

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74LVX14FN

## Hex Schmitt Inverter

The TC74LVX14FN is a high-speed CMOS HEX SCHMITT INVERTER fabricated with silicon gate CMOS technology. Designed for use in 3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

This device is suitable for low-voltage and battery operated systems.

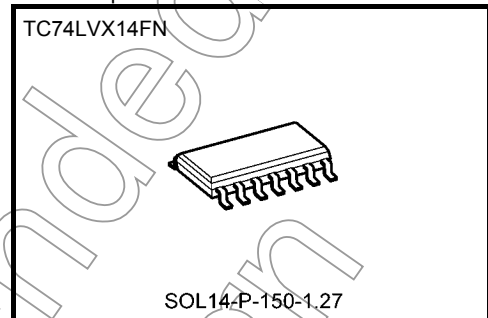
Pin configuration and function are the same as the TC74LVX04 but the inputs have hysteresis and with its schmitt trigger function, the TC74LVX14 can be used as a line receivers which will receive slow input signals.

An input protection circuit ensures that 0 to 5.5V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

## Features

- High-speed:  $t_{pd} = 6.8 \text{ ns (typ.) (VCC = 3.3 V)}$
- Low power dissipation:  $I_{CC} = 2 \mu\text{A (max) (Ta = 25^\circ\text{C})}$
- Power-down protection provided on all inputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Low noise:  $V_{OLP} = 0.5 \text{ V (max)}$
- Pin and function compatible with 74HC14

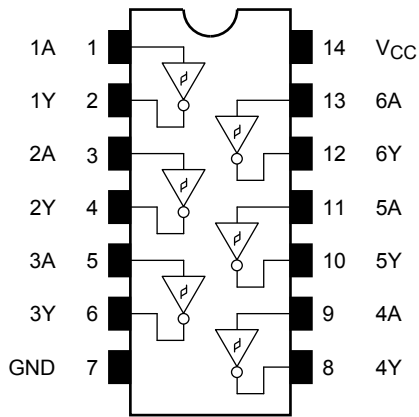
Note: xxxFN (JEDEC SOP) is not available in Japan.



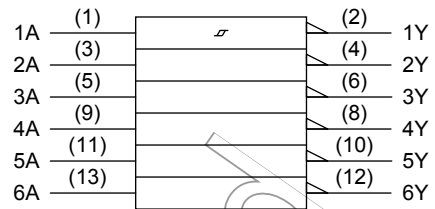
Weight  
SOL14-P-150-1.27 : 0.12 g (typ.)

Not Recommended for New Designs

**Pin Assignment (top view)**



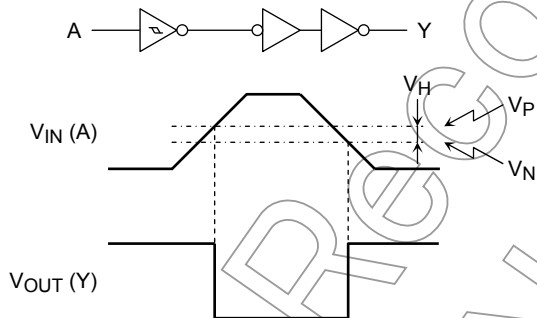
**IEC Logic Symbol**



**Truth Table**

| Inputs | Outputs |
|--------|---------|
| A      | Y       |
| L      | H       |
| H      | L       |

**System Diagram, Waveform**



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## Absolute Maximum Ratings (Note)

| Characteristics             | Symbol    | Rating                 | Unit        |
|-----------------------------|-----------|------------------------|-------------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7.0            | V           |
| DC input voltage            | $V_{IN}$  | -0.5 to 7.0            | V           |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$ | V           |
| Input diode current         | $I_{IK}$  | -20                    | mA          |
| Output diode current        | $I_{OK}$  | $\pm 20$               | mA          |
| DC output current           | $I_{OUT}$ | $\pm 25$               | mA          |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$               | mA          |
| Power dissipation           | $P_D$     | 180                    | mW          |
| Storage temperature         | $T_{stg}$ | -65 to 150             | $^{\circ}C$ |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## Operating Ranges (Note)

| Characteristics       | Symbol    | Rating        | Unit        |
|-----------------------|-----------|---------------|-------------|
| Supply voltage        | $V_{CC}$  | 2.0 to 3.6    | V           |
| Input voltage         | $V_{IN}$  | 0 to 5.5      | V           |
| Output voltage        | $V_{OUT}$ | 0 to $V_{CC}$ | V           |
| Operating temperature | $T_{opr}$ | -40 to 85     | $^{\circ}C$ |

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

| Characteristics          | Symbol   | Test Condition           | $T_a = 25^{\circ}C$ |                      |      | $T_a = -40$ to $85^{\circ}C$ |     | Unit      |         |      |   |
|--------------------------|----------|--------------------------|---------------------|----------------------|------|------------------------------|-----|-----------|---------|------|---|
|                          |          |                          | $V_{CC}$ (V)        | Min                  | Typ. | Max                          | Min |           | Max     |      |   |
| Threshold voltage        | H-level  | $V_P$                    | —                   | 3.0                  | —    | —                            | 2.2 | —         | 2.2     | V    |   |
|                          | L-level  | $V_N$                    | —                   | 3.0                  | 0.9  | —                            | —   | 0.9       | —       |      |   |
| Hysteresis voltage       | $V_H$    | —                        | 3.0                 | 0.3                  | —    | —                            | 1.2 | 0.3       | 1.2     | V    |   |
| Output voltage           | H-level  | $V_{OH}$                 | $V_{IN} = V_{IL}$   | $I_{OH} = -50 \mu A$ | 2.0  | 1.9                          | 2.0 | —         | 1.9     | —    | V |
|                          |          |                          |                     | $I_{OH} = -50 \mu A$ | 3.0  | 2.9                          | 3.0 | —         | 2.9     | —    |   |
|                          |          |                          |                     | $I_{OH} = -4 mA$     | 3.0  | 2.58                         | —   | —         | 2.48    | —    |   |
|                          | L-level  | $V_{OL}$                 | $V_{IN} = V_{IH}$   | $I_{OL} = 50 \mu A$  | 2.0  | —                            | 0   | 0.1       | —       | 0.1  |   |
|                          |          |                          |                     | $I_{OL} = 50 \mu A$  | 3.0  | —                            | 0   | 0.1       | —       | 0.1  |   |
|                          |          |                          |                     | $I_{OL} = 4 mA$      | 3.0  | —                            | —   | 0.36      | —       | 0.44 |   |
| Input leakage current    | $I_{IN}$ | $V_{IN} = 5.5 V$ or GND  | 3.6                 | —                    | —    | $\pm 0.1$                    | —   | $\pm 1.0$ | $\mu A$ |      |   |
| Quiescent supply current | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND | 3.6                 | —                    | —    | 2.0                          | —   | 20.0      | $\mu A$ |      |   |

### AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics               | Symbol            | Test Condition | Ta = 25°C           |                     |     | Ta = -40 to 85°C |      | Unit |      |     |
|-------------------------------|-------------------|----------------|---------------------|---------------------|-----|------------------|------|------|------|-----|
|                               |                   |                | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min | Typ.             | Max  |      | Min  | Max |
| Propagation delay time        | t <sub>pLH</sub>  | —              | 2.7                 | 15                  | —   | 8.7              | 16.3 | 1.0  | 19.5 | ns  |
|                               |                   |                |                     | 50                  | —   | 11.2             | 19.8 | 1.0  | 23.0 |     |
|                               | t <sub>pHL</sub>  |                | 3.3 ± 0.3           | 15                  | —   | 6.8              | 10.6 | 1.0  | 12.5 |     |
|                               |                   |                |                     | 50                  | —   | 9.3              | 14.1 | 1.0  | 16.0 |     |
| Output to output skew         | t <sub>osLH</sub> | (Note 1)       | 2.7                 | 50                  | —   | —                | 1.5  | —    | 1.5  | ns  |
|                               | t <sub>osHL</sub> |                |                     |                     | —   | —                | 1.5  | —    | 1.5  |     |
| Input capacitance             | C <sub>IN</sub>   |                | (Note 2)            | —                   | 4   | 10               | —    | 10   | pF   |     |
| Power dissipation capacitance | C <sub>PD</sub>   |                | (Note 3)            | —                   | 21  | —                | —    | —    | pF   |     |

Note 1: Parameter guaranteed by design.  
 ( $t_{osLH} = |t_{pLHm} - t_{pLHn}|$ ,  $t_{osHL} = |t_{pHLm} - t_{pHLn}|$ )

Note 2: Parameter guaranteed by design.

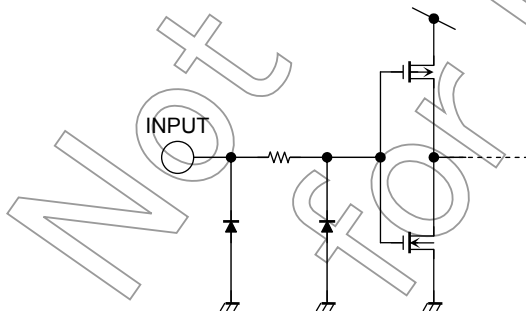
Note 3: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation:  
 $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6$  (per gate)

### Noise Characteristics (Ta = 25°C, input: $t_r = t_f = 3 \text{ ns}$ , C<sub>L</sub> = 50 pF)

| Characteristics  | Symbol           | Test Condition | V <sub>CC</sub> (V) | Typ. | Limit | Unit |
|--|------------------|----------------|---------------------|------|-------|------|
|  |                  |                | 3.3                 |      |       |      |
| Quiet output maximum dynamic V <sub>OL</sub>             | V <sub>OLP</sub> | —              | 3.3                 | 0.3  | 0.5   | V    |
| Quiet output minimum dynamic V <sub>OL</sub>             | V <sub>OLV</sub> | —              | 3.3                 | -0.3 | -0.5  | V    |
| Minimum high level dynamic input voltage V <sub>IH</sub> | V <sub>IHD</sub> | —              | 3.3                 | —    | 2.2   | V    |
| Maximum low level dynamic input voltage V <sub>IL</sub>  | V <sub>ILD</sub> | —              | 3.3                 | —    | 0.9   | V    |

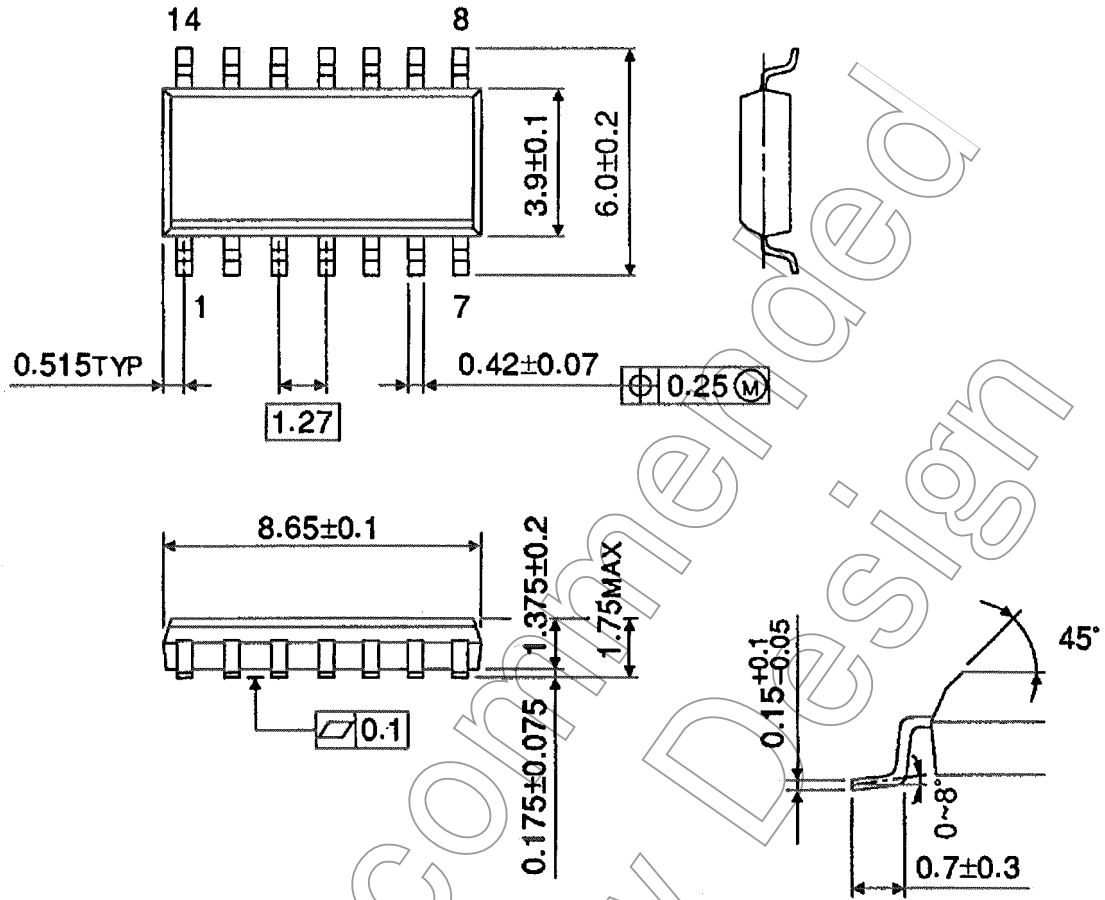
### Input Equivalent Circuit



Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Not Recommended for New Design

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