CMOS Digital Integrated Circuits Silicon Monolithic

TC74AC74P

1. Functional Description

- Dual D-Type Flip-Flop with Preset and Clear

2. General

The TC74AC74P is an advanced high speed CMOS D-FLIP FLOP fabricated with silicon gate and double-layer metal wiring C^2MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CK pulse.

$\overline{CLR}$ and $\overline{PR}$ are independent of the CK and are accomplished by setting the appropriate input to an "L" level.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

3. Features

(1) High speed: f_{MAX} = 200 MHz (typ.) at V_{CC} = 5.0 V

(2) Low power dissipation: I_{CC} = 4.0 μA (max) at T_a = 25°C

(3) High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)

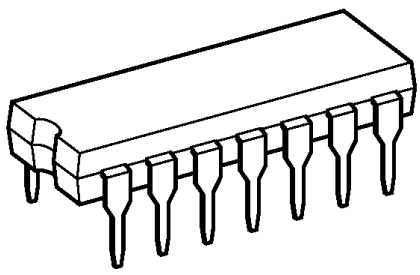
(4) Output current: $|I_{OH}|/I_{OL}$ = 24 mA (min) (V_{CC} = 4.5 V)

(5) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

(6) Wide operating voltage range: $V_{CC(opr)}$ = 2.0 V to 5.5 V

(7) Pin and function compatible with 74F74.

4. Packaging

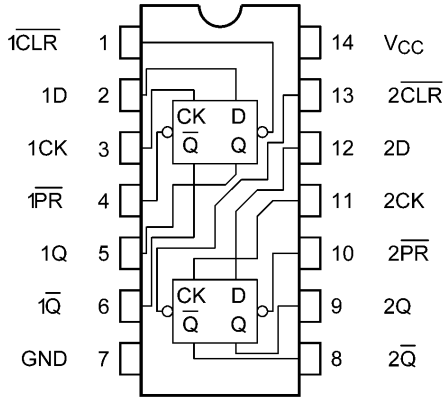


DIP14

Start of commercial production

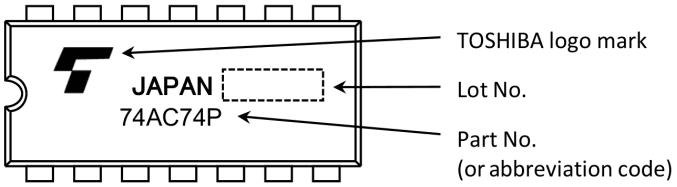
1986-05

5. Pin Assignment

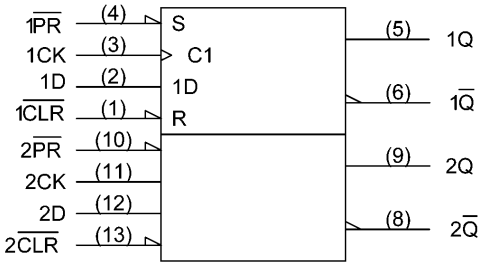


(top view)

6. Marking



7. IEC Logic Symbol

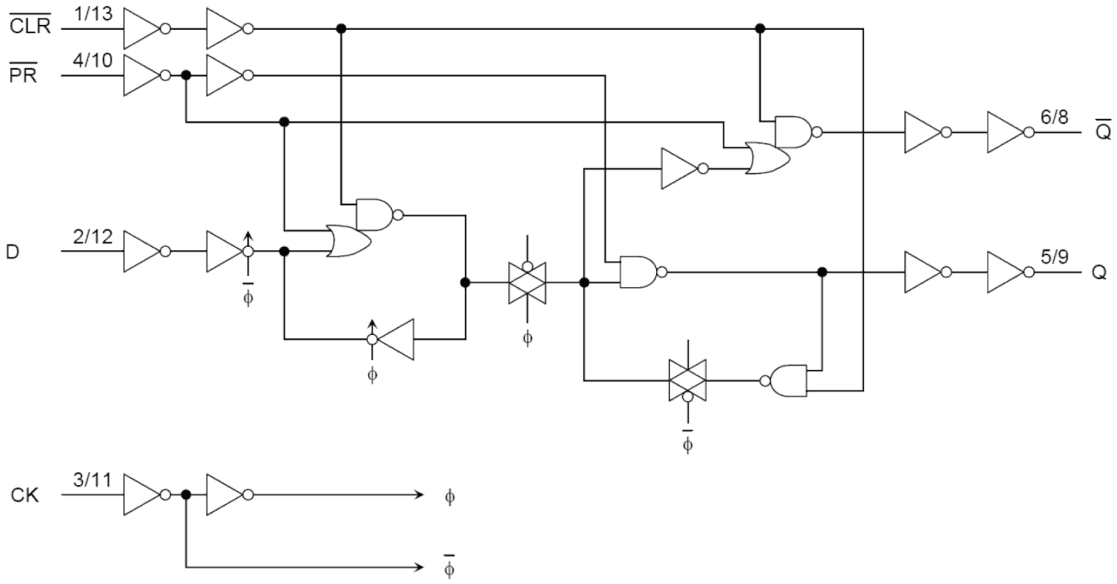


8. Truth Table

Inputs				Outputs		Function
$\overline{CLR}$	$\overline{PR}$	D	CK	Q	$\overline{Q}$	
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	↓	Qn	$\overline{Qn}$	No Change

X: Don't care

9. System Diagram



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to V_{CC} + 0.5	V
Output voltage	V_{OUT}		-0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}		±20	mA
Output diode current	I_{OK}		±50	mA
Output current	I_{OUT}		±50	mA
V_{CC}/ground current	I_{CC}		±100	mA
Power dissipation	P_D	(Note 1)	500	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: 500 mW in the range of T_a = -40 to 65°C. From T_a = 65 to 85°C a derating factor of -10 mW/°C shall be applied until 300 mW.

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V_{CC}		2.0 to 5.5	V
Input voltage	V_{IN}		0 to V_{CC}	V
Output voltage	V_{OUT}		0 to V_{CC}	V
Operating temperature	T_{opr}		-40 to 85	°C
Input rise and fall times	dt/dv	V_{CC} = 3.3 ± 0.3 V	0 to 100	ns/V
		V_{CC} = 5.0 ± 0.5 V	0 to 20	

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.

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	V
				3.0	2.10	—	—	
				5.5	3.85	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	V
				3.0	—	—	0.90	
				5.5	—	—	1.65	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			I_{OH} = -4 mA	3.0	2.58	—	—	
			I_{OH} = -24 mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			I_{OL} = 12 mA	3.0	—	—	0.36	
			I_{OL} = 24 mA	4.5	—	—	0.36	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		5.5	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	4.0	μA

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

Characteristics	Symbol	Test Condition		Note	V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—			2.0	1.50	—	V
					3.0	2.10	—	
					5.5	3.85	—	
Low-level input voltage	V_{IL}	—			2.0	—	0.50	V
					3.0	—	0.90	
					5.5	—	1.65	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA		2.0	1.9	—	V
					3.0	2.9	—	
					4.5	4.4	—	
			I_{OH} = -4 mA		3.0	2.48	—	
			I_{OH} = -24 mA		4.5	3.80	—	
			I_{OH} = -75 mA	(Note 1)	5.5	3.85	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA		2.0	—	0.1	V
					3.0	—	0.1	
					4.5	—	0.1	
			I_{OL} = 12 mA		3.0	—	0.44	
			I_{OL} = 24 mA		4.5	—	0.44	
			I_{OL} = 75 mA	(Note 1)	5.5	—	1.65	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND			5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND			5.5	—	40.0	μA

Note 1: This spec indicates the capability of driving 50 Ω transmission lines.
One output should be tested within a 10 ms maximum duration.

12.3. Timing Requirements (Unless otherwise specified, T_a = 25°C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}$,$t_{w(H)}$	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	7.0	ns
			5.0 ± 0.5	5.0	
Minimum pulse width ($\overline{CLR}$, $\overline{PR}$)	$t_{w(L)}$	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	7.0	ns
			5.0 ± 0.5	5.0	
Minimum setup time	t_s	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	6.0	ns
			5.0 ± 0.5	3.5	
Minimum hold time	t_h	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	1.0	ns
			5.0 ± 0.5	1.0	
Minimum removal time ($\overline{CLR}$, $\overline{PR}$)	t_{rem}	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	4.0	ns
			5.0 ± 0.5	2.0	

12.4. Timing Requirements (Unless otherwise specified, T_a = -40 to 85°C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}$,$t_{w(H)}$	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	7.0	ns
			5.0 ± 0.5	5.0	
Minimum pulse width ($\overline{CLR}$, $\overline{PR}$)	$t_{w(L)}$	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	7.0	ns
			5.0 ± 0.5	5.0	
Minimum setup time	t_s	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	6.0	ns
			5.0 ± 0.5	3.5	
Minimum hold time	t_h	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	1.0	ns
			5.0 ± 0.5	1.0	
Minimum removal time ($\overline{CLR}$, $\overline{PR}$)	t_{rem}	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	4.0	ns
			5.0 ± 0.5	2.0	

12.5. AC Characteristics (Unless otherwise specified, T_a = 25 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
Propagation delay time (CK-Q, $\overline{Q}$)	t_{PLH},t_{PHL}		C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	—	8.2	13.9	ns
				5.0 ± 0.5	—	6.1	8.7	
Propagation delay time ($\overline{CLR}$, $\overline{PR}$-Q, $\overline{Q}$)	t_{PLH},t_{PHL}		C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	—	8.0	13.1	ns
				5.0 ± 0.5	—	5.7	8.2	
Maximum clock frequency	f_{MAX}		C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	60	120	—	MHz
				5.0 ± 0.5	100	160	—	
Input capacitance	C_{IN}		—		—	5	10	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—		—	77	—	pF

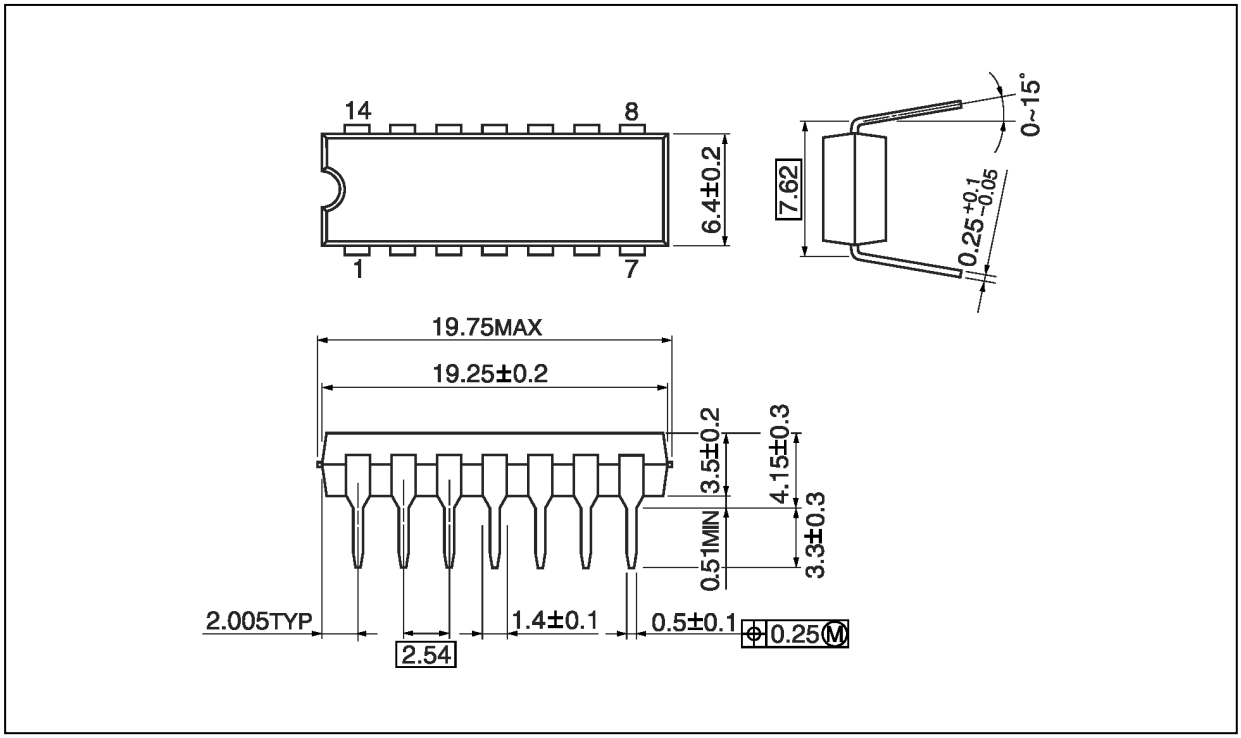
Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation.
$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$ (per F/F)

12.6. 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)	Min	Max	Unit
Propagation delay time (CK-Q, $\overline{Q}$)	t_{PLH},t_{PHL}	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	1.0	16.0	ns
			5.0 ± 0.5	1.0	10.0	
Propagation delay time ($\overline{CLR}$, $\overline{PR}$-Q, $\overline{Q}$)	t_{PLH},t_{PHL}	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	1.0	15.0	ns
			5.0 ± 0.5	1.0	9.4	
Maximum clock frequency	f_{MAX}	C_L = 50 pF R_L = 500 Ω	3.3 ± 0.3	60	—	MHz
			5.0 ± 0.5	100	—	
Input capacitance	C_{IN}	—		—	10	pF

Package Dimensions

Unit: mm



Weight: 0.96 g (typ.)

Package Name(s)
Nickname: DIP14

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