

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX16244FT

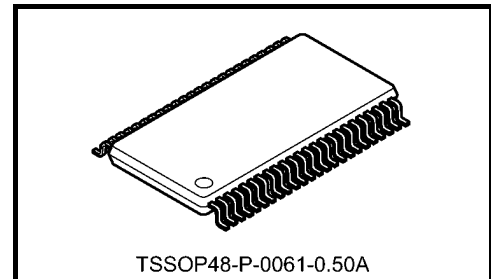
Low-Voltage 16-Bit Bus Buffer with 5-V Tolerant Inputs and Outputs

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.



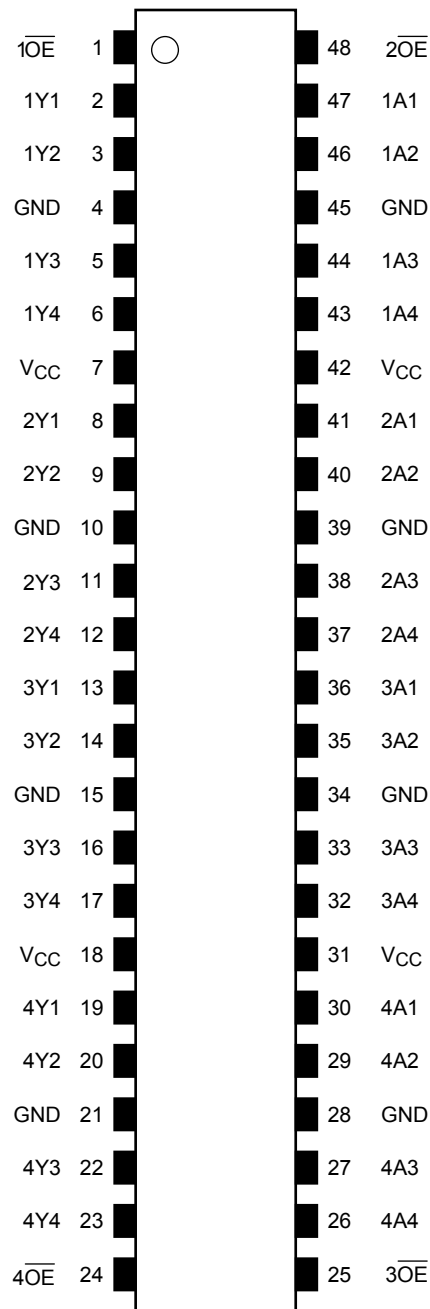
Weight: 0.25 g (typ.)

Features

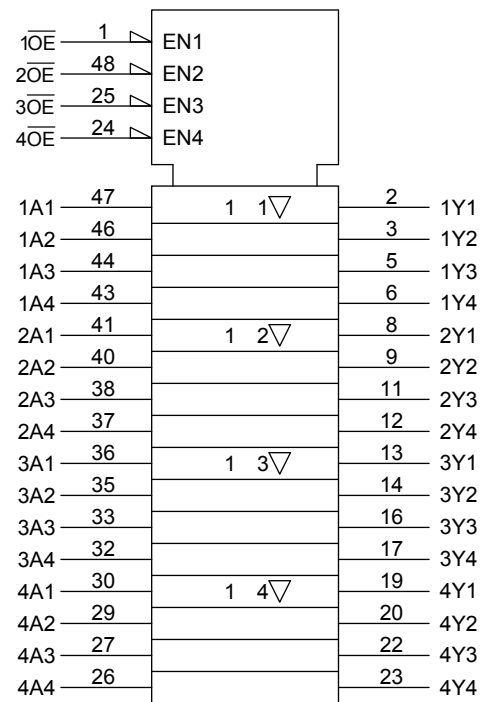
- Low-voltage operation: $V_{CC} = 2.0$ to 3.6 V
- High-speed operation: $t_{pd} = 4.5$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
- Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- Latch-up performance: -500 mA
- Package: TSSOP
- Power-down protection provided on all inputs and outputs

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

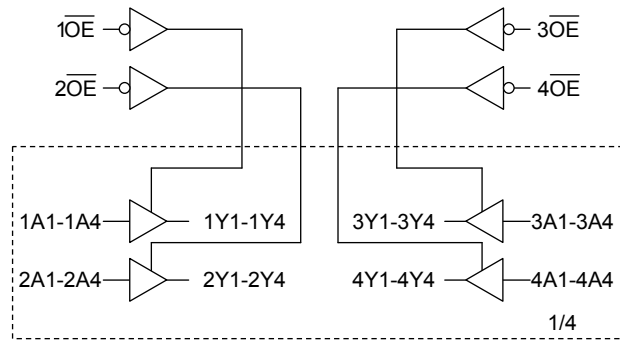
Inputs		Outputs
$\overline{3OE}$	3A1-3A4	3Y1-3Y4
L	L	L
L	H	H
H	X	Z

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

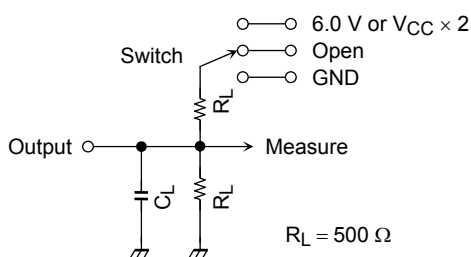
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit	
Input capacitance	C_{IN}	—	3.3	7	pF	
Output capacitance	C_{OUT}	—	3.3	8	pF	
Power dissipation capacitance	C_{PD}	$f_{IN} = 10 \text{ MHz}$	(Note)	3.3	25	pF

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

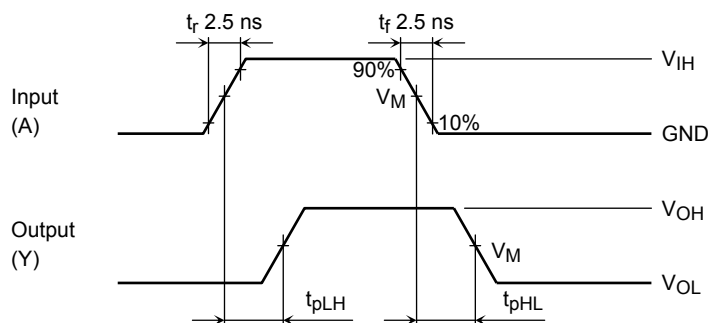


Figure 2 t_{pLH}, t_{pHL}

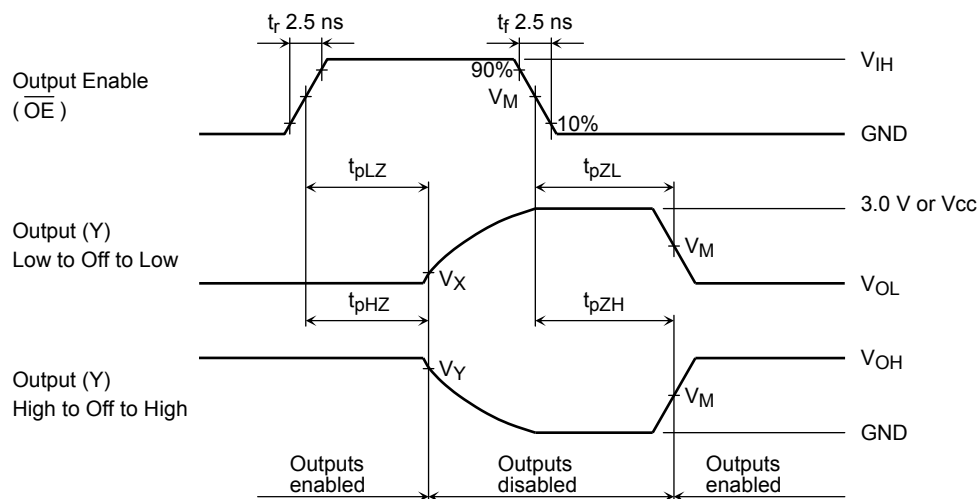


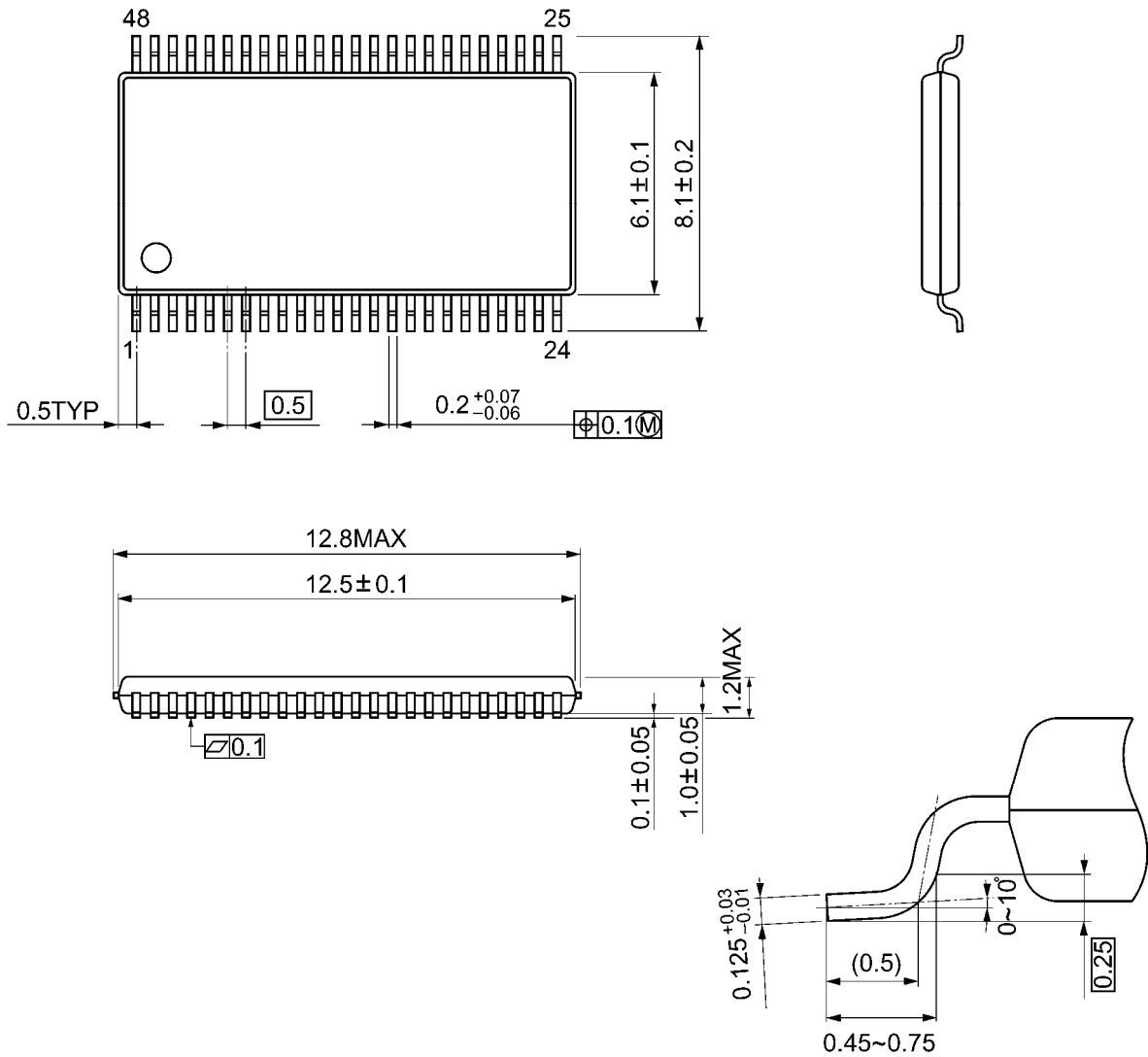
Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

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

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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