

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HCT174AP, TC74HCT174AF

Hex D-Type Flip Flop with Clear

The TC74HCT174A 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.

This device may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. The inputs are compatible with TTL, NMOS and CMOS output voltage levels.

Information signals applied to the D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

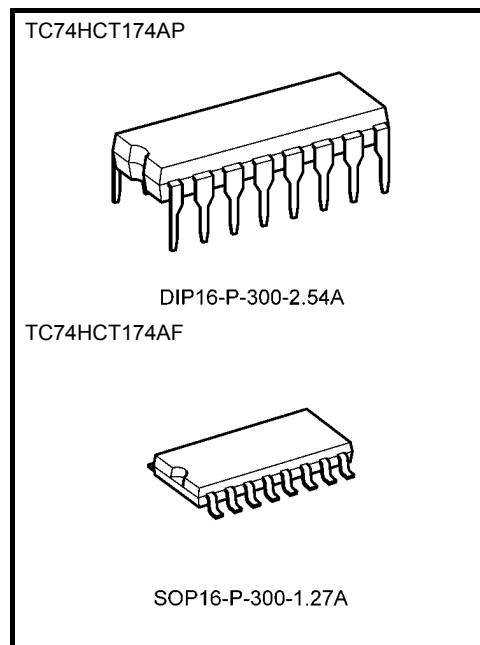
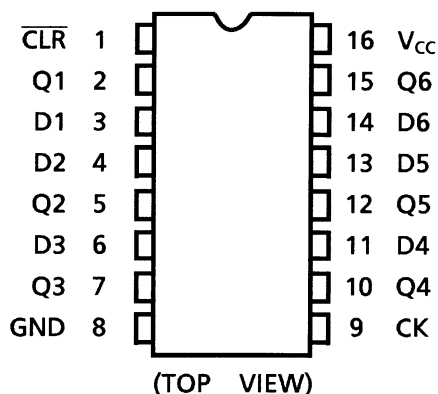
When the $\overline{\text{CLR}}$ input is held low, the Q outputs are in the low logic level independent of the other inputs.

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

Features

- High speed: $f_{\text{max}} = 56 \text{ MHz}$ (typ.) at $V_{\text{CC}} = 5 \text{ V}$
- Low power dissipation: $I_{\text{CC}} = 4 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- Compatible with TTL outputs: $V_{\text{IH}} = 2.0 \text{ V}$ (min)
 $V_{\text{IL}} = 0.8 \text{ V}$ (max)
- Wide interfacing ability: LSTTL, NMOS, CMOS
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{\text{OH}}| = I_{\text{OL}} = 4 \text{ mA}$ (min)
- Balanced propagation delays: $t_{\text{pLH}} \approx t_{\text{pHL}}$
- Pin and function compatible with 74LS174

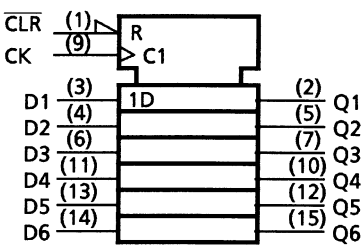
Pin Assignment



Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)

IEC Logic Symbol

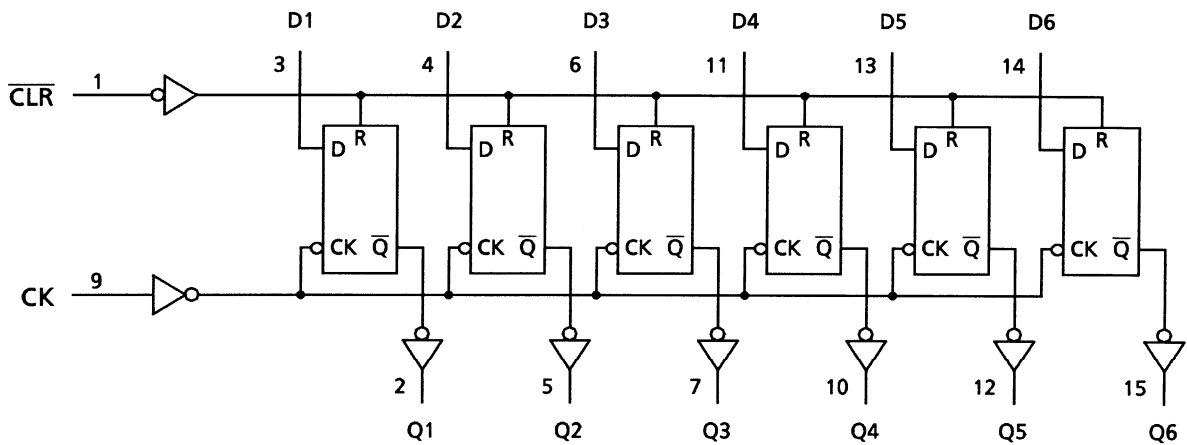


Truth Table

Inputs			Output	Function
CLR	D	CK	Q	
L	X	X	L	Clear
H	L		L	—
H	H		H	—
H	X		Q _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 mW/°C shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	4.5 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 time	t_r, t_f	0 to 500	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	
			VCC (V)		Min	Typ.	Max	Min	Max		
High-level input voltage	VIH	—		4.5 to 5.5	2.0	—	—	2.0	—	V	
Low-level input voltage	VIL	—		4.5 to 5.5	—	—	0.8	—	0.8	V	
High-level output voltage	VOH	VIN = VIH or VIL	I _{OH} = -20 μA	4.5	4.4	4.5	—	4.4	—	V	
			I _{OH} = -4 mA	4.5	4.18	4.31	—	4.13	—		
Low-level output voltage	VOL	VIN = VIH or VIL	I _{OL} = 20 μA	4.5	—	0.0	0.1	—	0.1	V	
			I _{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33		
Input leakage current	IIN	VIN = VCC or GND			5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	ICC	VIN = VCC or GND			5.5	—	—	4.0	—	40.0	μA
	IC	Per input: VIN = 0.5 V or 2.4 V Other input: VCC or GND			5.5	—	—	2.0	—	2.9	mA

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)	—	4.5	—	15	ns
	t_W (H)		5.5	—	14	
Minimum pulse width ($\overline{\text{CLR}}$)	t_W (L)	—	4.5	—	15	ns
			5.5	—	14	
Minimum set-up time	t_s	—	4.5	—	20	ns
			5.5	—	18	
Minimum hold time	t_h	—	4.5	—	5	ns
			5.5	—	5	
Minimum removal time ($\overline{\text{CLR}}$)	t_{rem}	—	4.5	—	10	ns
			5.5	—	10	
Clock frequency	f	—	4.5	—	30	MHz
			5.5	—	33	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH}	—	—	12	15	ns
	t_{THL}					
Propagation delay time (CK-Q)	t_{pLH}	—	—	29	36	ns
	t_{pHL}					
Propagation delay time ($\overline{\text{CLR}}$ -Q)	t_{pHL}	—	—	29	36	ns
Maximum clock frequency	f_{max}	—	32	61	—	MHz

AC Characteristics ($C_L = 50 \text{ pF}$, input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit
			$V_{CC} \text{ (V)}$	Min	Typ.	Max	Min	Max
Output transition time	t_{TLH}	—	4.5	—	8	15	—	19
	t_{THL}		5.5	—	7	14	—	18
Propagation delay time (CK-Q)	t_{pLH}	—	4.5	—	20	34	—	43
	t_{pHL}		5.5	—	17	31	—	39
Propagation delay time ($\overline{\text{CLR}}$ -Q)	t_{pHL}	—	4.5	—	20	34	—	43
			5.5	—	17	31	—	39
Maximum clock frequency	f_{max}	—	4.5	30	54	—	24	—
			5.5	33	57	—	26	—
Input capacitance	C_{IN}	—	—	—	5	10	—	10
Power dissipation capacitance	C_{PD} (Note)	—	—	—	30	—	—	—

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:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per F/F)}$$

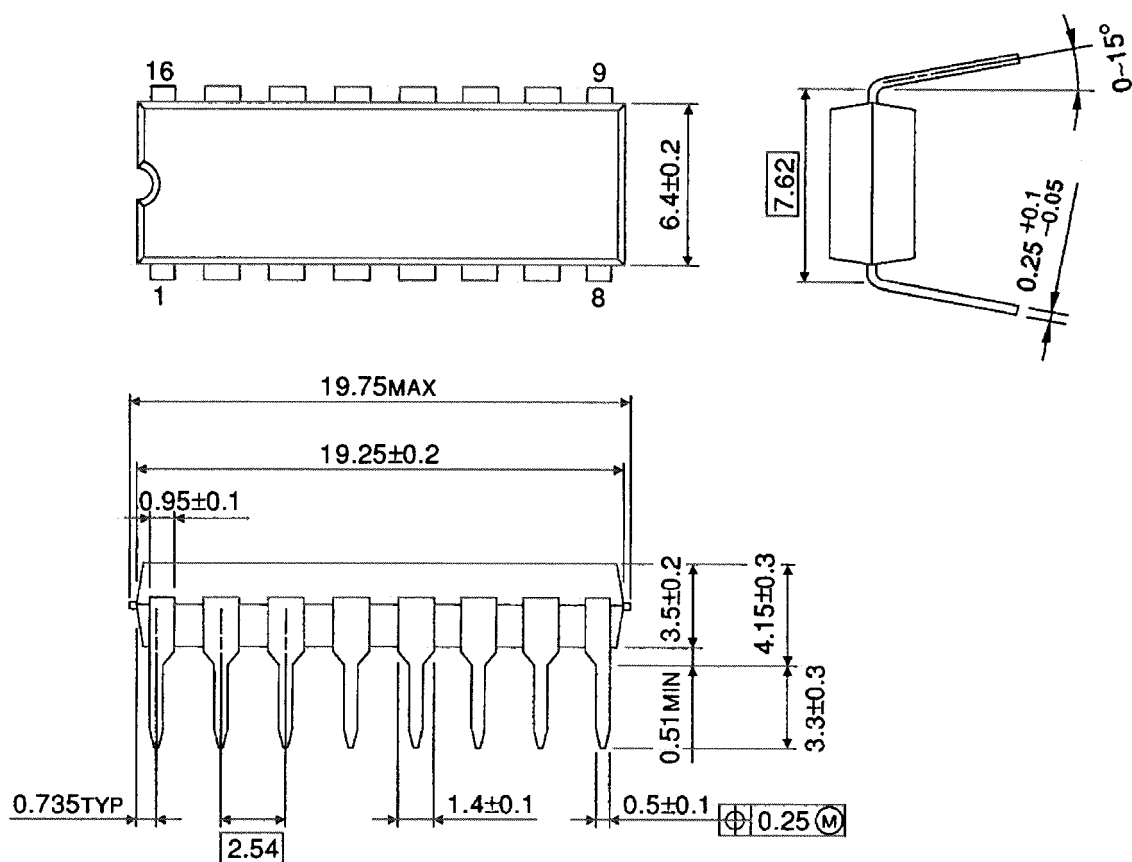
And the total C_{PD} when n pcs. of flip flop operate can be gained by the following equation:

$$C_{PD}(\text{total}) = 18 + 12 \cdot n$$

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

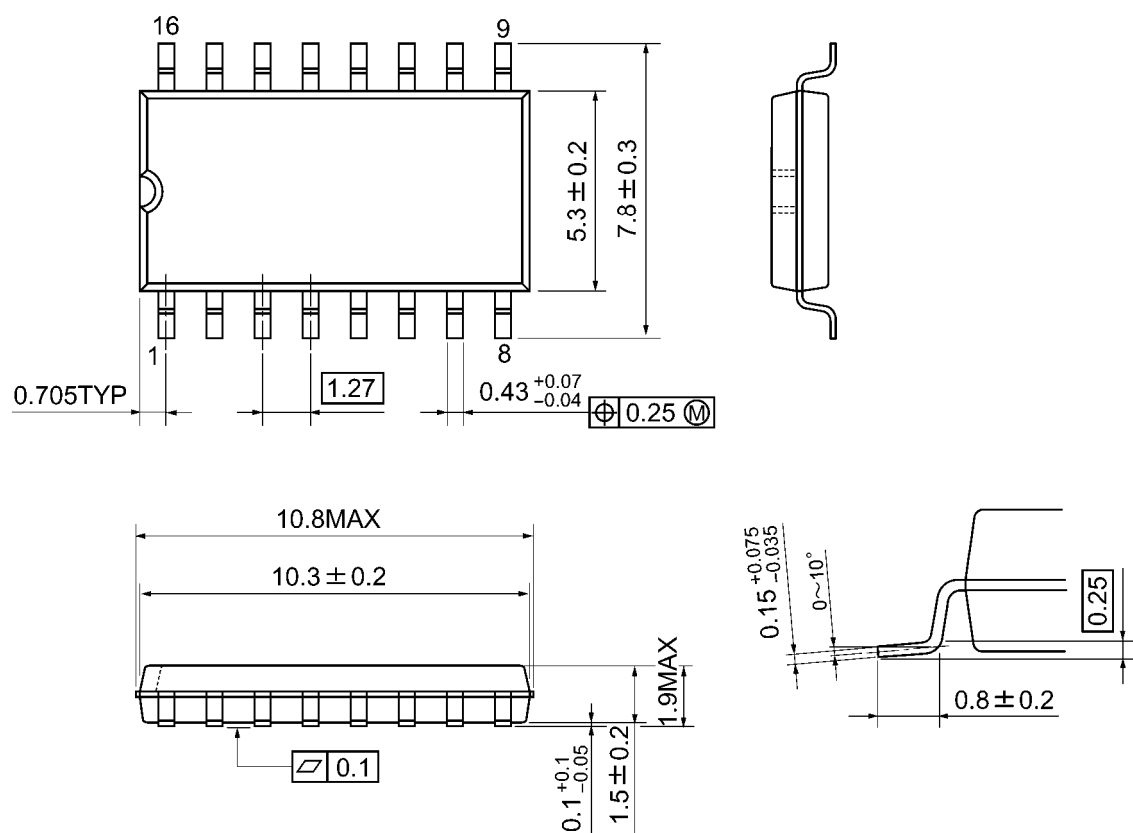


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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