CMOS Digital Integrated Circuits Silicon Monolithic

74LCX574FT

1. Functional Description

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

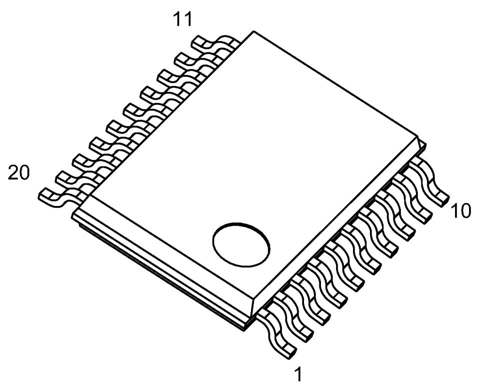
2. General

The 74LCX574FT is a high-performance CMOS octal 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) V_{CC} applications, but it could be used to interface to 5-V supply environment for both inputs and outputs.
This 8-bit D-type flip-flop is controlled by a clock input (CK) and an output enable input ($\overline{OE}$).
When the $\overline{OE}$ input is high, the eight outputs are in a high-impedance state.
All inputs are equipped with protection circuits against static discharge.

3. Features

(1) Low-voltage operation: V_{CC} = 1.65 to 3.6 V
(2) High-speed operation: t_{pd} = 8.5 ns (max) (V_{CC} = 3.0 to 3.6 V)
(3) Output current: $|I_{OH}|/I_{OL}$ = 24 mA (min) (V_{CC} = 3.0 V)
(4) Power-down protection provided on all inputs and outputs
(5) Pin and function compatible with the 74 series
(74LVC/ALVC/ etc.) 574 type

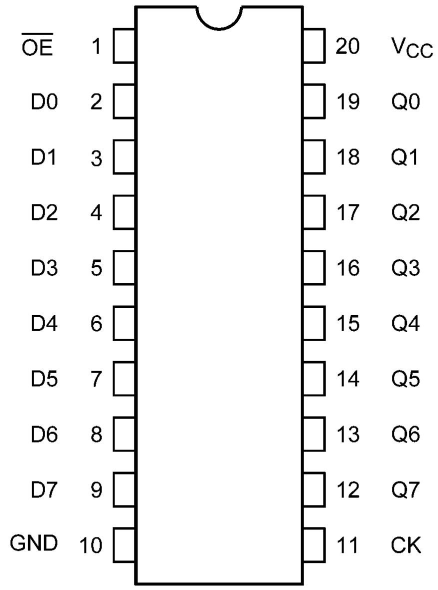
4. Packaging



TSSOP20B

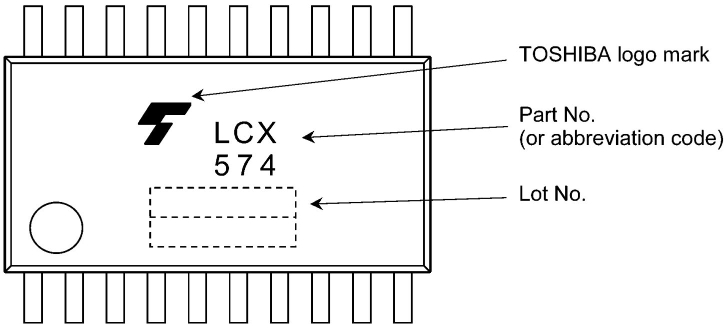
Start of commercial production
2013-10

5. Pin Assignment

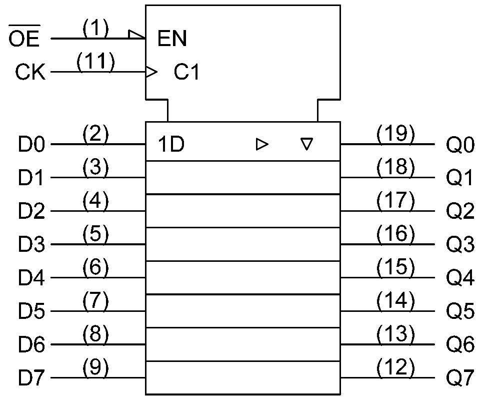


(top view)

6. Marking



7. IEC Logic Symbol

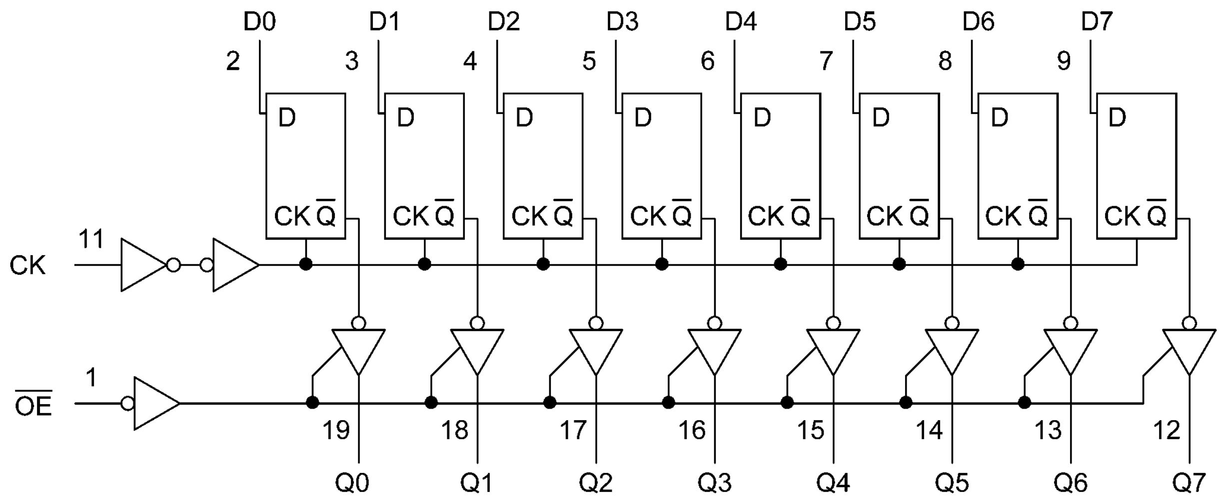


8. Truth Table

Inputs			Outputs
$\overline{OE}$	CK	D	
H	X	X	Z
L	↓	X	Q_n
L	↑	L	L
L	↑	H	H

X: Don't care
Z: High impedance
Q_n: No change

9. System Diagram



10. 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		180	mW
V_{CC}/ground current	I_{CC}/I_{GND}		±100	mA
Storage temperature	T_{stg}		-65 to 150	°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: Output in OFF state.

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

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

11. 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 85	°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: Output in OFF state.

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

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		1.65 to 2.3	V_{CC} × 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} × 0.1	
				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 μA	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} or V_{IL}	I_{OL} = 100 μA	1.65 to 3.6	—	0.2	
			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
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 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}/V_{OUT} = 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 input)		2.7 to 3.6	—	500	

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Max	Unit
Maximum clock frequency	f_{MAX}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	50	—	MHz
				2.5 ± 0.2	100	—	
				2.7	100	—	
				3.3 ± 0.3	150	—	
Propagation delay time (CK-Q)	t_{PLH},t_{PHL}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	—	30.0	ns
				2.5 ± 0.2	—	10.5	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.5	
Output enable time	t_{PZL},t_{PZH}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.2, Table 12.6.1	1.8 ± 0.15	—	34.0	ns
				2.5 ± 0.2	—	17.0	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.5	
Output disable time	t_{PLZ},t_{PHZ}		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.2, Table 12.6.1	1.8 ± 0.15	—	28.0	ns
				2.5 ± 0.2	—	14.0	
				2.7	—	7.0	
				3.3 ± 0.3	1.5	6.5	
Minimum pulse width(CK)	$t_{w(L)}$,$t_{w(H)}$		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	10.0	—	ns
				2.5 ± 0.2	5.0	—	
				2.7	3.3	—	
				3.3 ± 0.3	3.3	—	
Minimum setup time	t_S		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	10.0	—	ns
				2.5 ± 0.2	5.0	—	
				2.7	2.5	—	
				3.3 ± 0.3	2.5	—	
Minimum hold time	t_h		See 12.5 AC Test Circuit, Table 12.5.1, Fig. 12.6.1, Table 12.6.1	1.8 ± 0.15	1.5	—	ns
				2.5 ± 0.2	1.5	—	
				2.7	1.5	—	
				3.3 ± 0.3	1.5	—	
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} = $|t_{PHLm} - t_{PHLn}|$)

12.3. Dynamic Switching Characteristics (Unless otherwise specified, T_a = 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

12.4. Capacitive Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	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}	(Note 1)	f_{IN} = 10 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.

$I_{CC}(opr) = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$ (per bit)

12.5. AC Test Circuit

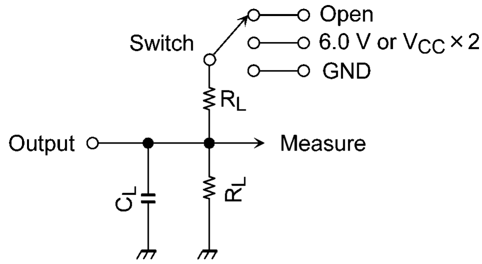


Table 12.5.1 Parameter for AC Test Circuit

Parameter	Switch	Test Condition
t_{PLH}, t_{PHL}	OPEN	—
t_{PLZ}, t_{PZL}	6.0 V	V_{CC} = 3.3 ± 0.3 V
		V_{CC} = 2.7 V
	V_{CC} × 2	V_{CC} = 2.5 ± 0.2 V
		V_{CC} = 1.8 ± 0.15 V
t_{PHZ}, t_{PZH}	GND	—
t_w, t_s, t_h	OPEN	—

12.6. AC Waveform

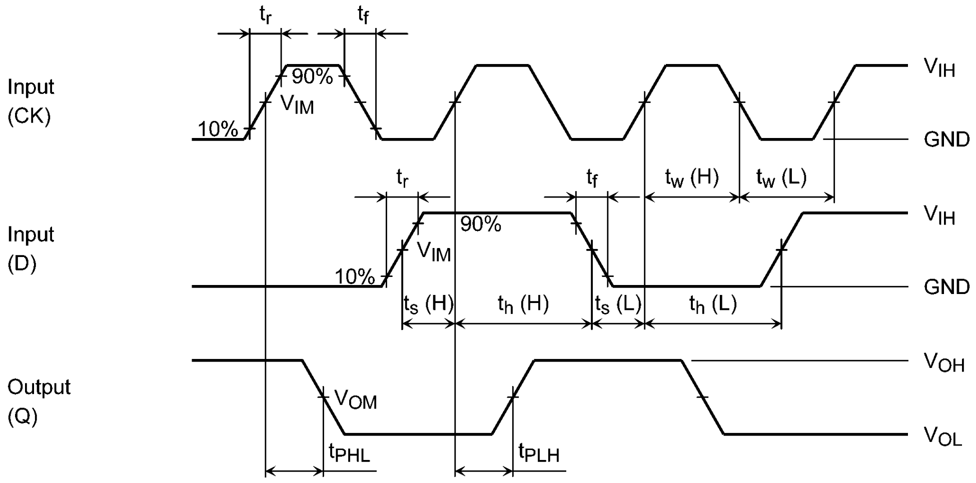


Fig. 12.6.1 t_{PLH}, t_{PHL}, t_w, t_s, t_h

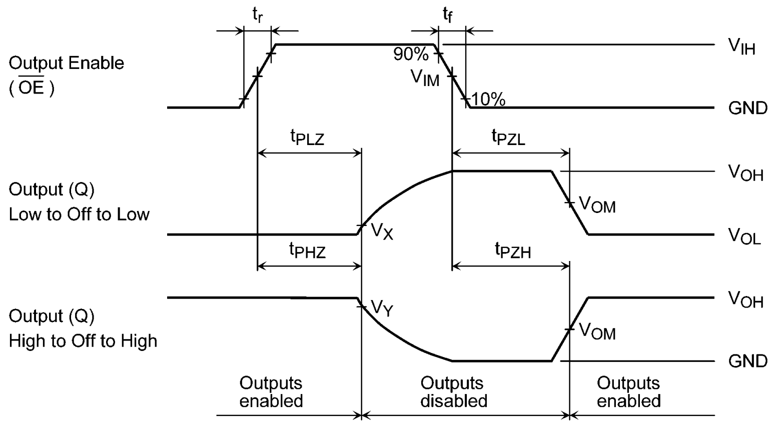


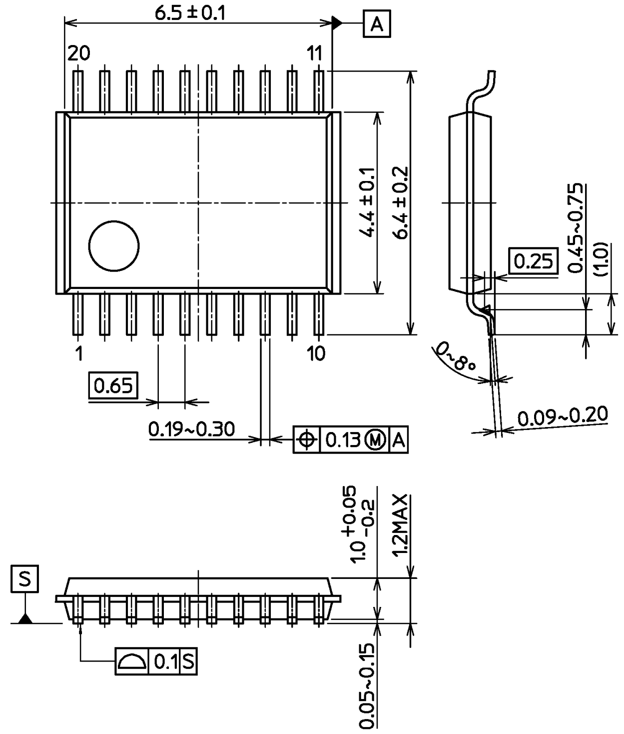
Fig. 12.6.2 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

Table 12.6.1 AC Waveform Symbols

	Symbol	V_{CC} = 3.3 ± 0.3 V V_{CC} = 2.7 V	V_{CC} = 2.5 ± 0.2 V	V_{CC} = 1.8 ± 0.15 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	$V_{OH}/2$	$V_{OH}/2$
	V_X	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V
	V_Y	V_{OH} - 0.3 V	V_{OH} - 0.15 V	V_{OH} - 0.15 V
Load	C_L	50 pF	30 pF	30 pF
	R_L	500 Ω	500 Ω	1 kΩ

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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