

## MAX9092/MAX9093/ MAX9094/MAX9095

## General-Purpose, Low-Voltage, Dual/Quad, Tiny Pack Comparators

### General Description

The MAX9092/MAX9093/MAX9094/MAX9095 comparators are pin-for-pin compatible replacements for the LMX393/LMX393H/LMX339/LMX339H, respectively. The MAX9093/MAX9095 have the added benefit of internal hysteresis to provide noise immunity, preventing output oscillations even with slow-moving input signals.

Advantages of the ICs include low supply voltage, small package, and low cost. They also offer a wide supply voltage range, wide operating temperature range, competitive CMRR and PSRR, response time characteristics, input offset, low noise, output saturation voltage, input bias current, and RF immunity.

The ICs are available in both 8-pin SOT23/ $\mu$ MAX<sup>®</sup> and 14-pin TSSOP/SO packages.

### Applications

- Mobile Communications
- Notebooks and PDAs
- Battery-Powered Electronics
- General-Purpose Portable Devices
- General-Purpose Low-Voltage Applications

### Features

- Guaranteed +1.8V to +5.5V Performance
- -40°C to +125°C Automotive Temperature Range
- S Low Supply Current (65 $\mu$ A/Channel at  $V_{DD} = +5.0V$ )
- Input Common-Mode Voltage Range Includes Ground
- No Phase Reversal for Overdriven Inputs
- Low Output Saturation Voltage (120mV)
- Internal 2mV Hysteresis (MAX9093/MAX9095)
- Fast 100ns Propagation Delay
- Open-Drain Outputs
- 8-Pin SOT23/ $\mu$ MAX and 14-Pin TSSOP/SO Packages

Ordering Information appears at end of data sheet.

$\mu$ MAX is a registered trademark of Maxim Integrated Products, Inc.

# MAX9092/MAX9093/ MAX9094/MAX9095

## General-Purpose, Low-Voltage, Dual/Quad, Tiny Pack Comparators

### Absolute Maximum Ratings

Supply Voltage ( $V_{DD}$  to  $V_{SS}$ ).....-0.3V to +6V  
 All Other Pins except OUT\_..... ( $V_{SS} - 0.3V$ ) to ( $V_{DD} + 0.3V$ )  
 OUT\_.....( $V_{SS} - 0.3$ ) to 6V  
 Differential Input Voltage ( $IN_+$ ,  $IN_-$ ).....  $\pm 3.6V$   
 Continuous Power Dissipation (Multilayer Board)( $T_A = +70^\circ C$ )  
   SOT23 (derate 5.1mW/ $^\circ C$  above  $+70^\circ C$ ).....408.2mW  
    $\mu$ MAX (derate 4.8mW/ $^\circ C$  above  $+70^\circ C$ ) .....387.8mW

TSSOP (derate 10mW/ $^\circ C$  above  $+70^\circ C$ ) .....796mW  
 SO (derate 11.9mW/ $^\circ C$  above  $+70^\circ C$ ) .....952mW  
 Operating Temperature Range.....  $-40^\circ C$  to  $+125^\circ C$   
 Junction Temperature.....  $+150^\circ C$   
 Storage Temperature Range.....  $-65^\circ C$  to  $+150^\circ C$   
 Lead Temperature (soldering, 10s) .....  $+300^\circ C$   
 Soldering Temperature (reflow) .....  $+260^\circ C$

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.

### Package Thermal Characteristics (Note 1)

#### SOT23

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ).....196 $^\circ C/W$   
 Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....70 $^\circ C/W$

#### $\mu$ MAX

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ).....206.3 $^\circ C/W$   
 Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....42 $^\circ C/W$

#### TSSOP

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ).....100.4 $^\circ C/W$   
 Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....30 $^\circ C/W$

#### SO

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ).....84 $^\circ C/W$   
 Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....34 $^\circ C/W$

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

### DC Electrical Characteristics—2.7V Operation

( $V_{DD} = 2.7V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                      | SYMBOL     | CONDITIONS                             | MIN | TYP          | MAX                         | UNITS            |
|------------------------------------------------|------------|----------------------------------------|-----|--------------|-----------------------------|------------------|
| Input Offset Voltage                           | $V_{OS}$   |                                        |     | 0.4          | 7                           | mV               |
| Input Voltage Hysteresis                       | $V_{HYST}$ | MAX9093/MAX9095                        |     | 2            |                             | mV               |
| Input Offset Voltage Average Temperature Drift | $TCV_{OS}$ |                                        |     | 1.5          |                             | $\mu V/^\circ C$ |
| Input Bias Current                             | $I_B$      | $T_A = +25^\circ C$                    |     | $\pm 0.0003$ | $\pm 250$                   | nA               |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$   |     |              | <b><math>\pm 400</math></b> |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$  |     |              | <b><math>\pm 400</math></b> |                  |
| Input Offset Current                           | $I_{OS}$   | $T_A = +25^\circ C$                    |     | $\pm 0.0003$ | $\pm 50$                    | nA               |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$   |     |              | <b><math>\pm 150</math></b> |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$  |     |              | <b><math>\pm 150</math></b> |                  |
| Input Voltage Range                            | $V_{CM}$   |                                        |     | -0.1         |                             | V                |
|                                                |            |                                        |     | 2            |                             |                  |
| Voltage Gain                                   | $A_V$      | MAX9092/MAX9094                        |     | 500          |                             | V/mV             |
| Output Saturation Voltage                      | $V_{SAT}$  | $I_{SINK} \leq 1mA$                    |     | 25           |                             | mV               |
| Output Sink Current                            | $I_{OUT}$  | $V_{OUT} \leq 1.5V$                    | 5   | 16           |                             | mA               |
| Supply Current                                 | $I_S$      | MAX9092/MAX9093 (both comparators)     |     | 100          | 180                         | $\mu A$          |
|                                                |            | MAX9094/MAX9095 (all four comparators) |     | 220          | 360                         |                  |
| Output Leakage Current                         |            | $T_A = +25^\circ C$                    |     | 0.005        |                             | $\mu A$          |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$   |     |              | <b>1</b>                    |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$  |     |              | <b>2</b>                    |                  |

## AC Electrical Characteristics—2.7V Operation

( $V_{DD} = 2.7V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                     | SYMBOL    | CONDITIONS              | MIN | TYP | MAX | UNITS |
|-----------------------------------------------|-----------|-------------------------|-----|-----|-----|-------|
| Propagation Delay Output High to Low (Note 3) | $t_{PHL}$ | Input overdrive = 10mV  |     | 70  |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 50  |     |       |
| Propagation Delay Output Low to High (Note 3) | $t_{PLH}$ | Input overdrive = 10mV  |     | 115 |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 100 |     |       |

## DC Electrical Characteristics—5.0V Operation

( $V_{DD} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                      | SYMBOL     | CONDITIONS                                 | MIN                                   | TYP         | MAX                         | UNITS            |
|------------------------------------------------|------------|--------------------------------------------|---------------------------------------|-------------|-----------------------------|------------------|
| Input Offset Voltage                           | $V_{OS}$   | $T_A = +25^\circ C$                        |                                       | 0.4         | 7                           | mV               |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$       |                                       |             | <b>9</b>                    |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$      |                                       |             | <b>9</b>                    |                  |
| Input Voltage Hysteresis                       |            | MAX9093/MAX9095                            |                                       | 2           |                             | mV               |
| Input Offset Voltage Average Temperature Drift | $TCV_{OS}$ |                                            |                                       | 1.5         |                             | $\mu V/^\circ C$ |
| Input Bias Current                             | $I_B$      | $T_A = +25^\circ C$                        |                                       | $\pm 0.027$ | $\pm 250$                   | nA               |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$       |                                       |             | <b><math>\pm 400</math></b> |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$      |                                       |             | <b><math>\pm 400</math></b> |                  |
| Input Offset Current                           | $I_{OS}$   | $T_A = +25^\circ C$                        |                                       | $\pm 0.007$ | $\pm 50$                    | nA               |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$       |                                       |             | <b><math>\pm 150</math></b> |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$      |                                       |             | <b><math>\pm 150</math></b> |                  |
| Input Voltage Range                            | $V_{CM}$   |                                            |                                       | -0.1        |                             | V                |
|                                                |            |                                            |                                       | 4.2         |                             |                  |
| Voltage Gain (Note 4)                          | $A_V$      | MAX9092/MAX9094                            | 20                                    | 500         |                             | V/mV             |
| Output Saturation Voltage                      | $V_{SAT}$  | $I_{SINK} \leq 4mA$                        | $T_A = +25^\circ C$                   | 120         | 400                         | mV               |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+85^\circ C$  |             | <b>700</b>                  |                  |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+125^\circ C$ |             | <b>700</b>                  |                  |
| Output Sink Current                            | $I_{OUT}$  | $V_{OUT} \leq 1.5V$                        | 10                                    | 35          |                             | mA               |
| Supply Current (Note 5)                        | $I_S$      | MAX9092/<br>MAX9093 (both comparators)     | $T_A = +25^\circ C$                   | 130         | 200                         | $\mu A$          |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+85^\circ C$  |             | <b>250</b>                  |                  |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+125^\circ C$ |             | <b>300</b>                  |                  |
|                                                |            | MAX9094/<br>MAX9095 (all four comparators) | $T_A = +25^\circ C$                   | 250         | 400                         | $\mu A$          |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+85^\circ C$  |             | <b>500</b>                  |                  |
|                                                |            |                                            | $T_A = -40^\circ C$ to $+125^\circ C$ |             | <b>500</b>                  |                  |
| Output Leakage Current                         |            | $T_A = +25^\circ C$                        |                                       | 0.005       |                             | $\mu A$          |
|                                                |            | $T_A = -40^\circ C$ to $+85^\circ C$       |                                       |             | <b>1</b>                    |                  |
|                                                |            | $T_A = -40^\circ C$ to $+125^\circ C$      |                                       |             | <b>2</b>                    |                  |

**AC Electrical Characteristics—5.0V Operation**

( $V_{DD} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                     | SYMBOL    | CONDITIONS              | MIN | TYP | MAX | UNITS |
|-----------------------------------------------|-----------|-------------------------|-----|-----|-----|-------|
| Propagation Delay Output High to Low (Note 3) | $t_{PHL}$ | Input overdrive = 10mV  |     | 70  |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 50  |     |       |
| Propagation Delay Output Low to High (Note 3) | $t_{PLH}$ | Input overdrive = 10mV  |     | 110 |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 100 |     |       |

**DC Electrical Characteristics—1.8V Operation**

( $V_{DD} = 1.8V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                      | SYMBOL     | CONDITIONS                             | MIN | TYP    | MAX | UNITS            |
|------------------------------------------------|------------|----------------------------------------|-----|--------|-----|------------------|
| Input Offset Voltage                           | $V_{OS}$   |                                        |     | 0.4    | 5   | mV               |
| Input Voltage Hysteresis                       |            | MAX9093/MAX9095                        |     | 2      |     | mV               |
| Input Offset Voltage Average Temperature Drift | $TCV_{OS}$ |                                        |     | 1.5    |     | $\mu V/^\circ C$ |
| Input Bias Current                             | $I_B$      |                                        |     | 0.0016 |     | nA               |
| Input Offset Current                           | $I_{OS}$   |                                        |     | 0.0003 |     | nA               |
| Input Voltage Range                            | $V_{CM}$   |                                        |     | -0.1   |     | V                |
|                                                |            |                                        |     | 1      |     |                  |
| Output Saturation Voltage                      | $V_{SAT}$  | $I_{SINK} \leq 1mA$                    |     | 56     |     | mV               |
| Power-Supply Rejection Ratio                   | PSRR       | $V_{DD} = 1.8V$ to 5.5V                | 60  | 90     |     | dB               |
| Output Sink Current                            | $I_{OUT}$  | $V_{OUT} \leq 1.5V$                    |     | 6.4    |     | mA               |
| Supply Current (Note 5)                        | $I_S$      | MAX9092/MAX9093 (both comparators)     |     | 120    | 170 | $\mu A$          |
|                                                |            | MAX9094/MAX9095 (all four comparators) |     | 210    | 340 |                  |
| Output Leakage Current                         |            |                                        |     | 0.001  |     | $\mu A$          |

**AC Electrical Characteristics—1.8V Operation**

( $V_{DD} = 1.8V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$  connected to  $V_{DD}$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted. **Boldface** limits apply at the defined temperature extremes.) (Note 2)

| PARAMETER                                     | SYMBOL    | CONDITIONS              | MIN | TYP | MAX | UNITS |
|-----------------------------------------------|-----------|-------------------------|-----|-----|-----|-------|
| Propagation Delay Output High to Low (Note 3) | $t_{PHL}$ | Input overdrive = 10mV  |     | 70  |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 60  |     |       |
| Propagation Delay Output Low to High (Note 3) | $t_{PLH}$ | Input overdrive = 10mV  |     | 120 |     | ns    |
|                                               |           | Input overdrive = 100mV |     | 110 |     |       |

**Note 2:** All devices are production tested at  $T_A = +25^\circ C$ , unless otherwise noted. All temperature limits are guaranteed by design.

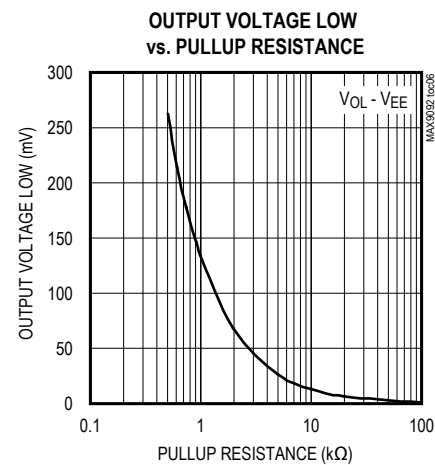
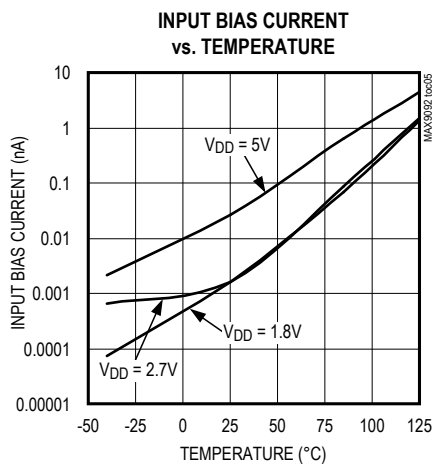
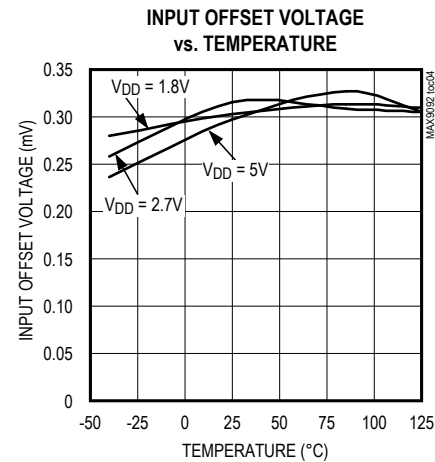
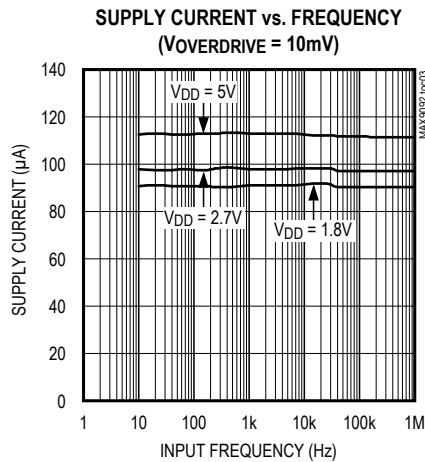
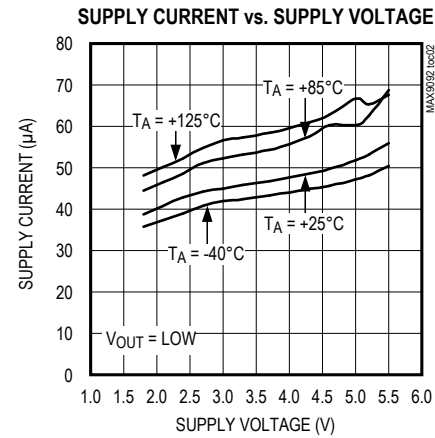
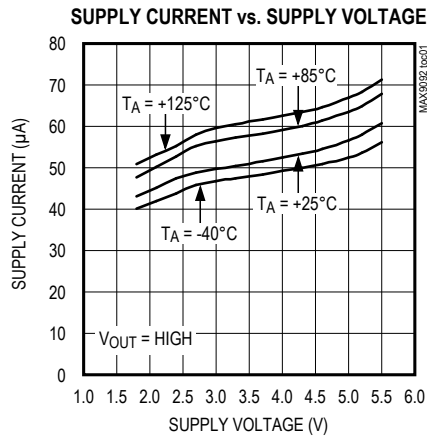
**Note 3:** Input overdrive is the overdrive voltage beyond the offset and hysteresis-determined trip points.

**Note 4:** Guaranteed by design.

**Note 5:** Supply current when output is high.

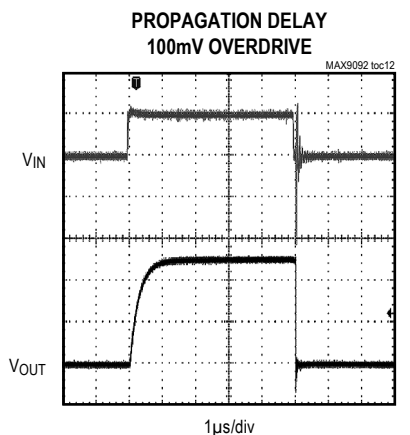
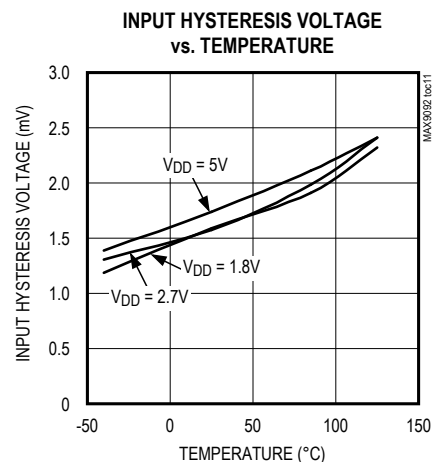
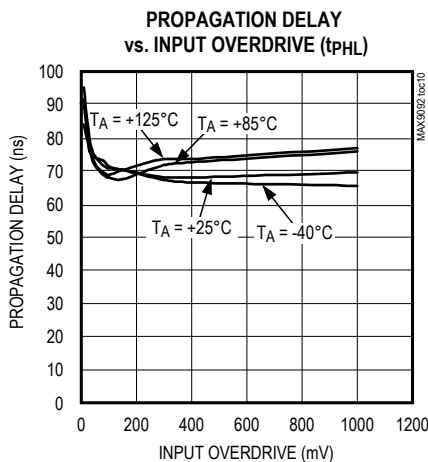
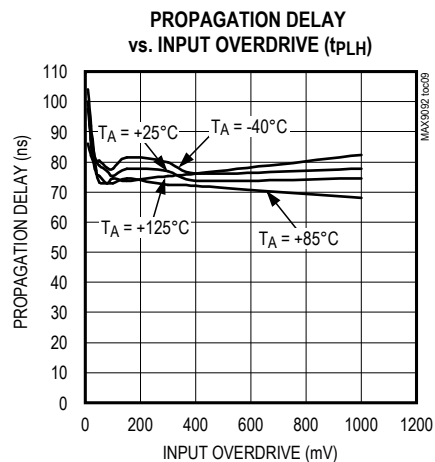
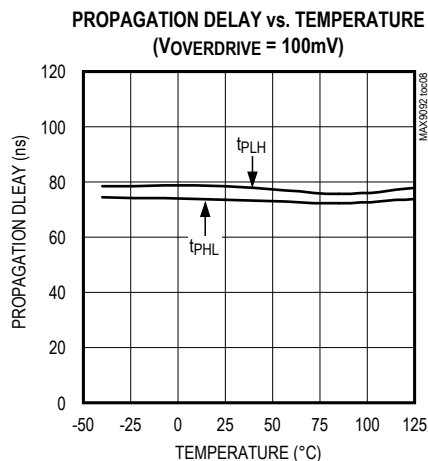
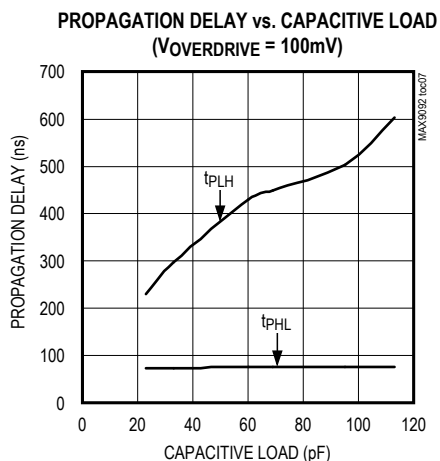
## Typical Operating Characteristics

( $V_{DD} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$ ,  $C_L = 10pF$ , overdrive = 100mV,  $T_A = +25^\circ C$ , unless otherwise noted.)



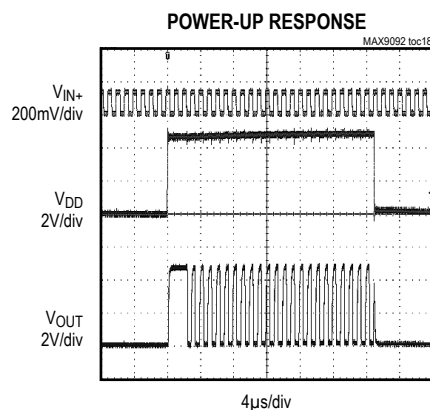
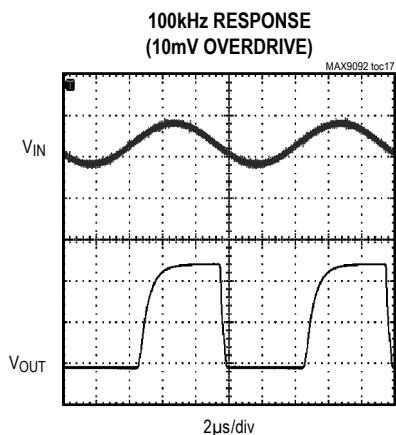
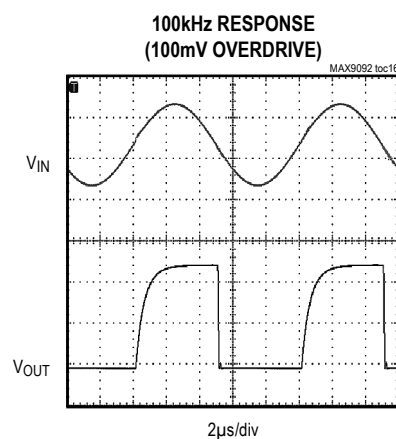
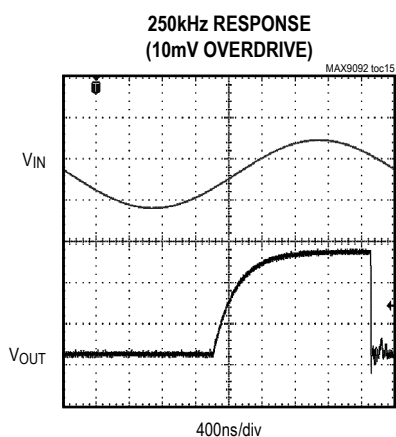
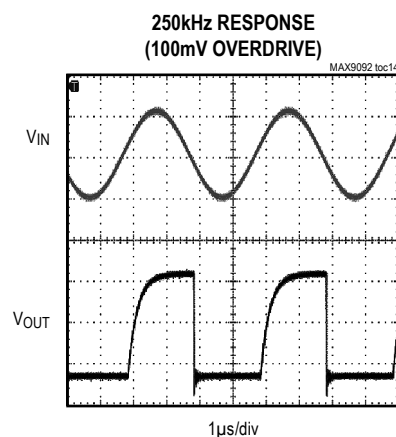
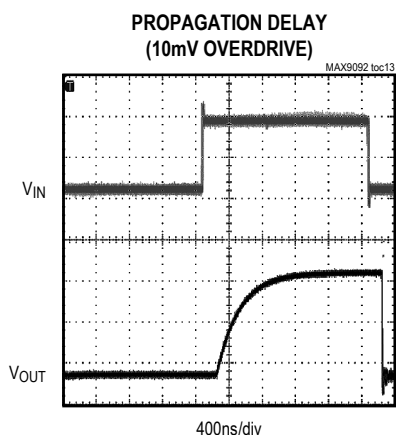
## Typical Operating Characteristics (continued)

( $V_{DD} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$ ,  $C_L = 10pF$ , overdrive = 100mV,  $T_A = +25^\circ C$ , unless otherwise noted.)



## Typical Operating Characteristics (continued)

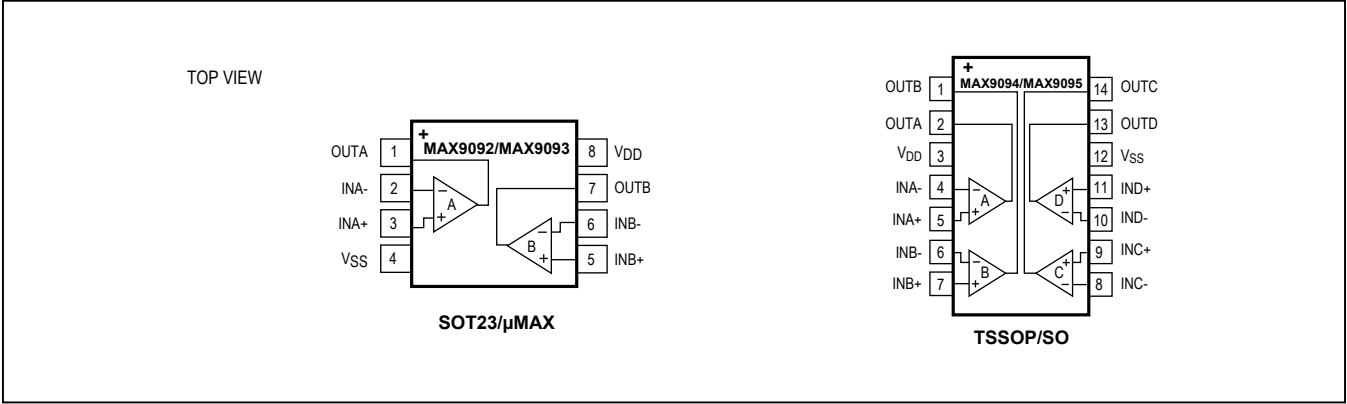
( $V_{DD} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{CM} = 0V$ ,  $R_L = 5.1k\Omega$ ,  $C_L = 10pF$ , overdrive = 100mV,  $T_A = +25^\circ C$ , unless otherwise noted.)



MAX9092/MAX9093/  
MAX9094/MAX9095

General-Purpose, Low-Voltage,  
Dual/Quad, Tiny Pack Comparators

Pin Configurations



Pin Description

| PIN             |                 | NAME | FUNCTION                            |
|-----------------|-----------------|------|-------------------------------------|
| MAX9092/MAX9093 | MAX9094/MAX9095 |      |                                     |
| 1               | 2               | OUTA | Comparator A Output (Open Drain)    |
| 2               | 4               | INA- | Comparator A Inverting Input        |
| 3               | 5               | INA+ | Comparator A Noninverting Input     |
| 4               | 12              | VSS  | Negative Supply (Connect to Ground) |
| 5               | 7               | INB+ | Comparator B Noninverting Input     |
| 6               | 6               | INB- | Comparator B Inverting Input        |
| 7               | 1               | OUTB | Comparator B Output (Open Drain)    |
| 8               | 3               | VDD  | Positive Supply                     |
| —               | 8               | INC- | Comparator C Inverting Input        |
| —               | 9               | INC+ | Comparator C Noninverting Input     |
| —               | 10              | IND- | Comparator D Inverting Input        |
| —               | 11              | IND+ | Comparator D Noninverting Input     |
| —               | 13              | OUTD | Comparator D Output (Open Drain)    |
| —               | 14              | OUTC | Comparator C Output (Open Drain)    |

## MAX9092/MAX9093/ MAX9094/MAX9095

### Detailed Description

The MAX9092/MAX9093/MAX9094/MAX9095 are low-cost, general-purpose comparators that have a single-supply +1.8V to +5V operating voltage range. The common-mode input range extends from -0.1V below the negative supply to within +0.8V of the positive supply. They require approximately 65µA per comparator with a 5V supply and 50µA with a 2.7V supply.

The MAX9093/MAX9095 have 2mV of hysteresis for noise immunity. This significantly reduces the chance of output oscillations even with slow-moving input signals.

### Applications Information

#### Hysteresis

Many comparators oscillate in the linear region of operation because of noise or undesired parasitic feedback. This tends to occur when the voltage on one input is equal or very close to the voltage on the other input. The MAX9093/MAX9095 have internal hysteresis to counter parasitic effects and noise.

The hysteresis in a comparator creates two trip points: one for the rising input voltage and one for the falling input voltage (Figure 1). The difference between the trip points is the hysteresis. When the comparator's input voltages are equal, the hysteresis effectively causes one comparator input to move quickly past the other, thus taking the input out of the region where oscillation occurs. This provides clean output transitions for noisy, slow-moving input signals.

Additional hysteresis can be generated with two resistors using positive feedback (Figure 2). Use the following procedure to calculate resistor values:

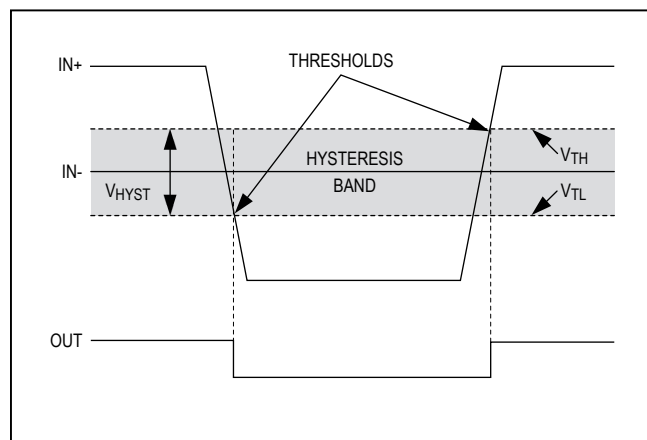


Figure 1. Threshold Hysteresis Band (Not to Scale)

## General-Purpose, Low-Voltage, Dual/Quad, Tiny Pack Comparators

- 1) Find output voltage when output is high:

$$V_{OUT(HIGH)} = V_{DD} - I_{LOAD} \times R_L$$

- 2) Find the trip points of the comparator using these formulas:

$$V_{TH} = V_{REF} + ((V_{OUT(HIGH)} - V_{REF})R_2)/(R_1 + R_2)$$

$$V_{TL} = V_{REF}(1 - (R_2/(R_1 + R_2)))$$

where  $V_{TH}$  is the threshold voltage at which the comparator switches its output from high to low as  $V_{IN}$  rises above the trip point, and  $V_{TL}$  is the threshold voltage at which the comparator switches its output from low to high as  $V_{IN}$  drops below the trip point.

- 3) The hysteresis band is:

$$V_{HYST} = V_{TH} - V_{TL} = V_{DD}(R_2/(R_1 + R_2))$$

In this example, let  $V_{DD} = 5V$ ,  $V_{REF} = 2.5V$ ,  $I_{LOAD} = 50nA$ , and  $R_L = 5.1k\Omega$ .

$$V_{OUT(HIGH)} = 5.0V - (50 \times 10^{-9} \times 5.1 \times 10^3\Omega) \approx 5.0V$$

$$V_{TH} = 2.5 + 2.5(R_2/(R_1 + R_2))$$

$$V_{TL} = 2.5(1 - (R_2/(R_1 + R_2)))$$

Select  $R_2$ . In this example, choose 1kΩ.

Select  $V_{HYST}$ . In this example, choose 50mV.

Solve for  $R_1$ .

$$V_{HYST} = V_{OUT(HIGH)}(R_2/(R_1 + R_2))V$$

$$0.050V = 5(1000/(R_1 + 1000))V$$

where  $R_1 \approx 100k\Omega$ ,  $V_{TH} = 2.525V$ , and  $V_{TL} = 2.475V$

Choose  $R_1$  and  $R_2$  to be large enough as not to exceed the amount of current the reference can supply.

The source current required is  $V_{REF}/(R_1 + R_2)$ .

The sink current is  $(V_{OUT(HIGH)} - V_{REF}) \times (R_1 + R_2)$ .

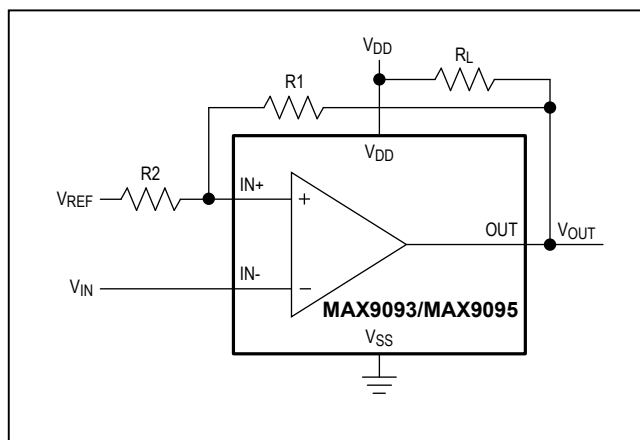


Figure 2. Adding Hysteresis with External Resistors

## MAX9092/MAX9093/ MAX9094/MAX9095

## General-Purpose, Low-Voltage, Dual/Quad, Tiny Pack Comparators

Choose  $R_L$  to be large enough to avoid drawing excess current, yet small enough to supply the necessary current to drive the load.  $R_L$  should be between 1k $\Omega$  and 10k $\Omega$ . Choose  $R_1$  to be much larger than  $R_L$  to avoid lowering  $V_{OUT(HIGH)}$  or raising  $V_{OUT(LOW)}$ .

### Board Layout and Bypassing

Use 0.1 $\mu$ F bypass capacitors from  $V_{DD}$  to  $V_{SS}$ . To maximize performance, minimize stray inductance by putting this capacitor close to the  $V_{DD}$  pin and reducing trace lengths. For slow-moving input signals (rise time > 1ms), use a 1nF capacitor between  $IN+$  and  $IN-$  to reduce high frequency noise.

### Chip Information

PROCESS: BiCMOS

### Ordering Information

| PART                | TEMP RANGE      | PIN-PACKAGE | TOP MARK |
|---------------------|-----------------|-------------|----------|
| <b>MAX9092</b> AKA+ | -40°C to +125°C | 8 SOT23     | +AESO    |
| MAX9092AUA+         | -40°C to +125°C | 8 $\mu$ MAX | —        |
| <b>MAX9093</b> AKA+ | -40°C to +125°C | 8 SOT23     | +AESP    |
| MAX9093AUA+         | -40°C to +125°C | 8 $\mu$ MAX | —        |
| <b>MAX9094</b> ASD+ | -40°C to +125°C | 14 SO       | —        |
| MAX9094AUD+         | -40°C to +125°C | 14 TSSOP    | —        |
| <b>MAX9095</b> ASD+ | -40°C to +125°C | 14 SO       | —        |
| MAX9095AUD+         | -40°C to +125°C | 14 TSSOP    | —        |

+Denotes lead(Pb)-free/RoHS-compliant package.

### Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO.             | LAND PATTERN NO.        |
|--------------|--------------|-------------------------|-------------------------|
| 8 SOT23      | K8+5         | <a href="#">21-0078</a> | <a href="#">90-0176</a> |
| 8 $\mu$ MAX  | U8+1         | <a href="#">21-0036</a> | <a href="#">90-0092</a> |
| 14 SO        | S14+1        | <a href="#">21-0041</a> | <a href="#">90-0112</a> |
| 14 TSSOP     | U14+1        | <a href="#">21-0066</a> | <a href="#">90-0113</a> |

MAX9092/MAX9093/  
MAX9094/MAX9095

General-Purpose, Low-Voltage,  
Dual/Quad, Tiny Pack Comparators

## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                                                                                                                                   | PAGES<br>CHANGED |
|--------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 0                  | 8/12             | Initial release                                                                                                                                               | —                |
| 1                  | 1/13             | Revised <i>Absolute Maximum Ratings</i> , <i>Electrical Characteristics</i> , and introduced the MAX9094/MAX9095 and released the MAX9092AUA+ and MAX9093AUA+ | 2, 3, 10         |
| 2                  | 9/14             | Removed automotive reference from data sheet                                                                                                                  | 1, 9             |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

*Maxim Integrated cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim Integrated product. No circuit patent licenses are implied. Maxim Integrated reserves the right to change the circuitry and specifications without notice at any time. The parametric values (min and max limits) shown in the Electrical Characteristics table are guaranteed. Other parametric values quoted in this data sheet are provided for guidance.*

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А