

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VHC574F, TC74VHC574FK

## Octal D-Type Flip Flop with 3-State Output

The TC74VHC574 is advanced high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate 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.

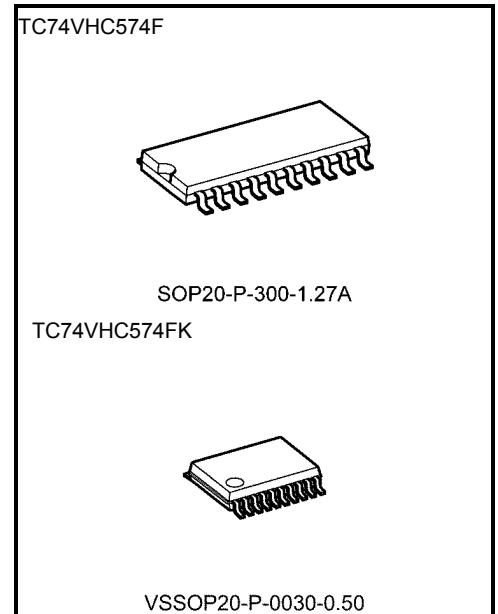
This 8-bit D-type flip-flop is controlled by a clock input (CK) and an output enable input ( $\overline{OE}$ ).

When the  $\overline{OE}$  input is high, the eight outputs are in a high impedance state.

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:  $f_{max} = 180 \text{ MHz}$  (typ.) at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \text{ } \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- Wide operating voltage range:  $V_{CC}(\text{opr}) = 2 \text{ to } 5.5 \text{ V}$
- Low noise:  $V_{OLP} = 1.0 \text{ V}$  (max)
- Pin and function compatible with 74ALS574

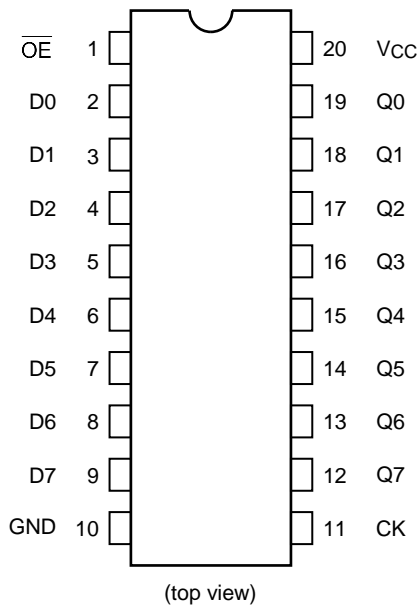


### Weight

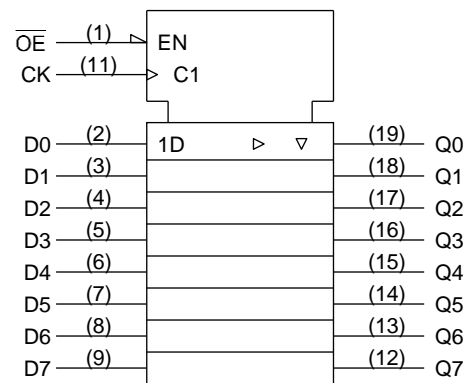
SOP20-P-300-1.27A	: 0.22 g (typ.)
VSSOP20-P-0030-0.50	: 0.03 g (typ.)

Start of commercial production  
1991-11

### Pin Assignment



### IEC Logic Symbol



### Truth Table

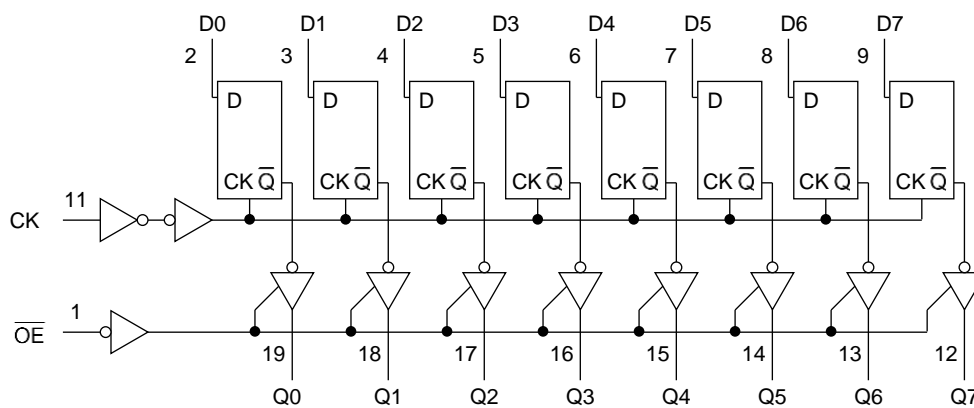
Inputs			Output
$\overline{OE}$	CK	D	
H	X	X	Z
L		X	Qn
L		L	L
L		H	H

X: Don't care

Z: High impedance

Qn: No change

### System Diagram



### Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 7.0	V
DC input voltage	V <sub>IN</sub>	-0.5 to 7.0	V
DC output voltage	V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	I <sub>IK</sub>	-20	mA
Output diode current	I <sub>OK</sub>	±20	mA
DC output current	I <sub>OUT</sub>	±25	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±75	mA
Power dissipation	P <sub>D</sub>	180	mW
Storage temperature	T <sub>stg</sub>	-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 <sub>CC</sub>	2.0 to 5.5	V
Input voltage	V <sub>IN</sub>	0 to 5.5	V
Output voltage	V <sub>OUT</sub>	0 to V <sub>CC</sub>	V
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 100 (V <sub>CC</sub> = 3.3 ± 0.3 V) 0 to 20 (V <sub>CC</sub> = 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<sub>CC</sub> 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	—		2.0 3.0 to 5.5	1.50 VCC × 0.7	— —	— —	1.50 VCC × 0.7	— —	V
Low-level input voltage	VIL	—		2.0 3.0 to 5.5	— —	— —	0.50 VCC × 0.3	— —	0.50 VCC × 0.3	V
High-level output voltage	VOH	VIN = VIH or VIL	IOH = -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	—	
			IOH = -4 mA IOH = -8 mA	3.0 4.5	2.58 3.94	— —	— —	2.48 3.80	— —	
Low-level output voltage	VOL	VIN = VIH or VIL	IOL = 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	
			IOL = 4 mA IOL = 8 mA	3.0 4.5	— —	— —	0.36 0.36	— —	0.44 0.44	
3-state output off-state current	IOZ	VIN = VIH or VIL VOUT = VCC or GND		5.5	—	—	±0.25	—	±2.50	µA
Input leakage current	IIN	VIN = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	µA
Quiescent supply current	ICC	VIN = VCC or GND		5.5	—	—	4.0	—	40.0	µA

## Timing Requirements (input: tr = tf = 3 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V <sub>CC</sub> (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	t <sub>w</sub> (H)	—	3.3 ± 0.3	—	5.0	5.0	ns
	t <sub>w</sub> (L)		5.0 ± 0.5	—	5.0	5.0	
Minimum set-up time	t <sub>s</sub>	—	3.3 ± 0.3	—	3.5	3.5	ns
			5.0 ± 0.5	—	3.5	3.5	
Minimum hold time	t <sub>h</sub>	—	3.3 ± 0.3	—	1.5	1.5	ns
			5.0 ± 0.5	—	1.5	1.5	

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

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40 to 85°C		Unit
			VCC (V)	CL (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-Q)	tpLH tpHL	—	3.3 ± 0.3	15	—	8.5	13.2	1.0	15.5	ns
				50	—	11.0	16.7	1.0	19.0	
			5.0 ± 0.5	15	—	5.6	8.6	1.0	10.0	
				50	—	7.1	10.6	1.0	12.0	
3-state output enable time	tpZL tpZH	RL = 1 kΩ	3.3 ± 0.3	15	—	8.2	12.8	1.0	15.0	ns
				50	—	10.7	16.3	1.0	18.5	
			5.0 ± 0.5	15	—	5.9	9.0	1.0	10.5	
				50	—	7.4	11.0	1.0	12.5	
3-state output disable time	tpLZ tpHZ	RL = 1 kΩ	3.3 ± 0.3	50	—	11.0	15.0	1.0	17.0	ns
			5.0 ± 0.5	50	—	7.1	10.1	1.0	11.5	
Maximum clock frequency	fmax	—	3.3 ± 0.3	15	80	125	—	65	—	MHz
				50	50	75	—	45	—	
			5.0 ± 0.5	15	130	180	—	110	—	
				50	85	115	—	75	—	
Output to output skew	tosLH tosHL	(Note 1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
			5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	CIN	—			—	4	10	—	10	pF
Output capacitance	COUT	—			—	6	—	—	—	pF
Power dissipation capacitance	CPD	(Note 2)			—	28	—	—	—	pF

Note 1: Parameter guaranteed by design.

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

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:

$$I_{CC(opr)} = CPD \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per F/F)}$$

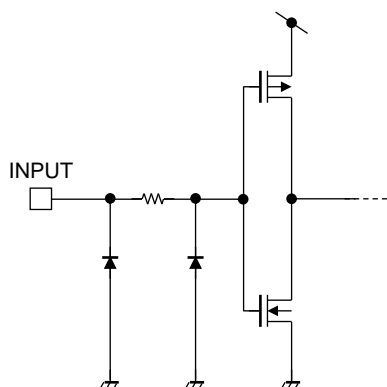
And the total CPD when n pcs. of latch operate can be gained by the following equation:

$$CPD \text{ (total)} = 20 + 8 \cdot n$$

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

Characteristics	Symbol	Test Condition	Ta = 25°C		Unit	
			VCC (V)	Typ.		Max
Quiet output maximum dynamic VOL	VOLP	CL = 50 pF	5.0	0.8	1.0	V
Quiet output minimum dynamic VOL	VOLV	CL = 50 pF	5.0	−0.8	−1.0	V
Minimum high level dynamic input voltage	VIHD	CL = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage	VILD	CL = 50 pF	5.0	—	1.5	V

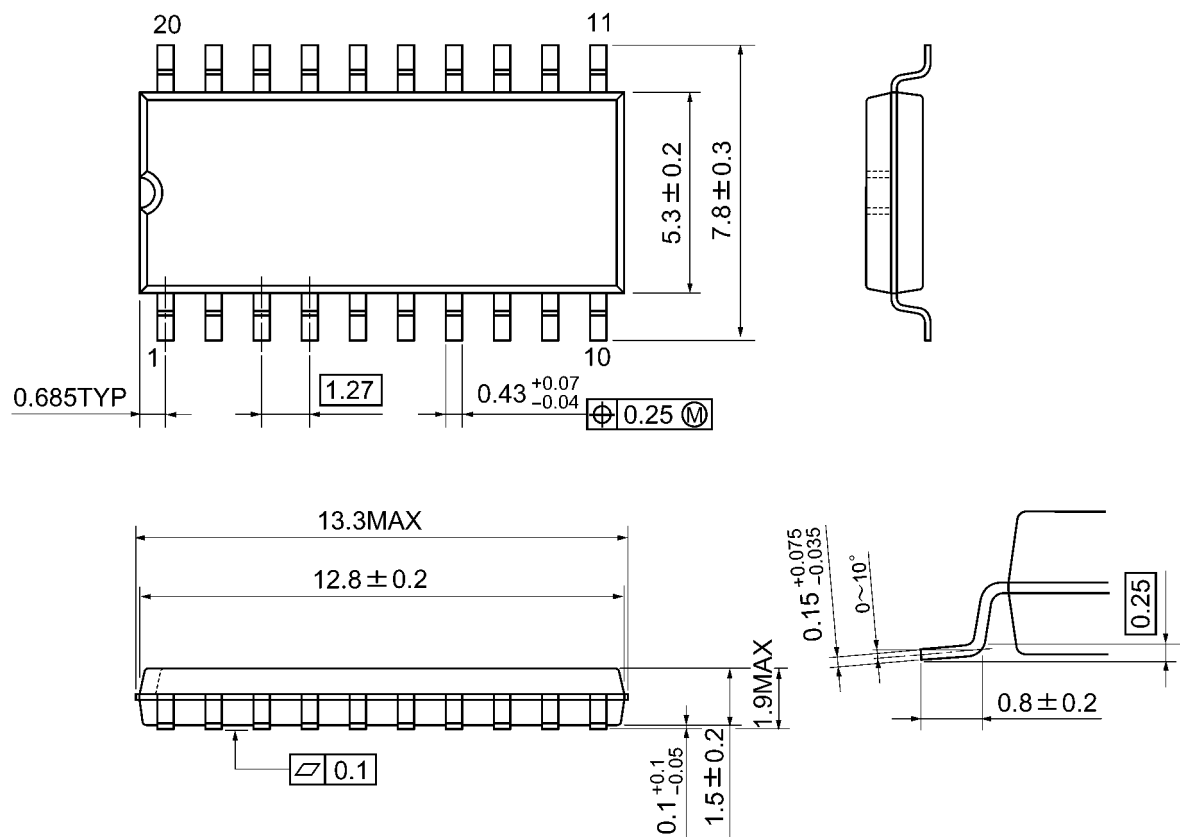
### Input Equivalent Circuit



### Package Dimensions

SOP20-P-300-1.27A

Unit: mm

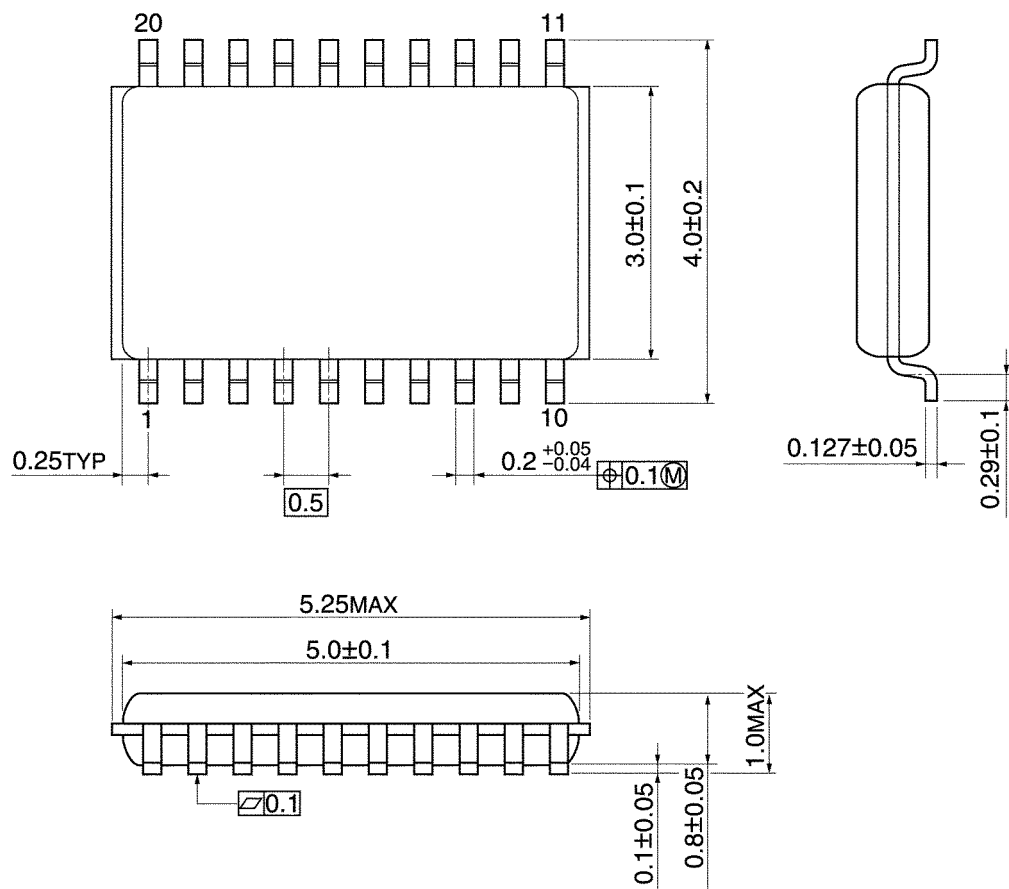


Weight: 0.22 g (typ.)

### Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)



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