## MC74LVX04

## Hex Inverter

## With 5 V-Tolerant Inputs

The MC74LVX04 is an advanced high speed CMOS hex inverter. The inputs tolerate voltages up to 7.0 V , allowing the interface of 5.0 V systems to 3.0 V systems.

## Features

- High Speed: $\mathrm{t}_{\mathrm{PD}}=4.1 \mathrm{~ns}$ (Typ) at $\mathrm{V}_{\mathrm{CC}}=3.3 \mathrm{~V}$
- Low Power Dissipation: $\mathrm{I}_{\mathrm{CC}}=2 \mu \mathrm{~A}(\mathrm{Max})$ at $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: $\mathrm{V}_{\mathrm{OLP}}=0.5 \mathrm{~V}$ (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:

Human Body Model > 2000 V;
Machine Model > 200 V

- These Devices are $\mathrm{Pb}-$ Free and are RoHS Compliant


Figure 1. Logic Diagram

## PIN NAMES

| Pins | Function |
| :--- | :--- |
| $\frac{\mathrm{An}}{\mathrm{On}}$ | Data Inputs <br> Outputs |

## FUNCTION TABLE

| An | On |
| :---: | :---: |
| $L$ | $H$ |
| $H$ | $L$ |

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ORDERING INFORMATION
See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
| :---: | :--- | :---: | :---: |
| $\mathrm{V}_{\mathrm{CC}}$ | DC Supply Voltage | -0.5 to +7.0 | V |
| $\mathrm{~V}_{\text {in }}$ | DC Input Voltage | -0.5 to +7.0 | V |
| $\mathrm{~V}_{\text {out }}$ | DC Output Voltage | -0.5 to $\mathrm{V}_{\mathrm{CC}}+0.5$ | V |
| $\mathrm{I}_{\mathrm{IK}}$ | Input Diode Current | -20 | mA |
| $\mathrm{I}_{\mathrm{OK}}$ | Output Diode Current | $\pm 20$ | mA |
| $\mathrm{I}_{\text {out }}$ | DC Output Current, per Pin | $\pm 25$ | mA |
| $\mathrm{I}_{\mathrm{CC}}$ | DC Supply Current, $\mathrm{V}_{\text {CC }}$ and GND Pins | $\pm 50$ | mA |
| $\mathrm{P}_{\mathrm{D}}$ | Power Dissipation | 180 | mW |
| $\mathrm{~T}_{\text {stg }}$ | Storage Temperature | -65 to +150 | ${ }^{\circ} \mathrm{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
| :---: | :--- | :---: | :---: | :---: |
| $\mathrm{V}_{\mathrm{CC}}$ | DC Supply Voltage | 2.0 | 3.6 | V |
| $\mathrm{~V}_{\text {in }}$ | DC Input Voltage | 0 | 5.5 | V |
| $\mathrm{~V}_{\text {out }}$ | DC Output Voltage | 0 | $\mathrm{~V}_{\mathrm{CC}}$ | V |
| $\mathrm{T}_{\mathrm{A}}$ | Operating Temperature, All Package Types | -40 | +85 | ${ }^{\circ} \mathrm{C}$ |
| $\Delta \mathrm{t} / \Delta \mathrm{V}$ | Input Rise and Fall Time | 0 | 100 | $\mathrm{~ns} / \mathrm{V}$ |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | $\begin{aligned} & V_{\mathrm{cc}} \\ & \text { (V) } \end{aligned}$ | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ |  |  | $\mathrm{T}_{\mathrm{A}}=-40$ to $85^{\circ} \mathrm{C}$ |  | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Min | Typ | Max | Min | Max |  |
| $\mathrm{V}_{\mathrm{IH}}$ | High-Level Input Voltage |  | $\begin{aligned} & \hline 2.0 \\ & 3.0 \\ & 3.6 \end{aligned}$ | $\begin{aligned} & 1.5 \\ & 2.0 \\ & 2.4 \end{aligned}$ |  |  | $\begin{aligned} & \hline 1.5 \\ & 2.0 \\ & 2.4 \end{aligned}$ |  | V |
| $\mathrm{V}_{\mathrm{IL}}$ | Low-Level Input Voltage |  | $\begin{aligned} & 2.0 \\ & 3.0 \\ & 3.6 \end{aligned}$ |  |  | $\begin{aligned} & 0.5 \\ & 0.8 \\ & 0.8 \end{aligned}$ |  | $\begin{aligned} & \hline 0.5 \\ & 0.8 \\ & 0.8 \end{aligned}$ | V |
| $\mathrm{V}_{\mathrm{OH}}$ | High-Level Output Voltage $\left(\mathrm{V}_{\mathrm{in}}=\mathrm{V}_{\mathrm{IH}} \text { or } \mathrm{V}_{\mathrm{IL}}\right)$ | $\begin{aligned} & \mathrm{I}_{\mathrm{OH}}=-50 \mu \mathrm{~A} \\ & \mathrm{I}_{\mathrm{OH}}=-50 \mu \mathrm{~A} \\ & \mathrm{I}_{\mathrm{OH}}=-4 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 2.0 \\ & 3.0 \\ & 3.0 \end{aligned}$ | $\begin{gathered} 1.9 \\ 2.9 \\ 2.58 \end{gathered}$ | $\begin{aligned} & 2.0 \\ & 3.0 \end{aligned}$ |  | $\begin{gathered} 1.9 \\ 2.9 \\ 2.48 \end{gathered}$ |  | V |
| $\mathrm{V}_{\text {OL }}$ | Low-Level Output Voltage $\left(\mathrm{V}_{\text {in }}=\mathrm{V}_{\mathrm{IH}}\right.$ or $\left.\mathrm{V}_{\mathrm{IL}}\right)$ | $\begin{aligned} & \mathrm{I} \mathrm{OL}=50 \mu \mathrm{~A} \\ & \mathrm{IOL}=50 \mu \mathrm{~A} \\ & \mathrm{I} \mathrm{OL}=4 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 2.0 \\ & 3.0 \\ & 3.0 \end{aligned}$ |  | $\begin{aligned} & \hline 0.0 \\ & 0.0 \end{aligned}$ | $\begin{gathered} \hline 0.1 \\ 0.1 \\ 0.36 \end{gathered}$ |  | $\begin{gathered} \hline 0.1 \\ 0.1 \\ 0.44 \end{gathered}$ | V |
| $1{ }_{\text {in }}$ | Input Leakage Current | $\mathrm{V}_{\text {in }}=5.5 \mathrm{~V}$ or GND | 3.6 |  |  | $\pm 0.1$ |  | $\pm 1.0$ | $\mu \mathrm{A}$ |
| ICC | Quiescent Supply Current | $\mathrm{V}_{\text {in }}=\mathrm{V}_{\text {CC }}$ or GND | 3.6 |  |  | 2.0 |  | 20.0 | $\mu \mathrm{A}$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

AC ELECTRICAL CHARACTERISTICS (Input $t_{r}=t_{f}=3.0 \mathrm{~ns}$ )

| Symbol | Parameter | Test Conditions |  | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ |  |  | $\mathrm{T}_{\mathrm{A}}=-40$ to $85^{\circ} \mathrm{C}$ |  | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Min | Typ | Max | Min | Max |  |
| $\begin{aligned} & \text { tpLH, } \\ & t_{\text {tPHL }} \end{aligned}$ | Propagation Delay, Input to Output | $\mathrm{V}_{\mathrm{CC}}=2.7 \mathrm{~V}$ | $\begin{aligned} & \mathrm{C}_{\mathrm{L}}=15 \mathrm{pF} \\ & \mathrm{C}_{\mathrm{L}}=50 \mathrm{pF} \end{aligned}$ |  | $\begin{aligned} & 5.4 \\ & 7.9 \end{aligned}$ | $\begin{aligned} & \hline 10.1 \\ & 13.6 \end{aligned}$ | $\begin{aligned} & \hline 1.0 \\ & 1.0 \end{aligned}$ | $\begin{aligned} & \hline 12.5 \\ & 16.0 \end{aligned}$ | ns |
|  |  | $\mathrm{V}_{\mathrm{CC}}=3.3 \pm 0.3 \mathrm{~V}$ | $\begin{aligned} & C_{\mathrm{L}}=15 \mathrm{pF} \\ & \mathrm{C}_{\mathrm{L}}=50 \mathrm{pF} \end{aligned}$ |  | $\begin{aligned} & 4.1 \\ & 6.6 \end{aligned}$ | $\begin{aligned} & 6.2 \\ & 9.7 \end{aligned}$ | $\begin{aligned} & \hline 1.0 \\ & 1.0 \end{aligned}$ | $\begin{gathered} \hline 7.5 \\ 11.0 \end{gathered}$ |  |
| toshl tosth | Output-to-Output Skew (Note 1) | $\begin{aligned} & \hline \mathrm{V}_{\mathrm{CC}}=2.7 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{CC}}=3.3 \pm 0.3 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & C_{\mathrm{L}}=50 \mathrm{pF} \\ & \mathrm{C}_{\mathrm{L}}=50 \mathrm{pF} \end{aligned}$ |  |  | $\begin{aligned} & 1.5 \\ & 1.5 \end{aligned}$ |  | $\begin{aligned} & 1.5 \\ & 1.5 \end{aligned}$ | ns |

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (toshl) or LOW-to-HIGH (tosLh); parameter guaranteed by design.

## CAPACITIVE CHARACTERISTICS

|  | Parameter | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ |  |  | $\mathrm{T}_{\mathrm{A}}=-40$ to $85^{\circ} \mathrm{C}$ |  | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Symbol |  | Min | Typ | Max | Min | Max |  |
| Cin | Input Capacitance |  | 4 | 10 |  | 10 | pF |
| $\mathrm{C}_{\text {PD }}$ | Power Dissipation Capacitance (Note 2) |  | 18 |  |  |  | pF |

2. $\mathrm{C}_{\mathrm{PD}}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{C C(O P R)}=C_{P D} \bullet V_{C C} \bullet f_{\text {in }}+I_{C C} / 6$ (per buffer). $C_{P D}$ is used to determine the no-load dynamic power consumption; $\mathrm{P}_{\mathrm{D}}=\mathrm{C}_{\mathrm{PD}} \bullet \mathrm{V}_{\mathrm{CC}}{ }^{2} \bullet \mathrm{f}_{\mathrm{in}}+\mathrm{I}_{\mathrm{CC}} \bullet \mathrm{V}_{\mathrm{CC}}$.

NOISE CHARACTERISTICS (Input $\mathrm{t}_{\mathrm{r}}=\mathrm{t}_{\mathrm{f}}=3.0 \mathrm{~ns}, \mathrm{C}_{\mathrm{L}}=50 \mathrm{pF}, \mathrm{V}_{\mathrm{CC}}=3.3 \mathrm{~V}$, Measured in SOIC Package)

| Symbol | Characteristic | $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ |  | Unit |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Typ | Max |  |
| $\mathrm{V}_{\text {OLP }}$ | Quiet Output Maximum Dynamic $\mathrm{V}_{\mathrm{OL}}$ | 0.3 | 0.5 | V |
| $\mathrm{V}_{\text {OLV }}$ | Quiet Output Minimum Dynamic $\mathrm{V}_{\text {OL }}$ | -0.3 | -0.5 | V |
| $\mathrm{V}_{\text {IHD }}$ | Minimum High Level Dynamic Input Voltage |  | 2.0 | V |
| $\mathrm{V}_{\text {ILD }}$ | Maximum Low Level Dynamic Input Voltage |  | 0.8 | V |




Includes all probe and jig capacitance
Figure 3. Test Circuit

ORDERING INFORMATION

| Device | Package | Shipping $^{\dagger}$ |
| :--- | :---: | :---: |
| MC74LVX04DR2G | SOIC-14 NB <br> (Pb-Free) | 2500 Tape \& Reel |
| MC74LVX04DTR2G | TSSOP-14 <br> (Pb-Free) | 2500 Tape \& Reel |

$\dagger$ For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.


SOIC-14 NB
CASE 751A-03
ISSUE L
SCALE 1:1


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR

PROTRUSION. ALLOWABLE PROTRUSION
SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION
4. DIMENSIONS D AND E DO NOT INCLUDE

MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |  |  | INCHES |  |
| :---: | ---: | :---: | ---: | ---: | :---: |
|  | MIN | MAX | MIN | MAX |  |
|  | 1.35 | 1.75 | 0.054 | 0.068 |  |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |  |
| A3 | 0.19 | 0.25 | 0.008 | 0.010 |  |
| b | 0.35 | 0.49 | 0.014 | 0.019 |  |
| D | 8.55 | 8.75 | 0.337 | 0.344 |  |
| E | 3.80 | 4.00 | 0.150 | 0.157 |  |
| e | 1.27 BSC | 0.050 | BSC |  |  |
| H | 5.80 | 6.20 | 0.228 | 0.244 |  |
| h | 0.25 | 0.50 | 0.010 | 0.019 |  |
| L | 0.40 | 1.25 | 0.016 | 0.049 |  |
| M | 0 | $7^{\circ}$ | $7^{\circ}$ | $0^{\circ}$ |  |



SOLDERING FOOTPRINT*


For additional information on our $\mathrm{Pb}-$ Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## STYLES ON PAGE 2

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STYLE 1:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. NO CONNECTION
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. NO CONNECTION
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
4. COMMON ANODE

STYLE 5
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHOD
4. ANODE/CATHOD
4. ANODE/CATHODE
5. ANODE/CATHODE
6. NO CONNECTION
7. COMMON ANODE
8. COMMON CATHOD
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 2 :
CANCELLED

STYLE 3:
PIN 1. NO CONNECTION 2. ANODE 3. ANODE
4. NO CONNECTION 5. ANODE
6. NO CONNECTION
7. ANODE
8. ANODE
9. ANODE
10. NO CONNECTION
11. ANODE
12. ANODE
13. NO CONNECTION
14. COMMON CATHODE

## STYLE 6

PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
5. CATHODE
6. CATHODE
7. CATHOD
8. ANODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE

STYLE 7:
PIN 1. ANODE/CATHODE
2. COMMON ANODE
3. COMMON CATHODE
4. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. ANODE/CATHODE
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. COMMON CATHODE
11. COMMON CATHOD
13. ANODE/CATHODE
14. ANODE/CATHODE

STYLE 4:
PIN 1. NO CONNECTION 2. CATHODE
3. CATHODE
4. NO CONNECTION
5. CATHODE
6. NO CONNECTION
7. CATHODE
. CATHODE
9. CATHODE
10. NO CONNECTION
11. CATHODE
12. CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 8:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
4. NO CONNECTION
5. ANODE/CATHODE
6. ANODE/CATHODE
7. COMMON ANODE
8. COMMON ANODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. NO CONNECTION
11. NO CONNECTION
12. ANODE/CATHODE
12. ANODE/CATHODE
13. ANODE/CATHODE
13. ANODE/CATHODE
14. COMMON CATHODE

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