TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX16240FT

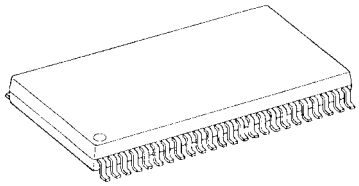
Low-Voltage 16-Bit Bus Buffer (inverted) with 5-V Tolerant Inputs and Outputs

The TC74LCX16240FT 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) V_{CC} applications, but it could be used to interface to 5-V supply environment for both inputs and outputs.

This device is 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.



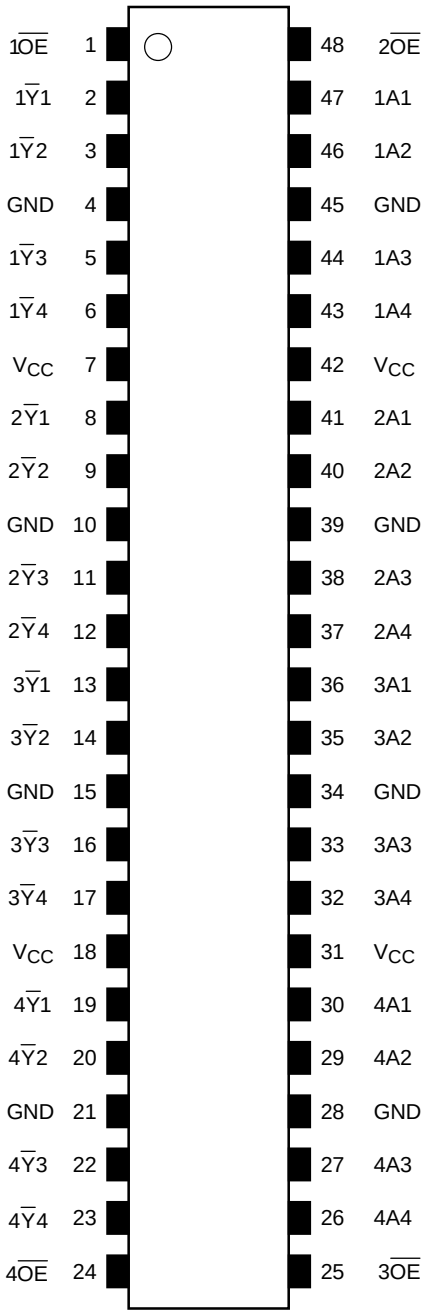
TSSOP48-P-0061-0.50

Weight: 0.25 g (typ.)

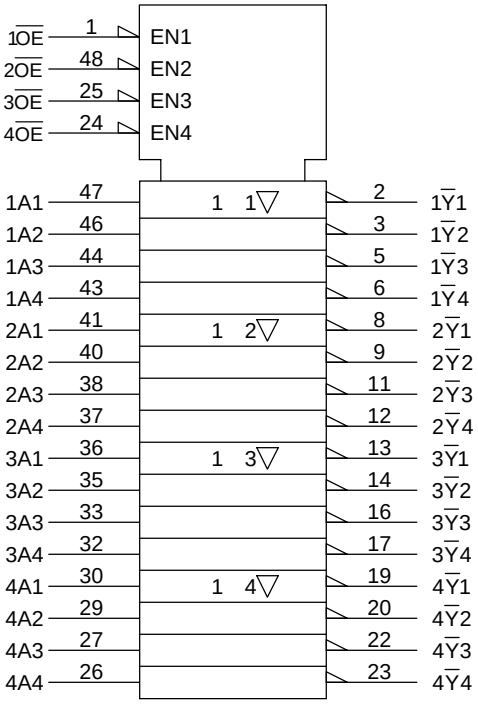
Features

- 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 (thin shrink small outline package)
- Power-down protection provided on all inputs and outputs

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs		Outputs
$1\overline{OE}$	1A1-1A4	$1\overline{Y}1$ - $1\overline{Y}4$
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$2\overline{OE}$	2A1-2A4	$2\overline{Y}1$ - $2\overline{Y}4$
L	L	H
L	H	L
H	X	Z

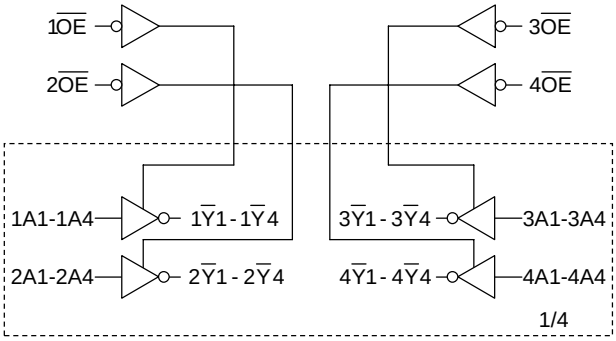
Inputs		Outputs
$3\overline{OE}$	3A1-3A4	$3\overline{Y}1$ - $3\overline{Y}4$
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$4\overline{OE}$	4A1-4A4	$4\overline{Y}1$ - $4\overline{Y}4$
L	L	H
L	H	L
H	X	Z

X: Don’t care

Z: High impedance

System Diagram



Maximum Ratings

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 1)	V
		−0.5 to V_{CC} + 0.5 (Note 2)	
Input diode current	I_{IK}	−50	mA
Output diode current	I_{OK}	±50 (Note 3)	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	°C

Note 1: Output in OFF state

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

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

Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2.0 to 3.6	V
		1.5 to 3.6 (Note 4)	
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to 5.5 (Note 5)	V
		0 to V_{CC} (Note 6)	
Output current	I_{OH}/I_{OL}	±24 (Note 7)	mA
		±12 (Note 8)	
		±8 (Note 9)	
Operating temperature	T_{opr}	−40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 10)	ns/V

Note 4: Data retention only

Note 5: Output in OFF state

Note 6: High or low state

Note 7: V_{CC} = 3.0 to 3.6 V

Note 8: V_{CC} = 2.7 to 3.0 V

Note 9: V_{CC} = 2.3 to 2.7 V

Note 10: 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 Icc 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)	CL(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	5.3	
			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	7.0	ns
			2.7	50	1.5	6.0	
			3.3 ± 0.3	50	1.5	5.4	
3-state output disable time	t_{pLZ} t_{pHZ}	Figure 1, Figure 3	2.5 ± 0.2	30	1.5	6.4	ns
			2.7	50	1.5	5.4	
			3.3 ± 0.3	50	1.5	5.3	
Output to output skew	t_{osLH} t_{osHL}	(Note 11)	2.5 ± 0.2	30	—	—	ns
			2.7	50	—	—	
			3.3 ± 0.3	50	—	1.0	

Note 11: Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

Dynamic Switching Characteristics
(Ta = 25°C, input: $t_r = t_f = 2.5$ ns, $R_L = 500\ \Omega$)

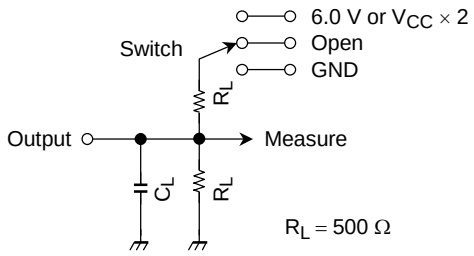
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	V_{IH} = 2.5 V, V_{IL} = 0 V, C_L =30pF	2.5	0.6	V
		V_{IH} = 3.3 V, V_{IL} = 0 V, C_L =50pF	3.3	0.8	
Quiet output minimum dynamic V_{OL}	$\|V_{OLV}\|$	V_{IH} = 2.5 V, V_{IL} = 0 V, C_L =30pF	2.5	0.6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

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}	—	3.3	8	pF
Power dissipation capacitance	C_{PD}	f_{IN} = 10 MHz (Note 12)	3.3	25	pF

Note 12: 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:
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16$ (per bit)

AC Test Circuit



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

Figure 1

AC Waveform

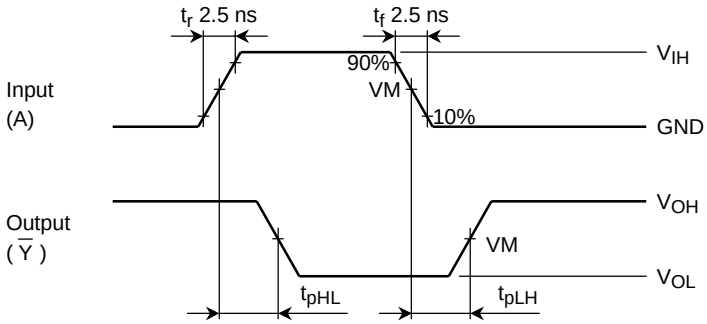


Figure 2 t_{pLH}, t_{pHL}

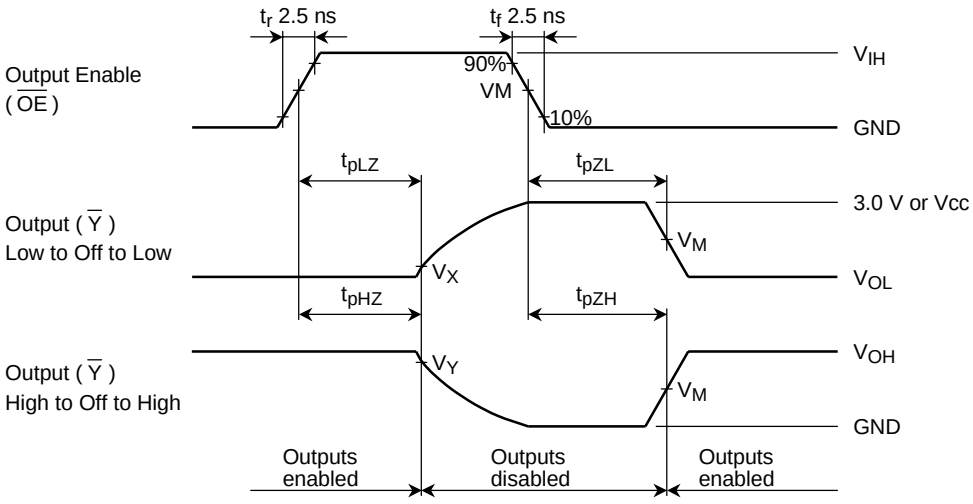
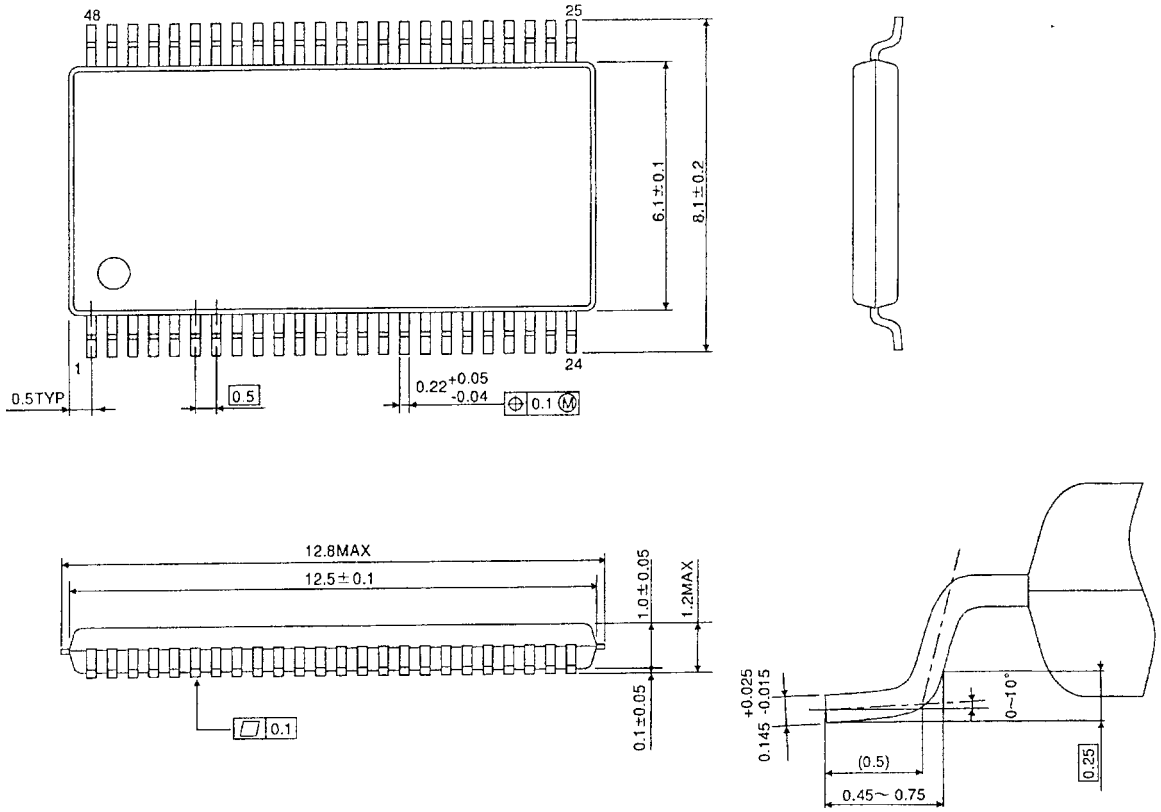


Figure 3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

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-0061-0.50 Unit : mm



Weight: 0.25 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.