



# Ultra-Fast ECL-Output Comparator

MAX9690

## General Description

The MAX9690 is an ultra-fast ECL comparator manufactured with a high-frequency bipolar process ( $f_T = 6\text{GHz}$ ) capable of very short propagation delays. This design maintains the excellent DC matching characteristics normally found only in slower comparators. The MAX9690 is similar in function to the MAX9685, except the latch-enable input is eliminated.

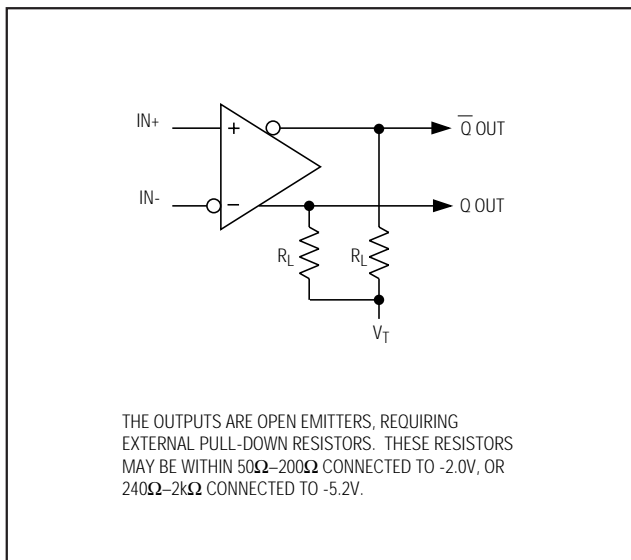
The MAX9690 is pin-compatible with the CMP-08 but exceeds the AC characteristics of that device.

The MAX9690 has differential inputs and complementary outputs that are fully compatible with ECL-logic levels. Output current levels are capable of driving  $50\Omega$  terminated transmission lines. The ultra-fast operation makes signal processing possible at frequencies in excess of 600MHz.

## Applications

High-Speed A/D Converters  
 High-Speed Line Receivers  
 Peak Detectors  
 Threshold Detectors

## Functional Diagram



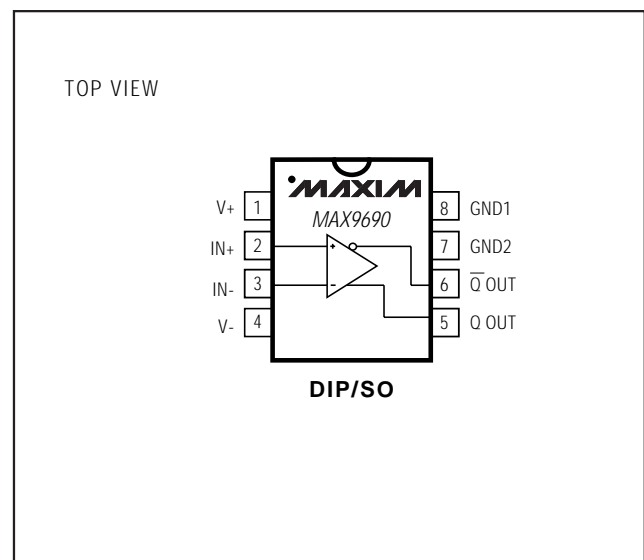
## Features

- ◆ 1.3ns Propagation Delay
- ◆ +5V, -5.2V Power Supplies
- ◆ Pin-Compatible with CMP-08
- ◆ Available in Commercial, Extended-Industrial, and Military Temperature Ranges
- ◆ Available in Small-Outline Package

## Ordering Information

| PART         | TEMP. RANGE     | PIN-PACKAGE   |
|--------------|-----------------|---------------|
| MAX9690CPA-4 | 0°C to +70°C    | 8 Plastic DIP |
| MAX9690CSA   | 0°C to +70°C    | 8 SO          |
| MAX9690CJA   | 0°C to +70°C    | 8 CERDIP      |
| MAX9690EPA   | -40°C to +85°C  | 8 Plastic DIP |
| MAX9690ESA   | -40°C to +85°C  | 8 SO          |
| MAX9690MJA-4 | -55°C to +125°C | 8 CERDIP      |

## Pin Configuration



# Ultra-Fast ECL-Output Comparator

## ABSOLUTE MAXIMUM RATINGS

|   |       |
|---|-------|
| Supply Voltages.....                                  | ±6V   |
| Input Voltages.....                                   | ±5V   |
| Differential Input Voltages.....                      | ±3.5V |
| Output Current.....                                   | 30mA  |
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |       |
| Plastic DIP (derate 9.09mW/°C above +70°C).....       | 727mW |
| SO (derate 5.88mW/°C above +70°C).....                | 471mW |
| CERDIP (derate 8.00mW/°C above +70°C).....            | 640mW |

### Operating Temperature Ranges

|  |                 |
|--|-----------------|
| MAX9690C_ A.....                         | 0°C to +70°C    |
| MAX9690E_ A.....                         | -40°C to +85°C  |
| MAX9690MJA.....                          | -55°C to +125°C |
| Storage Temperature Range.....           | -55°C to +150°C |
| Lead Temperature (soldering, 10sec)..... | +300°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>+</sub> = +5V, V<sub>-</sub> = -5.2V, R<sub>L</sub> = 50Ω, V<sub>T</sub> = -2V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                    | SYMBOL               | CONDITIONS   | MAX9690C/E                        |       |      | MAX9690M |     |       | UNITS |   |
|------------------------------|----------------------|--|-----------------------------------|-------|------|----------|-----|-------|-------|---|
|                              |                      |  | MIN                               | TYP   | MAX  | MIN      | TYP | MAX   |       |   |
| Input Offset Voltage         | V <sub>OS</sub>      | T <sub>A</sub> = +25°C   | -5                                |       | 5    | -5       |     | 5     | mV    |   |
|                              |                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 1) | -7                                |       | 7    | -8       |     | 8     |       |   |
| Temperature Coefficient      | ΔV <sub>OS</sub> /ΔT |  |                                   | 10    |      | 15       |     | μV/°C |       |   |
| Input Offset Current         | I <sub>OS</sub>      | T <sub>A</sub> = +25°C   |                                   |       | 5    |          |     | 5     | μA    |   |
|                              |                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>          |                                   |       | 8    |          |     | 12    |       |   |
| Input Bias Current           | I <sub>B</sub>       | T <sub>A</sub> = +25°C   |                                   | 10    | 20   |          | 10  | 20    | μA    |   |
|                              |                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>          |                                   |       | 30   |          |     | 40    |       |   |
| Input Voltage Range          | V <sub>CM</sub>      | (Note 1)   | -2.5                              |       | +2.5 | -2.5     |     | +2.5  | V     |   |
| Common-Mode Rejection Ratio  | CMRR                 | (Note 1)   |                                   | 80    |      |          | 80  |       | dB    |   |
| Power-Supply Rejection Ratio | PSRR                 |  |                                   | 60    |      |          | 60  |       | dB    |   |
| Input Resistance             | R <sub>IN</sub>      | (Note 1)   |                                   | 60    |      |          | 60  |       | kΩ    |   |
| Input Capacitance            | C <sub>IN</sub>      |  |                                   | 3     |      |          | 3   |       | pF    |   |
| Logic Output High Voltage    | V <sub>OH</sub>      | MAX9690C, MAX9690M   | T <sub>A</sub> = T <sub>MIN</sub> | -1.05 |      | -0.87    |     | -1.16 | -0.89 | V |
|                              |                      |  | T <sub>A</sub> = T <sub>MAX</sub> | -0.89 |      | -0.70    |     | -0.88 | -0.69 |   |
|                              |                      |  | T <sub>A</sub> = +25°C            | -0.96 |      | -0.81    |     | -0.96 | -0.81 |   |
|                              |                      | MAX9690E   | T <sub>A</sub> = T <sub>MIN</sub> | -1.14 |      | -0.88    |     |       |       |   |
|                              |                      |  | T <sub>A</sub> = T <sub>MAX</sub> | -0.88 |      | -0.70    |     |       |       |   |
|                              |                      |  | T <sub>A</sub> = +25°C            | -0.96 |      | -0.81    |     |       |       |   |
| Logic Output Low Voltage     | V <sub>OL</sub>      | MAX9690C, MAX9690M   | T <sub>A</sub> = T <sub>MIN</sub> | -1.83 |      | -1.57    |     | -1.82 | -1.55 | V |
|                              |                      |  | T <sub>A</sub> = T <sub>MAX</sub> | -1.89 |      | -1.65    |     | -1.90 | -1.65 |   |
|                              |                      |  | T <sub>A</sub> = +25°C            | -1.85 |      | -1.65    |     | -1.85 | -1.65 |   |
|                              |                      | MAX9690E   | T <sub>A</sub> = T <sub>MIN</sub> | -1.90 |      | -1.65    |     |       |       |   |
|                              |                      |  | T <sub>A</sub> = T <sub>MAX</sub> | -1.83 |      | -1.57    |     |       |       |   |
|                              |                      |  | T <sub>A</sub> = +25°C            | -1.85 |      | -1.65    |     |       |       |   |
| Positive Supply Current      |                      | T <sub>A</sub> = +25°C   |                                   | 16    | 22   |          | 16  | 22    | mA    |   |
|                              |                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>          |                                   |       | 24   |          |     | 25    |       |   |
| Negative Supply Current      |                      | T <sub>A</sub> = +25°C   |                                   | 20    | 32   |          | 20  | 32    | mA    |   |
|                              |                      | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>          |                                   |       | 36   |          |     | 37    |       |   |

# Ultra-Fast ECL-Output Comparator

MAX9690

## SWITCHING CHARACTERISTICS

( $V_+ = +5V$ ,  $V_- = -5.2V$ ,  $R_L = 50\Omega$ ,  $V_T = -2V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

| PARAMETER                            | SYMBOL    | CONDITIONS                            | MAX9690C/E |     |     | MAX9690M |     |     | UNITS |
|--------------------------------------|-----------|---------------------------------------|------------|-----|-----|----------|-----|-----|-------|
|                                      |           |                                       | MIN        | TYP | MAX | MIN      | TYP | MAX |       |
| Input to Output High<br>(Notes 1, 2) | $t_{pd+}$ | $T_A = +25^\circ C$                   |            | 1.3 | 1.8 |          | 1.3 | 1.8 | ns    |
|                                      |           | $T_A = 0^\circ C$ to $+70^\circ C$    |            | 1.5 | 2.0 |          |     |     |       |
|                                      |           | $T_A = -55^\circ C$ to $+125^\circ C$ |            |     |     |          | 1.7 | 2.4 |       |
| Input to Output Low<br>(Notes 1, 2)  | $t_{pd-}$ | $T_A = +25^\circ C$                   |            | 1.3 | 1.8 |          | 1.3 | 1.8 | ns    |
|                                      |           | $T_A = 0^\circ C$ to $+70^\circ C$    |            | 1.5 | 2.0 |          |     |     |       |
|                                      |           | $T_A = -55^\circ C$ to $+125^\circ C$ |            |     |     |          | 1.7 | 2.4 |       |

**Note 1:** Not tested, guaranteed by design.

**Note 2:**  $V_{IN} = 100mV$ ,  $V_{OD} = 10mV$ .

## Applications Information

### Layout

Because of the MAX9690's large gain-bandwidth characteristic, special precautions need to be taken if its high-speed capabilities are to be used. A PC board with a ground plane is mandatory. Mount all decoupling capacitors as close to the power-supply pins as possible, and process the ECL outputs in microstrip fashion, consistent with the load termination of  $50\Omega$  to  $120\Omega$ . For low-impedance applications, microstrip layout at the input may also be helpful. Pay close attention to the bandwidth of the decoupling and terminating components. Chip components can be used to minimize lead inductance.

### Input Slew-Rate Requirements

As with all high-speed comparators, the high gain-bandwidth product of these devices creates oscillation problems when the input traverses through the linear region. For clean switching without oscillation or steps in the output waveform, the input must meet certain minimum slew-rate requirements. The tendency of the part to oscillate is a function of the layout and source impedance of the circuit employed. Both poor layout and larger source impedance increase the minimum slew-rate requirement.

## Timing Diagram

The timing diagram illustrates the series of events that completes the compare function, under worst-case conditions. The leading edge of the input signal (illustrated as a large-amplitude, small-overdrive pulse) switches the comparator. Outputs  $\bar{Q}$  and  $Q$  are similar in timing.

### Definition of Terms

|           |   |
|-----------|---|
| $V_{OS}$  | Input Offset Voltage—The voltage required between the input terminals to obtain 0V differential at the output.  |
| $V_{IN}$  | Input Voltage Pulse Amplitude   |
| $V_{OD}$  | Input Voltage Overdrive   |
| $t_{pd+}$ | Input to Output High Delay—The propagation delay measured from the time the input signal crosses the input offset voltage to the 50% point of an output low-to-high transition. |
| $t_{pd-}$ | Input to Output Low Delay—The propagation delay measured from the time the input signal crosses the input offset voltage to the 50% point of an output high-to-low transition.  |

# Ultra-Fast ECL-Output Comparator

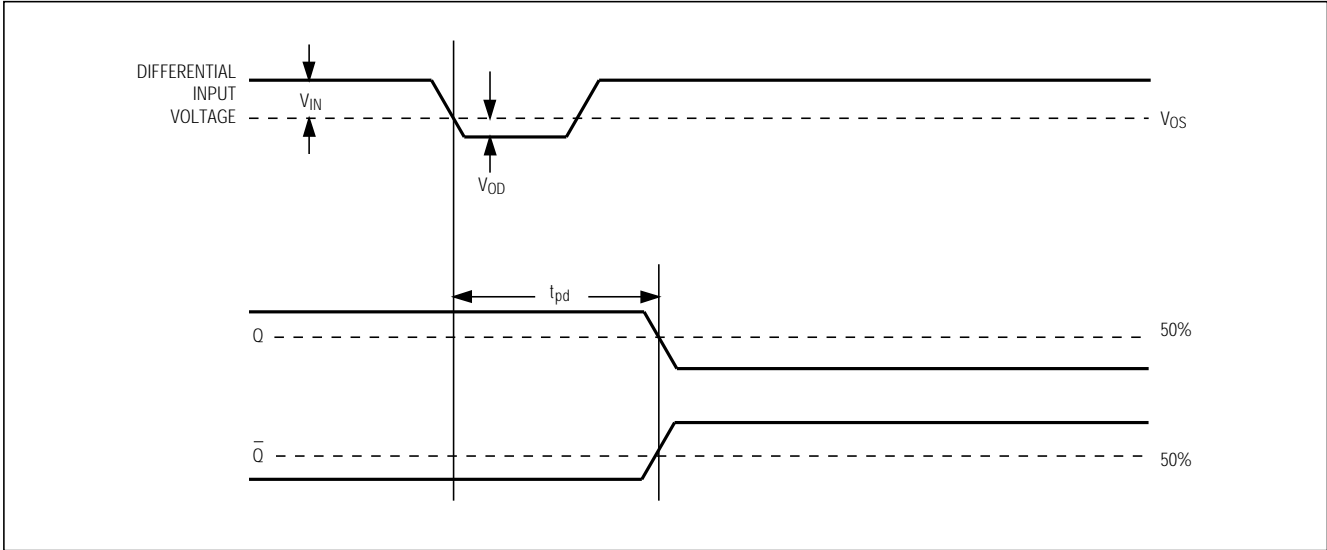


Figure 1. Timing Diagram

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

4 Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600