

# 74VHCV573FT

## 1. Functional Description

- Octal Schmitt D-Type Latch with 3-State Outputs

## 2. General

The 74VHCV573FT is an advanced high speed CMOS OCTAL LATCH 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 latch is controlled by a latch enable input (LE) 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 74VHCV573FT 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.

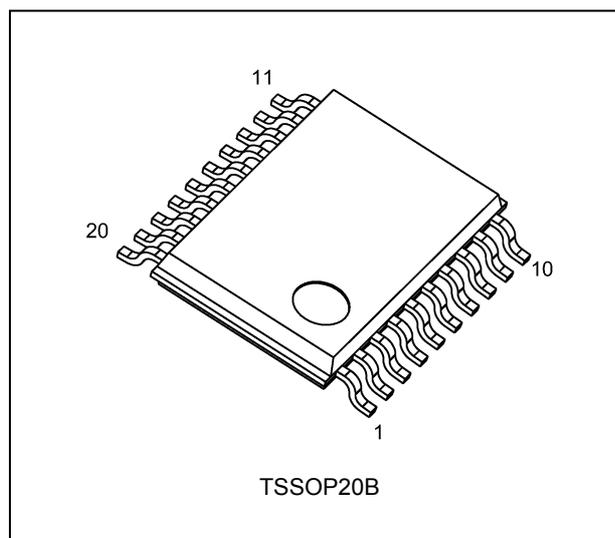
Note: Output in off-state.

## 3. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C
- (3) High speed:  $t_{pd} = 5.0$  ns (typ.) at  $V_{CC} = 5.0$  V
- (4) Low power dissipation:  $I_{CC} = 2.0$   $\mu$ A (max) at  $T_a = 25$ °C
- (5) Wide operating voltage range:  $V_{CC(opr)} = 1.8$  V to  $5.5$  V
- (6) Output current:  $|I_{OH}|/I_{OL} = 16$  mA (min)( $V_{CC} = 4.5$  V)
- (7) Power-down protection is provided on all inputs and outputs.
- (8) 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.

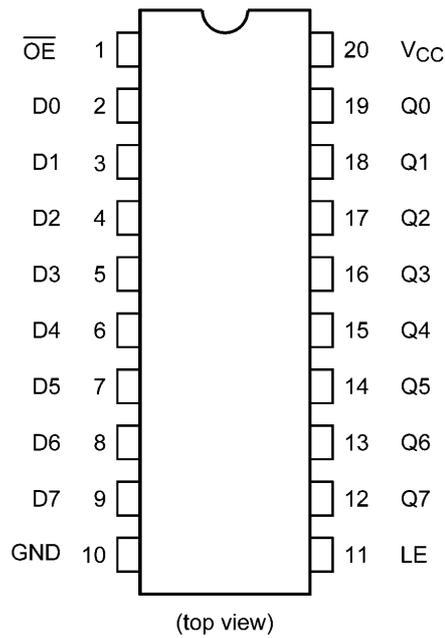
## 4. Packaging



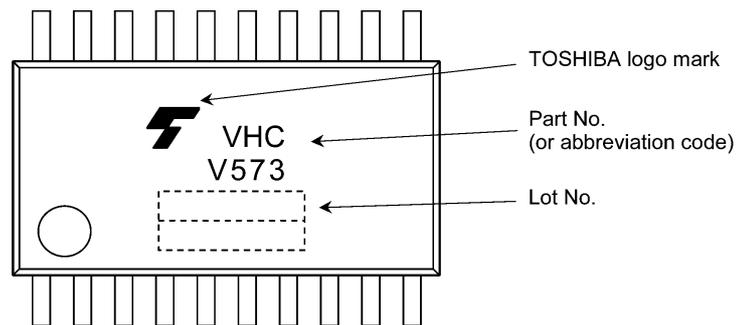
Start of commercial production

2014-07

**5. Pin Assignment**



**6. Marking**

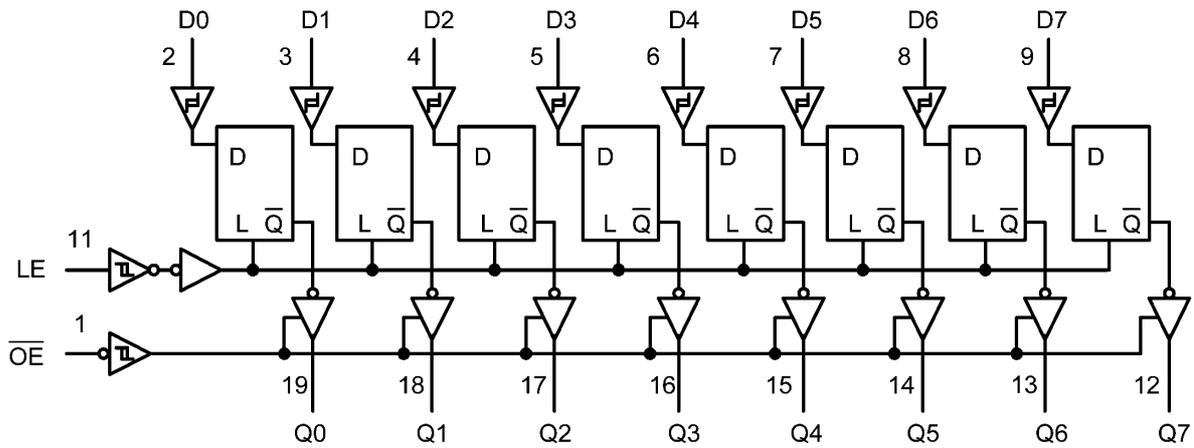


**7. Truth Table**

Input $\overline{OE}$	Input LE	Input D	Output
H	X	X	Z
L	L	X	Qn
L	H	L	L
L	H	H	H

- X: Don't care
- Z: High impedance
- Qn: Q outputs are latched at the time when the LE input is taken to low logic level.

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)	$\pm 50$	mA
Output current	$I_{OUT}$		$\pm 50$	mA
Power dissipation	$P_D$	(Note 4)	180	mW
$V_{CC}$ /ground current	$I_{CC}/I_{GND}$		$\pm 100$	mA
Storage temperature	$T_{stg}$		-65 to 150	$^{\circ}C$

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

Note 4: 180 mW in the range of  $T_a = -40$  to  $85^{\circ}C$ . From  $T_a = 85$  to  $125^{\circ}C$  a derating factor of  $-3.25$  mW/ $^{\circ}C$  shall be applied until 50 mW.

**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 125	$^{\circ}C$
Input rise and fall times	dt/dv	$V_{CC} = 3.3 \pm 0.3$ V		0 to 20	ms/V
		$V_{CC} = 5.0 \pm 0.5$ 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	—	
			$I_{OH} = -8\text{ mA}$	3.0	2.58	—	—	
				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	
				4.5	—	—	0.44	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $5.5\text{ V}$	1.8 to 5.5	—	—	$\pm 0.5$	$\mu\text{A}$	
Power-OFF leakage current	$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5\text{ V}$	0	—	—	0.5	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\text{ V}$ or GND	0 to 5.5	—	—	$\pm 0.1$	$\mu\text{A}$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	2.0	$\mu\text{A}$	

**11.2. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $85$  °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 $V_{IL}$	$I_{OH} = -50 \mu A$	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -8 \text{ mA}$	3.0	2.48	—	
				4.5	3.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 8 \text{ mA}$	3.0	—	0.44	
				4.5	—	0.55	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $5.5 \text{ V}$	1.8 to 5.5	—	$\pm 5.0$	$\mu A$	
Power-OFF leakage current	$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5 \text{ V}$	0	—	5.0	$\mu A$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V}$ or GND	0 to 5.5	—	$\pm 1.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	20.0	$\mu A$	

**11.3. DC Characteristics (Unless otherwise specified,  $T_a = -40$  to  $125$  °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 $V_{IL}$	$I_{OH} = -50 \mu A$	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -8 \text{ mA}$	3.0	2.40	—	
			$I_{OH} = -16 \text{ mA}$	4.5	3.70	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			$I_{OL} = 8 \text{ mA}$	3.0	—	0.55	
			$I_{OL} = 16 \text{ mA}$	4.5	—	0.65	
3-state output OFF-state leakage current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0$ to $5.5 \text{ V}$	1.8 to 5.5	—	$\pm 20.0$	$\mu A$	
Power-OFF leakage current	$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5 \text{ V}$	0	—	20.0	$\mu A$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V}$ or GND	0 to 5.5	—	$\pm 2.0$	$\mu A$	
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	40.0	$\mu A$	

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

Characteristics	Symbol	$V_{CC}$ (V)	Typ.	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	$2.5 \pm 0.2$	—	6.5	ns
		$3.3 \pm 0.3$	—	5.0	
		$5.0 \pm 0.5$	—	5.0	
Minimum setup time	$t_s$	$2.5 \pm 0.2$	—	5.0	ns
		$3.3 \pm 0.3$	—	3.5	
		$5.0 \pm 0.5$	—	3.5	
Minimum hold time	$t_h$	$2.5 \pm 0.2$	—	2.0	ns
		$3.3 \pm 0.3$	—	1.5	
		$5.0 \pm 0.5$	—	1.5	

**11.5. Timing Requirements (Unless otherwise specified,  $T_a = -40$  to  $85^\circ\text{C}$ , Input:  $t_r = t_f = 3 \text{ ns}$ )**

Characteristics	Symbol	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	$2.5 \pm 0.2$	6.5	ns
		$3.3 \pm 0.3$	5.0	
		$5.0 \pm 0.5$	5.0	
Minimum setup time	$t_s$	$2.5 \pm 0.2$	5.0	ns
		$3.3 \pm 0.3$	3.5	
		$5.0 \pm 0.5$	3.5	
Minimum hold time	$t_h$	$2.5 \pm 0.2$	2.0	ns
		$3.3 \pm 0.3$	1.5	
		$5.0 \pm 0.5$	1.5	

**11.6. Timing Requirements (Unless otherwise specified,  $T_a = -40$  to  $125^\circ\text{C}$ , Input:  $t_r = t_f = 3 \text{ ns}$ )**

Characteristics	Symbol	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	$2.5 \pm 0.2$	6.5	ns
		$3.3 \pm 0.3$	5.0	
		$5.0 \pm 0.5$	5.0	
Minimum setup time	$t_s$	$2.5 \pm 0.2$	6.5	ns
		$3.3 \pm 0.3$	4.5	
		$5.0 \pm 0.5$	4.0	
Minimum hold time	$t_h$	$2.5 \pm 0.2$	2.0	ns
		$3.3 \pm 0.3$	1.5	
		$5.0 \pm 0.5$	1.5	

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

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max	Unit
Propagation delay time (LE-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	—	8.9	16.2	ns
					50	—	11.8	19.1	
				$3.3 \pm 0.3$	15	—	6.6	11.9	
					50	—	8.8	15.4	
				$5.0 \pm 0.5$	15	—	5.0	7.7	
					50	—	6.6	9.7	
Propagation delay time (D-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	—	10.4	15.8	ns
					50	—	13.2	20.7	
				$3.3 \pm 0.3$	15	—	7.5	11.0	
					50	—	9.5	14.5	
				$5.0 \pm 0.5$	15	—	5.4	6.8	
					50	—	7.0	8.8	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	15	—	7.6	16.2	ns
					50	—	10.7	19.0	
				$3.3 \pm 0.3$	15	—	5.7	11.5	
					50	—	8.1	15.0	
				$5.0 \pm 0.5$	15	—	4.2	7.7	
					50	—	6.1	9.7	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	50	—	13.6	17.3	ns
				$3.3 \pm 0.3$	50	—	10.5	14.5	
				$5.0 \pm 0.5$	50	—	8.2	9.7	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$2.5 \pm 0.2$	50	—	—	2.0	ns
				$3.3 \pm 0.3$	50	—	—	1.5	
				$5.0 \pm 0.5$	50	—	—	1.0	
Input capacitance	$C_{IN}$		—			—	4	10	pF
Output capacitance	$C_{OUT}$		—			—	6	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 2)	—			—	25	—	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.

$$C_{PD} \text{ (total)} = 13 + 12 \times n$$

**11.8. 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 (LE-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	1.0	19.0	ns
					50	1.0	23.0	
				$3.3 \pm 0.3$	15	1.0	14.0	
					50	1.0	17.5	
				$5.0 \pm 0.5$	15	1.0	9.0	
					50	1.0	11.0	
Propagation delay time (D-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	1.0	18.0	ns
					50	1.0	23.5	
				$3.3 \pm 0.3$	15	1.0	13.0	
					50	1.0	16.5	
				$5.0 \pm 0.5$	15	1.0	8.0	
					50	1.0	10.0	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1$ k $\Omega$	$2.5 \pm 0.2$	15	1.0	19.0	ns
					50	1.0	22.0	
				$3.3 \pm 0.3$	15	1.0	13.5	
					50	1.0	17.0	
				$5.0 \pm 0.5$	15	1.0	9.0	
					50	1.0	11.0	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1$ k $\Omega$	$2.5 \pm 0.2$	50	1.0	19.0	ns
				$3.3 \pm 0.3$	50	1.0	16.5	
				$5.0 \pm 0.5$	50	1.0	11.0	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$2.5 \pm 0.2$	50	—	2.0	ns
				$3.3 \pm 0.3$	50	—	1.5	
				$5.0 \pm 0.5$	50	—	1.0	
Input capacitance	$C_{IN}$		—			—	10	pF

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

**11.9. AC Characteristics**  
 (Unless otherwise specified,  $T_a = -40$  to  $125\text{ }^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time (LE-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	1.0	21.0	ns
					50	1.0	26.0	
				$3.3 \pm 0.3$	15	1.0	16.0	
					50	1.0	19.5	
				$5.0 \pm 0.5$	15	1.0	10.5	
					50	1.0	12.5	
Propagation delay time (D-Q)	$t_{PLH}, t_{PHL}$		—	$2.5 \pm 0.2$	15	1.0	19.5	ns
					50	1.0	25.5	
				$3.3 \pm 0.3$	15	1.0	15.0	
					50	1.0	18.5	
				$5.0 \pm 0.5$	15	1.0	9.0	
					50	1.0	11.0	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	15	1.0	21.0	ns
					50	1.0	24.0	
				$3.3 \pm 0.3$	15	1.0	15.5	
					50	1.0	19.0	
				$5.0 \pm 0.5$	15	1.0	10.5	
					50	1.0	12.5	
3-state output disable time	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$2.5 \pm 0.2$	50	1.0	20.5	ns
				$3.3 \pm 0.3$	50	1.0	18.5	
				$5.0 \pm 0.5$	50	1.0	12.5	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$2.5 \pm 0.2$	50	—	2.0	ns
				$3.3 \pm 0.3$	50	—	1.5	
				$5.0 \pm 0.5$	50	—	1.0	
Input capacitance	$C_{IN}$		—			—	10	pF

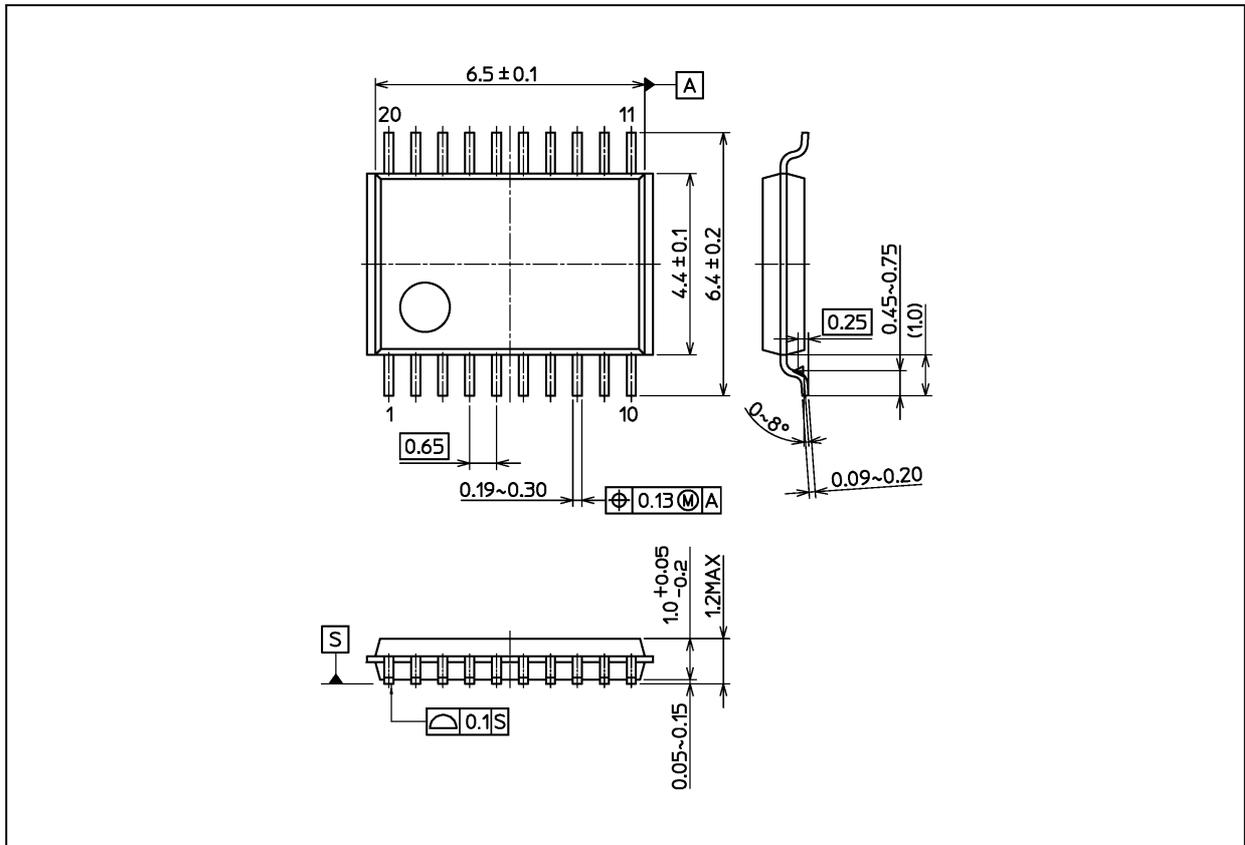
Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Max	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50\text{ pF}$	3.3	0.4	—	V
			5.0	0.8	—	
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$	$C_L = 50\text{ pF}$	3.3	-0.1	—	V
			5.0	-0.4	—	
Minimum high-level dynamic input voltage	$V_{IHD}$	$C_L = 50\text{ pF}$	5.0	—	3.5	V
Maximum low-level dynamic input voltage	$V_{ILD}$	$C_L = 50\text{ pF}$	5.0	—	1.5	V

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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