

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74AC175P, TC74AC175F, TC74AC175FT

### Quad D-Type Flip Flop with Clear

The TC74AC175 is an advanced high speed CMOS QUAD D-TYPE FLIP FLOP fabricated with silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

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

These four flip-flops are controlled by a clock input (CK) and a clear input (CLR).

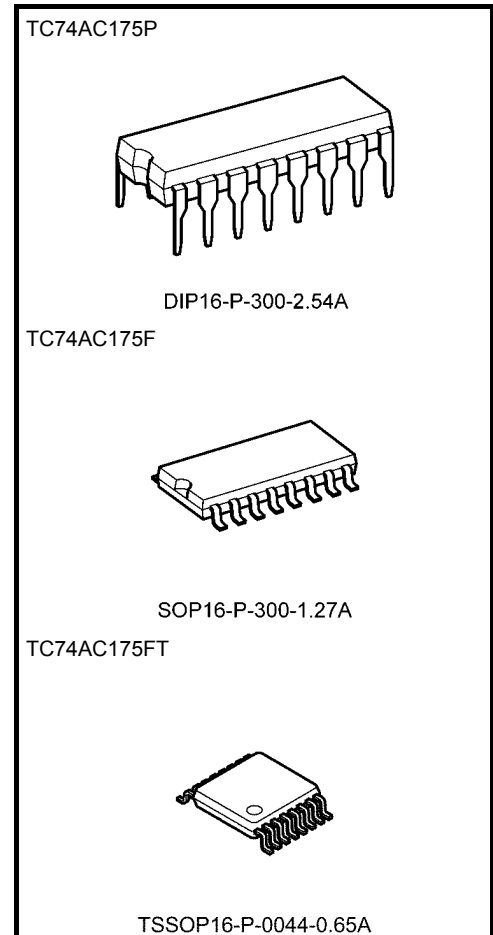
The information data applied to the D inputs (D1 thru D4) are transferred to the outputs (Q1 thru Q4 and  $\bar{Q}1$  thru  $\bar{Q}4$ ) on the positive-going edge of the clock pulse.

Reset function is accomplished when the clear input is taken low, and all Q outputs are kept in low level regardless of other input conditions.

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

### Features

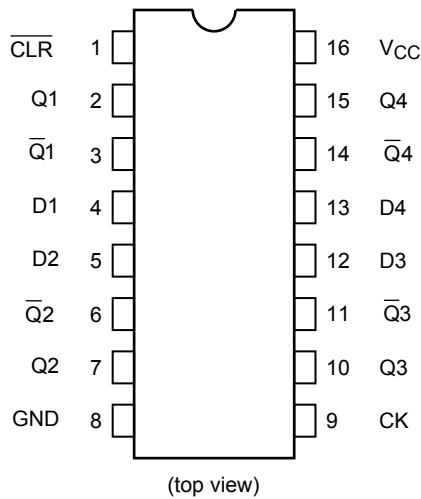
- High speed:  $f_{max} = 170$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 8$   $\mu$ A (max) at  $T_a = 25^\circ$ C
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 24$  mA (min)  
Capability of driving 50  $\Omega$  transmission lines.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC(opr)} = 2$  to 5.5 V
- Pin and function compatible with 74F175



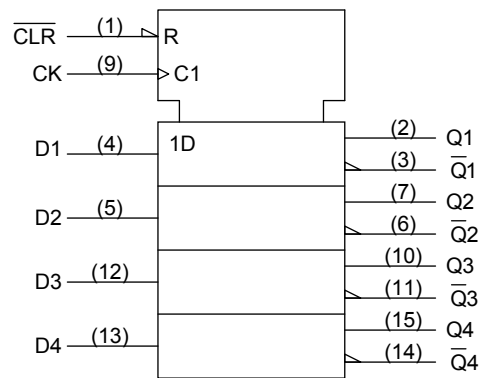
### Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)

## Pin Assignment



## IEC Logic Symbol

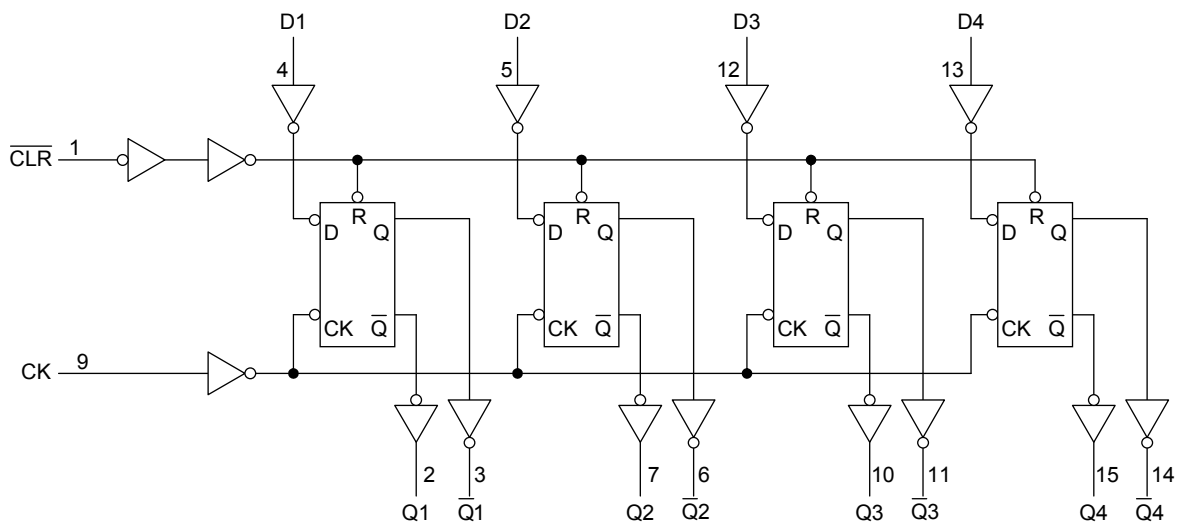


## Truth Table

Inputs			Output		Function
$\overline{\text{CLR}}$	D	CK	Q	$\overline{\text{Q}}$	
L	X	X	L	H	Clear
H	L		L	H	—
H	H		H	L	—
H	X		$Q_n$	$\overline{Q}_n$	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 7.0	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	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 50$	mA
DC output current	$I_{OUT}$	$\pm 50$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 200$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP/TSSOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}\text{C}$

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  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10$  mW/ $^{\circ}\text{C}$  should be applied up to 300 mW.

**Operating Ranges (Note)**

Characteristics	Symbol	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	$^{\circ}\text{C}$
Input rise and fall time	$dt/dV$	0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ( $V_{CC} = 5 \pm 0.5$ V)	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0	1.50	—	—	1.50	—	V
				3.0	2.10	—	—	2.10	—	
				5.5	3.85	—	—	3.85	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.50	—	0.50	V
				3.0	—	—	0.90	—	0.90	
				5.5	—	—	1.65	—	1.65	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
				4.5	4.4	4.5	—	4.4	—	
			I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
				4.5	3.94	—	—	3.80	—	
I <sub>OH</sub> = -24 mA	4.5	—	—	—	3.80	—				
I <sub>OH</sub> = -75 mA (Note)	5.5	—	—	—	3.85	—				
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
				4.5	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 12 mA	3.0	—	—	0.36	—	0.44	
				4.5	—	—	0.36	—	0.44	
I <sub>OL</sub> = 24 mA	4.5	—	—	0.36	—	0.44				
I <sub>OL</sub> = 75 mA (Note)	5.5	—	—	—	—	1.65				
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	8.0	—	80.0	μA

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

### Timing Requirements (input: t<sub>r</sub> = t<sub>f</sub> = 3 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C	Ta = -40 to 85°C	Unit	
				V <sub>CC</sub> (V)	Limit		Limit
Minimum pulse width (CK)	t <sub>w</sub> (L) t <sub>w</sub> (H)	—		3.3 ± 0.3	7.0	7.0	ns
				5.0 ± 0.5	5.0	5.0	
Minimum pulse width ( $\overline{\text{CLR}}$ )	t <sub>w</sub> (L)	—		3.3 ± 0.3 5.0 ± 0.5	7.0 5.0	7.0 5.0	ns
Minimum set-up time	t <sub>s</sub>	—		3.3 ± 0.3	12.0	12.0	ns
				5.0 ± 0.5	6.5	6.5	
Minimum hold time	t <sub>h</sub>	—		3.3 ± 0.3	0.0	0.0	ns
				5.0 ± 0.5	0.0	0.0	
Minimum removal time ( $\overline{\text{CLR}}$ )	t <sub>rem</sub>	—		3.3 ± 0.3	7.0	7.0	ns
				5.0 ± 0.5	5.0	5.0	

### AC Characteristics ( $C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$ , input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Propagation delay time (CK-Q, $\bar{Q}$ )	t <sub>pLH</sub>	—	3.3 ± 0.3	—	8.2	13.9	1.0	16.0	ns
	t <sub>pHL</sub>		5.0 ± 0.5	—	6.1	8.7	1.0	10.0	
Propagation delay time ( $\bar{\text{CLR}}\text{-Q}$ , $\bar{Q}$ )	t <sub>pLH</sub>	—	3.3 ± 0.3	—	7.8	13.3	1.0	15.3	ns
	t <sub>pHL</sub>		5.0 ± 0.5	—	6.1	8.7	1.0	10.0	
Maximum clock frequency	f <sub>max</sub>	—	3.3 ± 0.3	40	80	—	40	—	MHz
			5.0 ± 0.5	80	150	—	80	—	
Input capacitance	C <sub>IN</sub>	—	—	5	10	—	10	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note)	—	85	—	—	—	pF	

Note: C<sub>PD</sub> 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<sub>PD</sub> when n pcs of flip flop operate can be gained by the following equation:

$$C_{PD \text{ (total)}} = 35 + 50 \cdot n$$

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

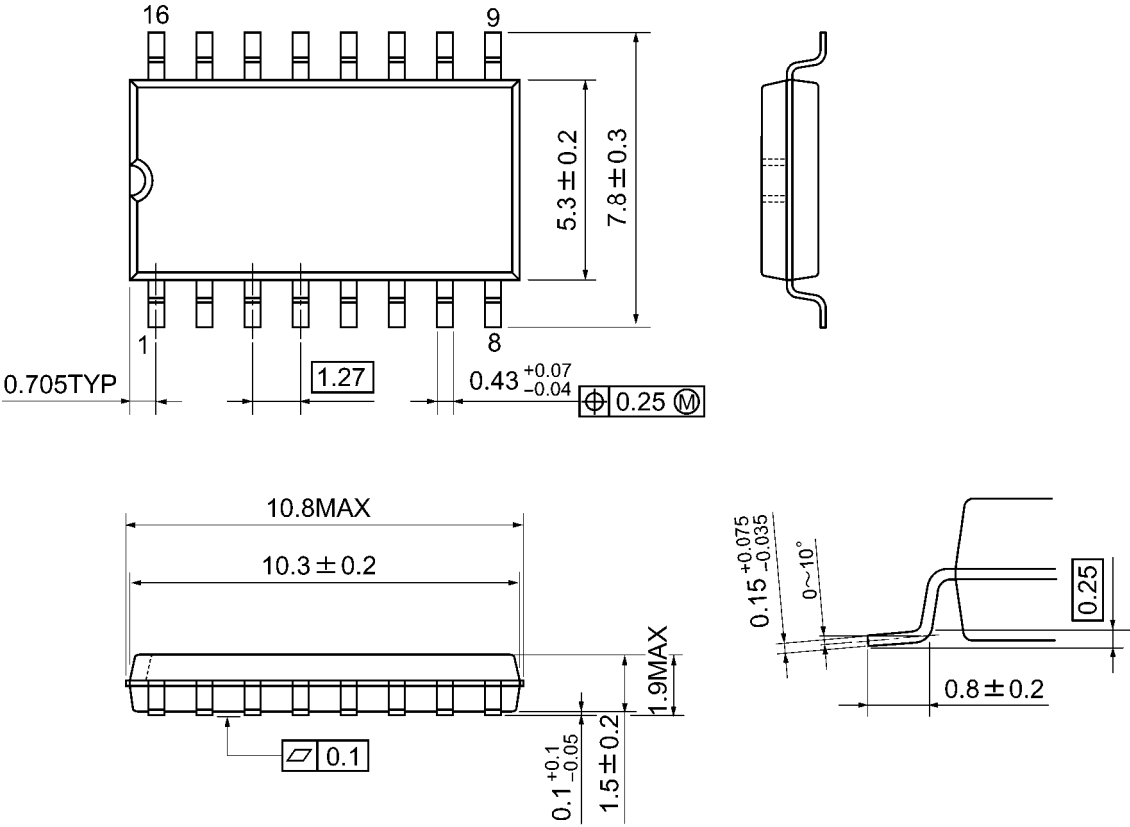


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm

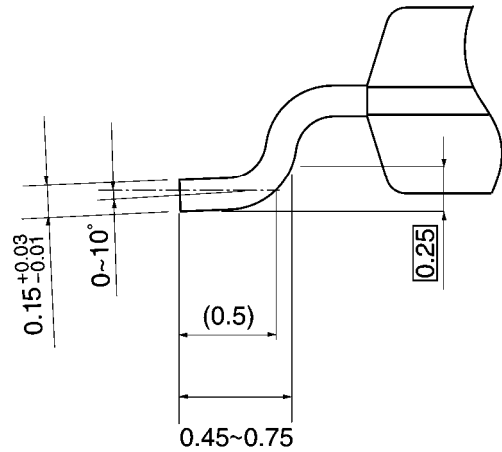
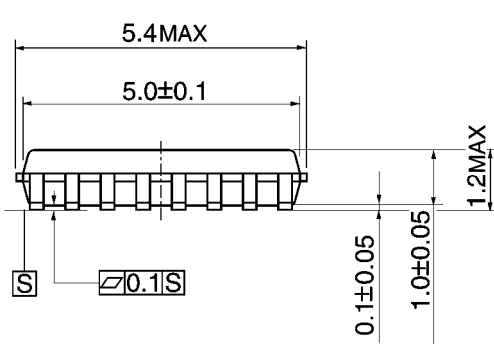
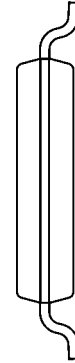
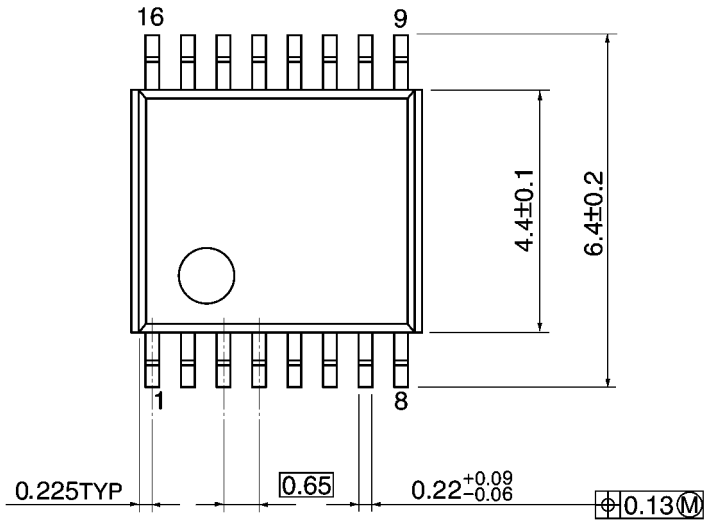


Weight: 0.18 g (typ.)

**Package Dimensions**

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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