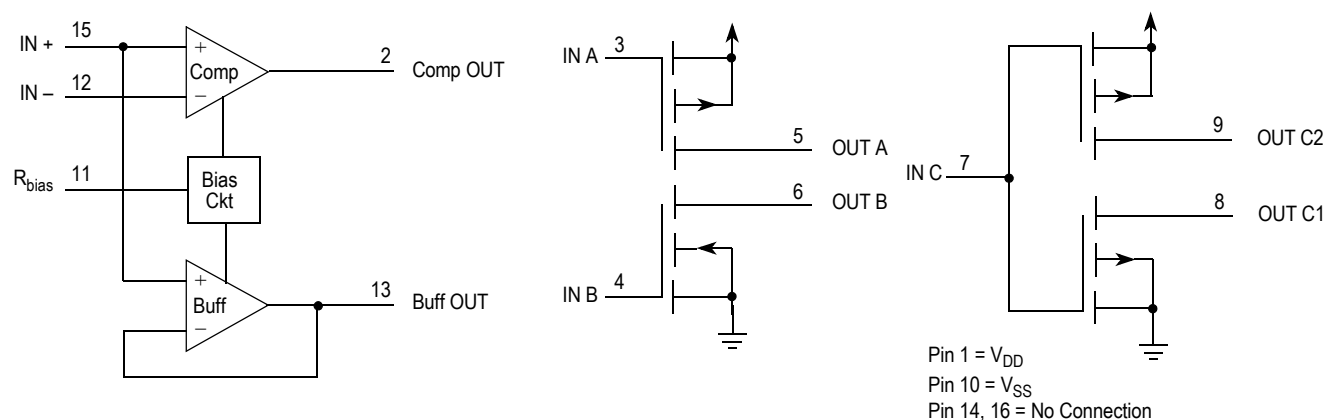


Figure 2. Block Diagram

Table 1. Maximum Ratings⁽¹⁾
 (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} | ± 10 | mA |
| DC Output Current, IN + | I_{in} | ± 1.0 | mA |
| DC Output Current, per Pin | I_{out} | ± 25 | mA |
| DC Supply Current, V_{DD} and V_{SS} Pins | I_{DD} | ± 50 | mA |
| Power Dissipation, per Package | P_D | 500 | mW |
| Storage Temperature | T_{stg} | -65 to +150 | °C |
| Lead Temperature (10-Second Soldering) | T_L | 260 | °C |

- 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°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} | $V_{out} = 9.0 \text{ V}$, $I_{out} < 1 \mu\text{A}$ | 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} | $V_{out} = 1.0 \text{ V}$, $I_{out} < 1 \mu\text{A}$ | 10.0 | 8.0 | V |
| Comparator Input Offset Voltage | V_{IO} | $T_A = 25^\circ\text{C}$, Over Common Mode Range | 10.0 | ± 50 | mV |
| | | $T_A = 0^\circ$ to 50°C , Over Common Mode Range | 3.5 to 14.0 | ± 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 -: $V_{in} = V_{DD}$, $I_{out} = 30 \mu\text{A}$ | 10.0 | 0.5 | V |
| Minimum High-Level Comparator Output Voltage | V_{OH} | IN +: $V_{in} = V_{DD}$, IN -: $V_{in} = V_{SS}$, $I_{out} = -30 \mu\text{A}$ | 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 | — | ± 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, $I_{out} = 270 \mu\text{A}$ | 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, $I_{out} = 270 \mu\text{A}$ | 10.0 | 9.5 | V |
| Maximum Input Leakage Current IN + (DIP Only) | I_{in} | $T_A = 25^\circ\text{C}$, 40% R.H., $V_{in} = V_{SS}$ or V_{DD} | 10.0 | ± 1.0 | pA |
| IN + (DIP Only) | | $T_A = 50^\circ\text{C}$, $V_{in} = V_{SS}$ or V_{DD} | 10.0 | ± 6.0 | |
| IN + (SOG), IN A, IN B, IN C, IN - | | $V_{in} = V_{SS}$ or V_{DD} | 10.0 | ± 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 | ± 100 | nA |
| | | IN B, IN C: $V_{in} = V_{SS}$, OUT B, OUT C1: $V_{out} = V_{SS}$ or V_{DD} | 10.0 | ± 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} , $I_{VIN+} - I_{VIN-} = 100 \text{ mV}$ $I_{out} = 0 \mu\text{A}$ | 10.0 | 10 | μA |
| Maximum Input Capacitance IN + Other Inputs | C_{in} | $f = 1 \text{ kHz}$ | — — | 5.0 15 | pF |

APPLICATIONS INFORMATION

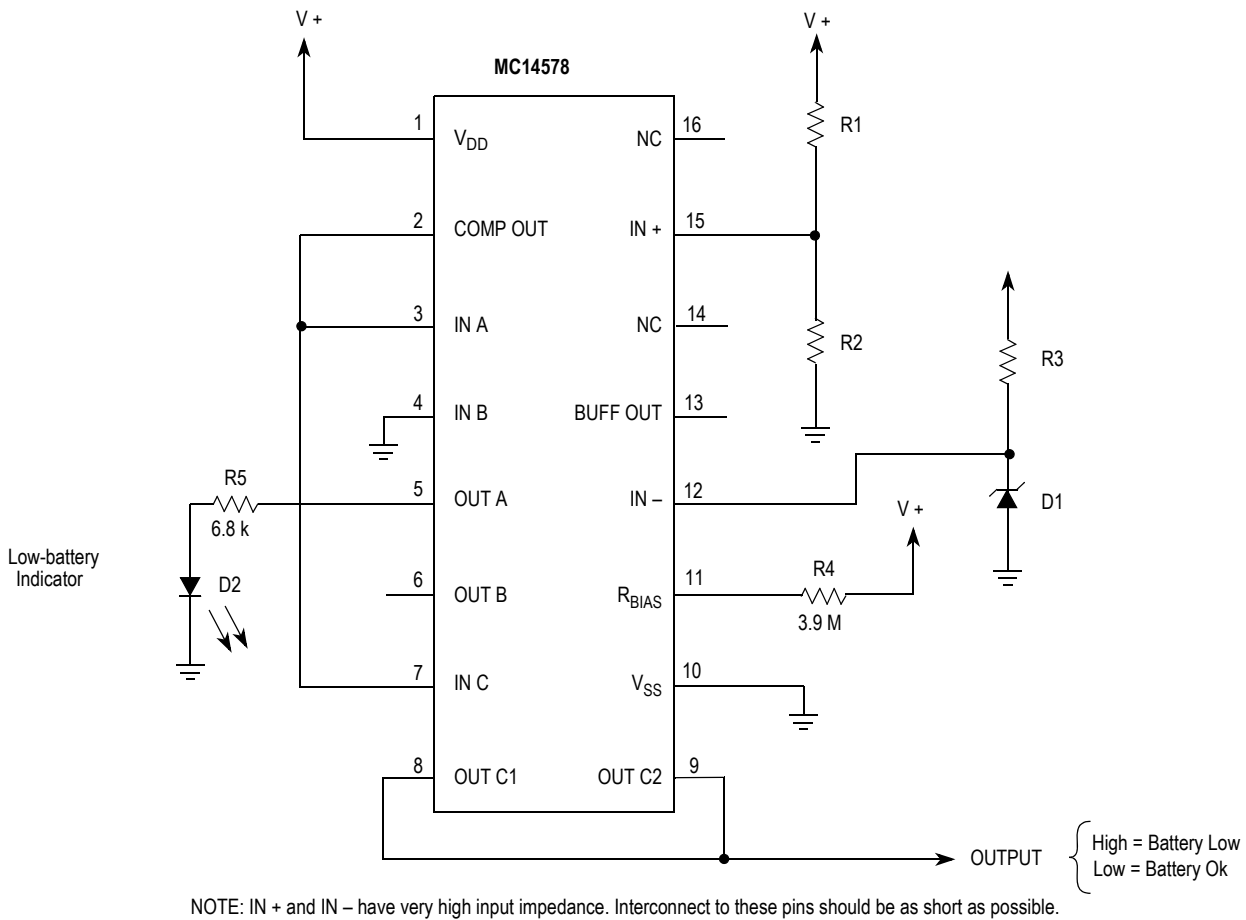


Figure 3. Low-Battery Detector

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 |

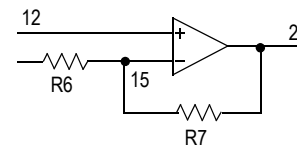
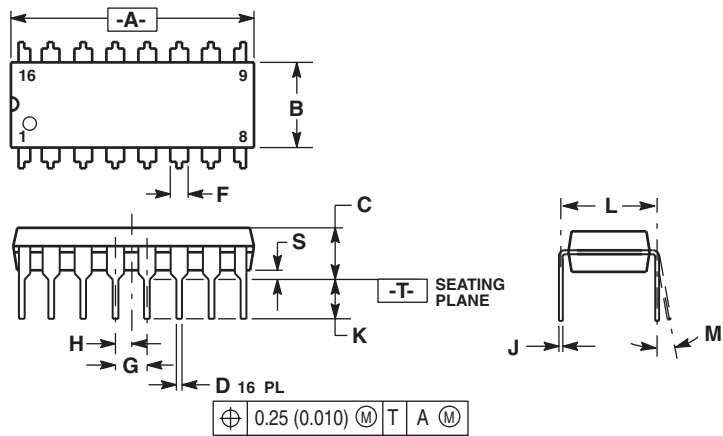


Figure 4. Adding Hysteresis

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 |

CASE 648-08
ISSUE R
16-LEAD PLASTIC DIP

NOTES

Archive Information

Archive Information

NOTES

Archive Information

Archive Information

How to Reach Us:

Home Page:
www.freescale.com

E-mail:
support@freescale.com

USA/Europe or Locations Not Listed:
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

For Literature Requests Only:
Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or 303-675-2140
Fax: 303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2005. All rights reserved.

