CMOS Digital Integrated Circuits Silicon Monolithic

74VHC573FT

1. Functional Description

· Octal D-Type Latch with 3-State Outputs

2. General

The 74VHC573FT is an advanced high speed CMOS OCTAL LATCH with 3-STATE OUTPUT 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.

This 8-bit D-type latch is controlled by a latch enable input (LE) and an output enable input ($\overline{\text{OE}}$).

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

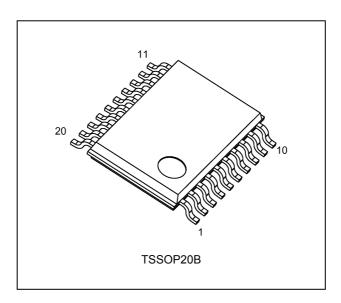
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input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

3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range: $T_{opr} = -40$ to 125 °C
- (3) High speed: $t_{pd} = 4.5$ ns (typ.) at $V_{CC} = 5.0$ V
- (4) Low power dissipation: $I_{CC} = 4.0 \mu A \text{ (max)}$ at $T_a = 25^{\circ}\text{C}$
- (5) High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- (6) Power-down protection is provided on all inputs.
- (7) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- (8) Wide operating voltage range: $V_{CC(opr)} = 2.0 \text{ V}$ to 5.5 V
- (9) Low noise: $V_{OLP} = 1.0 \text{ V (max)}$
- (10) Pin and function compatible with the 74 series (74AC/HC/AHC/LV etc.) 573 type.

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

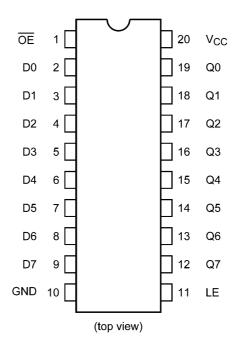
4. Packaging



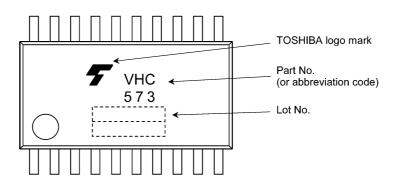
Start of commercial production



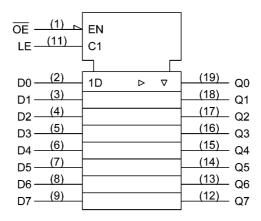
5. Pin Assignment



6. Marking



7. IEC Logic Symbol



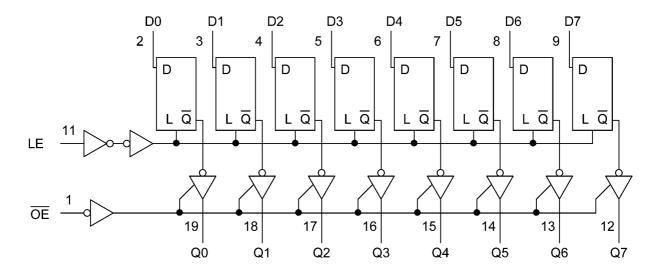
8. Truth Table

INPUT OE	INPUT LE	INPUT D	OUTPUT
Н	Х	Х	Z
L	L	Х	Qn
L	Н	L	L
L	Н	Н	Н

X: Don't careZ: High impedance

Qn: Q outputs are latched at the time when the LE input is taken to low logic level.

9. System Diagram





10. 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}		-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	(Note 1)	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).

Note 1: 180 mW in the range of T_a = -40 to 85 °C. From T_a = 85 to 125 °C a derating factor of -3.25 mW/°C shall be applied until 50 mW.

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 125	°C
Input rise and fall times	dt/dv	V_{CC} = 3.3 ± 0.3 V	0 to 100	ns/V
		V_{CC} = 5.0 ± 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	Тур.	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	_	_	$V_{CC} \times 0.3$	
High-level output voltage	V _{OH}	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -50 \mu\text{A}$		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}	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	_	±0.25	μА
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND		0 to 5.5	_	_	±0.1	
Quiescent supply current	Icc	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	$V_{CC} \times 0.7$	_	
Low-level input voltage	V _{IL}	_		2.0	_	0.50	V
				3.0 to 5.5	_	$V_{CC} \times 0.3$	
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}	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	±2.50	μА
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. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condit	tion	V _{CC} (V)	Min	Max	Unit
High-level input voltage	V _{IH}	_		2.0	1.50	_	V
				3.0 to 5.5	$V_{CC} \times 0.7$	_	
Low-level input voltage	V _{IL}	_		2.0	_	0.50	V
				3.0 to 5.5	_	$V_{CC} \times 0.3$	
High-level output voltage	voltage V _{OH} V _{IN} = V _{IH} or V _{IL}		I _{OH} = -50 μA	2.0	1.9	_	٧
				3.0	2.9	_	
				4.5	4.4	_	
			$I_{OH} = -4 \text{ mA}$	3.0	2.40	_	
			I _{OH} = -8 mA	4.5	3.70	_	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	2.0	_	0.1	٧
				3.0	_	0.1	
				4.5	_	0.1	
			I _{OL} = 4 mA	3.0	_	0.55	
			I_{OL} = 8 mA	4.5	_	0.55	
3-state output OFF-state leakage current	I _{OZ}	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{OUT} = V_{CC} \text{ or GND}$		5.5	_	±10.0	μА
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND		0 to 5.5	_	±2.0	μА
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		5.5	_	80.0	μΑ



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

Characteristics	Symbol	Test Condition	V _{CC} (V)	Limit	Unit
Minimum pulse width	t _{w(H)}	_	3.3 ± 0.3	5.0	ns
(LE)			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

12.5. Timing Requirements (Unless otherwise specified, T_a = -40 to 85°C, Input: t_f = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Limit	Unit
Minimum pulse width	t _{w(H)}	_	3.3 ± 0.3	5.0	ns
(LE)			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	

12.6. Timing Requirements (Unless otherwise specified, T_a = -40 to 125 °C, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Limit	Unit
Minimum pulse width	t _{w(H)}	_	3.3 ± 0.3	5.0	ns
(LE)			5.0 ± 0.5	5.0	
Minimum setup time	ts	_	3.3 ± 0.3	4.5	ns
			5.0 ± 0.5	4.0	
Minimum hold time	t _h	_	3.3 ± 0.3	1.5	ns
			5.0 ± 0.5	1.5	



12.7. 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	Тур.	Max	Unit
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	_	7.6	11.9	ns
(LE-Q)					50	_	10.1	15.4	
				5.0 ± 0.5	15	_	5.0	7.7	
					50	_	6.5	9.7	
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	_	7.0	11.0	ns
(D-Q)					50	_	9.5	14.5	
				5.0 ± 0.5	15	_	4.5	6.8	
					50	_	6.0	8.8	
3-state output enable time	t_{PZL},t_{PZH}		$R_L = 1 k\Omega$	3.3 ± 0.3	15	_	7.3	11.5	ns
					50	_	9.8	15.0	
				5.0 ± 0.5	15	_	5.2	7.7	
					50	_	6.7	9.7	
3-state output disable time	t_{PLZ}, t_{PHZ}		$R_L = 1 k\Omega$	3.3 ± 0.3	50	_	10.7	14.5	ns
				5.0 ± 0.5	50	_	6.7	9.7	
Output skew	t _{osLH} ,t _{osHL}	(Note 1)	_	3.3 ± 0.3	50	_	_	1.5	ns
				5.0 ± 0.5	50	_	_	1.0	
Input capacitance	C _{IN}		_			_	4	10	pF
Output capacitance	C _{OUT}		_			_	6	_	pF
Power dissipation capacitance	C _{PD}	(Note 2)		•		_	29	_	pF

Note 1: Parameter guaranteed by design. $(t_{osLH} = |t_{PLH}m-t_{PLH}n|, t_{osHL} = |t_{PHL}m-t_{PHL}n|)$

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 latch)

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

 C_{PD} (total) = 21 + 8 × n

12.8. 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	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	1.0	14.0	ns
(LE-Q)					50	1.0	17.5	
				5.0 ± 0.5	15	1.0	9.0	
					50	1.0	11.0	
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	1.0	13.0	ns
(D-Q)					50	1.0	16.5	
				5.0 ± 0.5	15	1.0	8.0	
					50	1.0	10.0	
3-state output enable time	t _{PZL} ,t _{PZH}		$R_L = 1 \text{ k}\Omega$	3.3 ± 0.3	15	1.0	13.5	ns
					50	1.0	17.0	
				5.0 ± 0.5	15	1.0	9.0	
					50	1.0	11.0	
3-state output disable time	t_{PLZ}, t_{PHZ}		$R_L = 1 k\Omega$	3.3 ± 0.3	50	1.0	16.5	ns
				5.0 ± 0.5	50	1.0	11.0	
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. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)



12.9. AC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C, Input: t_r = t_f = 3 ns)

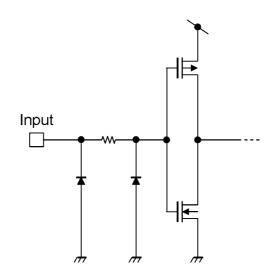
Characteristics	Symbol	Note	Test Condition	V _{CC} (V)	C _L (pF)	Min	Max	Unit
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	1.0	16.0	ns
(LE-Q)					50	1.0	19.5	
				5.0 ± 0.5	15	1.0	10.5	
					50	1.0	12.5	
Propagation delay time	t _{PLH} ,t _{PHL}		_	3.3 ± 0.3	15	1.0	15.0	ns
(D-Q)					50	1.0	18.5	
				5.0 ± 0.5	15	1.0	9.0	
					50	1.0	11.0	
3-state output enable time	t _{PZL} ,t _{PZH}		$R_L = 1 k\Omega$	3.3 ± 0.3	15	1.0	15.5	ns
					50	1.0	19.0	
				5.0 ± 0.5	15	1.0	10.5	
					50	1.0	12.5	
3-state output disable time	t _{PLZ} ,t _{PHZ}		$R_L = 1 k\Omega$	3.3 ± 0.3	50	1.0	18.5	ns
				5.0 ± 0.5	50	1.0	12.5	
Output skew	t _{osLH} ,t _{osHL}	(Note 1)	_	3.3 ± 0.3	50	1	1.5	ns
				5.0 ± 0.5	50	-	1.0	
Input capacitance	C _{IN}		_			1	10	pF

Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)

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

Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	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	

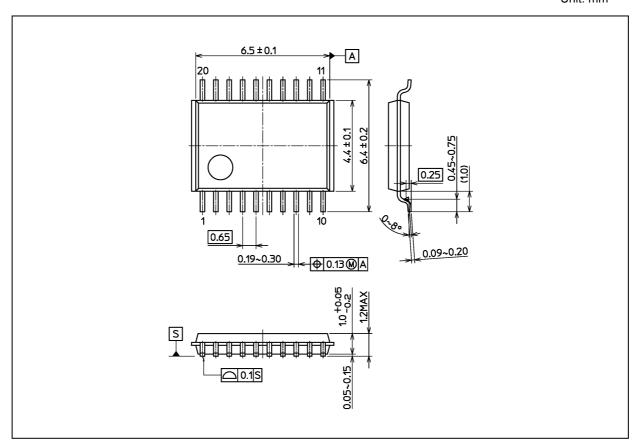
13. Input Equivalent Circuit





Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

	Package Name(s)
Nickname: TSSOP20B	



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