

74LCX00FT

1. Functional Description

- Low-Voltage Quad 2-Input NAND Gate with 5-V Tolerant Inputs and Outputs

2. General

The 74LCX00FT is a high-performance CMOS 2-input NAND gate. 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.

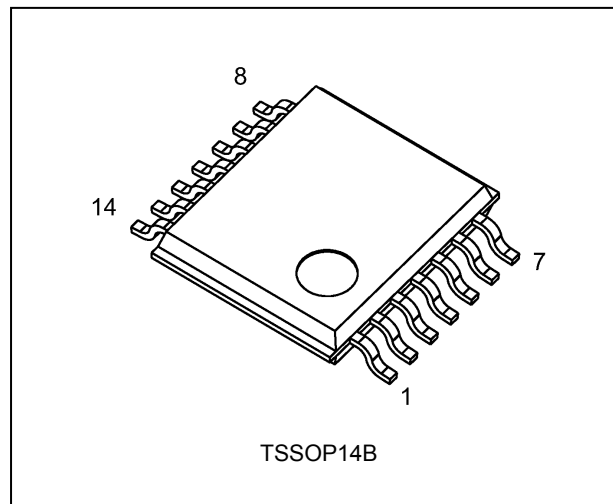
All inputs are equipped with protection circuits against static discharge.

3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range: $T_{opr} = -40$ to 125 °C
- (3) Low-voltage operation: $V_{CC} = 1.65$ to 3.6 V
- (4) High-speed operation: $t_{pd} = 6.0$ ns (max) ($V_{CC} = 3.3 \pm 0.3$ V)
- (5) Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- (6) Power-down protection provided on all inputs and outputs
- (7) Pin and function compatible with the 74 series
(74LVC/ALVC etc.) 00 type

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

4. Packaging



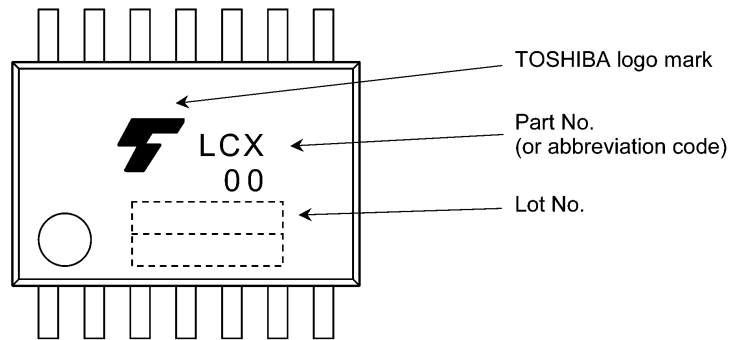
Start of commercial production

2014-06

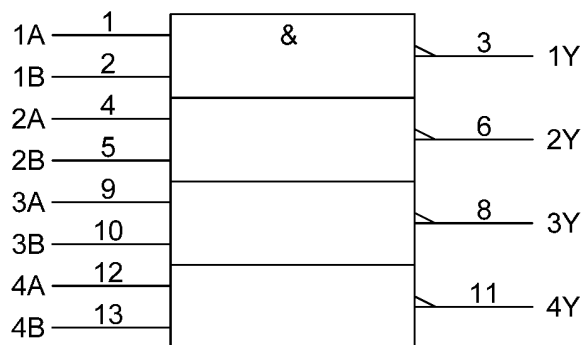
5. Pin Assignment



6. Marking



7. IEC Logic Symbol



8. Truth Table

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

9. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|--------------------------|------------------|----------|------------------------|-------------|
| Supply voltage | V_{CC} | | -0.5 to 6.5 | V |
| Input voltage | V_{IN} | | -0.5 to 6.5 | V |
| Output voltage | V_{OUT} | (Note 1) | -0.5 to 6.5 | V |
| | | (Note 2) | -0.5 to $V_{CC} + 0.5$ | |
| Input diode current | I_{IK} | | -50 | mA |
| Output diode current | I_{OK} | (Note 3) | ± 50 | mA |
| Output current | I_{OUT} | | ± 50 | mA |
| Power dissipation | P_D | (Note 4) | 180 | mW |
| V_{CC} /ground current | I_{CC}/I_{GND} | | ± 100 | mA |
| 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).

Note 1: $V_{CC} = 0$ V

Note 2: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

Note 4: 180 mW in the range of $T_a = -40$ to 85 $^{\circ}C$. From $T_a = 85$ to 125 $^{\circ}C$ a derating factor of -3.25 mW/ $^{\circ}C$ shall be applied until 50 mW.

10. Operating Ranges (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|---------------------------|------------------|----------|---------------|-------------|
| Supply voltage | V_{CC} | | 1.65 to 3.6 | V |
| | | (Note 1) | 1.5 to 3.6 | |
| Input voltage | V_{IN} | | 0 to 5.5 | V |
| Output voltage | V_{OUT} | (Note 2) | 0 to 5.5 | V |
| | | (Note 3) | 0 to V_{CC} | |
| Output current | I_{OH}, I_{OL} | (Note 4) | ± 24 | mA |
| | | (Note 5) | ± 12 | |
| Operating temperature | T_{opr} | | -40 to 125 | $^{\circ}C$ |
| Input rise and fall times | dt/dv | (Note 6) | 0 to 10 | ns/V |

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.

Note 1: Data retention only

Note 2: $V_{CC} = 0$ V

Note 3: High or low state

Note 4: $V_{CC} = 3.0$ to 3.6 V

Note 5: $V_{CC} = 2.7$ to 3.0 V

Note 6: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 $^{\circ}C$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit | |
|---------------------------|-----------------|--|-----------------------|---------------------|---------------------|---------|---|
| High-level input voltage | V_{IH} | | 1.65 to 2.3 | $V_{CC} \times 0.9$ | — | V | |
| | | | 2.3 to 2.7 | 1.7 | — | | |
| | | | 2.7 to 3.6 | 2.0 | — | | |
| Low-level input voltage | V_{IL} | | 1.65 to 2.3 | — | $V_{CC} \times 0.1$ | V | |
| | | | 2.3 to 2.7 | — | 0.7 | | |
| | | | 2.7 to 3.6 | — | 0.8 | | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -100 \mu A$ | 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 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ | $I_{OL} = 100 \mu A$ | 1.65 to 3.6 | — | 0.2 | V |
| | | | $I_{OL} = 4$ 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 | | |
| Quiescent supply current | ΔI_{CC} | $V_{IH} = V_{CC} - 0.6$ V (per 1 input) | 2.7 to 3.6 | — | 500 | μA | |

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to 125 °C)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit | |
|---------------------------|-----------------|--|-----------------------|---------------------|---------------------|---------|---|
| High-level input voltage | V_{IH} | — | 1.65 to 2.3 | $V_{CC} \times 0.9$ | — | V | |
| | | | 2.3 to 2.7 | 1.7 | — | | |
| | | | 2.7 to 3.6 | 2.0 | — | | |
| Low-level input voltage | V_{IL} | — | 1.65 to 2.3 | — | $V_{CC} \times 0.1$ | V | |
| | | | 2.3 to 2.7 | — | 0.7 | | |
| | | | 2.7 to 3.6 | — | 0.8 | | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -100 \mu A$ | 1.65 to 3.6 | $V_{CC} - 0.2$ | — | V |
| | | | $I_{OH} = -4$ mA | 1.65 | 0.9 | — | |
| | | | $I_{OH} = -8$ mA | 2.3 | 1.55 | — | |
| | | | $I_{OH} = -12$ mA | 2.7 | 2.0 | — | |
| | | | $I_{OH} = -18$ mA | 3.0 | 2.2 | — | |
| | | | $I_{OH} = -24$ mA | 3.0 | 2.0 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ | $I_{OL} = 100 \mu A$ | 1.65 to 3.6 | — | 0.2 | V |
| | | | $I_{OL} = 4$ mA | 1.65 | — | 0.65 | |
| | | | $I_{OL} = 8$ mA | 2.3 | — | 0.9 | |
| | | | $I_{OL} = 12$ mA | 2.7 | — | 0.6 | |
| | | | $I_{OL} = 16$ mA | 3.0 | — | 0.6 | |
| | | | $I_{OL} = 24$ mA | 3.0 | — | 0.75 | |
| Input leakage current | I_{IN} | $V_{IN} = 0$ to 5.5 V | 1.65 to 3.6 | — | ± 20.0 | μA | |
| Power-OFF leakage current | I_{OFF} | $V_{IN}/V_{OUT} = 5.5$ V | 0 | — | 40.0 | μA | |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 1.65 to 3.6 | — | 40.0 | μA | |
| | | $V_{IN}/V_{OUT} = 3.6$ to 5.5 V | 1.65 to 3.6 | — | ± 40.0 | | |
| Quiescent supply current | ΔI_{CC} | $V_{IH} = V_{CC} - 0.6$ V (per 1 input) | 2.7 to 3.6 | — | 5.0 | mA | |

11.3. AC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Min | Max | Unit |
|------------------------|----------------------|----------|---|----------------|-----|------|------|
| Propagation delay time | t_{PLH}, t_{PHL} | | See 11.7 AC Test Circuit, Fig. 11.8.1, Table 11.8.1 | 1.8 ± 0.15 | — | 20.0 | ns |
| | | | | 2.5 ± 0.2 | — | 7.0 | |
| | | | | 2.7 | — | 6.0 | |
| | | | | 3.3 ± 0.3 | 1.5 | 5.2 | |
| Output skew | t_{osLH}, t_{osHL} | (Note 1) | | 2.7 | — | — | ns |
| | | | | 3.3 ± 0.3 | — | 1.0 | |

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHM} - t_{PLHN}|$, $t_{osHL} = |t_{PHLM} - t_{PHLN}|$)

11.4. AC Characteristics (Unless otherwise specified, $T_a = -40$ to 125 °C)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Min | Max | Unit |
|------------------------|----------------------|----------|---|----------------|-----|------|------|
| Propagation delay time | t_{PLH}, t_{PHL} | | See 11.7 AC Test Circuit, Fig. 11.8.1, Table 11.8.1 | 1.8 ± 0.15 | — | 22.0 | ns |
| | | | | 2.5 ± 0.2 | — | 8.0 | |
| | | | | 2.7 | — | 7.0 | |
| | | | | 3.3 ± 0.3 | 1.5 | 6.0 | |
| Output skew | t_{osLH}, t_{osHL} | (Note 1) | — | 2.7 | — | — | ns |
| | | | | 3.3 ± 0.3 | — | 1.0 | |

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHM} - t_{PLHN}|$, $t_{osHL} = |t_{PHLM} - t_{PHLN}|$)

11.5. Dynamic Switching Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$, Input: $t_r = t_f = 2.5\text{ ns}$, $C_L = 50\text{ pF}$, $R_L = 500\text{ }\Omega$)

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

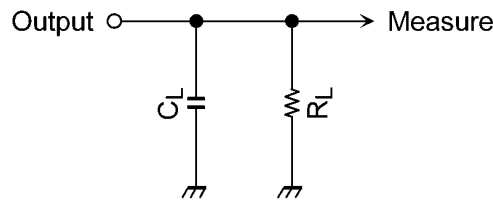
11.6. Capacitive Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Note | 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 | C_{PD} | (Note 1) | $f_{IN} = 10\text{ MHz}$ | 3.3 | 25 | pF |

Note 1: C_{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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4 \text{ (per 1 gate)}$$

11.7. AC Test Circuit



11.8. AC Waveform

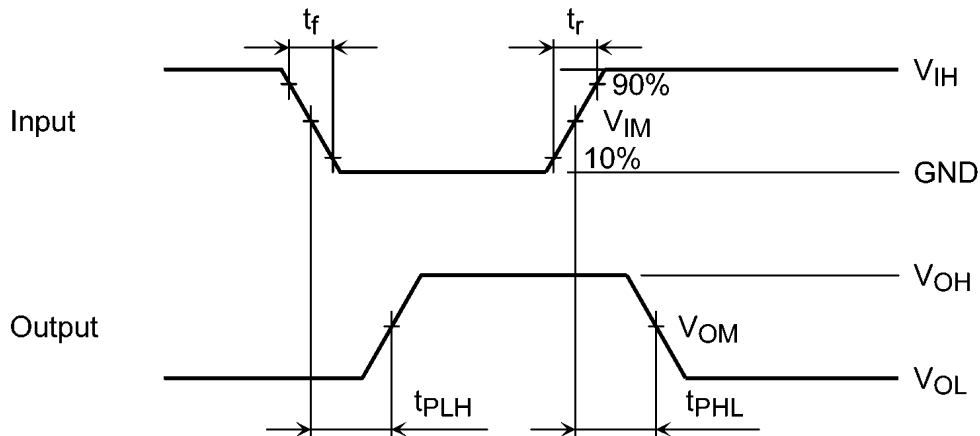


Fig. 11.8.1 T_{PLH}, T_{PHL}

Table 11.8.1 AC Waveform Symbols

| | Symbol | $V_{CC} = 3.3 \pm 0.3\text{ V}$ $V_{CC} = 2.7\text{ V}$ | $V_{CC} = 2.5 \pm 0.2\text{ V}$ | $V_{CC} = 1.8 \pm 0.15\text{ V}$ |
|--------|------------|--|---------------------------------|----------------------------------|
| 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 k Ω |

Package Dimensions

Unit: mm



Weight: 0.054 g (typ.)

| |
|--------------------|
| Package Name(s) |
| Nickname: TSSOP14B |

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