

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX14F, TC74LCX14FK

Low-Voltage Hex Schmitt Inverter with 5-V Tolerant Inputs and Outputs

The TC74LCX14 is a high-performance CMOS Schmitt inverter. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

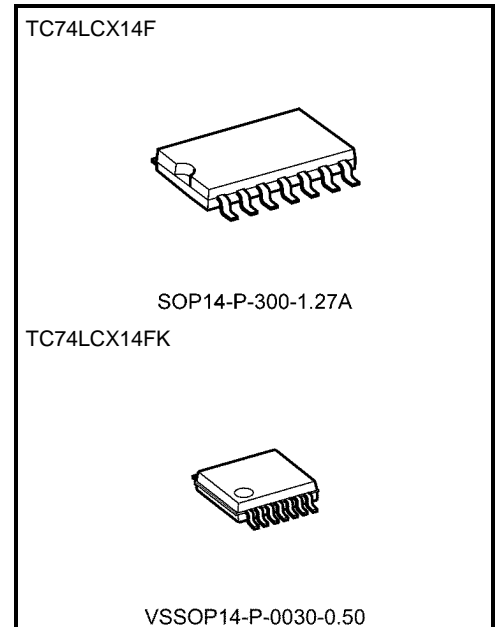
The device is designed for low-voltage (3.3 V) V_{CC} applications, but it could be used to interface to 5-V supply environment for inputs.

Pin configuration and function are the same as the TC74LCX04 but the inputs have hysteresis and with Schmitt trigger function, the TC74LCX14 can be used as line receivers which will receive slow input signals.

All inputs are equipped with protection circuits against static discharge.

Features

- Low-voltage operation: $V_{CC} = 1.65$ to 3.6 V
- High-speed operation: $t_{pd} = 6.5$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
- Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- Available in JEITA SOP, VSSOP (US)
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 14 type

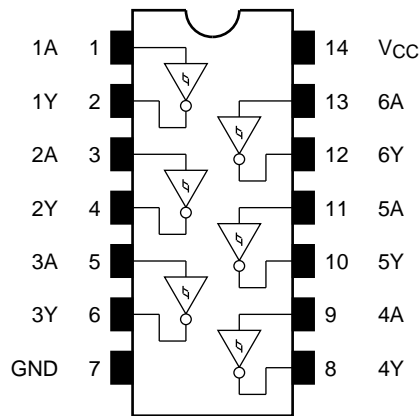


| | |
|---------------------|------------------|
| Weight | |
| SOP14-P-300-1.27A | : 0.18 g (typ.) |
| VSSOP14-P-0030-0.50 | : 0.02 g (typ.) |

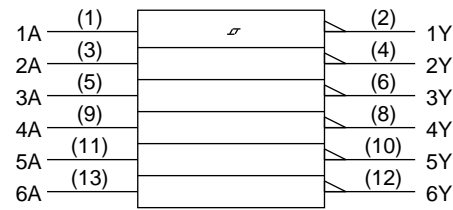
Note: The Electrical Characteristics of $V_{CC} = 1.8 \pm 0.15$ V is only applicable for products which manufactured from January 2009 onward.

Start of commercial production
1995-02

Pin Assignment (top view)



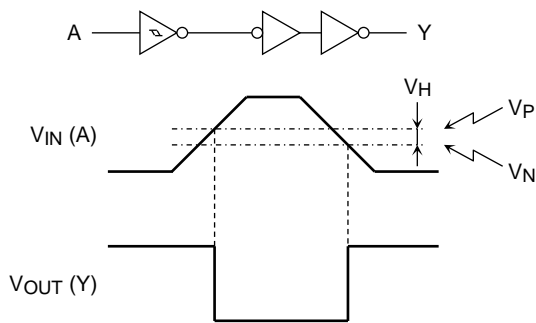
IEC Logic Symbol



Truth Table

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

System Diagram and waveform



Absolute Maximum Ratings (Note 1)

| Characteristics | Symbol | Rating | Unit |
|------------------------------------|-----------------------------------|--|------|
| Power supply voltage | 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 7.0 (Note 2) | V |
| | | −0.5 to V _{CC} + 0.5 (Note 3) | |
| Input diode current | I _{IK} | −50 | mA |
| Output diode current | I _{OK} | ±50 (Note 4) | mA |
| DC output current | I _{OUT} | ±50 | mA |
| Power dissipation | P _D | 180 | mW |
| DC V _{CC} /ground current | I _{CC} /I _{GND} | ±100 | mA |
| Storage temperature | T _{stg} | −65 to 150 | °C |

Note 1: 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).

Note 2: V_{CC} = 0 V

Note 3: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 4: V_{OUT} < GND, V_{OUT} > V_{CC}

Operating Ranges (Note 1)

| Characteristics | Symbol | Rating | Unit |
|-----------------------|----------------------------------|-------------------------------|------|
| Power supply voltage | V _{CC} | 1.65 to 3.6 | V |
| | | 1.5 to 3.6 (Note 2) | |
| Input voltage | V _{IN} | 0 to 5.5 | V |
| Output voltage | V _{OUT} | 0 to 5.5 (Note 3) | V |
| | | 0 to V _{CC} (Note 4) | |
| Output current | I _{OH} /I _{OL} | ±24 (Note 5) | mA |
| | | ±12 (Note 6) | |
| Operating temperature | T _{opr} | −40 to 85 | °C |

Note 1: 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.

Note 2: Data retention only

Note 3: V_{CC} = 0 V

Note 4: High or low state

Note 5: V_{CC} = 3.0 to 3.6 V

Note 6: V_{CC} = 2.7 to 3.0 V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

| Characteristics | | Symbol | Test Condition | | V _{CC} (V) | Min | Max | Unit |
|---------------------------------------|---------|------------------|---|---------------------------|---------------------|----------------------|-------|------|
| Threshold voltage | H-level | V _P | — | | 1.65 | 0.7 | 1.35 | V |
| | | | | | 2.3 | 0.95 | 1.7 | |
| | | | | | 3.0 | 1.2 | 2.2 | |
| | L-level | V _N | — | | 1.65 | 0.3 | 0.8 | |
| | | | | | 2.3 | 0.45 | 1.15 | |
| | | | | | 3.0 | 0.6 | 1.5 | |
| Hysteresis voltage | | V _H | — | | 1.65 | 0.3 | 0.8 | V |
| | | | | | 2.3 | 0.35 | 1.0 | |
| | | | | | 3.0 | 0.4 | 1.2 | |
| Output voltage | H-level | V _{OH} | V _{IN} = V _{IL} | I _{OH} = −100 μA | 1.65 to 3.6 | V _{CC} −0.2 | — | V |
| | | | | I _{OH} = −4 mA | 1.65 | 1.05 | — | |
| | | | | I _{OH} = −8 mA | 2.3 | 1.7 | — | |
| | | | | I _{OH} = −12 mA | 2.7 | 2.2 | — | |
| | | | | I _{OH} = −18 mA | 3.0 | 2.4 | — | |
| | | | | I _{OH} = −24 mA | 3.0 | 2.2 | — | |
| | L-level | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 100 μA | 1.65 to 3.6 | — | 0.2 | |
| | | | | I _{OL} = 4 mA | 1.65 | — | 0.45 | |
| | | | | I _{OL} = 8 mA | 2.3 | — | 0.7 | |
| | | | | I _{OL} = 12 mA | 2.7 | — | 0.4 | |
| | | | | I _{OL} = 16 mA | 3.0 | — | 0.4 | |
| | | | | I _{OL} = 24 mA | 3.0 | — | 0.55 | |
| Input leakage current | | I _{IN} | V _{IN} = 0 to 5.5 V | | 1.65 to 3.6 | — | ±5.0 | μA |
| Power-off leakage current | | I _{OFF} | V _{IN} /V _{OUT} = 5.5 V | | 0 | — | 10.0 | μA |
| Quiescent supply current | | I _{CC} | V _{IN} = V _{CC} or GND | | 1.65 to 3.6 | — | 10.0 | μA |
| | | | V _{IN} = 3.6 to 5.5 V | | 1.65 to 3.6 | — | ±10.0 | |
| Increase in I _{CC} per input | | ΔI _{CC} | V _{IH} = V _{CC} − 0.6 V (per 1 input) | | 2.7 to 3.6 | — | 500 | |

AC Characteristics (Ta = -40 to 85°C)

| Characteristics | Symbol | Test Condition | V _{CC} (V) | Min | Max | Unit |
|------------------------|--|--------------------|---------------------|-----|------|------|
| | | | | | | |
| Propagation delay time | t _{pLH} t _{pHL} | Figure 1, Figure 2 | 1.8 ± 0.15 | — | 25.0 | ns |
| | | | 2.5 ± 0.2 | — | 8.5 | |
| | | | 2.7 | — | 7.5 | |
| | | | 3.3 ± 0.3 | 1.5 | 6.5 | |
| Output to output skew | t _{osLH} t _{osHL} | (Note) | 2.7 | — | — | ns |
| | | | 3.3 ± 0.3 | — | 1.0 | |

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

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 2.5 ns, CL = 50 pF, RL = 500 Ω)

| Characteristics | Symbol | Test Condition | V _{CC} (V) | Typ. | Unit |
|--|------------------|--|---------------------|------|------|
| | | | | | |
| Quiet output maximum dynamic V _{OL} | V _{OLP} | V _{IH} = 3.3 V, V _{IL} = 0 V | 3.3 | 0.8 | V |
| Quiet output minimum dynamic V _{OL} | V _{OLV} | V _{IH} = 3.3 V, V _{IL} = 0 V | 3.3 | 0.8 | V |

Capacitive Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | V _{CC} (V) | Typ. | Unit |
|-------------------------------|------------------|---------------------------------|---------------------|------|------|
| | | | | | |
| Input capacitance | C _{IN} | — | 3.3 | 7 | pF |
| Output capacitance | C _{OUT} | — | 0 | 8 | pF |
| Power dissipation capacitance | CPD | f _{IN} = 10 MHz (Note) | 3.3 | 25 | pF |

Note: CPD 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:

$$I_{CC}(\text{opr}) = CPD \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per gate)}$$

AC Test Circuit

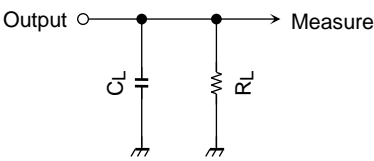


Figure 1

AC Waveform

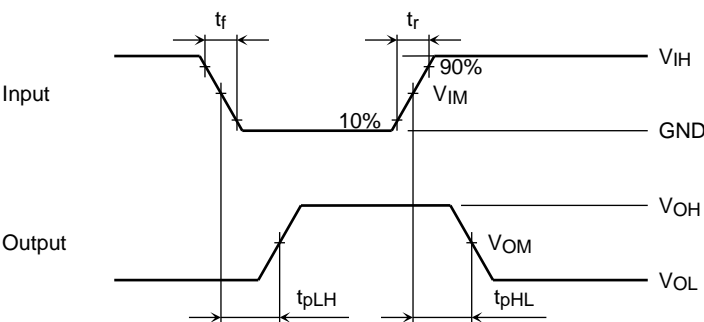


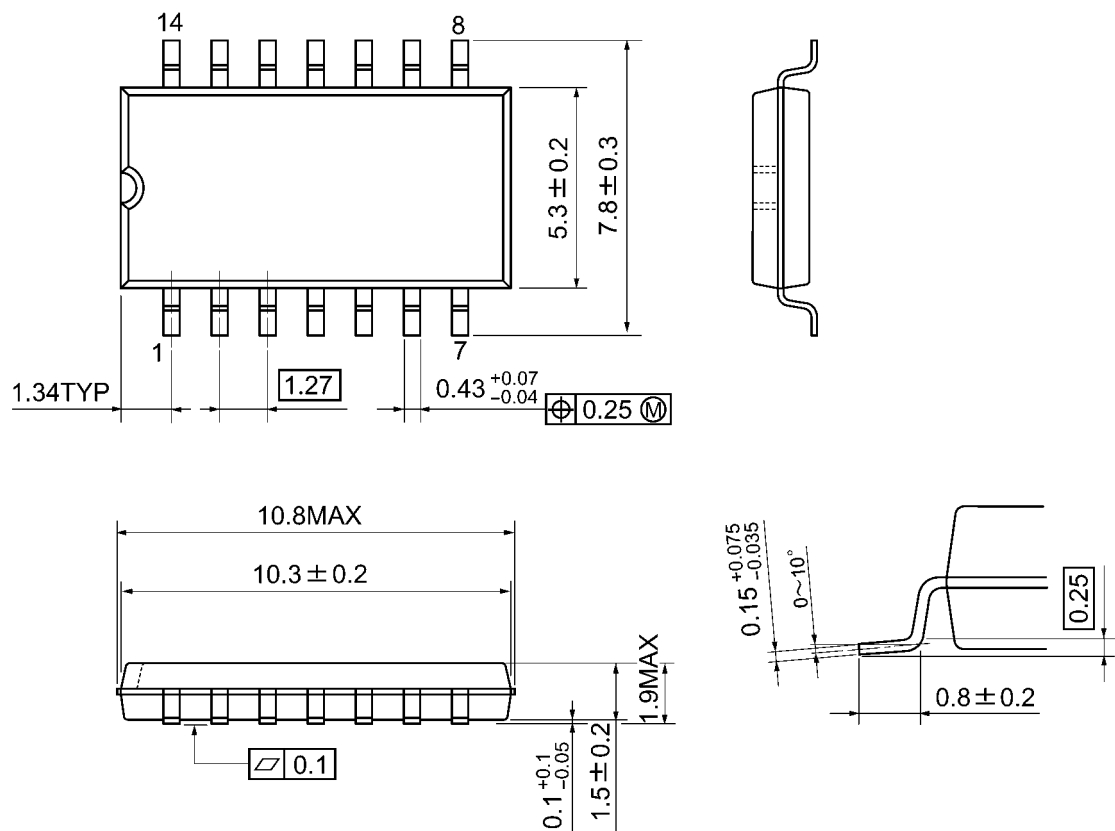
Figure 2 t_{pLH} , t_{pHL}

| | Symbol | Vcc | | |
|--------|------------|----------------------|-------------|--------------|
| | | 3.3 ± 0.3 V 2.7 V | 2.5 ± 0.2 V | 1.8 ± 0.15 V |
| Input | V_{IH} | 2.7 V | V_{CC} | V_{CC} |
| | V_{IM} | 1.5 V | $V_{CC}/2$ | $V_{CC}/2$ |
| | t_r, t_f | 2.5 ns | 2.0 ns | 2.0 ns |
| Output | V_{OM} | 1.5 V | $V_{OH}/2$ | $V_{OH}/2$ |
| Load | C_L | 50 pF | 30 pF | 30 pF |
| | R_L | 500 Ω | 500 Ω | 1 kΩ |

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

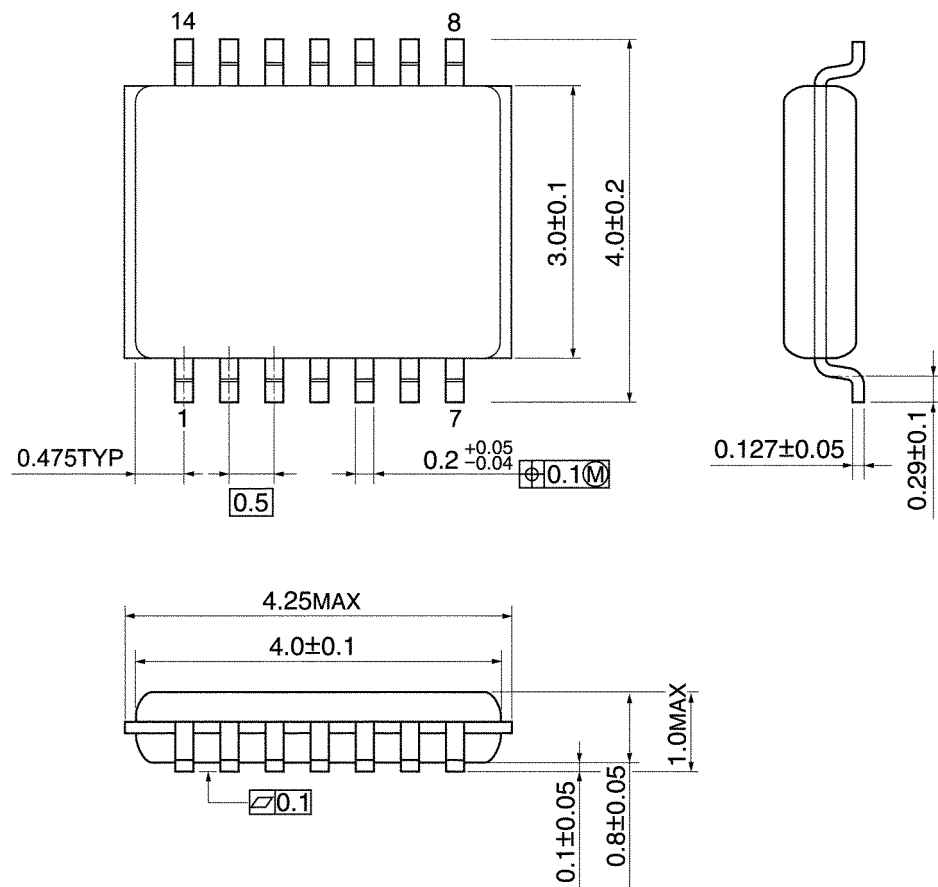


Weight: 0.18 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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