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^2MOS technology.

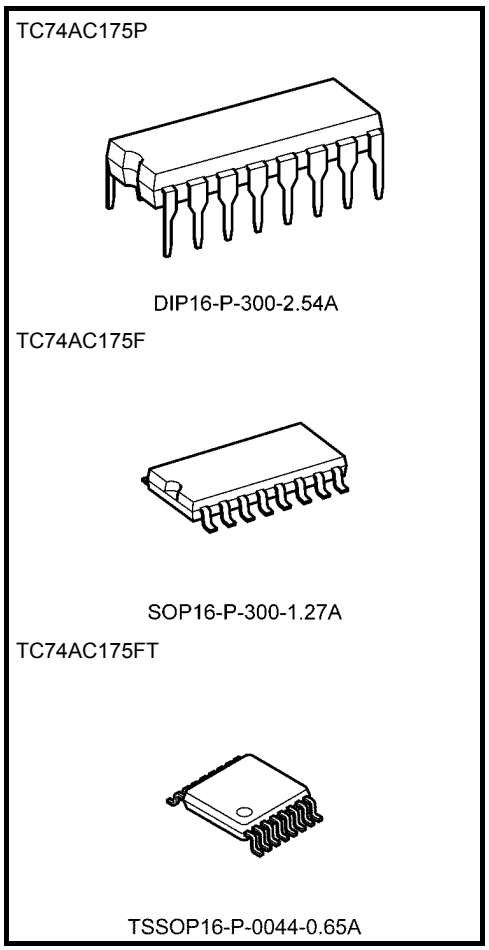
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

These four flip-flops are controlled by a clock input (CK) and a clear input ($\overline{CLR}$).

The information data applied to the D inputs (D1 thru D4) are transferred to the outputs (Q1 thru Q4 and $\overline{Q}1$ thru $\overline{Q}4$) 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.



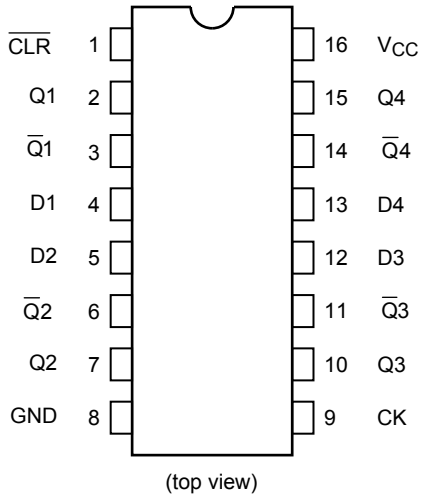
Weight

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.)

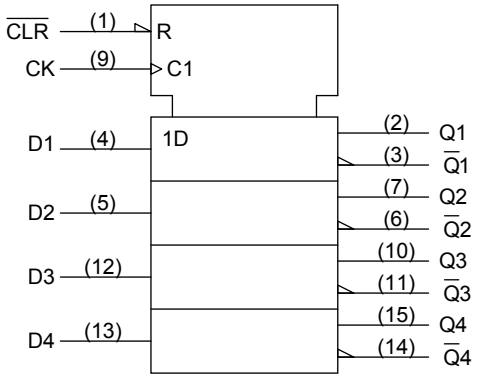
Features

- High speed: f_{max} = 170 MHz (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 8 μA (max) at Ta = 25°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 Ω transmission lines.
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: $V_{CC\ (opr)}$ = 2 to 5.5 V
- Pin and function compatible with 74F175

Pin Assignment



IEC Logic Symbol

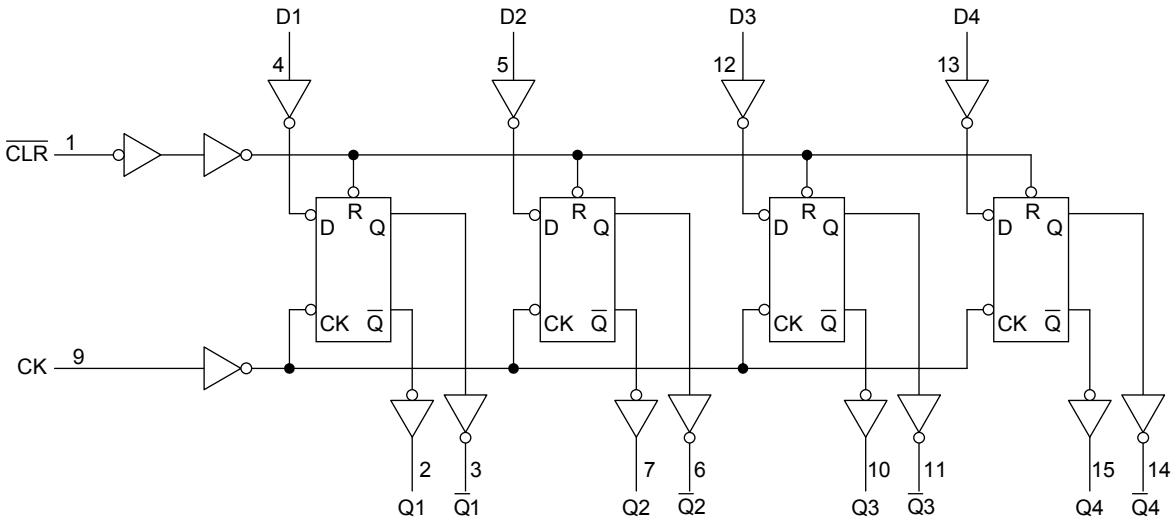


Truth Table

Inputs			Output		Function
$\overline{CLR}$	D	CK	Q	$\overline{Q}$	
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}	±20	mA
Output diode current	I_{OK}	±50	mA
DC output current	I_{OUT}	±50	mA
DC V_{CC}/ground current	I_{CC}	±200	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP/TSSOP)	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 Ta = −40 to 65°C. From Ta = 65 to 85°C a derating factor of −10 mW/°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	°C
Input rise and fall time	dt/dV	0 to 100 (V_{CC} = 3.3 ± 0.3 V) 0 to 20 (V_{CC} = 5 ± 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		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	1.50	—	V
				3.0	2.10	—	—	2.10	—	
				5.5	3.85	—	—	3.85	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	—	0.50	V
				3.0	—	—	0.90	—	0.90	
				5.5	—	—	1.65	—	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	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
				4.5	4.4	4.5	—	4.4	—	
			I_{OH} = −4 mA	3.0	2.58	—	—	2.48	—	
			I_{OH} = −24 mA	4.5	3.94	—	—	3.80	—	
			I_{OH} = −75 mA (Note)	5.5	—	—	—	3.85	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 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_{OL} = 12 mA	3.0	—	—	0.36	—	0.44	
			I_{OL} = 24 mA	4.5	—	—	0.36	—	0.44	
			I_{OL} = 75 mA (Note)	5.5	—	—	—	—	1.65	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} 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: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Ta = 25°C Limit	Ta = −40 to 85°C Limit	Unit
Minimum pulse width (CK)	$t_{w\,(L)}$	—	3.3 ± 0.3	7.0	7.0	ns
	$t_{w\,(H)}$		5.0 ± 0.5	5.0	5.0	
Minimum pulse width ($\overline{CLR}$)	$t_{w\,(L)}$	—	3.3 ± 0.3	7.0	7.0	ns
			5.0 ± 0.5	5.0	5.0	
Minimum set-up time	t_s	—	3.3 ± 0.3	12.0	12.0	ns
			5.0 ± 0.5	6.5	6.5	
Minimum hold time	t_h	—	3.3 ± 0.3	0.0	0.0	ns
			5.0 ± 0.5	0.0	0.0	
Minimum removal time ($\overline{CLR}$)	t_{rem}	—	3.3 ± 0.3	7.0	7.0	ns
			5.0 ± 0.5	5.0	5.0	

AC Characteristics (C_L = 50 pF, R_L = 500 Ω, input: $t_r = t_f$ = 3 ns)

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

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:

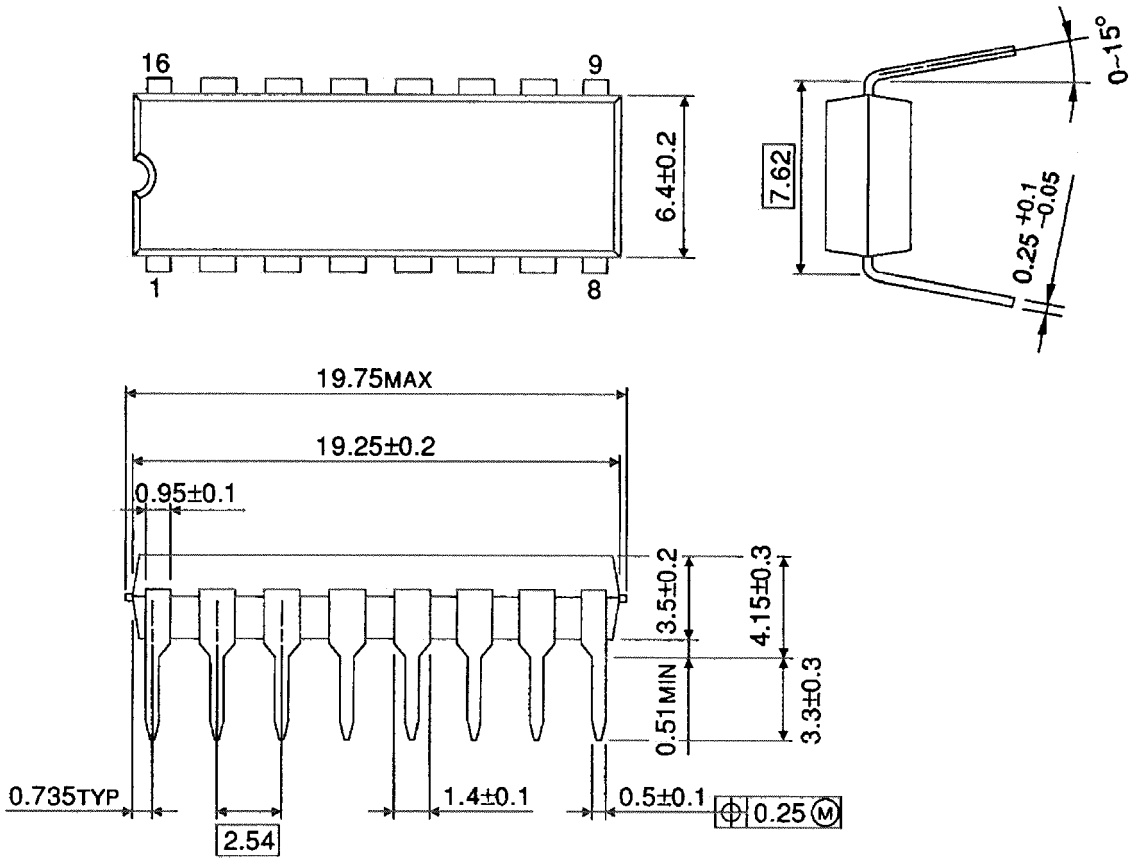
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4$ (per F/F)

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

C_{PD} (total) = 35 + 50·n

Package Dimensions

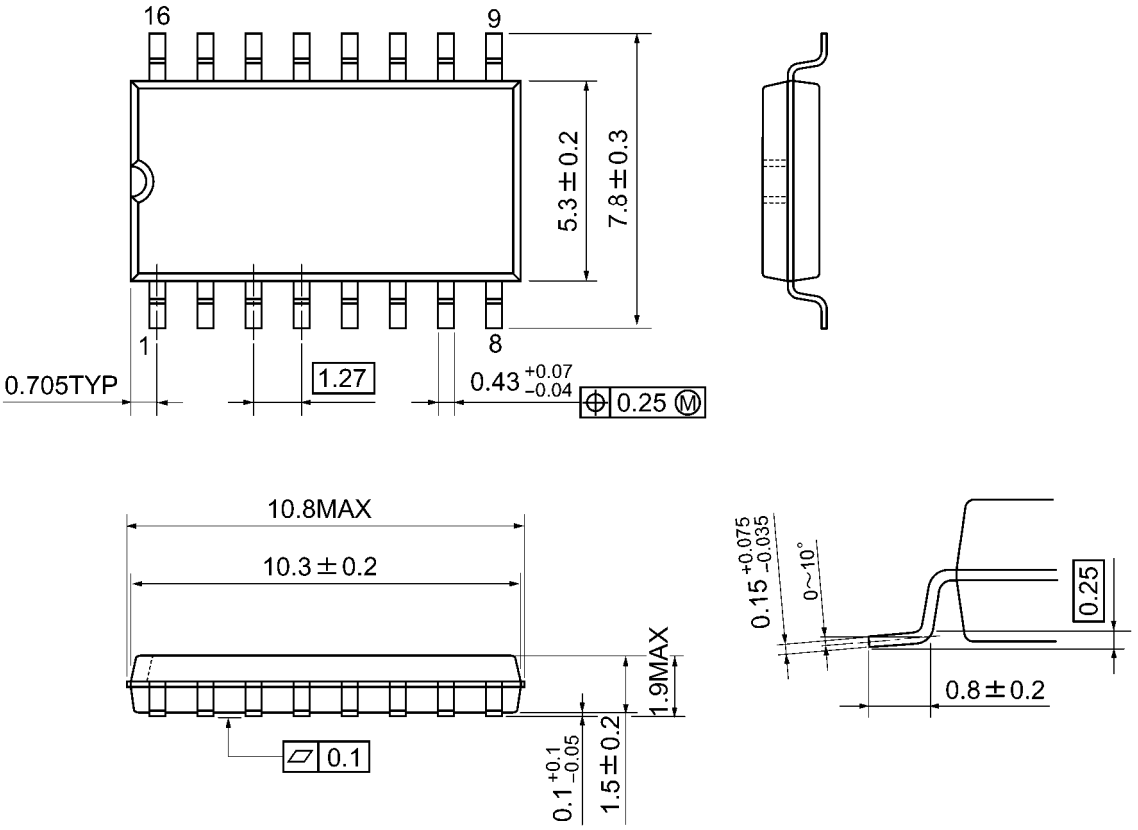
DIP16-P-300-2.54A Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

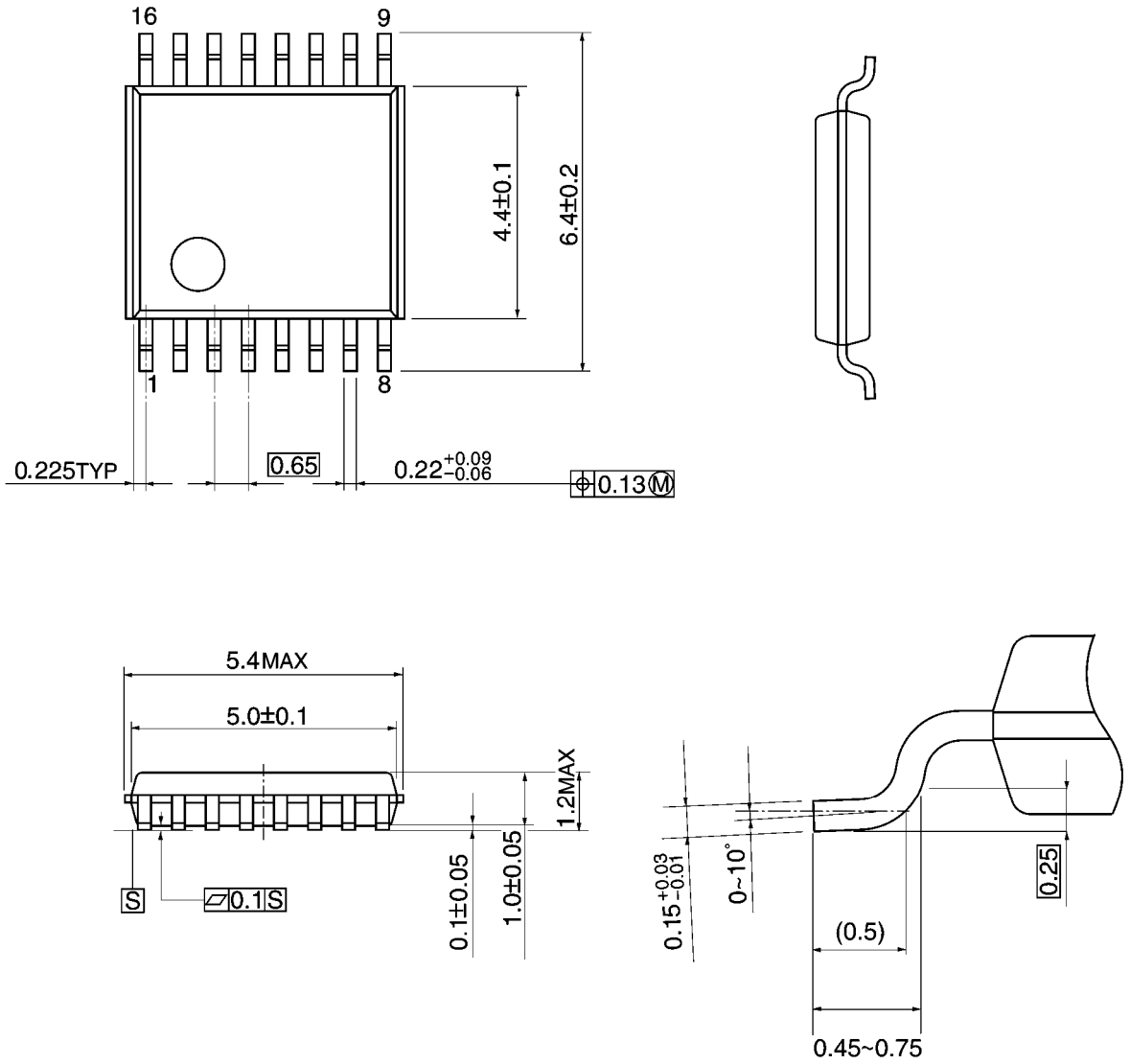
SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A Unit: mm



Weight: 0.06 g (typ.)

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