

TC74VHCV574FK

1. Functional Description

- Octal Schmitt D-Type Flip-Flop with 3-State Outputs

2. General

The TC74VHCV574FK is advanced high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate CMOS 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.

Input pin have hysteresis between the positive-going and negative-going thresholds. Thus the TC74VHCV574FK is capable of squaring up transitions of slowly changing input signals and provides an improved noise immunity.

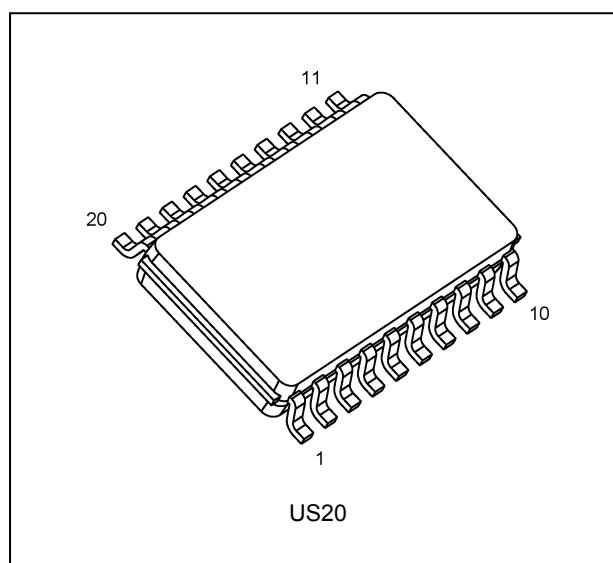
Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (Note) pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, etc.

Note: Output in off-state.

3. Features

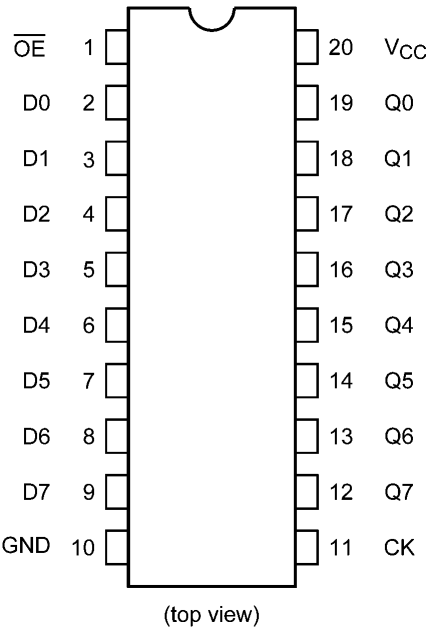
- (1) High speed: $f_{MAX} = 180$ MHz (typ.) at $V_{CC} = 5.0$ V
- (2) Low power dissipation: $I_{CC} = 2.0$ μ A (max) at $T_a = 25$ °C
- (3) Wide operating voltage range: $V_{CC(opr)} = 1.8$ V to 5.5 V
- (4) Output current: $|I_{OH}|/I_{OL} = 16$ mA (min)($V_{CC} = 4.5$ V)
- (5) Available in VSSOP (US)
- (6) Power-down protection is provided on all inputs and outputs.
- (7) Pin and function compatible with the 74 series (74AC/HC/AHC/LV etc.) 574 type.

4. Packaging

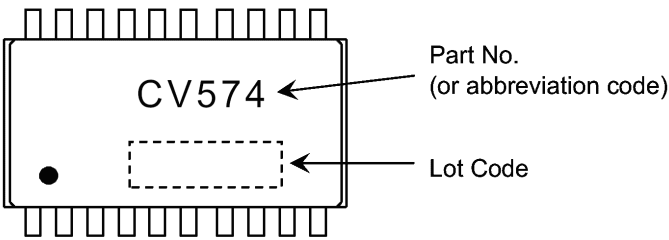


Start of commercial production
2010-01

5. Pin Assignment



6. Marking

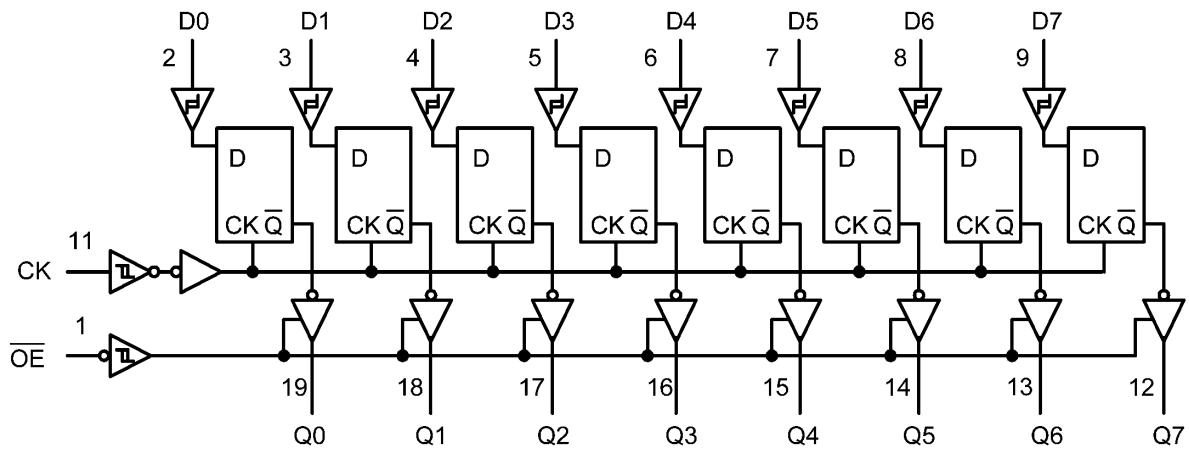


7. Truth Table

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

8. System Diagram



9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to 7.0	V
Output voltage	V_{OUT}	(Note 1)	-0.5 to 7.0	V
		(Note 2)	-0.5 to $V_{CC} + 0.5$	
Input diode current	I_{IK}		-50	mA
Output diode current	I_{OK}	(Note 3)	±50	mA
Output current	I_{OUT}		±50	mA
Power dissipation	P_D		180	mW
V_{CC} /ground current	I_{CC}/I_{GND}		±100	mA
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).

Note 1: Output in OFF state.

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

10. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Note	Rating	Unit
Supply voltage	V_{CC}	—		1.8 to 5.5	V
Input voltage	V_{IN}	—		0 to 5.5	V
Output voltage	V_{OUT}	—	(Note 1)	0 to 5.5	V
			(Note 2)	0 to V_{CC}	
Operating temperature	T_{opr}	—		-40 to 85	°C
Input rise and fall times	dt/dv	$V_{CC} = 3.3 \pm 0.3$ V		0 to 20	ms/V
		$V_{CC} = 5 \pm 0.5$ V		0 to 1	

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.

Note 1: Output in OFF state.

Note 2: High (H) or Low (L) state.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
Positive threshold voltage	V_P	—		1.8	—	—	1.65	V
				2.3	—	—	1.85	
				3.0	—	—	2.20	
				4.5	—	—	3.15	
				5.5	—	—	3.85	
Negative threshold voltage	V_N	—		1.8	0.15	—	—	V
				2.3	0.45	—	—	
				3.0	0.90	—	—	
				4.5	1.35	—	—	
				5.5	1.65	—	—	
Hysteresis voltage	V_H	—		1.8	0.15	—	1.05	V
				2.3	0.20	—	1.10	
				3.0	0.30	—	1.20	
				4.5	0.40	—	1.40	
				5.5	0.50	—	1.60	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50\text{ }\mu\text{A}$	1.8	1.7	1.8	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -8\text{ mA}$	3.0	2.58	—	—	
			$I_{OH} = -16\text{ mA}$	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50\text{ }\mu\text{A}$	1.8	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 8\text{ mA}$	3.0	—	—	0.36	
			$I_{OL} = 16\text{ mA}$	4.5	—	—	0.44	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V		1.8 to 5.5	—	—	± 0.5	μA
Power-OFF leakage current	I_{OFF}	$V_{IN}/V_{OUT} = 5.5\text{ V}$		0	—	—	0.5	μA
Input leakage current	I_{IN}	$V_{IN} = 5.5\text{ V}$ or GND		0 to 5.5	—	—	± 0.1	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	—	2.0	μA

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Positive threshold voltage	V_P	—		1.8	—	1.65	V
				2.3	—	1.85	
				3.0	—	2.20	
				4.5	—	3.15	
				5.5	—	3.85	
Negative threshold voltage	V_N	—		1.8	0.15	—	V
				2.3	0.45	—	
				3.0	0.90	—	
				4.5	1.35	—	
				5.5	1.65	—	
Hysteresis voltage	V_H	—		1.8	0.15	1.05	V
				2.3	0.20	1.10	
				3.0	0.30	1.20	
				4.5	0.40	1.40	
				5.5	0.50	1.60	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50\text{ }\mu\text{A}$	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -8\text{ mA}$	3.0	2.48	—	
			$I_{OH} = -16\text{ mA}$	4.5	3.80	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50\text{ }\mu\text{A}$	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 8\text{ mA}$	3.0	—	0.44	
			$I_{OL} = 16\text{ mA}$	4.5	—	0.55	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0$ to 5.5 V		1.8 to 5.5	—	± 5.0	μA
Power-OFF leakage current	I_{OFF}	$V_{IN}/V_{OUT} = 5.5\text{ V}$		0	—	5.0	μA
Input leakage current	I_{IN}	$V_{IN} = 5.5\text{ V}$ or GND		0 to 5.5	—	± 1.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	20.0	μA

11.3. Timing Requirements (Unless otherwise specified, $T_a = 25^{\circ}\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

Characteristics	Symbol	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	2.5 ± 0.2	7.0	ns
		3.3 ± 0.3	5.0	
		5.0 ± 0.5	5.0	
Minimum setup time	t_s	2.5 ± 0.2	5.5	ns
		3.3 ± 0.3	3.5	
		5.0 ± 0.5	3.5	
Minimum hold time	t_h	2.5 ± 0.2	2.0	ns
		3.3 ± 0.3	1.5	
		5.0 ± 0.5	1.5	

11.4. Timing Requirements

(Unless otherwise specified, $T_a = -40$ to 85°C , Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	V_{CC} (V)	Limit	Unit
Minimum pulse width (CK)	$t_{w(L)}, t_{w(H)}$	2.5 ± 0.2	7.0	ns
		3.3 ± 0.3	5.0	
		5.0 ± 0.5	5.0	
Minimum setup time	t_s	2.5 ± 0.2	5.5	ns
		3.3 ± 0.3	3.5	
		5.0 ± 0.5	3.5	
Minimum hold time	t_h	2.5 ± 0.2	2.0	ns
		3.3 ± 0.3	1.5	
		5.0 ± 0.5	1.5	

11.5. AC Characteristics (Unless otherwise specified, $T_a = 25^\circ\text{C}$, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}		—	2.5 ± 0.2	15	—	9.1	16.6	ns
					50	—	11.9	19.6	
				3.3 ± 0.3	15	—	6.7	13.2	
					50	—	8.9	16.7	
				5.0 ± 0.5	15	—	5.0	8.6	
					50	—	6.7	10.6	
3-state output enable time	t_{PZL}, t_{PZH}		$R_L = 1$ k Ω	2.5 ± 0.2	15	—	7.6	16.1	ns
					50	—	10.7	19.0	
				3.3 ± 0.3	15	—	5.7	12.8	
					50	—	8.1	16.3	
				5.0 ± 0.5	15	—	4.2	9.0	
					50	—	6.1	11.0	
3-state output disable time	t_{PLZ}, t_{PHZ}		$R_L = 1$ k Ω	2.5 ± 0.2	50	—	13.6	17.5	ns
				3.3 ± 0.3	50	—	10.5	15.0	
				5.0 ± 0.5	50	—	8.2	10.1	
Maximum clock frequency	f_{MAX}		—	2.5 ± 0.2	15	60	95	—	MHz
					50	50	75	—	
				3.3 ± 0.3	15	80	135	—	
					50	55	100	—	
				5.0 ± 0.5	15	130	180	—	
					50	85	135	—	
Output skew	t_{osLH}, t_{osHL}	(Note 1)	—	2.5 ± 0.2	50	—	—	2.0	ns
				3.3 ± 0.3	50	—	—	1.5	
				5.0 ± 0.5	50	—	—	1.0	ns
Input capacitance	C_{IN}		—			—	4	10	pF
Output capacitance	C_{OUT}		—			—	6	—	pF
Power dissipation capacitance	C_{PD}	(Note 2)	—			—	26	—	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHm} - t_{PLHn}|$, $t_{osHL} = |t_{PHLm} - t_{PHLn}|$)

Note 2: 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.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per latch)}$$

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

$$C_{PD} \text{ (total)} = 14 + 12 \times n$$

11.6. AC Characteristics

(Unless otherwise specified, $T_a = -40$ to 85 °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time (CK-Q)	t_{PLH}, t_{PHL}		—	2.5 ± 0.2	15	1.0	20.0	ns
					50	1.0	23.0	
				3.3 ± 0.3	15	1.0	15.5	
					50	1.0	19.0	
				5.0 ± 0.5	15	1.0	10.0	
					50	1.0	12.0	
3-state output enable time	t_{PZL}, t_{PZH}		$R_L = 1$ k Ω	2.5 ± 0.2	15	1.0	19.0	ns
					50	1.0	22.0	
				3.3 ± 0.3	15	1.0	15.0	
					50	1.0	18.5	
				5.0 ± 0.5	15	1.0	10.5	
					50	1.0	12.5	
3-state output disable time	t_{PLZ}, t_{PHZ}		$R_L = 1$ k Ω	2.5 ± 0.2	50	1.0	20.0	ns
				3.3 ± 0.3	50	1.0	17.0	
				5.0 ± 0.5	50	1.0	11.5	
Maximum clock frequency	f_{MAX}		—	2.5 ± 0.2	15	50	—	MHz
					50	40	—	
				3.3 ± 0.3	15	65	—	
					50	45	—	
				5.0 ± 0.5	15	110	—	
					50	75	—	
Output skew	t_{osLH}, t_{osHL}	(Note 1)	—	2.5 ± 0.2	50	—	2.0	ns
				3.3 ± 0.3	50	—	1.5	
				5.0 ± 0.5	50	—	1.0	ns
Input capacitance	C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLHM} - t_{PLHN}|$, $t_{osHL} = |t_{PHLM} - t_{PHLN}|$)

11.7. Noise Characteristics

(Unless otherwise specified, $T_a = 25$ °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Max	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	$C_L = 50$ pF	3.3	0.4	—	V
			5.0	0.8	—	
Quiet output minimum dynamic V_{OL}	V_{OLV}	$C_L = 50$ pF	3.3	-0.1	—	V
			5.0	-0.4	—	
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

Unit: mm

Weight: 0.03 g (typ.)

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