

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC175AP, TC74HC175AF

Quad D-Type Flip Flop with Clear

The TC74HC175A is a high speed CMOS D-TYPE FLIP FLOP fabricated with silicon gate C²MOS technology.

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

Information signals applied to D inputs are transferred to the Q and $\overline{Q}$ outputs on the positive going edge of the clock pulse.

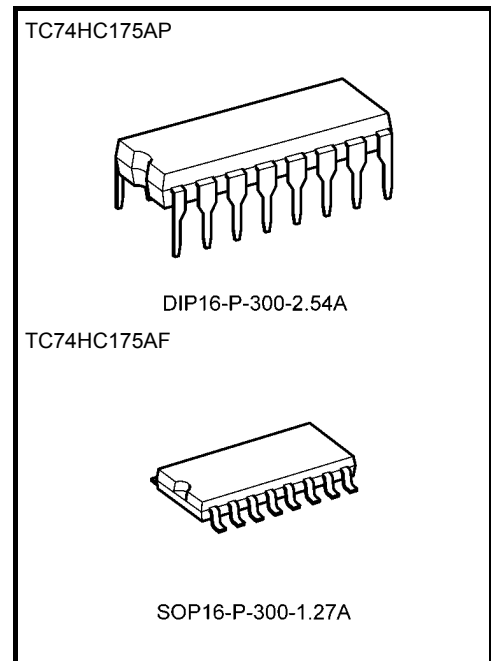
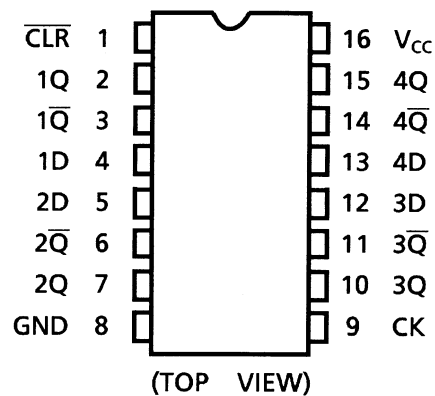
When the $\overline{\text{CLR}}$ input is held low, the Q outputs are at the low logic level and the $\overline{Q}$ outputs are at the high logic level independent of the other inputs.

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

Features

- High speed: $f_{\text{max}} = 63 \text{ MHz}$ (typ.) at $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation: $I_{\text{CC}} = 4 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}}$ (min)
- Symmetrical output impedance: $|I_{\text{OH}}| = I_{\text{OL}} = 4 \text{ mA}$ (min)
- Balanced propagation delays: $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Wide operating voltage range: $V_{\text{CC}} (\text{opr}) = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS175

Pin Assignment



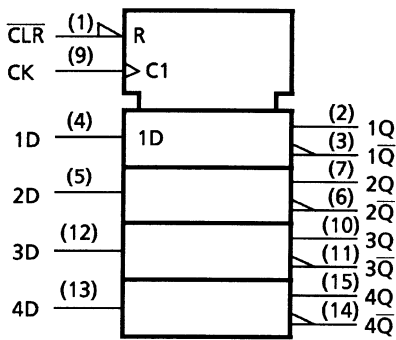
Weight

DIP16-P-300-2.54A : 1.00 g (typ.)

SOP16-P-300-1.27A : 0.18 g (typ.)

Start of commercial production
1986-11

IEC Logic Symbol

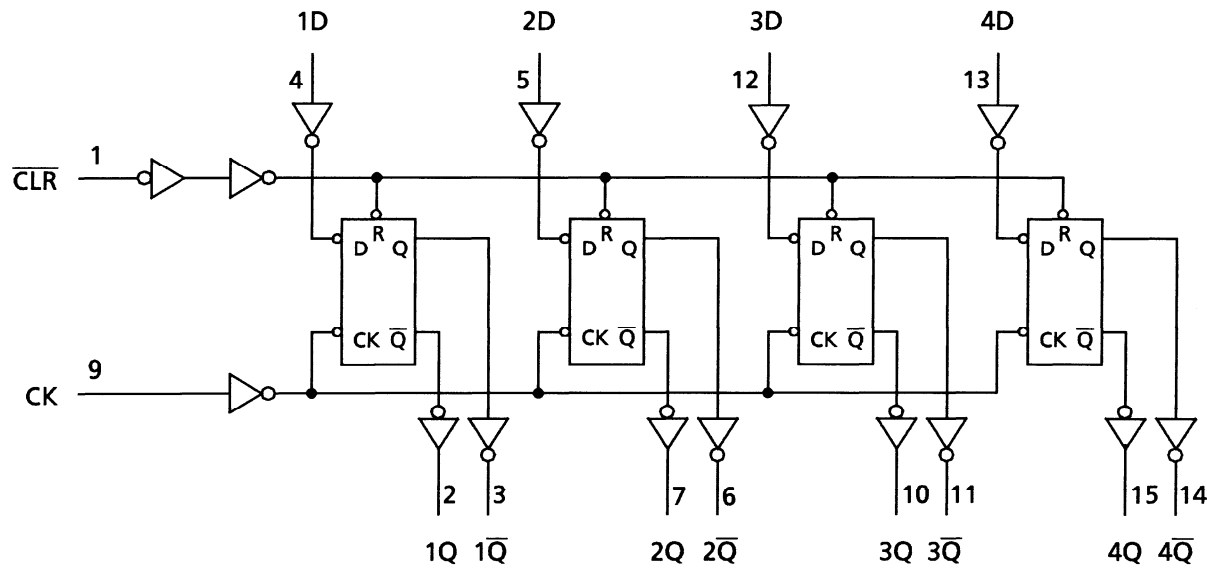


Truth Table

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

X: Don't care

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7	V
DC input voltage	V_{IN}	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	V_{OUT}	-0.5 to $V_{CC} + 0.5$	V
Input diode current	I_{IK}	± 20	mA
Output diode current	I_{OK}	± 20	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	-65 to 150	°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: 500 mW in the range of $T_a = -40$ to 65°C . From $T_a = 65$ to 85°C a derating factor of $-10\text{ mW}/^\circ\text{C}$ shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	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 time	t_r, t_f	0 to 1000 ($V_{CC} = 2.0\text{ V}$) 0 to 500 ($V_{CC} = 4.5\text{ V}$) 0 to 400 ($V_{CC} = 6.0\text{ V}$)	ns

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.

Electrical Characteristics
DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = –40 to 85°C		Unit	
				V _{CC} (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V _{IH}	—		2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	— — —	V
Low-level input voltage	V _{IL}	—		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	V
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = –20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I _{OH} = –4 mA	4.5	4.18	4.31	—	4.13	—	
I _{OH} = –5.2 mA	6.0	5.68		5.80	—	5.63	—			
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I _{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
I _{OL} = 5.2 mA	6.0	—		0.18	0.26	—	0.33			
Input leakage current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	4.0	—	40.0	μA

Timing Requirements (input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C	Unit
			V _{CC} (V)	Typ.	Limit	
Minimum pulse width (CK)	t_W (L) t_W (H)	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum pulse width ($\overline{\text{CLR}}$)	t_W (L)	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum set-up time	t_s	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum hold time	t_h	—	2.0	—	0	ns
			4.5	—	0	
			6.0	—	0	
Minimum removal time	t_{rem}	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Clock frequency	f	—	2.0	—	6	MHz
			4.5	—	31	
			6.0	—	36	

AC Characteristics ($C_L = 15 \text{ pF}$, $V_{CC} = 5 \text{ V}$, $T_a = 25^\circ\text{C}$, input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH}	—	—	4	8	ns
	t_{THL}					
Propagation delay time (CK-Q, $\overline{Q}$)	t_{pLH}	—	—	16	24	ns
	t_{pHL}					
Propagation delay time ($\overline{\text{CLR}}$ -Q, $\overline{Q}$)	t_{pLH}	—	—	13	21	ns
	t_{pHL}					
Maximum clock frequency	f_{max}	—	36	63	—	MHz

AC Characteristics (C_L = 50 pF, input: t_r = t_f = 6 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{CC} (V)	Min	Typ.	Max	Min	Max
Output transition time	t _{TLH} t _{THL}	—	2.0	—	30	75	—	95
			4.5	—	8	15	—	19
			6.0	—	7	13	—	16
Propagation delay time (CK-Q, $\overline{Q}$)	t _{pLH} t _{pHL}	—	2.0	—	70	140	—	175
			4.5	—	19	28	—	35
			6.0	—	16	24	—	30
Propagation delay time ($\overline{\text{CLR}}$ -Q, $\overline{Q}$)	t _{pLH} t _{pHL}	—	2.0	—	50	125	—	160
			4.5	—	16	25	—	32
			6.0	—	12	22	—	27
Maximum clock frequency	f _{max}	—	2.0	6	14	—	5	—
			4.5	31	53	—	25	—
			6.0	36	63	—	29	—
Input capacitance	C _{IN}	—	—	—	5	10	—	10
Power dissipation capacitance	C _{PD} (Note)	—	—	—	53	—	—	—

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:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per F/F)}$$

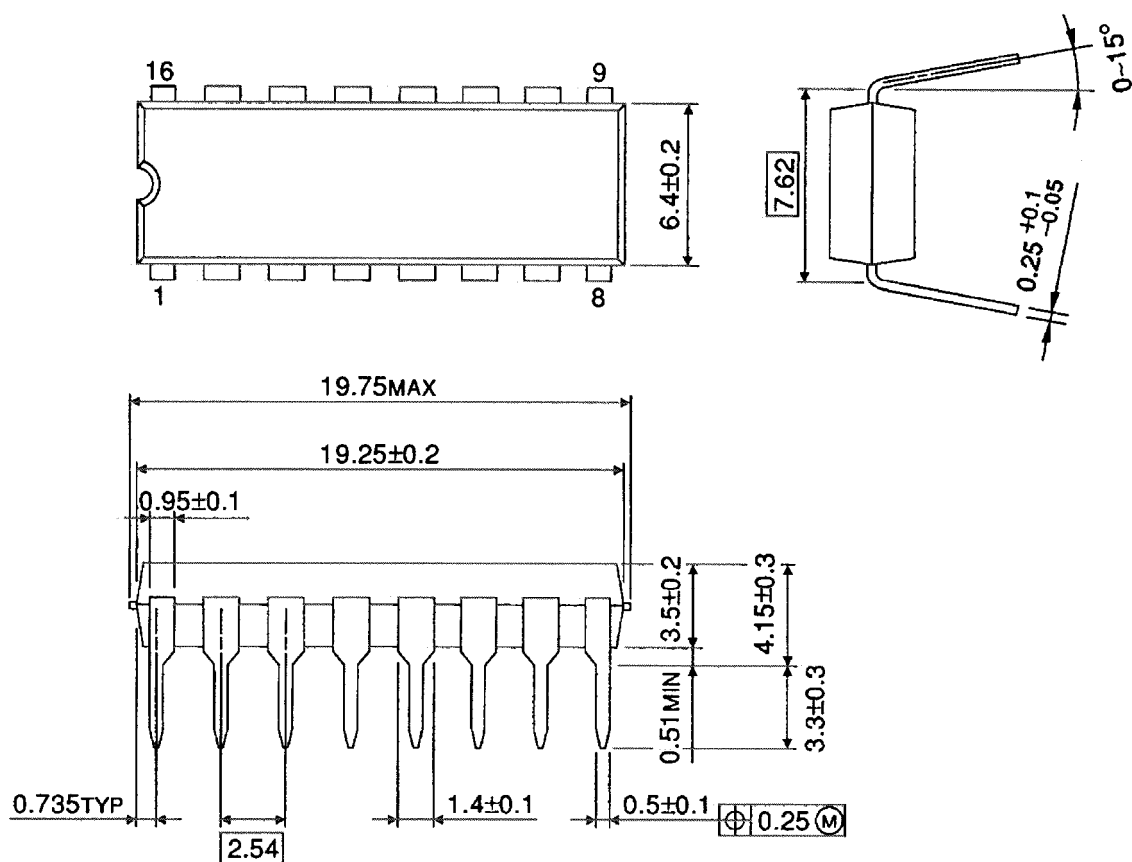
And the total C_{PD} when n pcs. of Flip Flop operate can be gained by the following equation:

$$C_{PD}(\text{total}) = 32 + 21 \cdot n$$

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

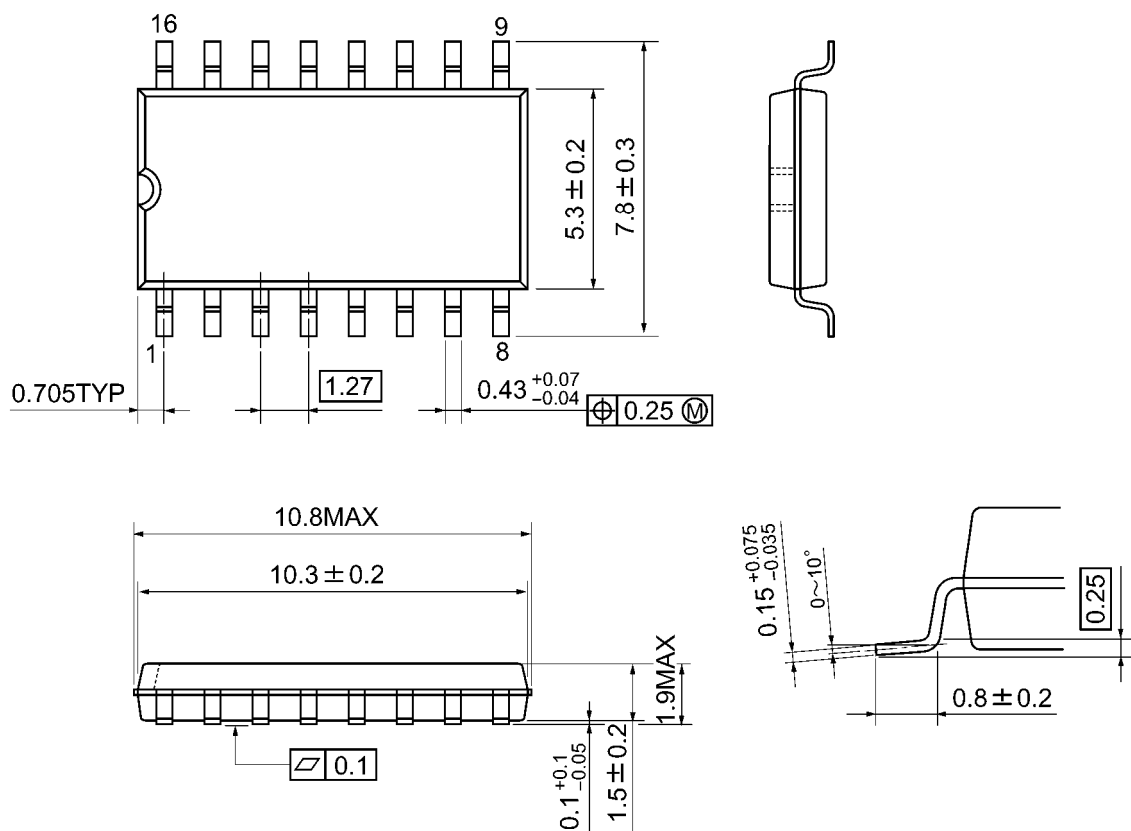


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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