CMOS Micro-Power Comparator plus Voltage Follower

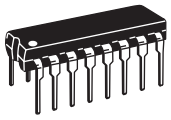
MC14578

**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 MΩ ±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.



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

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 (IN + Pin): ±1 pA @ 25°C (DIP Only)
- Quiescent Current: 10 μA @ 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

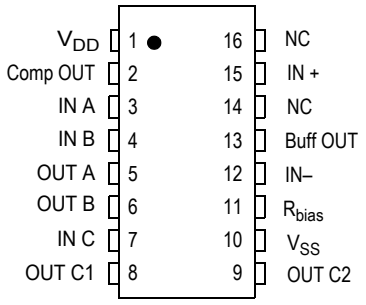


Figure 1. Pin Connections

freescale semiconductor

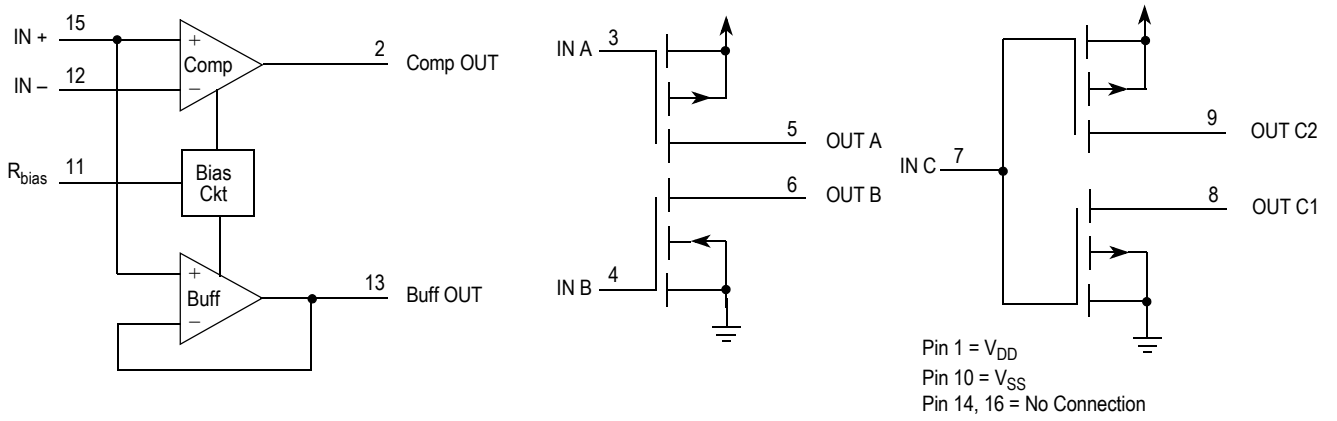


Figure 2. Block Diagram

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

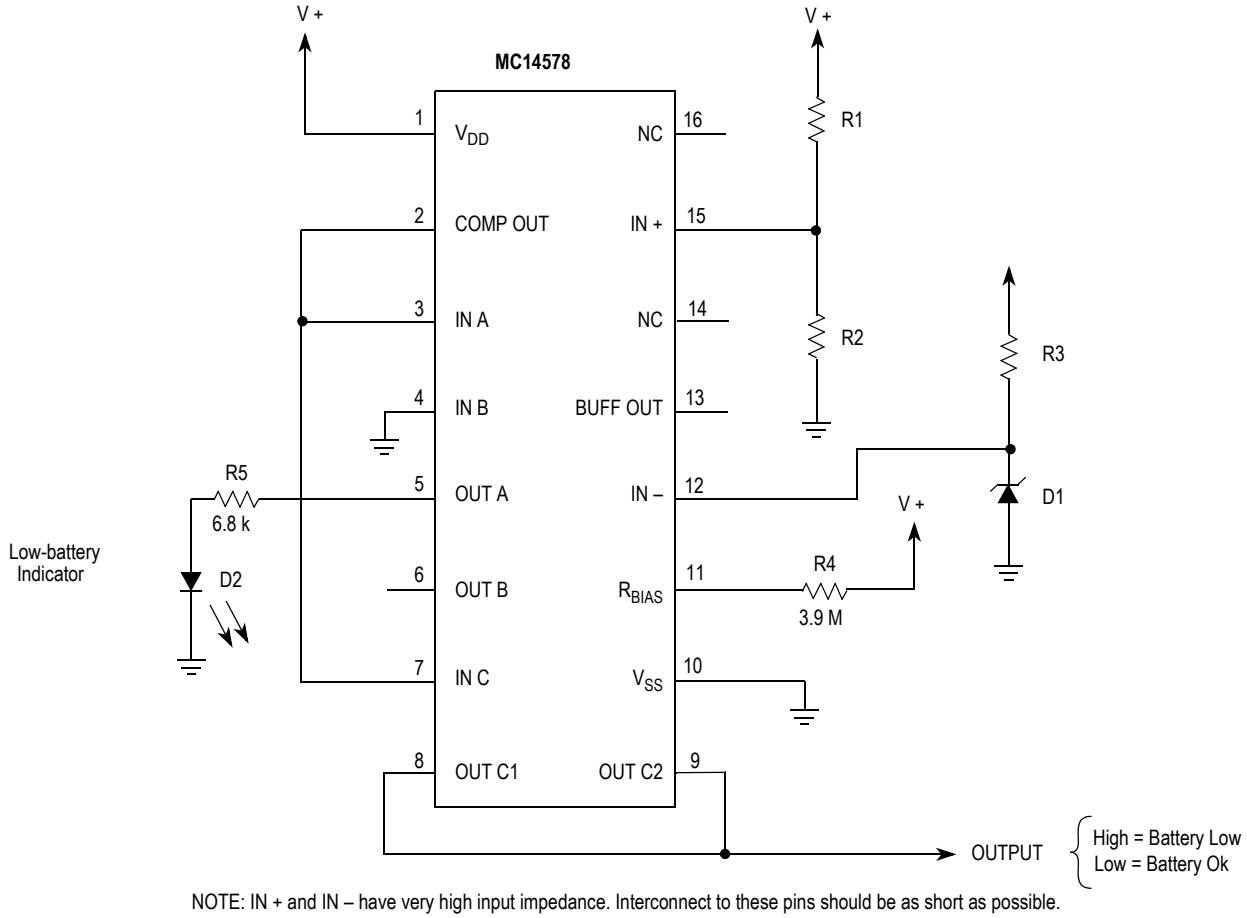
1. Maximum Ratings are those values beyond which damage to the device may occur. This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$. 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 MΩ to V_{DD}, T_A = -30° 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 V, $\|I_{out}\|$ <1 μA	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 V, $\|I_{out}\|$ <1 μA	10.0	8.0	V
Comparator Input Offset Voltage	V_{IO}	T_A = 25°C, Over Common Mode Range	10.0	±50	mV
		T_A = 0° 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 μA	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 μA	10.0	9.5	V
Buffer Amp Output Offset Voltage	V_{OO}	R_{load} = 10 MΩ 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 mA	10.0	0.5	V
		OUT A, OUT B, I_{out} = 270 μA	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 mA	10.0	9.5	V
		OUT A, OUT B, I_{out} = 270 μA	10.0	9.5	V
Maximum Input Leakage Current IN + (DIP Only)	I_{in}	T_A = 25°C, 40% R.H., V_{in} = V_{SS} or V_{DD}	10.0	±1.0	pA
IN + (DIP Only)		T_A = 50°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°C IN A, IN B, IN C: V_{in} = V_{SS} or V_{DD}, $\|V_{IN+} - V_{IN-}\|$ = 100 mV I_{out} = 0 μA	10.0	10	μA
Maximum Input Capacitance IN +	C_{in}	f = 1 kHz	—	5.0	pF
Other Inputs			—	15	

APPLICATIONS INFORMATION



NOTE: IN + and IN – have very high input impedance. Interconnect to these pins should be as short as possible.

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

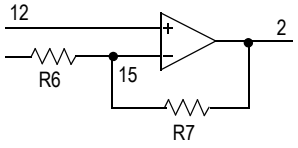
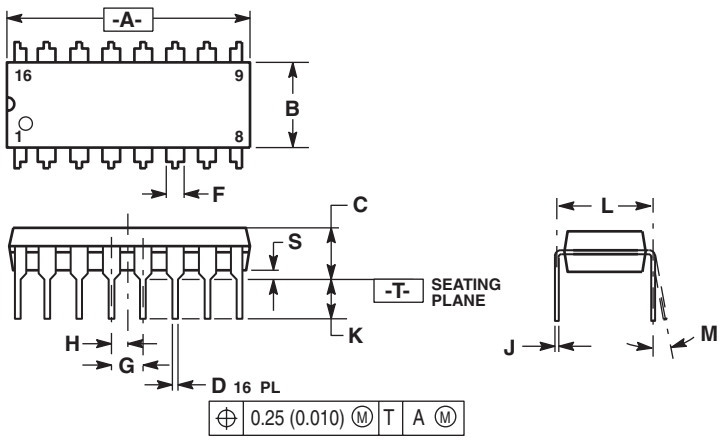


Figure 4. Adding Hysteresis

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.

	INCHES		MILLIMETERS	
DIM	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

NOTES

NOTES

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