

# 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 ( $\overline{OE}$ ).

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

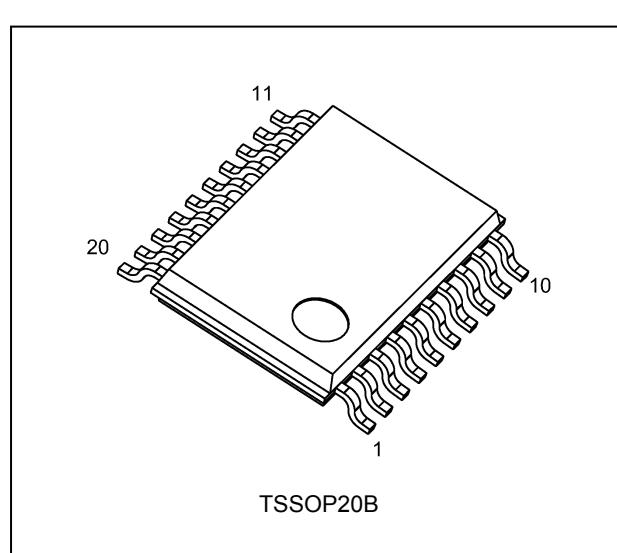
An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input 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 (max) at  $T_a = 25$  °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:  $V_{CC(opr)} = 2.0$  V to  $5.5$  V
- (9) Low noise:  $V_{OLP} = 1.0$  V (max)
- (10) Pin and function compatible with the 74 series  
(74AC/HC/AHC/LV etc.) 573 type.

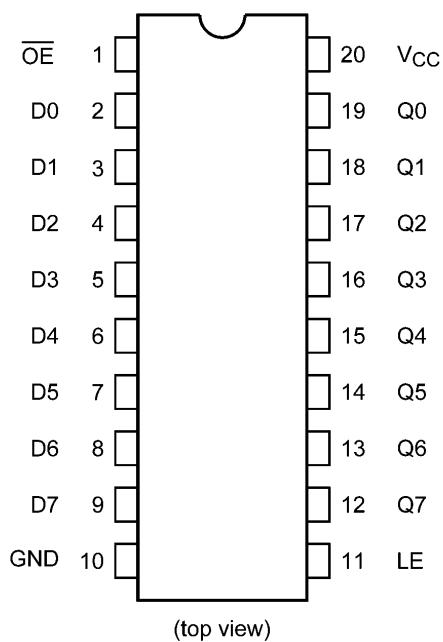
Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

## 4. Packaging

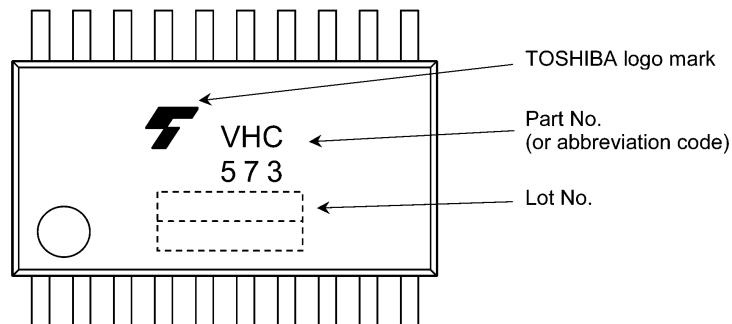


Start of commercial production  
2013-03

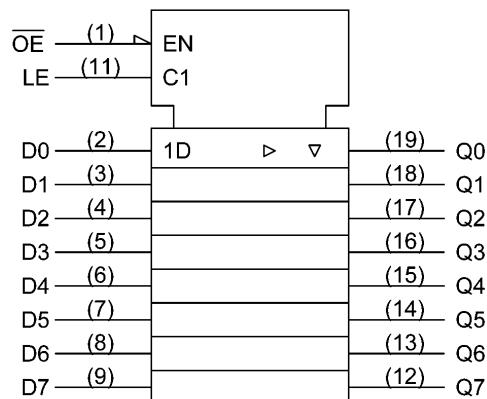
## 5. Pin Assignment



## 6. Marking



## 7. IEC Logic Symbol



## 8. Truth Table

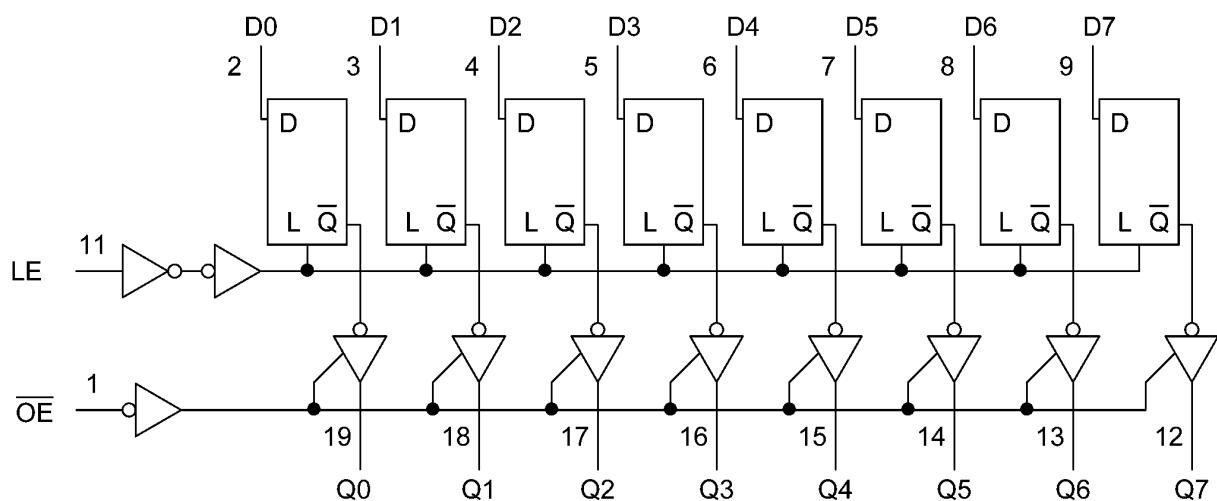
INPUT $\overline{OE}$	INPUT LE	INPUT D	OUTPUT
H	X	X	Z
L	L	X	$Q_n$
L	H	L	L
L	H	H	H

X: Don't care

Z: High impedance

$Q_n$ : 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	$I_{OK}$		$\pm 20$	mA
Output current	$I_{OUT}$		$\pm 25$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 75$	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	$dt/dv$	$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
		$V_{CC} = 5.0 \pm 0.5$ 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, $T_a = 25^\circ\text{C}$ )

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	$V_{CC} \times 0.7$	—	—		
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 $V_{IL}$	$I_{OH} = -50 \mu\text{A}$	2.0	1.9	2.0	—	V	
				3.0	2.9	3.0	—		
				4.5	4.4	4.5	—		
				$I_{OH} = -4 \text{ mA}$	3.0	2.58	—		
			$I_{OH} = -8 \text{ mA}$	4.5	3.94	—	—		
				2.0	—	0.0	0.1		
				3.0	—	0.0	0.1		
				4.5	—	0.0	0.1		
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu\text{A}$	3.0 to 5.5	—	—	0.36	V	
				$I_{OL} = 4 \text{ mA}$	3.0	—	0.36		
			$I_{OL} = 8 \text{ mA}$	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	—	—	$\pm 0.25$	$\mu\text{A}$	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V}$ or GND		0 to 5.5	—	—	$\pm 0.1$		
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 $85^\circ\text{C}$ )

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 $V_{IL}$	$I_{OH} = -50 \mu\text{A}$	2.0	1.9	—	V	
				3.0	2.9	—		
				4.5	4.4	—		
				$I_{OH} = -4 \text{ mA}$	3.0	2.48		
			$I_{OH} = -8 \text{ mA}$	4.5	3.80	—		
				2.0	—	0.1	V	
				3.0	—	0.1		
				4.5	—	0.1		
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu\text{A}$	$I_{OL} = 4 \text{ mA}$	3.0	—	0.44	$\mu\text{A}$
				$I_{OL} = 8 \text{ mA}$	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	—	$\pm 2.50$		
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V}$ or GND		0 to 5.5	—	$\pm 1.0$		
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 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 $V_{IL}$	$I_{OH} = -50 \mu A$	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			$I_{OH} = -4 mA$	3.0	2.40	—	
			$I_{OH} = -8 mA$	4.5	3.70	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50 \mu A$	2.0	—	0.1	V
				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	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND		5.5	—	$\pm 10.0$	$\mu A$
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 V$ or GND		0 to 5.5	—	$\pm 2.0$	$\mu A$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		5.5	—	80.0	$\mu A$

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	—	$3.3 \pm 0.3$	5.0	ns
			$5.0 \pm 0.5$	5.0	ns
Minimum setup time	$t_S$	—	$3.3 \pm 0.3$	3.5	ns
			$5.0 \pm 0.5$	3.5	ns
Minimum hold time	$t_h$	—	$3.3 \pm 0.3$	1.5	ns
			$5.0 \pm 0.5$	1.5	ns

**12.5. Timing Requirements**

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	—	$3.3 \pm 0.3$	5.0	ns
			$5.0 \pm 0.5$	5.0	
Minimum setup time	$t_S$	—	$3.3 \pm 0.3$	3.5	ns
			$5.0 \pm 0.5$	3.5	
Minimum hold time	$t_h$	—	$3.3 \pm 0.3$	1.5	ns
			$5.0 \pm 0.5$	1.5	

**12.6. Timing Requirements**

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

Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	—	$3.3 \pm 0.3$	5.0	ns
			$5.0 \pm 0.5$	5.0	
Minimum setup time	$t_S$	—	$3.3 \pm 0.3$	4.5	ns
			$5.0 \pm 0.5$	4.0	
Minimum hold time	$t_h$	—	$3.3 \pm 0.3$	1.5	ns
			$5.0 \pm 0.5$	1.5	

12.7. AC Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ , 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)	$t_{PLH}, t_{PHL}$		—	3.3 ± 0.3	15	—	7.6	11.9	ns
				50	—	—	10.1	15.4	
				5.0 ± 0.5	15	—	5.0	7.7	
				50	—	—	6.5	9.7	
Propagation delay time (D-Q)	$t_{PLH}, t_{PHL}$		—	3.3 ± 0.3	15	—	7.0	11.0	ns
				50	—	—	9.5	14.5	
				5.0 ± 0.5	15	—	4.5	6.8	
				50	—	—	6.0	8.8	
3-state output enable time	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	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	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	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. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )

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.

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

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

$$C_{PD} \text{ (total)} = 21 + 8 \times n$$

## 12.8. AC Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $85^\circ\text{C}$ , 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)	$t_{PLH}, t_{PHL}$		—	3.3 ± 0.3	15	1.0	14.0	ns
				50	1.0	—	17.5	
				5.0 ± 0.5	15	1.0	9.0	
				50	1.0	—	11.0	
Propagation delay time (D-Q)	$t_{PLH}, t_{PHL}$		—	3.3 ± 0.3	15	1.0	13.0	ns
				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	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	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	
Input capacitance	$C_{IN}$		—			—	10	pF

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

## 12.9. AC Characteristics

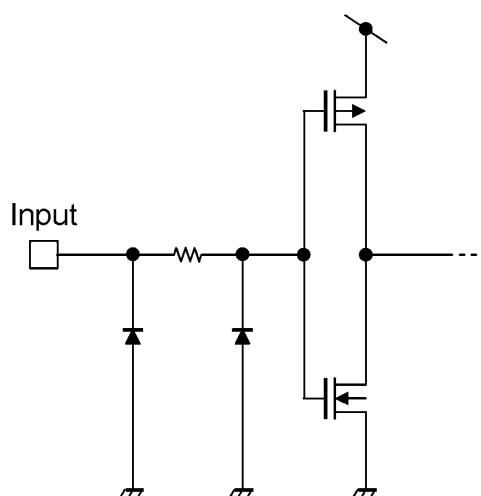
(Unless otherwise specified,  $T_a = -40$  to  $125^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

Characteristics	Symbol	Note	Test Condition	$V_{CC}$ (V)	$C_L$ (pF)	Min	Max	Unit
Propagation delay time (LE-Q)	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	1.0	16.0	ns
					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)	$t_{PLH}, t_{PHL}$		—	$3.3 \pm 0.3$	15	1.0	15.0	ns
					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	$t_{PZL}, t_{PZH}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	15	1.0	15.5	ns
					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	$t_{PLZ}, t_{PHZ}$		$R_L = 1\text{ k}\Omega$	$3.3 \pm 0.3$	50	1.0	18.5	ns
					50	1.0	12.5	
Output skew	$t_{osLH}, t_{osHL}$	(Note 1)	—	$3.3 \pm 0.3$	50	—	1.5	ns
					50	—	1.0	
Input capacitance	$C_{IN}$		—			—	10	pF

Note 1: Parameter guaranteed by design. ( $t_{osLH} = |t_{PLHM} - t_{PLHN}|$ ,  $t_{osHL} = |t_{PHLM} - t_{PHLN}|$ )12.10. Noise Characteristics (Unless otherwise specified,  $T_a = 25^\circ\text{C}$ , Input:  $t_r = t_f = 3\text{ ns}$ )

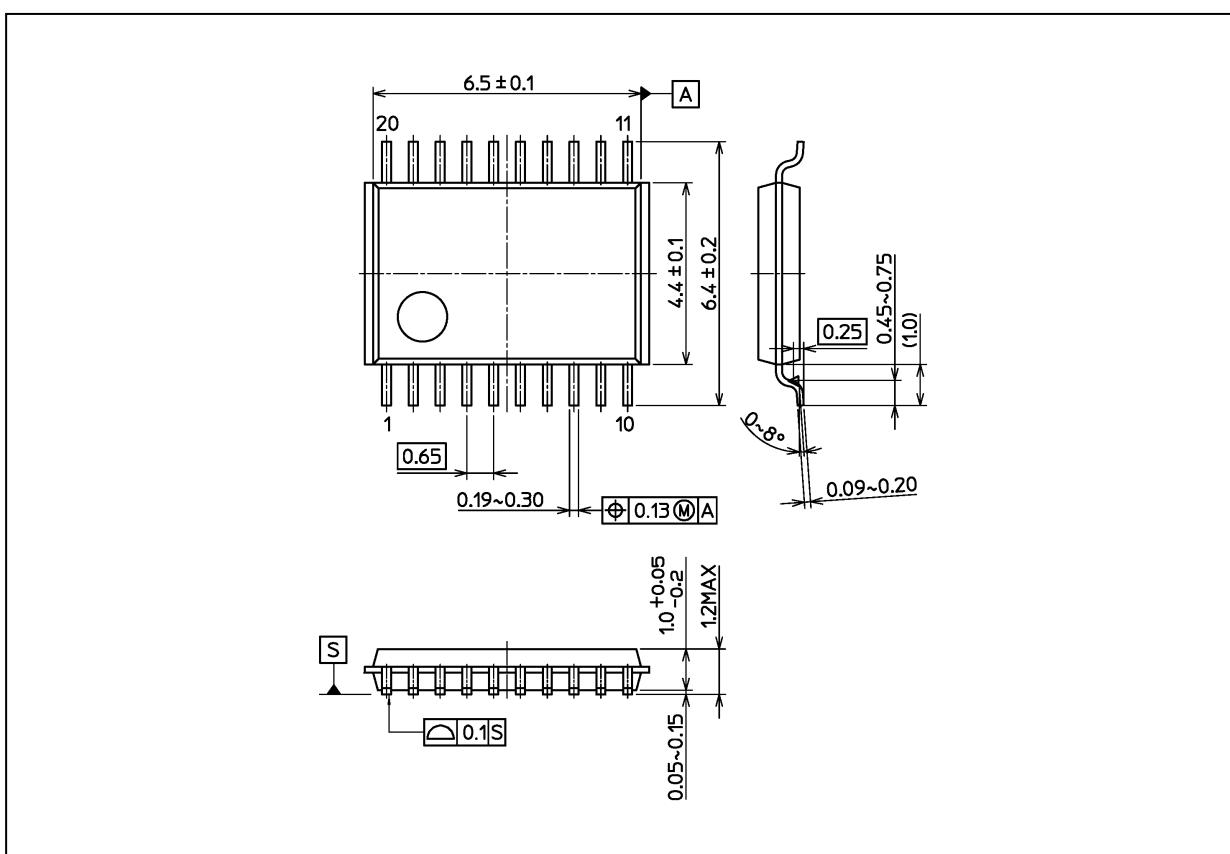
Characteristics	Symbol	Test Condition	$V_{CC}$ (V)	Typ.	Limit	Unit
Quiet output maximum dynamic $V_{OL}$	$V_{OLP}$	$C_L = 50\text{ pF}$	5.0	0.8	1.0	V
Quiet output minimum dynamic $V_{OL}$	$V_{OLV}$			-0.8	-1.0	
Minimum high-level dynamic input voltage	$V_{IHD}$		5.0	—	3.5	
Maximum low-level dynamic input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