

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX16244FT

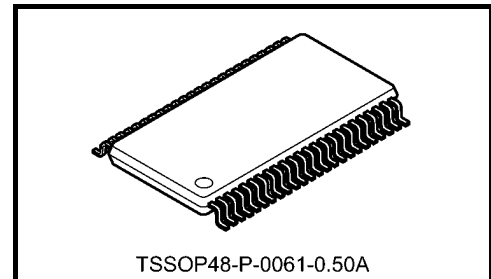
Low-Voltage 16-Bit Bus Buffer with 5-V Tolerant Inputs and Outputs

The TC74LCX16244FT is a high-performance CMOS 16-bit bus buffer. Designed for use in 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (2.5-V or 3.3-V) VCC applications, but it could be used to interface to 5 V supply environment for both inputs and outputs.

This device is non-inverting 3-state buffer having four active-low output enables. It can be used as four 4-bit buffers two 8-bit buffers or one 16-bit buffer. When the \overline{OE} input is high, the outputs are in a high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

All inputs are equipped with protection circuits against static discharge.



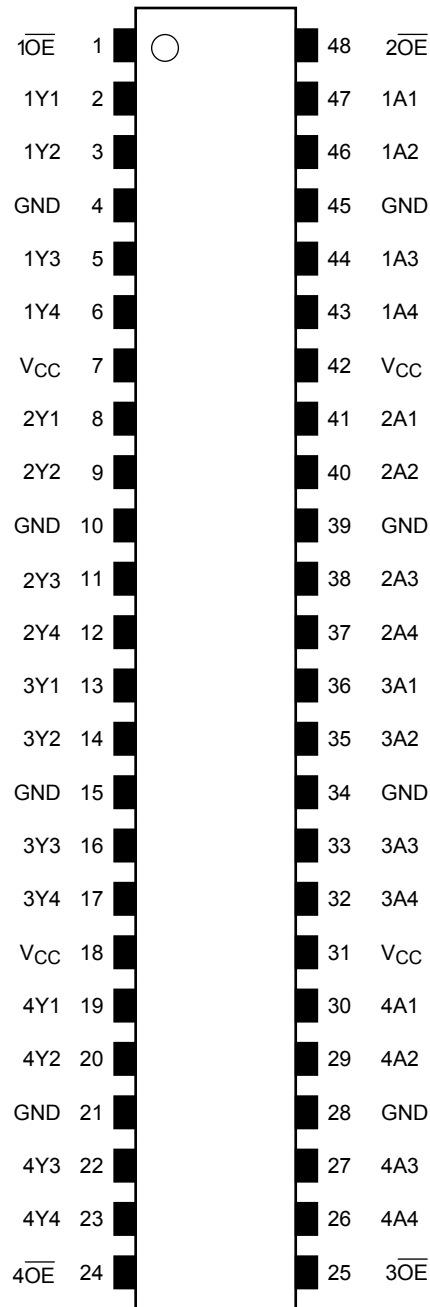
Weight: 0.25 g (typ.)

Features

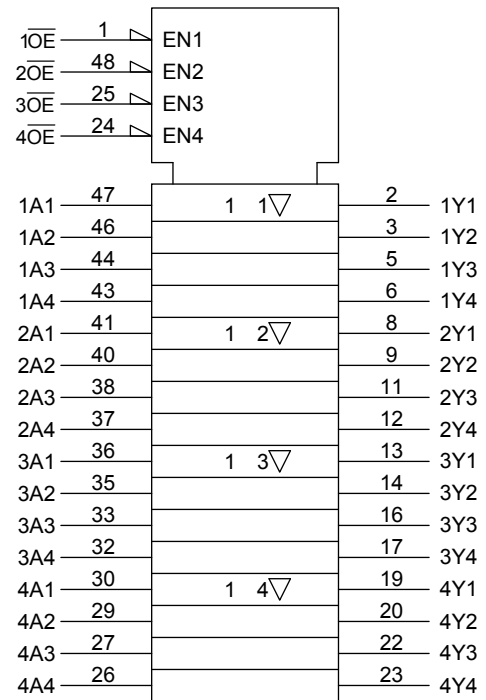
- Low-voltage operation: $V_{CC} = 2.0$ to 3.6 V
- High-speed operation: $t_{pd} = 4.5$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
- Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- Latch-up performance: -500 mA
- Package: TSSOP
- Power-down protection provided on all inputs and outputs

Start of commercial production
2002-03

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

| Inputs | | Outputs |
|------------------|---------|---------|
| $\overline{1OE}$ | 1A1-1A4 | 1Y1-1Y4 |
| L | L | L |
| L | H | H |
| H | X | Z |

| Inputs | | Outputs |
|------------------|---------|---------|
| $\overline{2OE}$ | 2A1-2A4 | 2Y1-2Y4 |
| L | L | L |
| L | H | H |
| H | X | Z |

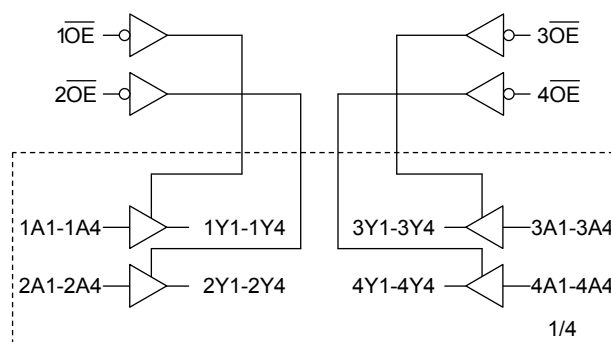
| Inputs | | Outputs |
|------------------|---------|---------|
| $\overline{3OE}$ | 3A1-3A4 | 3Y1-3Y4 |
| L | L | L |
| L | H | H |
| H | X | Z |

| Inputs | | Outputs |
|------------------|---------|---------|
| $\overline{4OE}$ | 4A1-4A4 | 4Y1-4Y4 |
| L | L | L |
| L | H | H |
| H | X | Z |

X: Don't care

Z: High impedance

System Diagram



Absolute Maximum Ratings (Note 1)

| Characteristics | Symbol | Rating | Unit |
|--|------------------|------------------------------------|--------------------|
| Power supply voltage | V_{CC} | -0.5 to 6.0 | V |
| Input voltage | V_{IN} | -0.5 to 7.0 | V |
| 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 | 400 | mW |
| DC V_{CC} /ground current per supply pin | I_{CC}/I_{GND} | ± 100 | mA |
| Storage temperature | T_{stg} | -65 to 150 | $^{\circ}\text{C}$ |

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: Output in OFF state

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

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

Operating Ranges (Note 1)

| Characteristics | Symbol | Rating | Unit |
|--------------------------|-----------------|------------------------|--------------------|
| Power supply voltage | V_{CC} | 2.0 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) | |
| | | ± 8 (Note 7) | |
| Operating temperature | T_{opr} | -40 to 85 | $^{\circ}\text{C}$ |
| Input rise and fall time | dt/dv | 0 to 10 (Note 8) | ns/V |

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: Output in OFF state

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

Note 7: $V_{CC} = 2.3$ to 2.7 V

Note 8: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

| Characteristics | | Symbol | Test Condition | | V _{CC} (V) | Min | Max | Unit | |
|---------------------------------------|---------|------------------|---|--|---------------------------|------------|-------------------------|------|---|
| | | | | | | | | | |
| Input voltage | H-level | V _{IH} | — | | 2.3 to 2.7 | 1.7 | — | V | |
| | | | | | 2.7 to 3.6 | 2.0 | — | | |
| | L-level | V _{IL} | | | 2.3 to 2.7 | — | 0.7 | | |
| | | | | | 2.7 to 3.6 | — | 0.8 | | |
| Output voltage | H-level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | | I _{OH} = -100 μA | 2.3 to 3.6 | V _{CC} -0.2 | — | V |
| | | | | | I _{OH} = -8 mA | 2.3 | 1.8 | — | |
| | | | | | 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} or V _{IL} | | I _{OL} = 100 μA | 2.3 to 3.6 | — | 0.2 | |
| | | | | | I _{OL} = 8 mA | 2.3 | — | 0.6 | |
| | | | | | 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 | | 2.3 to 3.6 | — | ±5.0 | μA | |
| 3-state output off-state current | | I _{OZ} | V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 5.5 V | | 2.3 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 | | 2.3 to 3.6 | — | 20.0 | μA | |
| | | | V _{IN} /V _{OUT} = 3.6 to 5.5 V | | 2.3 to 3.6 | — | ±20.0 | | |
| Increase in I _{CC} per input | | ΔI _{CC} | V _{IH} = V _{CC} - 0.6 V | | 2.3 to 3.6 | — | 500 | | |

AC Characteristics (Ta = -40 to 85°C)

| Characteristics | | Symbol | Test Condition | | V _{CC} (V) | C _L (pF) | Min | Max | Unit |
|-----------------------------|--|--------------------|----------------|-----------|---------------------|---------------------|-----|-----|------|
| | | | | | | | | | |
| Propagation delay time | t _{pLH} t _{pHL} | Figure 1, Figure 2 | | 2.5 ± 0.2 | 30 | 1.5 | 5.4 | ns | |
| | | | | 2.7 | 50 | 1.5 | 5.2 | | |
| | | | | 3.3 ± 0.3 | 50 | 1.5 | 4.5 | | |
| 3-state output enable time | t _{pZL} t _{pZH} | Figure 1, Figure 3 | | 2.5 ± 0.2 | 30 | 1.5 | 7.2 | ns | |
| | | | | 2.7 | 50 | 1.5 | 6.3 | | |
| | | | | 3.3 ± 0.3 | 50 | 1.5 | 5.5 | | |
| 3-state output disable time | t _{pLZ} t _{pHZ} | Figure 1, Figure 3 | | 2.5 ± 0.2 | 30 | 1.5 | 6.5 | ns | |
| | | | | 2.7 | 50 | 1.5 | 5.7 | | |
| | | | | 3.3 ± 0.3 | 50 | 1.5 | 5.4 | | |
| Output to output skew | t _{osLH} t _{osHL} | (Note) | | 2.5 ± 0.2 | 30 | — | — | ns | |
| | | | | 2.7 | 50 | — | — | | |
| | | | | 3.3 ± 0.3 | 50 | — | 1.0 | | |

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

Dynamic Switching Characteristics

($T_a = 25^\circ\text{C}$, input: $t_r = t_f = 2.5 \text{ ns}$, $R_L = 500 \Omega$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Typ. | Unit | |
|------------------------------|----------|----------------|---|------|------|---|
| | | | | | | |
| Quiet output maximum dynamic | V_{OL} | V_{OLP} | $V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}, C_L = 30\text{pF}$ | 2.5 | 0.6 | V |
| | | | $V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}, C_L = 50\text{pF}$ | 3.3 | 0.8 | |
| Quiet output minimum dynamic | V_{OL} | $ V_{OLV} $ | $V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}, C_L = 30\text{pF}$ | 2.5 | 0.6 | V |
| | | | $V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}, C_L = 50\text{pF}$ | 3.3 | 0.8 | |

Capacitive Characteristics ($T_a = 25^\circ\text{C}$)

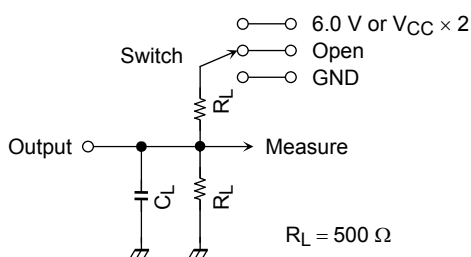
| Characteristics | Symbol | Test Condition | V_{CC} (V) | Typ. | Unit | |
|-------------------------------|-----------|---------------------------|--------------|------|------|----|
| | | | | | | |
| Input capacitance | C_{IN} | — | 3.3 | 7 | pF | |
| Output capacitance | C_{OUT} | — | 3.3 | 8 | pF | |
| Power dissipation capacitance | C_{PD} | $f_{IN} = 10 \text{ MHz}$ | (Note) | 3.3 | 25 | pF |

Note: 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:

$$I_{CC(\text{opr})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16 \text{ (per bit)}$$

AC Test Circuit



| Parameter | Switch |
|--------------------|--|
| t_{pLH}, t_{pHL} | Open |
| t_{pLZ}, t_{pZL} | 6.0 V @ $V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} \times 2$ @ $V_{CC} = 2.5 \pm 0.2 \text{ V}$ |
| t_{pHZ}, t_{pZH} | GND |

Figure 1

AC Waveform

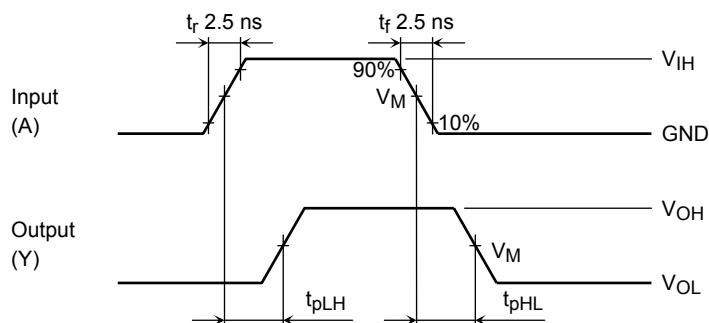


Figure 2 t_{pLH}, t_{pHL}

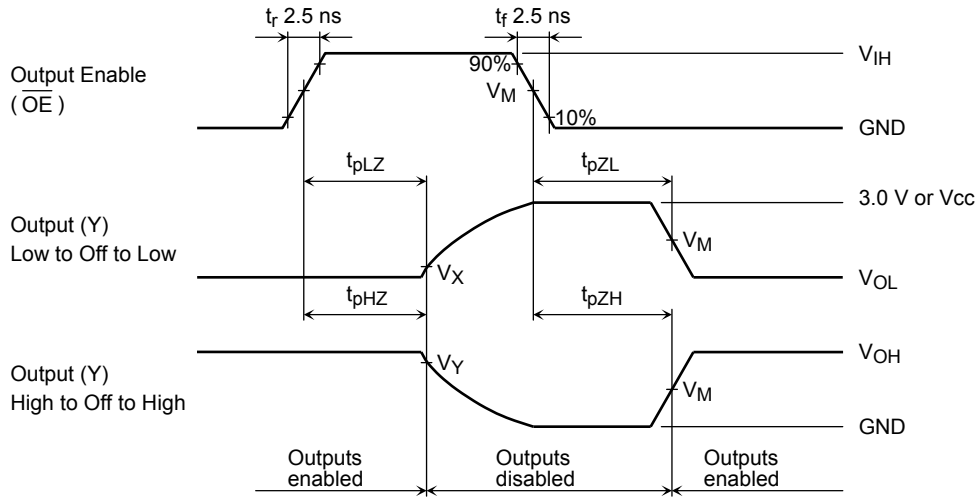


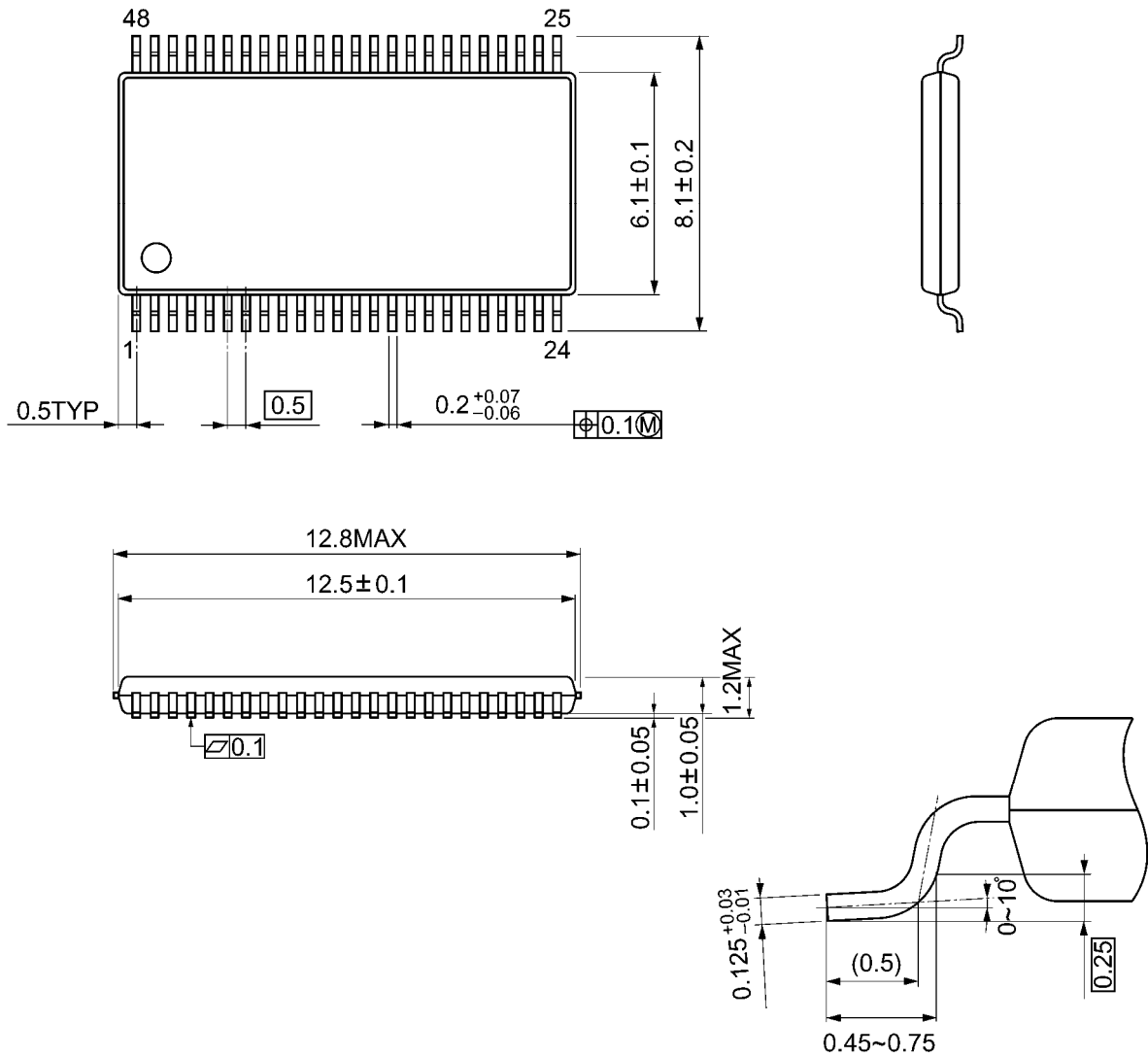
Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

| Symbol | V_{CC} | | |
|----------|------------------|------------------|-------------------|
| | 3.3 ± 0.3 V | 2.7 V | 2.5 ± 0.2 V |
| V_{IH} | 2.7 V | 2.7 V | V_{CC} |
| V_M | 1.5 V | 1.5 V | $V_{CC}/2$ |
| V_X | $V_{OL} + 0.3$ V | $V_{OL} + 0.3$ V | $V_{OL} + 0.15$ V |
| V_Y | $V_{OH} - 0.3$ V | $V_{OH} - 0.3$ V | $V_{OH} - 0.15$ V |

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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