

TC7WZ74FU

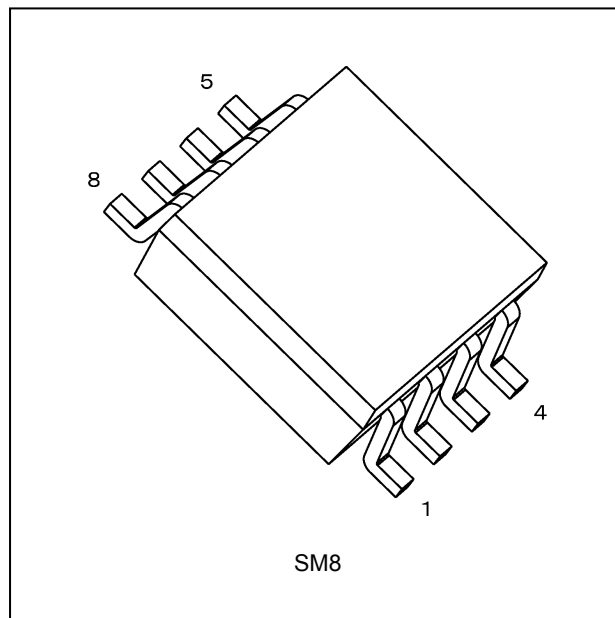
1. Functional Description

- D-Type Flip Flop with Preset and Clear

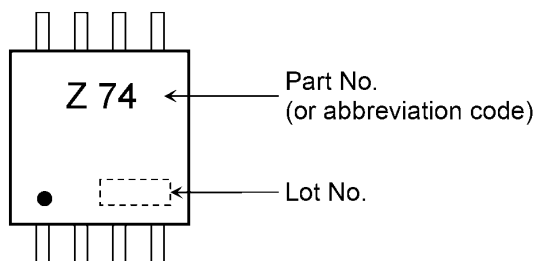
2. Features

- (1) Wide operating temperature range: $T_{opr} = -40$ to 85 °C
- (2) High output current: ± 24 mA (min) ($V_{CC} = 3.0$ V)
- (3) High speed operation: $t_{pd} = 2.8$ ns (typ.) ($V_{CC} = 5.0$ V, $C_L = 50$ pF)
- (4) Wide operating voltage range: $V_{CC} = 1.65$ to 5.5 V
- (5) 5.5 V tolerant inputs
- (6) 5.5 V power down protection output
- (7) Matches the performance of TC74LCX series when operated at 3.3 V V_{CC}

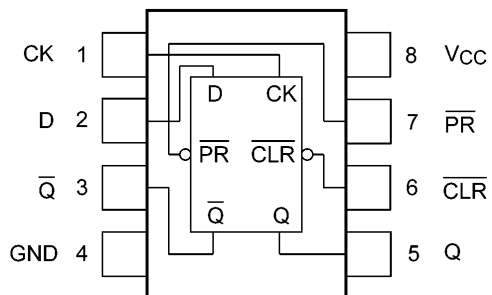
3. Packaging



4. Marking and Pin Assignment



Marking

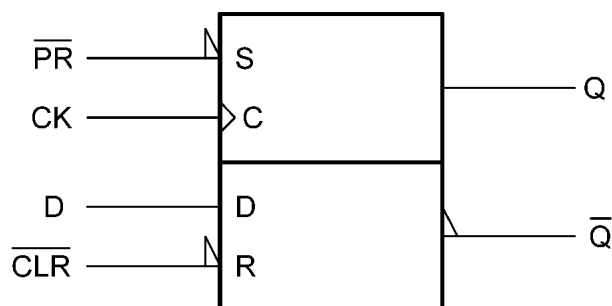


Pin Assignment (Top view)

Start of commercial production

2001-04

5. IEC Logic Symbol



6. Truth Table

Inputs				Outputs		Function
CLR	PR	D	CK	Q	Q̄	
L	H	X	X	L	H	Clear
H	L	X	X	H	L	Preset
L	L	X	X	H	H	—
H	H	L	↑	L	H	—
H	H	H	↑	H	L	—
H	H	X	↓	Q _n	Q̄ _n	No Change

X: Don't care

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V _{CC}		-0.5 to 6.0	V
Input voltage	V _{IN}		-0.5 to 6.0	V
DC output voltage	V _{OUT}	(Note 1)	-0.5 to 6.0	V
		(Note 2)	-0.5 to V _{CC} + 0.5	
Input diode current	I _{IK}		-20	mA
Output diode current	I _{OK}	(Note 3)	-20	
DC output current	I _{OUT}		±50	
V _{CC} /ground current	I _{CC}		±50	mA
Power dissipation	P _D		300	mW
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: V_{CC} = 0 V

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

Note 3: V_{OUT} < GND

8. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V_{CC}		—	1.65 to 5.5	V
		(Note 1)	—	1.5 to 5.5	
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}	
Operating temperature	T_{opr}		—	-40 to 85	°C
Input rise and fall time	dt/dv		$V_{CC} = 1.8 \pm 0.15 \text{ V}, 2.5 \pm 0.2 \text{ V}$	0 to 20	ns/V
			$V_{CC} = 3.3 \pm 0.3 \text{ V}$	0 to 10	
			$V_{CC} = 5.0 \pm 0.5 \text{ V}$	0 to 5	

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: $V_{CC} = 0 \text{ V}$

Note 3: High (H) or Low (L) state.

9. Electrical Characteristics

9.1. DC Characteristics (Unless otherwise specified, $T_a = 25 \text{ }^\circ\text{C}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit	
High-level input voltage	V_{IH}	—	1.65 to 1.8	$V_{CC} \times 0.75$	—	—	V	
			2.3 to 5.5	$V_{CC} \times 0.70$	—	—		
Low-level input voltage	V_{IL}	—	1.65 to 1.8	—	—	$V_{CC} \times 0.25$	V	
			2.3 to 5.5	—	—	$V_{CC} \times 0.30$		
High-level output voltage	V_{OH}	$V_{IN} = V_{IL} \text{ or } V_{IH}$	$I_{OH} = -100 \text{ } \mu\text{A}$	1.65	1.55	1.65	—	V
				2.3	2.2	2.3	—	
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -4 \text{ mA}$	1.65	1.29	1.52	—	
			$I_{OH} = -8 \text{ mA}$	2.3	1.9	2.15	—	
			$I_{OH} = -16 \text{ mA}$	3.0	2.4	2.8	—	
			$I_{OH} = -24 \text{ mA}$	3.0	2.3	2.68	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IL} \text{ or } V_{IH}$	$I_{OL} = 100 \text{ } \mu\text{A}$	1.65	—	0.0	0.1	V
				2.3	—	0.0	0.1	
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 4 \text{ mA}$	1.65	—	0.08	0.24	
			$I_{OL} = 8 \text{ mA}$	2.3	—	0.1	0.3	
			$I_{OL} = 16 \text{ mA}$	3.0	—	0.15	0.4	
			$I_{OL} = 24 \text{ mA}$	3.0	—	0.22	0.55	
Input leakage current	I_{IN}	$V_{IN} = 5.5 \text{ V or GND}$	0 to 5.5	—	—	± 1	μA	
Power-OFF leakage current	I_{OFF}	$V_{IN} \text{ or GND} = 5.5 \text{ V}$	0	—	—	1	μA	
Quiescent supply current	I_{CC}	$V_{IN} = 5.5 \text{ V or GND}$	1.65 to 5.5	—	—	1	μA	

9.2. 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 1.8	$V_{CC} \times 0.75$	—	V		
			2.3 to 5.5	$V_{CC} \times 0.70$	—			
Low-level input voltage	V_{IL}	—	1.65 to 1.8	—	$V_{CC} \times 0.25$	V		
			2.3 to 5.5	—	$V_{CC} \times 0.30$			
High-level output voltage	V_{OH}	$V_{IN} = V_{IL}$ or V_{IH}	$I_{OH} = -100 \mu A$	1.65	1.55	—	V	
				2.3	2.2	—		
				3.0	2.9	—		
				4.5	4.4	—		
				$I_{OH} = -4$ mA	1.65	1.29		—
				$I_{OH} = -8$ mA	2.3	1.9		—
				$I_{OH} = -16$ mA	3.0	2.4		—
				$I_{OH} = -24$ mA	3.0	2.3		—
Low-level output voltage	V_{OL}	$V_{IN} = V_{IL}$ or V_{IH}	$I_{OL} = 100 \mu A$	1.65	—	0.1	V	
				2.3	—	0.1		
				3.0	—	0.1		
				4.5	—	0.1		
				$I_{OL} = 4$ mA	1.65	—		0.24
				$I_{OL} = 8$ mA	2.3	—		0.3
				$I_{OL} = 16$ mA	3.0	—		0.4
				$I_{OL} = 24$ mA	3.0	—		0.55
Input leakage current	I_{IN}	$V_{IN} = 5.5$ V or GND	0 to 5.5	—	± 10	μA		
Power-OFF leakage current	I_{OFF}	V_{IN} or $V_{OUT} = 5.5$ V	0	—	10	μA		
Quiescent supply current	I_{CC}	$V_{IN} = 5.5$ V or GND	1.65 to 5.5	—	10	μA		

9.3. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Maximum clock frequency	f_{MAX}		$R_L = 500\ \Omega$	1.8 ± 0.15	50	51	—	—	MHz
				2.5 ± 0.2		130	—	—	
				3.3 ± 0.3		200	—	—	
				5.0 ± 0.5		200	—	—	
Propagation delay time (CK-Q, \bar{Q})	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$	1.8 ± 0.15	15	2.5	10.0	18.0	ns
				2.5 ± 0.2		2.0	4.9	7.5	
				3.3 ± 0.3		1.5	3.3	4.8	
				5.0 ± 0.5		1.0	2.4	3.5	
			$R_L = 500\ \Omega$	3.3 ± 0.3	50	2.0	4.3	5.7	
				5.0 ± 0.5		1.5	2.8	4.0	
Propagation delay time (CLR, PR-Q, \bar{Q})	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$	1.8 ± 0.15	15	2.5	10.0	17.0	ns
				2.5 ± 0.2		2.0	5.0	7.3	
				3.3 ± 0.3		1.5	3.4	4.8	
				5.0 ± 0.5		1.5	2.2	3.5	
			$R_L = 500\ \Omega$	3.3 ± 0.3	50	2.0	4.3	5.7	
				5.0 ± 0.5		1.0	3.1	3.9	
Minimum setup time	t_S		$R_L = 500\ \Omega$	2.5 ± 0.2	50	3.4	—	—	ns
				3.3 ± 0.3		2.1	—	—	
				5.0 ± 0.5		1.5	—	—	
Minimum hold time	t_H		$R_L = 500\ \Omega$	2.5 ± 0.2	50	2.4	—	—	ns
				3.3 ± 0.3		1.4	—	—	
				5.0 ± 0.5		1.0	—	—	
Minimum pulse width (CK)	$t_{W(L)}, t_{W(H)}$		$R_L = 500\ \Omega$	2.5 ± 0.2	50	3.0	—	—	ns
				3.3 ± 0.3		3.0	—	—	
				5.0 ± 0.5		3.0	—	—	
Minimum pulse width (CLR, PR)	$t_{W(L)}$		$R_L = 500\ \Omega$	2.5 ± 0.2	50	3.0	—	—	ns
				3.3 ± 0.3		3.0	—	—	
				5.0 ± 0.5		3.0	—	—	
Minimum removal time	t_{rem}		$R_L = 500\ \Omega$	2.5 ± 0.2	50	3.6	—	—	ns
				3.3 ± 0.3		2.2	—	—	
				5.0 ± 0.5		1.3	—	—	
Input capacitance	C_{IN}		—	0 to 5.5	—	—	3.0	10	pF
Output capacitance	C_{OUT}		—	0 to 5.5	—	—	5.0	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—	3.3	—	—	30	—	pF
				5.5		—	47	—	

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.

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

9.4. AC Characteristics
 (Unless otherwise specified, $T_a = -40$ to 85 °C, Input: $t_r = t_f = 3$ ns)



Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Maximum clock frequency	f_{MAX}	RL = 500 Ω	1.8 ± 0.15	50	38	—	MHz
			2.5 ± 0.2		100	—	
			3.3 ± 0.3		150	—	
			5.0 ± 0.5		180	—	
Propagation delay time (CK-Q, \bar{Q})	t_{PLH}, t_{PHL}	RL = 1 M Ω	1.8 ± 0.15	15	2.1	23.0	ns
			2.5 ± 0.2		1.7	9.0	
			3.3 ± 0.3		1.3	5.6	
			5.0 ± 0.5		1.0	3.9	
		RL = 500 Ω	3.3 ± 0.3	50	1.5	7.0	
			5.0 ± 0.5		1.3	4.4	
Propagation delay time (CLR, PR-Q, \bar{Q})	t_{PLH}, t_{PHL}	RL = 1 M Ω	1.8 ± 0.15	15	2.1	21.0	ns
			2.5 ± 0.2		1.7	8.8	
			3.3 ± 0.3		1.3	5.6	
			5.0 ± 0.5		1.0	3.9	
		RL = 500 Ω	3.3 ± 0.3	50	1.5	7.0	
			5.0 ± 0.5		1.0	4.3	
Minimum setup time	t_S	RL = 500 Ω	2.5 ± 0.2	50	4.1	—	ns
			3.3 ± 0.3		2.5	—	
			5.0 ± 0.5		1.7	—	
Minimum hold time	t_H	RL = 500 Ω	2.5 ± 0.2	50	2.9	—	ns
			3.3 ± 0.3		1.5	—	
			5.0 ± 0.5		1.1	—	
Minimum pulse width (CK)	$t_{W(L)}, t_{W(H)}$	RL = 500 Ω	2.5 ± 0.2	50	3.6	—	ns
			3.3 ± 0.3		3.3	—	
			5.0 ± 0.5		3.2	—	
Minimum pulse width (CLR, PR)	$t_{W(L)}$	RL = 500 Ω	2.5 ± 0.2	50	3.6	—	ns
			3.3 ± 0.3		3.3	—	
			5.0 ± 0.5		3.2	—	
Minimum removal time	t_{rem}	RL = 500 Ω	2.5 ± 0.2	50	4.4	—	ns
			3.3 ± 0.3		2.5	—	
			5.0 ± 0.5		1.4	—	

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