

# HI-8573,4,5

## Quad CMOS Op Amp/Comparator

T-79-09  
T-73-53

### General Description

The HI-8573, HI-8574, and HI-8575 devices are designed using low power CMOS technology. The operating current is externally programmable with a resistor to give the optimum tradeoff between power dissipation and slew rate. The operational amplifiers are internally compensated.

All three versions offer a high degree of versatility and are well suited for both line-powered and battery-powered systems. Features include a typical offset voltage of  $\pm 5\text{mV}$ , high input impedance and low current drain. Either single or dual power supply operation may be used up to  $15\text{VDC}$ . The comparators are CMOS and TTL compatible. The three devices are direct replacements for the Motorola MC14573, MC14574 and MC14575, respectively.

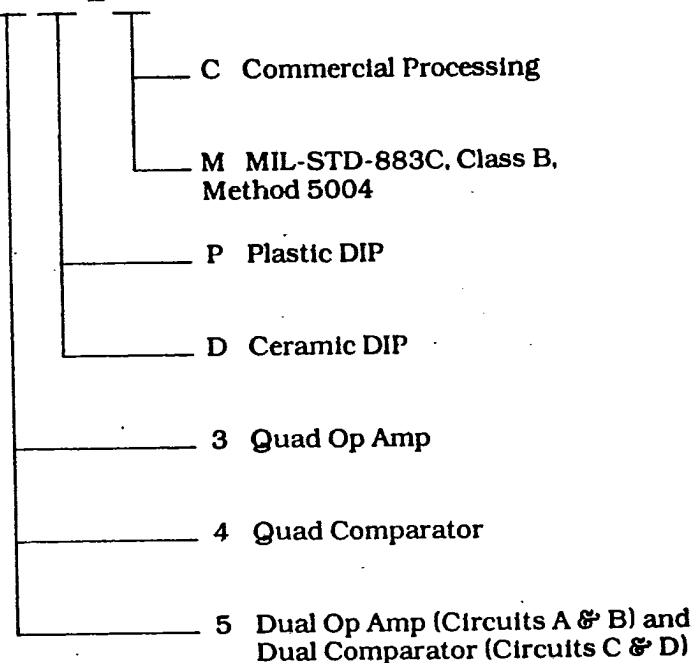
Some typical applications include oscillators, function generators, active filters, logic level converters, A to D converters, voltage reference, zero cross detectors, limit set alarm detectors, and instrumentation.

### Features

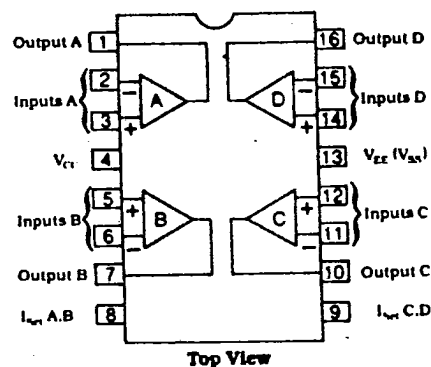
- Single or Dual Power Supply —  $+3$  to  $15\text{Vdc}$  or  $\pm 1.5$  to  $\pm 7.5\text{Vdc}$
- Wide Input Voltage Range
- Common Mode Range  $0$  to  $V_{CC} - 2\text{Vdc}$ , single supply
- Adjustable Current/Slew Rate
- Typical Offset,  $\pm 5\text{mV}$
- Internally Compensated Op Amps
- High Input Impedance
- CMOS and TTL Compatible Comparators
- MIL-STD-883C Equivalent Processing Available
- Direct Replacements for Motorola MC14573, MC14574, and MC14575

### Ordering Information

HI-857



### Pin Configuration



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# Absolute Maximum Ratings (Voltages Referenced to V<sub>EE</sub>)

|                                          |                                |                                            |                 |
|------------------------------------------|--------------------------------|--------------------------------------------|-----------------|
| DC Supply Voltage, V <sub>CC</sub> ..... | -0.5V to +18V                  | Operating Temperature Range: Plastic ..... | -40°C to +85°C  |
| Input Voltage, All Inputs .....          | -0.5V to V <sub>CC</sub> +0.5V | Ceramic .....                              | -55°C to +125°C |
| DC Current Drain Per Input Pin .....     | 10mADC                         | Storage Temperature Range: Plastic .....   | -40°C to +125°C |
|                                          |                                | Ceramic .....                              | -65°C to +150°C |

**NOTE:** Stresses above 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 above 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.

## Operational Amplifier Electrical Characteristics (V<sub>EE</sub> = 0V, T<sub>A</sub> = 25°C)

| Parameter                                                                                                   | Symbol           | V <sub>CC</sub> (Vdc) | Min.                 | Typ.              | Max.         | Units   |
|-------------------------------------------------------------------------------------------------------------|------------------|-----------------------|----------------------|-------------------|--------------|---------|
| Recommended Operating Range<br>(V <sub>CC</sub> - V <sub>EE</sub> )                                         | —                | —                     | 3                    | —                 | 15           | Vdc     |
| Input Common Mode Voltage Range<br>(I <sub>SET</sub> = 200 μA)                                              | V <sub>ICR</sub> | 5<br>10<br>15         | 0<br>0<br>0          | —<br>—<br>—       | 3<br>8<br>13 | Vdc     |
| Output Voltage Range<br>(I <sub>SET</sub> = 50 μA)<br>(R <sub>L</sub> = 100K connected to V <sub>EE</sub> ) | V <sub>OR</sub>  | 5<br>10<br>15         | 1.05<br>1.05<br>1.05 | —<br>—<br>—       | 4<br>9<br>14 | Vdc     |
| Input Offset Voltage<br>(I <sub>SET</sub> = 50 μA)                                                          | V <sub>IO</sub>  | 10                    | —                    | ±5                | ±25          | mVdc    |
| Average Temperature Coefficient<br>of Input Offset Voltage                                                  | —                | —                     | —                    | 20                | —            | μV/°C   |
| Input Bias Current                                                                                          | I <sub>IB</sub>  | 10                    | —                    | —                 | 1            | nA      |
| Input Offset Current                                                                                        | I <sub>IO</sub>  | 10                    | —                    | —                 | 200          | pA      |
| Open Loop Voltage Gain<br>(I <sub>SET</sub> = 50 μA)                                                        | A <sub>VOL</sub> | 10                    | —                    | 90                | —            | dB      |
| Power Supply Rejection Ratio                                                                                | PSRR             | 10                    | —                    | 70                | —            | dB      |
| Common Mode Rejection Ratio                                                                                 | CMRR             | 10                    | —                    | 80                | —            | dB      |
| Channel Separation                                                                                          | —                | 10                    | —                    | -100              | —            | dB      |
| Slew Rate (I <sub>SET</sub> = 40 μA)                                                                        | SR               | 10                    | —                    | 2.5               | —            | V. μs   |
| Phase Margin                                                                                                | Φ <sub>M</sub>   | 10                    | —                    | 45                | —            | Degrees |
| Supply Current — Per Pair<br>(R <sub>SET</sub> = 1MΩ)                                                       | I <sub>CC</sub>  | 5<br>10<br>15         | —<br>—<br>—          | 50<br>100<br>150  | —<br>—<br>—  | μA      |
| Supply Current — Per Pair<br>(R <sub>SET</sub> = 100K)                                                      | I <sub>CC</sub>  | 5<br>10<br>15         | —<br>—<br>—          | 0.5<br>1.2<br>1.8 | —<br>—<br>—  | mA      |
| Gain x Bandwidth Product<br>(I <sub>SET</sub> = 40 μA)                                                      | GBP              | 10                    | —                    | 1.4               | —            | MHz     |

T-73-53

## Comparator

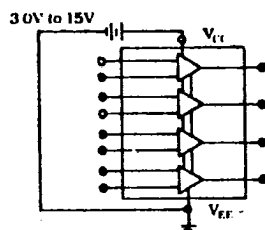
Electrical Characteristics ( $V_{EE} = 0V$ ,  $T_A = 25^\circ C$ )

| Parameter                                                                                                          | Symbol               | $V_{CC}$ (Vdc)     | Min.                           | Typ.                            | Max.                 | Units            |
|--------------------------------------------------------------------------------------------------------------------|----------------------|--------------------|--------------------------------|---------------------------------|----------------------|------------------|
| Recommended Operating Range<br>( $V_{CC} - V_{EE}$ )                                                               | —                    | —                  | 3                              | —                               | 15                   | Vdc              |
| Input Common Mode Voltage Range<br>( $I_{SET} = 200 \mu A$ )                                                       | $V_{ICR}$            | 5<br>10<br>15      | 0<br>0<br>0                    | —<br>—<br>—                     | 3<br>8<br>13         | Vdc              |
| Output Low Voltage, "0" Level                                                                                      | $V_{OL}$             | 5<br>10<br>15      | —<br>—<br>—                    | 0<br>0<br>0                     | 0.05<br>0.05<br>0.05 | Vdc              |
| Output High Voltage, "1" Level                                                                                     | $V_{OH}$             | 5<br>10<br>15      | 4.95<br>9.95<br>14.95          | 5<br>10<br>15                   | —<br>—<br>—          | Vdc              |
| Output Source Current<br>$V_{OH} = 2.5$ Vdc)<br>$V_{OH} = 4.6$ Vdc)<br>$V_{OH} = 9.5$ Vdc)<br>$V_{OH} = 13.5$ Vdc) | $I_{OH}$             | 5<br>5<br>10<br>15 | -0.24<br>-0.51<br>-1.3<br>-3.4 | -0.42<br>-0.88<br>-2.25<br>-8.8 | —<br>—<br>—<br>—     | mAdc             |
| Output Sink Current<br>( $V_{OL} = 0.4$ Vdc)<br>( $V_{OL} = 0.5$ Vdc)<br>( $V_{OL} = 1.5$ Vdc)                     | $I_{OL}$             | 5<br>10<br>15      | 1.25<br>3.25<br>8.5            | 2.25<br>5.6<br>20               | —<br>—<br>—          | mAdc             |
| Input Offset Voltage<br>( $I_{SET} = 50 \mu A$ )                                                                   | $V_{IO}$             | 10                 | —                              | $\pm 5$                         | $\pm 25$             | mVdc             |
| Average Temperature Coefficient<br>of Input Offset Voltage                                                         | —                    | —                  | —                              | 20                              | —                    | $\mu V/^\circ C$ |
| Input Bias Current                                                                                                 | $I_{IB}$             | 10                 | —                              | —                               | 1                    | nA               |
| Input Offset Current                                                                                               | $I_{IO}$             | 10                 | —                              | —                               | 200                  | pA               |
| Open Loop Voltage Gain<br>( $I_{SET} = 50 \mu A$ )                                                                 | $A_{VOL}$            | 10                 | —                              | 96                              | —                    | dB               |
| Power Supply Rejection Ratio                                                                                       | PSRR                 | 10                 | —                              | 70                              | —                    | dB               |
| Common Mode Rejection Ratio                                                                                        | CMRR                 | 10                 | —                              | 80                              | —                    | dB               |
| Channel Separation                                                                                                 | —                    | 10                 | —                              | -100                            | —                    | dB               |
| Output Rise and Fall Time<br>( $C_L = 50$ pF)                                                                      | $t_{LH}$<br>$t_{HL}$ | 10                 | —                              | 100                             | —                    | ns               |
| Propagation Delay Time, 5 mV<br>Overdrive<br>( $I_{SET} = 50 \mu A$ , $C_L = 50$ pF)                               | $t_D$                | 10                 | —                              | 1000                            | —                    | ns               |
| Supply Current — Per Pair<br>( $R_{SET} = 1M\Omega$ )                                                              | $I_{CC}$             | 5<br>10<br>15      | —<br>—<br>—                    | 50<br>100<br>150                | —<br>—<br>—          | $\mu A$          |
| Supply Current — Per Pair<br>( $R_{SET} = 100K$ )                                                                  | $I_{CC}$             | 5<br>10<br>15      | —<br>—<br>—                    | 0.45<br>1.0<br>1.5              | —<br>—<br>—          | mA               |

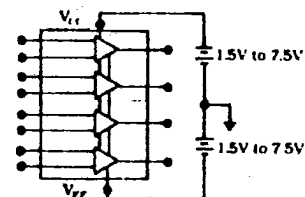
NOTE: Unused inputs should always be tied to either  $V_{DD}$  or  $V_{EE}$ .

## Power Options

Single Supply

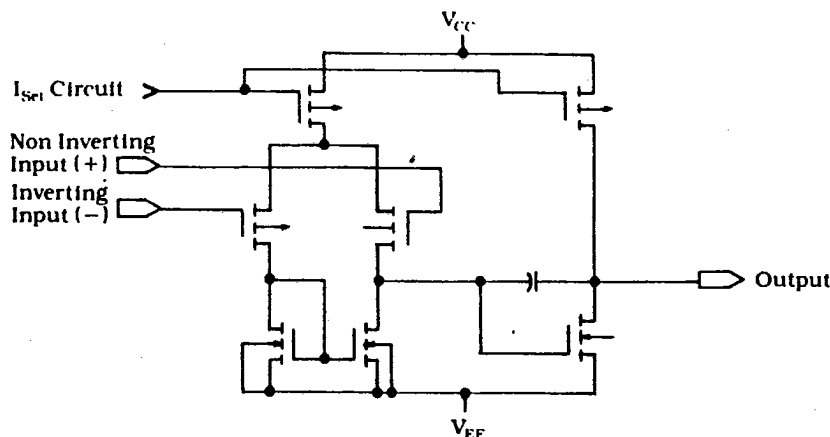


Split Supply

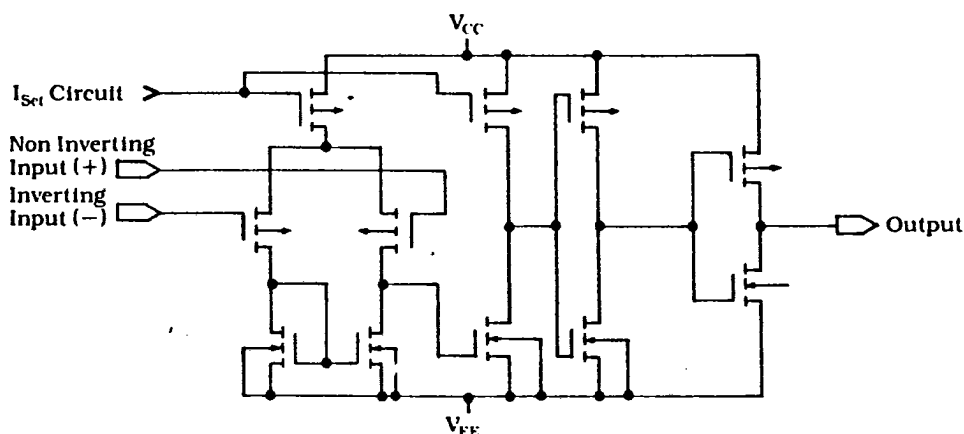


# Circuit Diagrams

Operational Amplifier



Comparator



## Programming Current

The programming current  $I_{Set}$  is fixed by an external resistor  $R_{Set}$  connected between  $V_{EE}$  and either one or both of the  $I_{Set}$  pins (8 and 9). When two external programming resistors are used, the set currents for each op amp pair or comparator are given by:

$$I_{Set} (\mu A) \approx \frac{V_{CC} - V_{EE} - 1}{R_{Set} (M\Omega)}$$

Pins 8 and 9 may be tied together for use with a single programming resistor. The set currents for each op amp pair or comparator pair are then given by:

$$I_{Set A,B} = I_{Set C,D} (\mu A) \approx \frac{V_{CC} - V_{EE} - 1}{2 R_{Set} (M\Omega)}$$

If a pair of op amps or comparators are not used, the  $I_{Set}$  pin for that pair may be tied to  $V_{CC}$  for minimum power consumption.

It should be noted that increasing  $I_{Set}$  for comparators will decrease propagation delay for that comparator.

For operational amplifiers, the maximum obtainable output voltage ( $V_{OH}$ ) for a given load resistor connected to  $V_{EE}$  is given by:

$$V_{OH} = (4 \times 10^{-3} I_{Set}) R_L - 0.05 \text{ v, } R_L \text{ in } K\Omega$$

if  $(4 \times 10^{-3} I_{Set}) R_L < V_{DD}$ ,  $I_{Set}$  in  $\mu A$

Typical op amp slew rates are given by:

$$S_R \approx 0.05 I_{Set} (V/\mu s), I_{Set} \text{ in } \mu A$$

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