

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHC174F, TC74VHC174FK

Hex D-Type Flip Flop with Clear

The TC74VHC174 is an advanced high speed CMOS HEX D-TYPE FLIP FLOP fabricated with silicon gate C²MOS technology.

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

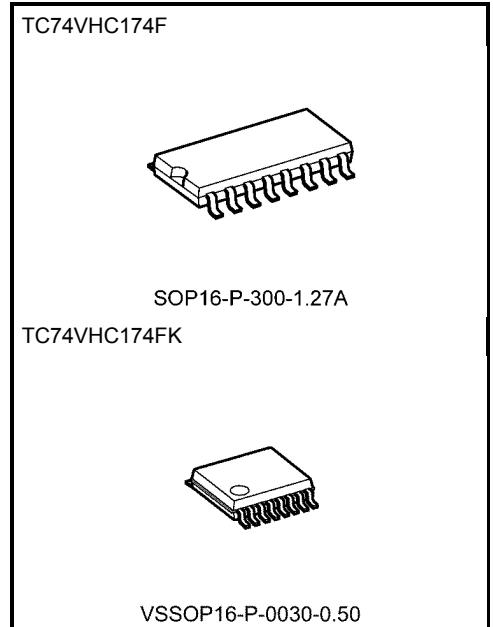
Information signals applied to D inputs are transferred to the Q output on the positive going edge of the clock pulse.

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

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High speed: $f_{\text{max}} = 175 \text{ MHz}$ (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)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Wide operating voltage range: $V_{\text{CC}}(\text{opr}) = 2 \text{ to } 5.5 \text{ V}$
- Low noise: $V_{\text{OLP}} = 0.8 \text{ V}$ (max)
- Pin and function compatible with 74ALS174



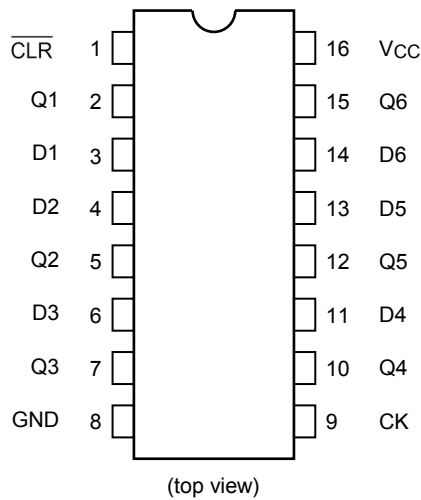
Weight

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

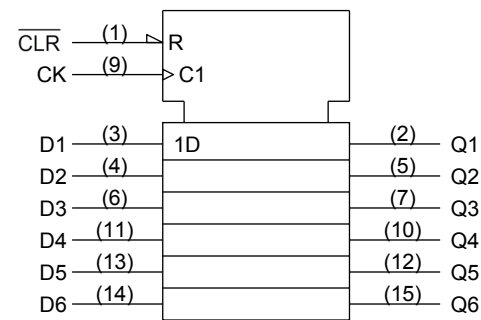
VSSOP16-P-0030-0.50 : 0.02 g (typ.)

Start of commercial production
1991-11

Pin Assignment



IEC Logic Symbol

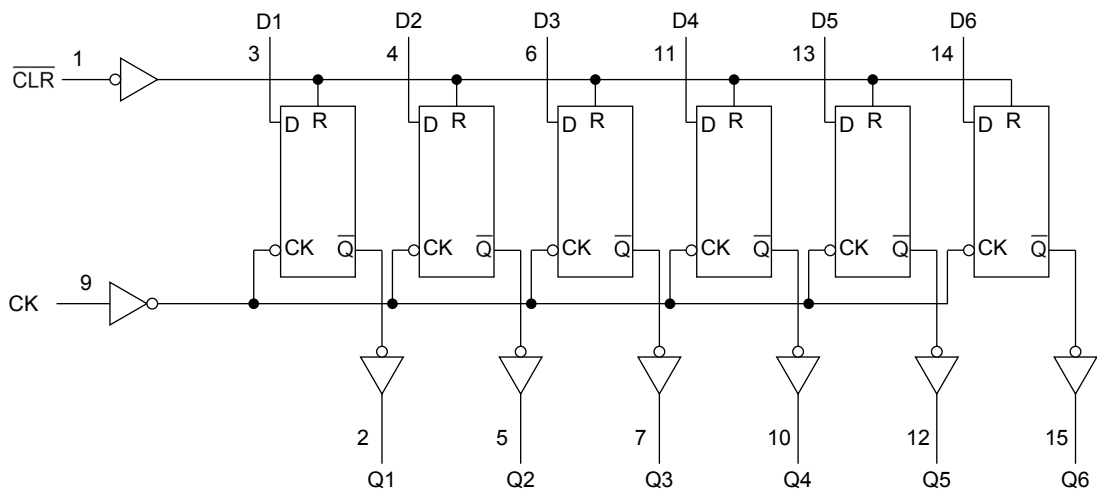


Truth Table

Inputs			Output	Function
CLR	D	CK	Q	
L	X	X	L	Clear
H	L		L	—
H	H		H	—
H	X		Qn	No Change

X: Don't care

System Diagram



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V _{CC}	-0.5 to 7.0	V
DC input voltage	V _{IN}	-0.5 to 7.0	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	180	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).

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V _{CC}	2.0 to 5.5	V
Input voltage	V _{IN}	0 to 5.5	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 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 3.0 to 5.5	1.50 V _{CC} × 0.7	— —	— —	1.50 V _{CC} × 0.7	— —	V
Low-level input voltage	V _{IL}	—	2.0 3.0 to 5.5	— —	— —	0.50 V _{CC} × 0.3	— —	0.50 V _{CC} × 0.3	V
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	V
			I _{OH} = -4 mA	3.0	2.58	—	—	2.48	
			I _{OH} = -8 mA	4.5	3.94	—	—	3.80	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	2.0 3.0 4.5	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	V
			I _{OL} = 4 mA	3.0	—	—	0.36	—	
			I _{OL} = 8 mA	4.5	—	—	0.36	—	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND	0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	5.5	—	—	4.0	—	40.0	μA

Timing Requirements (input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40 to 85°C	Unit
			V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	t _w (L)	—	3.3 ± 0.3	—	5.0	5.0	ns
	t _w (H)		5.0 ± 0.5	—	5.0	5.0	
Minimum pulse width (CLR)	t _w (L)	—	3.3 ± 0.3 5.0 ± 0.5	— —	5.0 5.0	5.0 5.0	ns
Minimum set-up time	t _s	—	3.3 ± 0.3	—	5.0	6.0	ns
			5.0 ± 0.5	—	4.5	4.5	
Minimum hold time	t _h	—	3.3 ± 0.3	—	0.0	0.0	ns
			5.0 ± 0.5	—	0.5	0.5	
Minimum removal time (CLR)	t _{rem}	—	3.3 ± 0.3	—	3.0	3.0	ns
			5.0 ± 0.5	—	2.5	2.5	

AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{CC} (V)	C _L (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-Q)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	7.2	11.0	1.0	13.0	ns
				50	—	9.7	14.5	1.0	16.5	
			5.0 ± 0.5	15	—	4.9	7.2	1.0	8.5	
				50	—	6.4	9.2	1.0	10.5	
Propagation delay time ($\overline{\text{CLR}}$ -Q)	t_{pHL}	—	3.3 ± 0.3	15	—	7.4	11.4	1.0	13.5	ns
				50	—	9.9	14.9	1.0	17.0	
			5.0 ± 0.5	15	—	5.1	7.6	1.0	9.0	
				50	—	6.6	9.6	1.0	11.0	
Maximum clock frequency	f_{max}	—	3.3 ± 0.3	15	95	150	—	80	—	MHz
				50	55	85	—	50	—	
			5.0 ± 0.5	15	130	175	—	110	—	
				50	90	120	—	80	—	
Output to output skew	t_{osLH} t_{osHL}	(Note 1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
			5.5 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	C _{IN}	—			—	4	10	—	10	pF
Power dissipation capacitance	CPD	(Note 2)			—	29	—	—	—	pF

Note 1: Parameter guaranteed by design.

$$t_{\text{osLH}} = |t_{pLHm} - t_{pLHn}|, t_{\text{osHL}} = |t_{pHLm} - t_{pHLn}|$$

Note 2: CPD 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:

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

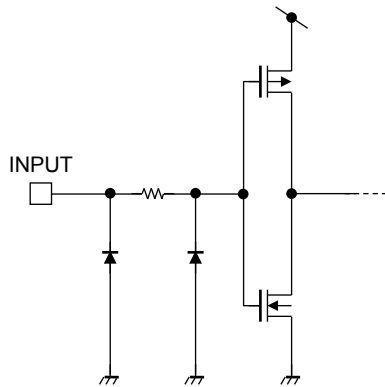
And the total CPD when n pcs. of flip flop operate can be gained by the following equation:

$$\text{CPD (total)} = 19 + 10 \cdot n$$

Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition		Ta = 25°C		Unit
			V _{CC} (V)	Typ.	Max	
Quiet output maximum dynamic V _{OL}	V _{OLP}	C _L = 50 pF	5.0	0.4	0.8	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	C _L = 50 pF	5.0	-0.4	-0.8	V
Minimum high level dynamic input voltage	V _{IHD}	C _L = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage	V _{ILD}	C _L = 50 pF	5.0	—	1.5	V

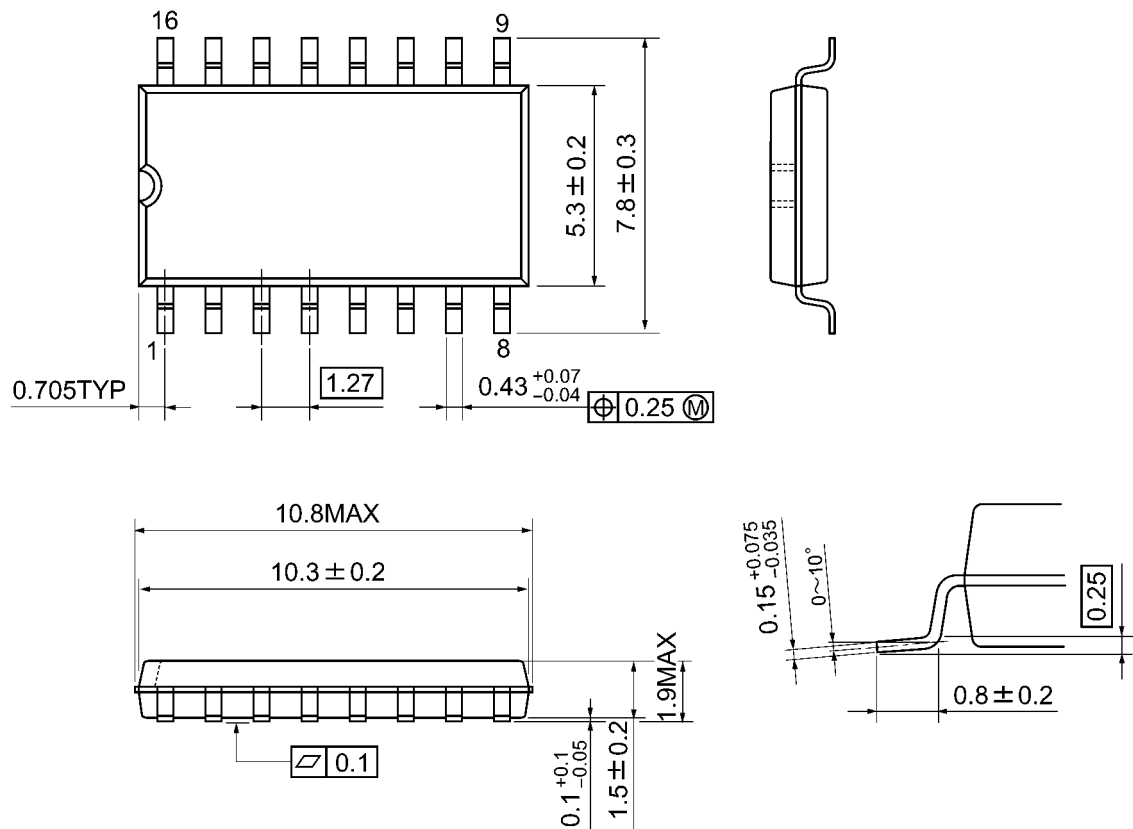
Input Equivalent Circuit



Package Dimensions

SOP16-P-300-1.27A

Unit: mm

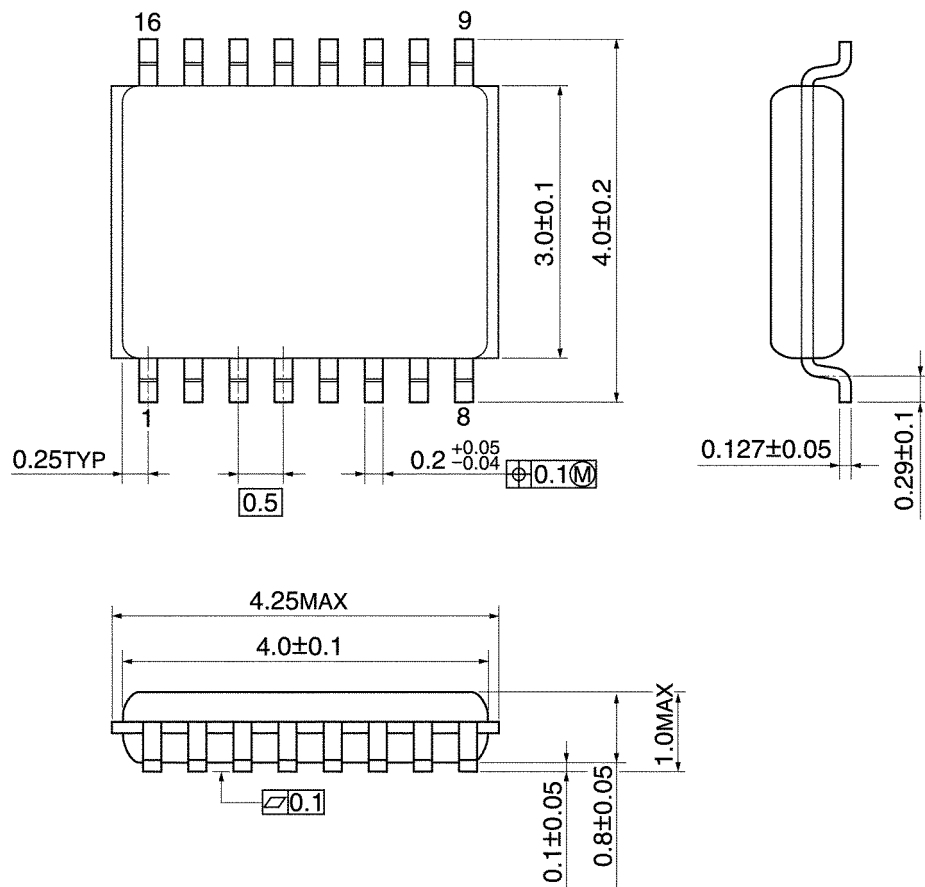


Weight: 0.18 g (typ.)

Package Dimensions

VSSOP16-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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