

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX16374AFT

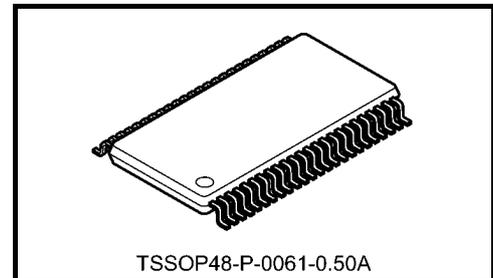
Low-Voltage 16-Bit D-Type Flip-Flop with 5-V Tolerant Inputs and Outputs

The TC74LCX16374AFT is a high-performance CMOS 16-bit D-type flip-flop. 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) VCC applications, but it could be used to interface to 5-V supply environment for both inputs and outputs.

This 16-bit D-type flip-flop is controlled by a clock input (CK) and an output enable input (\overline{OE}) which are common to each byte. It can be used as two 8-bit flip-flops or one 16-bit flip-flop. When the \overline{OE} input is high, the outputs are in a high-impedance state.

All inputs are equipped with protection circuits against static discharge.

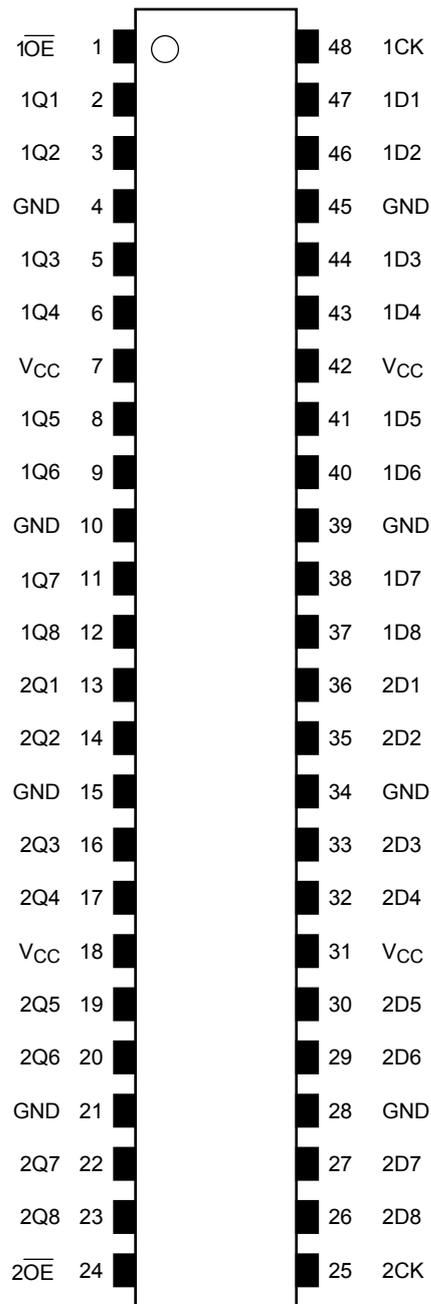


Weight: 0.25 g (typ.)

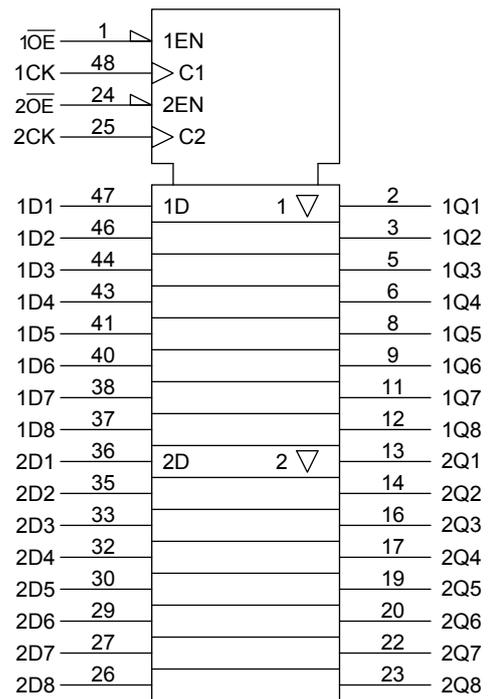
Features

- Low-voltage operation: $V_{CC} = 2.0$ to 3.6 V
- High-speed operation: $t_{pd} = 7.0$ 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

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs			Outputs
$\overline{1OE}$	1CK	1D1-1D8	1Q1-1Q8
H	X	X	Z
L		X	Qn
L		L	L
L		H	H

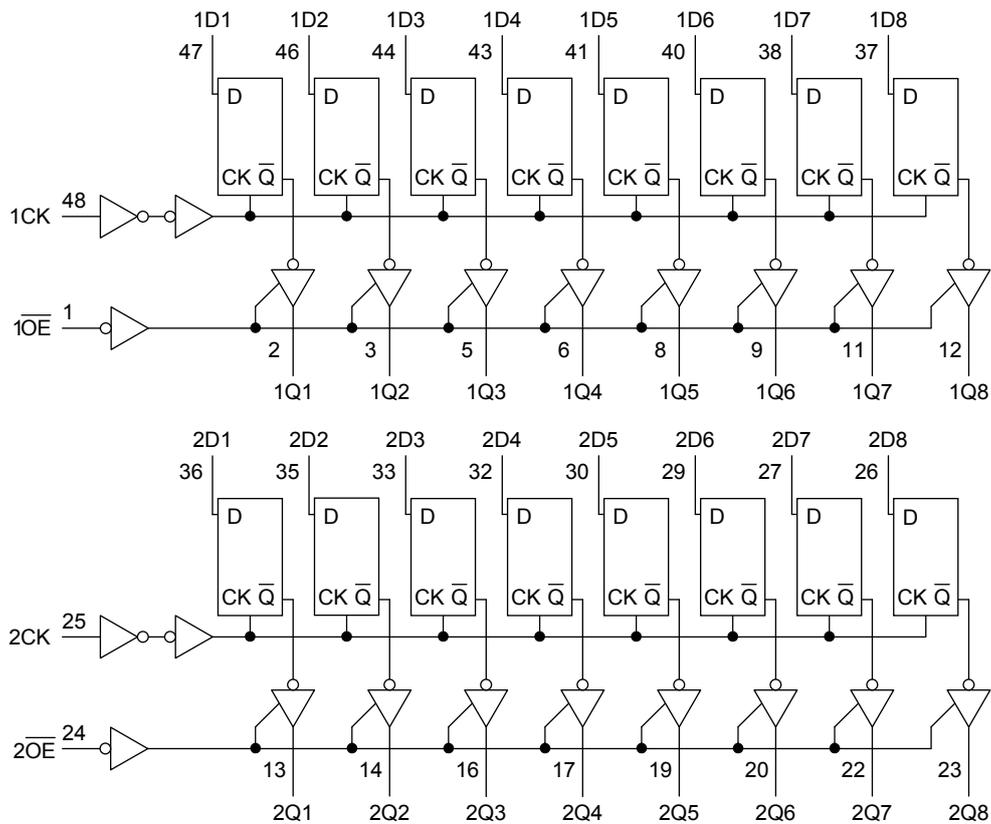
Inputs			Outputs
$\overline{2OE}$	2CK	2D1-2D8	2Q1-2Q8
H	X	X	Z
L		X	Qn
L		L	L
L		H	H

X: Don't care

Z: High impedance

Qn: No change

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 7.0	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	$^{\circ}C$

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

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)	
Operating temperature	T_{opr}	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 10 (Note 7)	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: $V_{IN} = 0.8$ 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}	—		2.7 to 3.6	2.0	—	V
	L-level	V _{IL}	—		2.7 to 3.6	—	0.8	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.7 to 3.6	V _{CC} - 0.2	—	V
				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	2.7 to 3.6	—	0.2	
				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		2.7 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		2.7 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		2.7 to 3.6	—	20.0	μA
			V _{IN} /V _{OUT} = 3.6 to 5.5 V		2.7 to 3.6	—	±20.0	
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} - 0.6 V		2.7 to 3.6	—	500	

AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Maximum clock frequency	f _{max}	Figure 1, Figure 2	2.7	—	—	MHz
			3.3 ± 0.3	170	—	
Propagation delay time (CK-Q)	t _{pLH}	Figure 1, Figure 2	2.7	—	8.0	ns
	t _{pHL}		3.3 ± 0.3	1.5	7.0	
3-state output enable time	t _{pZL}	Figure 1, Figure 3	2.7	—	8.2	ns
	t _{pZH}		3.3 ± 0.3	1.5	7.2	
3-state output disable time	t _{pLZ}	Figure 1, Figure 3	2.7	—	8.2	ns
	t _{pHZ}		3.3 ± 0.3	1.5	7.2	
Minimum pulse width (CK)	t _w (H)	Figure 1, Figure 2	2.7	4.0	—	ns
	t _w (L)		3.3 ± 0.3	3.0	—	
Minimum setup time	t _s	Figure 1, Figure 2	2.7	2.5	—	ns
			3.3 ± 0.3	2.5	—	
Minimum hold time	t _h	Figure 1, Figure 2	2.7	1.5	—	ns
			3.3 ± 0.3	1.5	—	
Output to output skew	t _{osLH}	(Note)	2.7	—	—	ns
	t _{osHL}		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: t_r = t_f = 2.5 ns, C_L = 50 pF, R_L = 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)

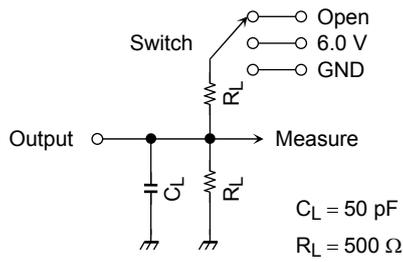
Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit	
Input capacitance	C _{IN}	—	3.3	7	pF	
Output capacitance	C _{OUT}	—	3.3	8	pF	
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz	(Note)	3.3	25	pF

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:

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

AC Test Circuit



Parameter	Switch
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V
t_{pHZ}, t_{pZH}	GND
t_w, t_s, t_h, f_{max}	Open

Figure 1

AC Waveform

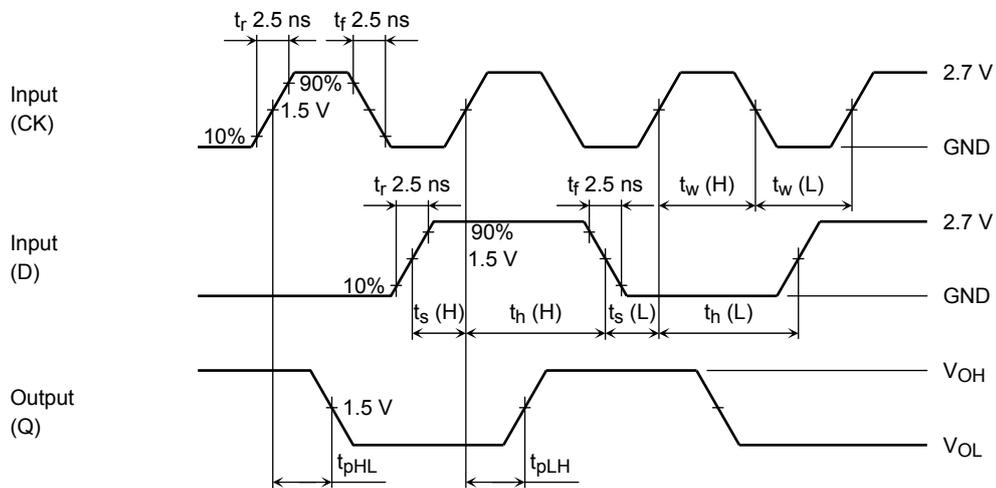


Figure 2 $t_{pLH}, t_{pHL}, t_w, t_s, t_h$

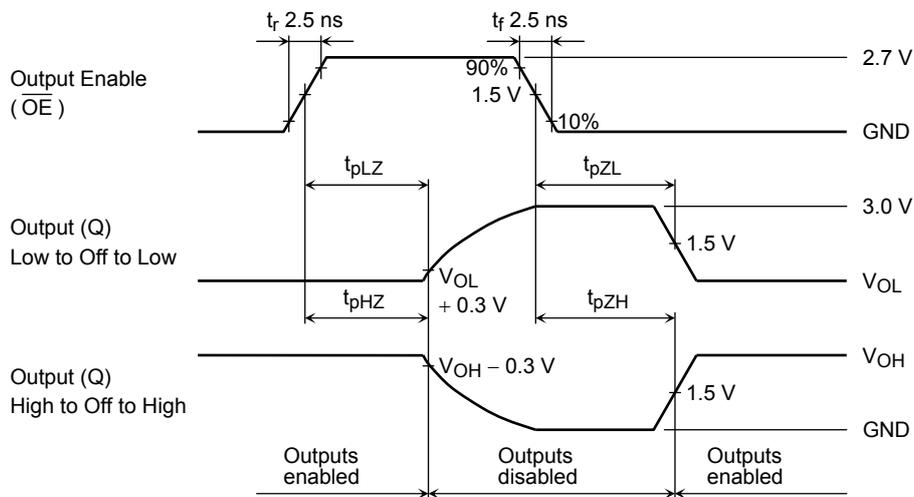
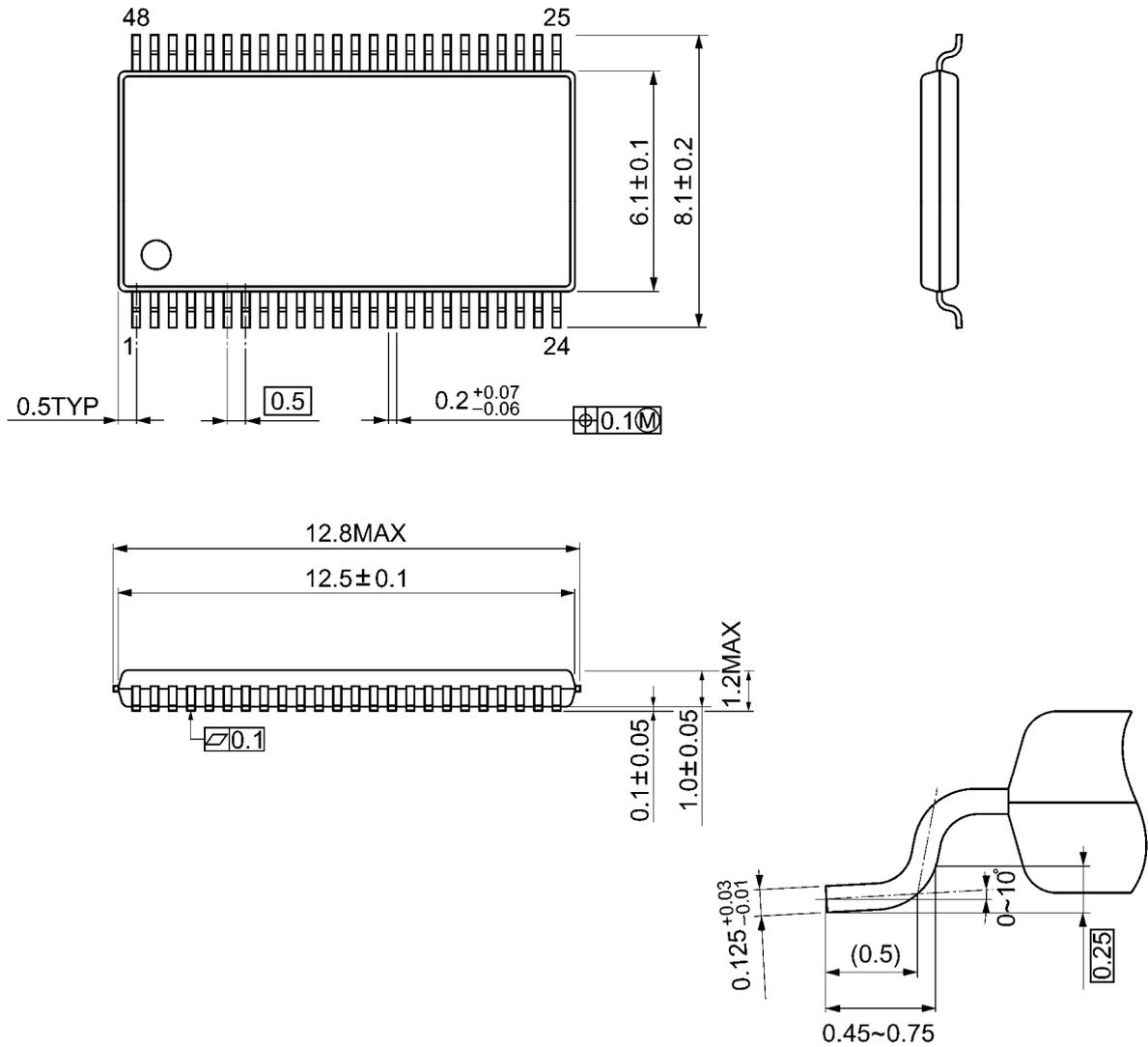


Figure 3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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