

# Low Voltage Hex Inverter

## 74LVX04

### General Description

The LVX04 contains six inverters. The inputs tolerate voltages up to 6.5 V allowing the interface of 5 V systems to 3 V systems.

### Features

- Input Voltage Level Translation From 5 V to 3 V
- Ideal for Low Power/Low Noise 3.3 V Applications
- Guaranteed Simultaneous Switching Noise Level and Dynamic Threshold Performance
- This is a Pb-Free and Halide Free Device

### Logic Symbol

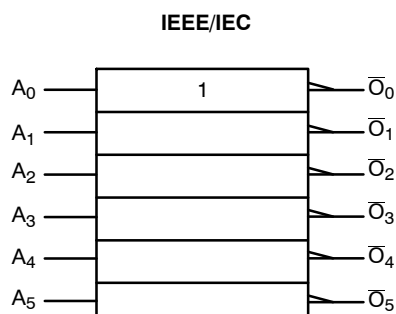
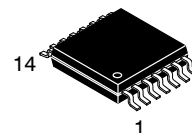
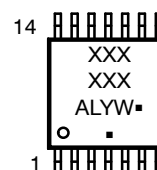


Figure 1. Logic Symbol



TSSOP-14 WB  
CASE 948G

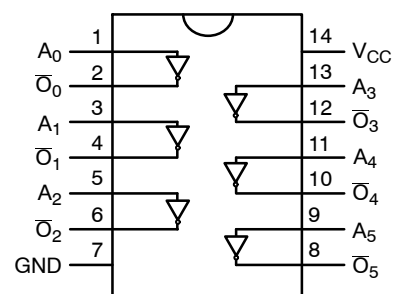
### MARKING DIAGRAM



XXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### CONNECTION DIAGRAM



### PIN DESCRIPTION

| Pin Names   | Description |
|-------------|-------------|
| $A_n$       | Inputs      |
| $\bar{O}_n$ | Outputs     |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

## MAXIMUM RATINGS

| Symbol                | Parameter                                                           | Value                  | Unit |
|-----------------------|---------------------------------------------------------------------|------------------------|------|
| $V_{CC}$              | DC Supply Voltage                                                   | -0.5 to +6.5           | V    |
| $I_{IK}$              | DC Input Diode Current, $V_I = -0.5$ V                              | -20                    | mA   |
| $V_I$                 | DC Input Voltage                                                    | -0.5 to +6.5           | V    |
| $I_{OK}$              | DC Output Diode Current<br>$V_O = -0.5$ V<br>$V_O = V_{CC} + 0.5$ V | -20<br>+20             | mA   |
| $V_O$                 | DC Output Voltage                                                   | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_O$                 | DC Output Source or Sink Current                                    | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Group Current                                        | $\pm 50$               | mA   |
| $T_{STG}$             | Storage Temperature                                                 | -65 to +150            | °C   |
| $P_D$                 | Power Dissipation                                                   | 833                    | mW   |

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 (Note 1)

| Symbol                | Parameter               | Value         | Unit |
|-----------------------|-------------------------|---------------|------|
| $V_{CC}$              | Supply Voltage          | 2.0 to 3.6    | V    |
| $V_I$                 | Input Voltage           | 0 to 5.5      | V    |
| $V_O$                 | Output Voltage          | 0 to $V_{CC}$ | V    |
| $T_A$                 | Operating Temperature   | -40 to 85     | °C   |
| $\Delta T / \Delta V$ | Input Rise or Fall Rate | 0 to 100      | ns/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.

1. Unused inputs must be held HIGH or LOW. They may not float.

## DC ELECTRICAL CHARACTERISTICS

| Symbol   | Parameter                 | $V_{CC}$ (V) | Conditions                                                    | $T_A = 25^\circ\text{C}$ |     |           | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |           | Unit          |
|----------|---------------------------|--------------|---------------------------------------------------------------|--------------------------|-----|-----------|-------------------------------------------------|-----------|---------------|
|          |                           |              |                                                               | Min                      | Typ | Max       | Min                                             | Max       |               |
| $V_{IH}$ | HIGH Level Input Voltage  | 2.0          |                                                               | 1.5                      | -   | -         | 1.5                                             | -         | V             |
|          |                           | 3.0          |                                                               | 2.0                      | -   | -         | 2.0                                             | -         |               |
|          |                           | 3.6          |                                                               | 2.4                      | -   | -         | 2.4                                             | -         |               |
| $V_{IL}$ | LOW Level Input Voltage   | 2.0          |                                                               | -                        | -   | 0.5       | -                                               | 0.5       | V             |
|          |                           | 3.0          |                                                               | -                        | -   | 0.8       | -                                               | 0.8       |               |
|          |                           | 3.6          |                                                               | -                        | -   | 0.8       | -                                               | 0.8       |               |
| $V_{OH}$ | HIGH Level Output Voltage | 2.0          | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OH} = -50 \mu\text{A}$ | 1.9                      | 2.0 | -         | 1.9                                             | -         | V             |
|          |                           | 3.0          | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OH} = -50 \mu\text{A}$ | 2.9                      | 3.0 | -         | 2.9                                             | -         |               |
|          |                           |              | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OH} = -4 \text{ mA}$   | 2.58                     | -   | -         | 2.48                                            | -         |               |
| $V_{OL}$ | LOW Level Output Voltage  | 2.0          | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OL} = 50 \mu\text{A}$  | -                        | 0.0 | 0.1       | -                                               | 0.1       | V             |
|          |                           | 3.0          | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OL} = 50 \mu\text{A}$  | -                        | 0.0 | 0.1       | -                                               | 0.1       |               |
|          |                           |              | $V_{IN} = V_{IL}$ or $V_{IH}$ ,<br>$I_{OL} = 4 \text{ mA}$    | -                        | -   | 0.36      | -                                               | 0.44      |               |
| $I_{IN}$ | Input Leakage Current     | 3.6          | $V_{IN} = 5.5 \text{ V or GND}$                               | -                        | -   | $\pm 0.1$ | -                                               | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$ | Quiescent Supply Current  | 3.6          | $V_{IN} = V_{CC}$ or GND                                      | -                        | -   | 2.0       | -                                               | 20.0      | $\mu\text{A}$ |

# 74LVX04

## NOISE CHARACTERISTICS (Note 2)

| Symbol           | Parameter                                    | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | T <sub>A</sub> = 25°C |        | Unit |
|------------------|----------------------------------------------|---------------------|---------------------|-----------------------|--------|------|
|                  |                                              |                     |                     | Typ                   | Limits |      |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 3.3                 | 50                  | 0.3                   | 0.5    | V    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 3.3                 | 50                  | -0.3                  | -0.5   | V    |
| V <sub>IHD</sub> | Minimum HIGH Level Dynamic Input Voltage     | 3.3                 | 50                  | -                     | 2.0    | V    |
| V <sub>ILD</sub> | Maximum LOW Level Dynamic Input Voltage      | 3.3                 | 50                  | -                     | 0.8    | V    |

2. Input = t<sub>f</sub> = 3 ns

## AC ELECTRICAL CHARACTERISTICS

| Symbol                                   | Parameter                         | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | T <sub>A</sub> = 25°C |     |      | T <sub>A</sub> = -40°C to +85°C |      | Unit |
|------------------------------------------|-----------------------------------|---------------------|---------------------|-----------------------|-----|------|---------------------------------|------|------|
|                                          |                                   |                     |                     | Min                   | Typ | Max  | Min                             | Max  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub>   | Propagation Delay Time            | 2.7                 | 15                  | -                     | 5.4 | 10.1 | 1.0                             | 12.5 | ns   |
|                                          |                                   |                     | 50                  | -                     | 7.9 | 13.6 | 1.0                             | 16.0 |      |
|                                          |                                   | 3.3 ± 0.3           | 15                  | -                     | 4.1 | 6.2  | 1.0                             | 7.5  |      |
|                                          |                                   |                     | 50                  | -                     | 6.6 | 9.7  | 1.0                             | 11.0 |      |
| t <sub>OSLH</sub> ,<br>t <sub>OSHL</sub> | Output to Output Skew<br>(Note 3) | 2.7                 | 50                  | -                     | -   | 1.5  | -                               | 1.5  | ns   |
|                                          |                                   | 3.3                 |                     | -                     | -   | 1.5  | -                               | 1.5  |      |

3. Parameter guaranteed by design t<sub>OSLH</sub> = |t<sub>PLHm</sub> - t<sub>PLHn</sub>|, t<sub>OSHL</sub> = |t<sub>PHLm</sub> - t<sub>PHLn</sub>|

## CAPACITANCE

| Symbol          | Parameter                              | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -40°C to +85°C |     | Unit |
|-----------------|----------------------------------------|-----------------------|-----|-----|---------------------------------|-----|------|
|                 |                                        | Min                   | Typ | Max | Min                             | Max |      |
| C <sub>IN</sub> | Input Capacitance                      | -                     | 4   | 10  | -                               | 10  | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 4) | -                     | 18  | -   | -                               | -   | pF   |

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.

4. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance, which is calculated from the operating current consumption without load.

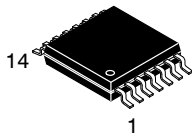
Average operating current can be obtained from the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \times V_{CC} \times f_{IN} \times I_{CC} / 6 \text{ (per Gate).}$$

## ORDERING INFORMATION

| Device Order Number | Top Marking | Package Type                         | Shipping†              |
|---------------------|-------------|--------------------------------------|------------------------|
| 74LVX04MTCX         | LVX<br>04   | TSSOP-14BW<br>(Pb-Free, Halide Free) | 2,500 /<br>Tape & Reel |

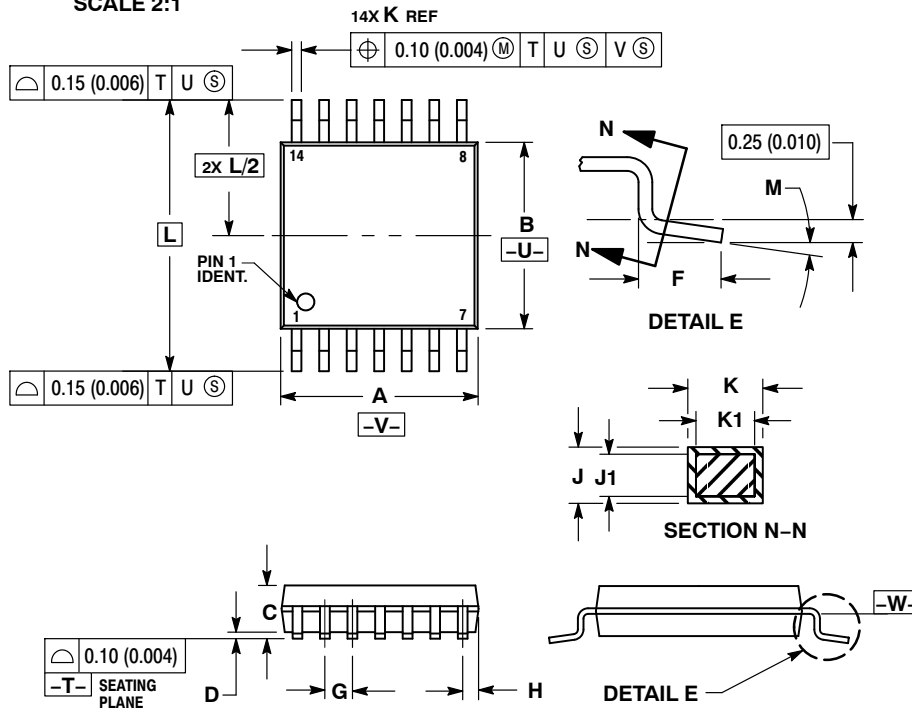
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).



**SCALE 2:1**

**TSSOP-14 WB**  
CASE 948G  
ISSUE C

DATE 17 FEB 2016

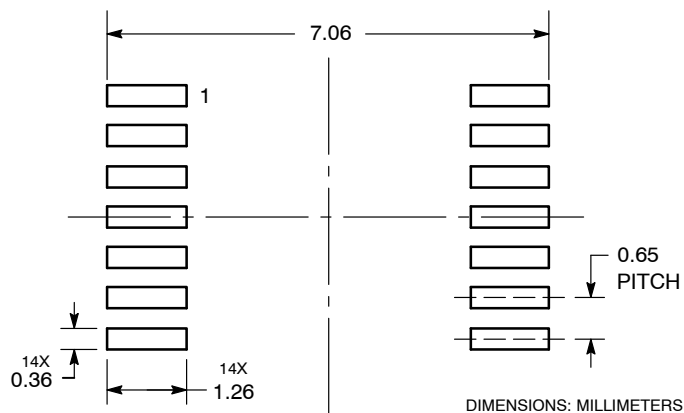


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

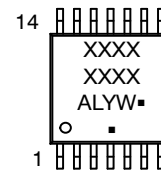
|     | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
| DIM | MIN         | MAX  | MIN       | MAX   |
| A   | 4.90        | 5.10 | 0.193     | 0.200 |
| B   | 4.30        | 4.50 | 0.169     | 0.177 |
| C   | ----        | 1.20 | ----      | 0.047 |
| D   | 0.05        | 0.15 | 0.002     | 0.006 |
| F   | 0.50        | 0.75 | 0.020     | 0.030 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.50        | 0.60 | 0.020     | 0.024 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0°          | 8°   | 0°        | 8°    |

### RECOMMENDED SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

### GENERIC MARKING DIAGRAM\*



A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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