CMOS Digital Integrated Circuits Silicon Monolithic

74VHC574FT

1. Functional Description

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

2. General

The 74VHC574FT is an advanced high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate C^2MOS 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.

3. Features

(1) High speed: f_{MAX} = 180 MHz (typ.) at V_{CC} = 5 V

(2) Low power dissipation: I_{CC} = 4 μA (max) at T_a = 25°C

(3) High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)

(4) Power-down protection is provided on all inputs.

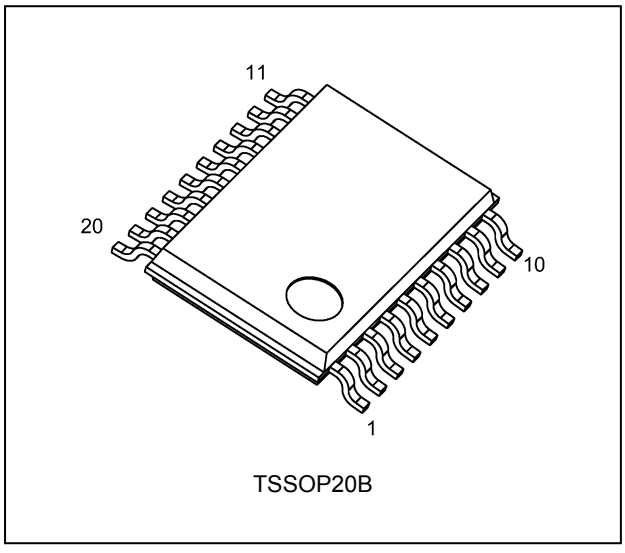
(5) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

(6) Wide operating voltage range: $V_{CC(opr)}$ = 2 V to 5.5 V

(7) Low noise: V_{OLP} = 1.0 V (max)

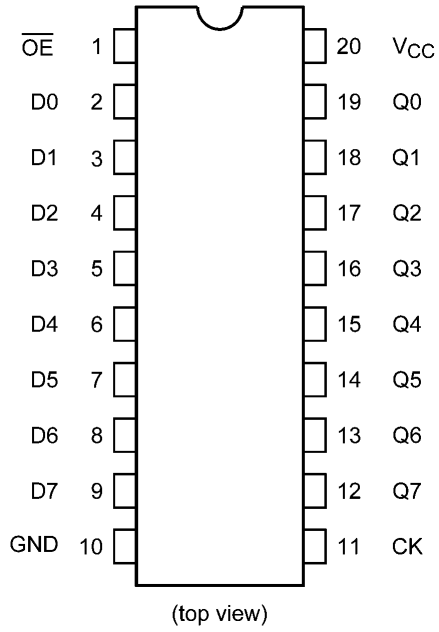
(8) Pin and function compatible with the 74 series (74AC/HC/AHC/LV etc.) 574 type.

4. Packaging



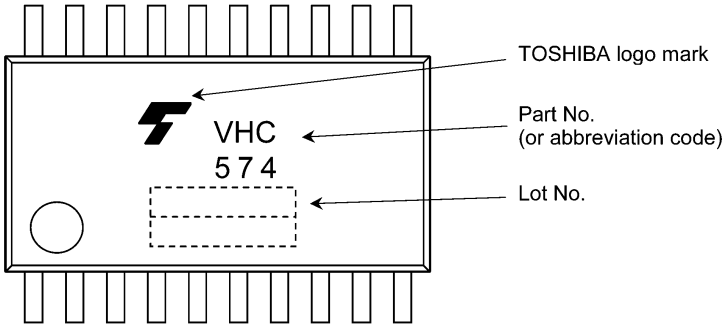
TSSOP20B

5. Pin Assignment

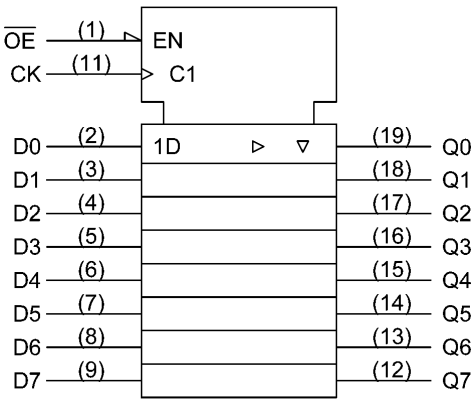


(top view)

6. Marking



7. IEC Logic Symbol

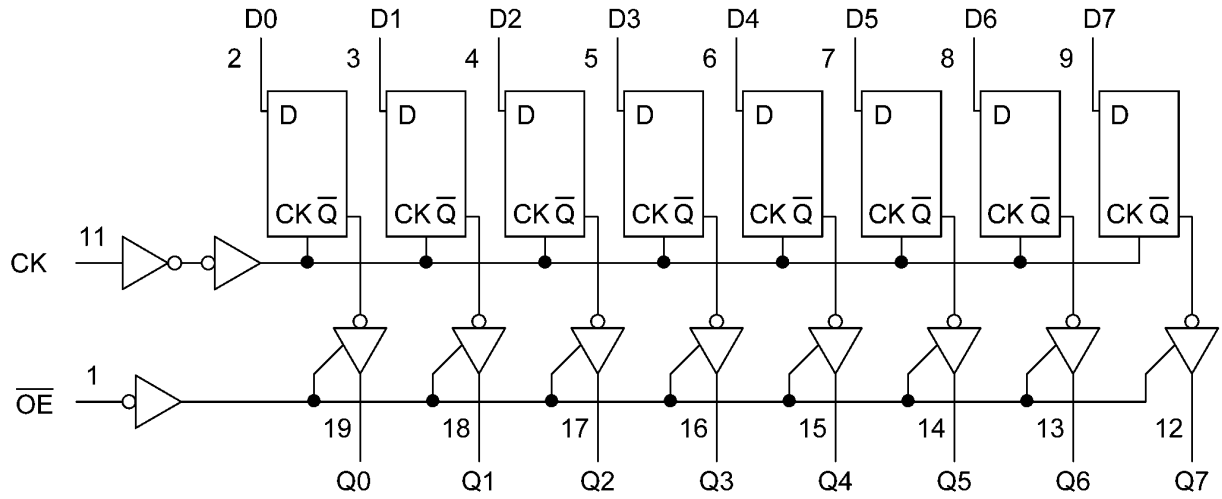


8. Truth Table

Inputs			Output
$\overline{OE}$	CK	D	
H	X	X	Z
L	↓	X	Q_n
L	↑	L	L
L	↑	H	H

X: Don't care
Z: High impedance
Q_n: No change

9. System Diagram



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	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}	-0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	±20	mA
Output current	I_{OUT}	±25	mA
V_{CC}/ground current	I_{CC}	±75	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).

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	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 times	dt/dv	V_{CC} = 3.3 ± 0.3 V	0 to 100	ns/V
		V_{CC} = 5 ± 0.5 V	0 to 20	

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs and bus inputs must be tied to either V_{CC} or GND.

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	V
				3.0 to 5.5	V_{CC} × 0.7	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	V
				3.0 to 5.5	—	—	V_{CC} × 0.3	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			I_{OH} = -4 mA	3.0	2.58	—	—	
			I_{OH} = -8 mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			I_{OL} = 4 mA	3.0	—	—	0.36	
			I_{OL} = 8 mA	4.5	—	—	0.36	
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		5.5	—	—	±0.25	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	4.0	

12.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	V
				3.0 to 5.5	V_{CC} × 0.7	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				3.0 to 5.5	—	V_{CC} × 0.3	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -50 μA	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -4 mA	3.0	2.48	—	
			I_{OH} = -8 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 4 mA	3.0	—	0.44	
			I_{OL} = 8 mA	4.5	—	0.44	
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		5.5	—	±2.50	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±1.0	
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	40.0	

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

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

12.4. 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)	$t_{w(L)}$,$t_{w(H)}$	3.3 ± 0.3	5.0	ns
		5.0 ± 0.5	5.0	
Minimum setup time	t_s	3.3 ± 0.3	3.5	ns
		5.0 ± 0.5	3.5	
Minimum hold time	t_h	3.3 ± 0.3	1.5	ns
		5.0 ± 0.5	1.5	

12.5. AC Characteristics (Unless otherwise specified, T_a = 25 °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}		—	3.3 ± 0.3	15	—	8.5	13.2	ns
					50	—	11.0	16.7	
				5.0 ± 0.5	15	—	5.6	8.6	
					50	—	7.1	10.6	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	3.3 ± 0.3	15	—	8.2	12.8	ns
					50	—	10.7	16.3	
				5.0 ± 0.5	15	—	5.9	9.0	
					50	—	7.4	11.0	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	3.3 ± 0.3	50	—	11.0	15.0	ns
				5.0 ± 0.5	50	—	7.1	10.1	
Maximum clock frequency	f_{MAX}		—	3.3 ± 0.3	15	80	125	—	MHz
					50	50	75	—	
				5.0 ± 0.5	15	130	180	—	
					50	85	115	—	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	—	1.5	ns
				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)	—			—	28	—	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.

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

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

C_{PD} (total) = 20 + 8 × n

12.6. 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}		—	3.3 ± 0.3	15	1.0	15.5	ns
					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 kΩ	3.3 ± 0.3	15	1.0	15.0	ns
					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 kΩ	3.3 ± 0.3	50	1.0	17.0	ns
					15	1.0	11.5	
Maximum clock frequency	f_{MAX}		—	3.3 ± 0.3	15	65	—	MHz
					50	45	—	
				5.0 ± 0.5	15	110	—	
					50	75	—	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
				5.0 ± 0.5	50	—	1.0	ns
Input capacitance	C_{IN}		—			—	10	pF

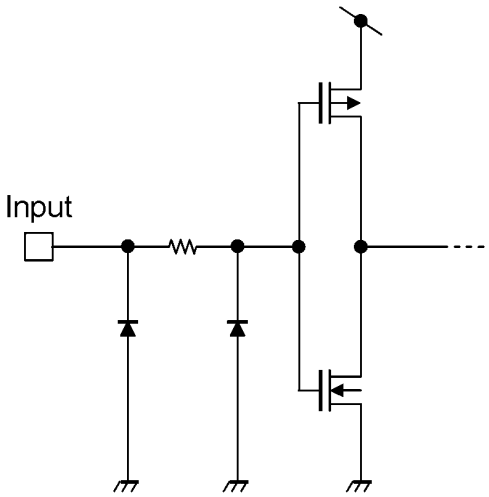
Note 1: Parameter guaranteed by design.

$t_{osLH} = |t_{PLHm} - t_{PLHn}|$, $tosHL = |t_{PHLm} - t_{PHLn}|$

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

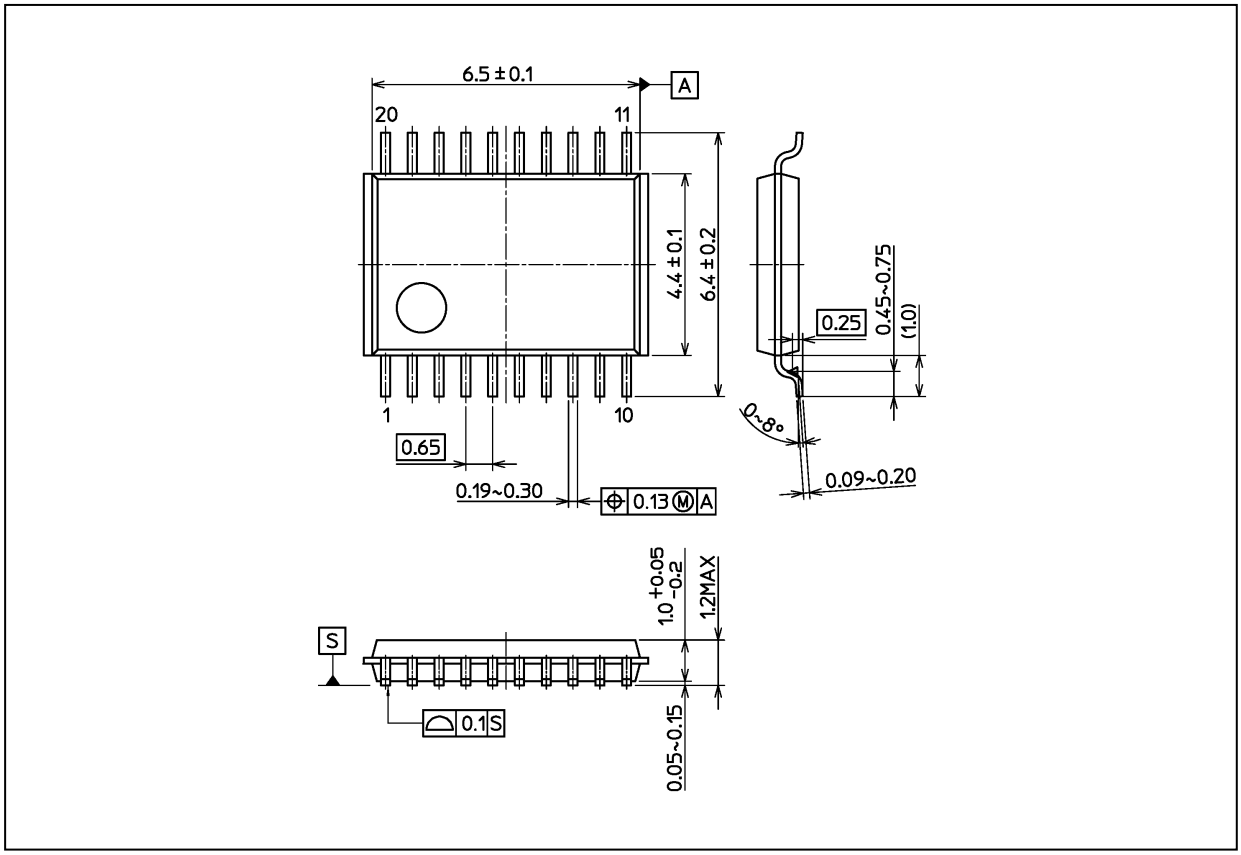
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Limit	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.8	1.0	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-0.8	-1.0	
Minimum high-level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	3.5	
Maximum low-level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	1.5	

13. Input Equivalent Circuit



Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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