CMOS Digital Integrated Circuits Silicon Monolithic

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^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 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 μA (max) at T_a = 25°C

(5) Wide operating voltage range: $V_{CC(opr)}$ = 1.8 V to 5.5 V

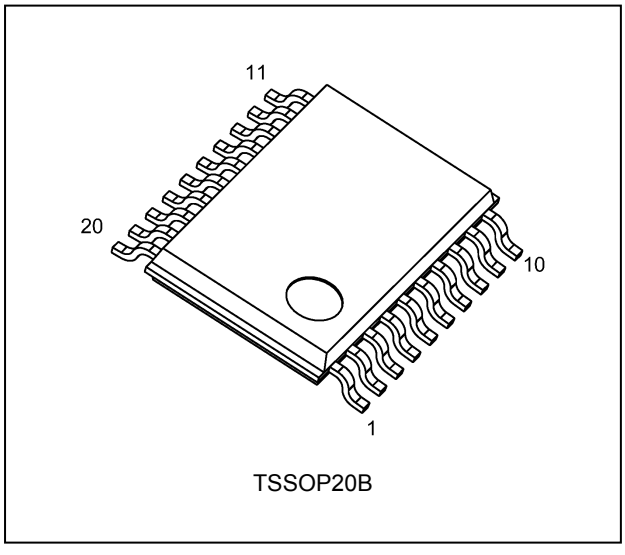
(6) Output current: $|I_{OH}|/I_{OL}$ = 16 mA (min)(V_{CC} = 4.5 V)

(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.

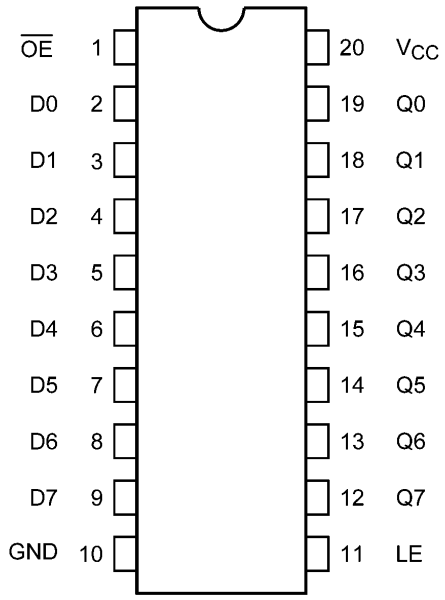
4. Packaging



TSSOP20B

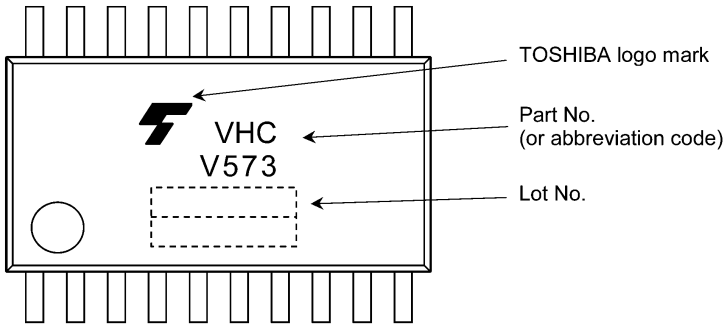
Start of commercial production
2014-07

5. Pin Assignment



(top view)

6. Marking

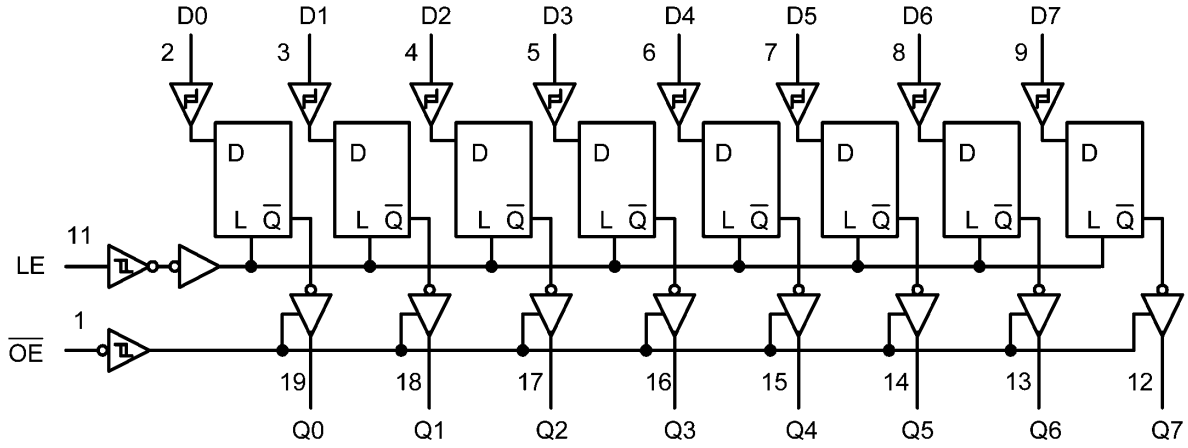


7. Truth Table

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)	±50	mA
Output current	I_{OUT}		±50	mA
Power dissipation	P_D	(Note 4)	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}

Note 4: 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.

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	°C
Input rise and fall times	dt/dv	V_{CC} = 3.3 ± 0.3 V		0 to 20	ms/V
		V_{CC} = 5.0 ± 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 °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 μA	1.8	1.7	1.8	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			I_{OH} = -8 mA	3.0	2.58	—	—	
			I_{OH} = -16 mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			I_{OL} = 8 mA	3.0	—	—	0.36	
			I_{OL} = 16 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 V		0	—	—	0.5	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 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 °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 μA	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -8 mA	3.0	2.48	—	
			I_{OH} = -16 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 8 mA	3.0	—	0.44	
			I_{OL} = 16 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 V		0	—	5.0	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 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. 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 μA	1.8	1.7	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -8 mA	3.0	2.40	—	
			I_{OH} = -16 mA	4.5	3.70	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA	1.8	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 8 mA	3.0	—	0.55	
			I_{OL} = 16 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 V		1.8 to 5.5	—	±20.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	20.0	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±2.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	40.0	μA

11.4. 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 (LE)	$t_{w(H)}$	2.5 ± 0.2	—	6.5	ns
		3.3 ± 0.3	—	5.0	
		5.0 ± 0.5	—	5.0	
Minimum setup time	t_S	2.5 ± 0.2	—	5.0	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. 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 (LE)	$t_{w(H)}$	2.5 ± 0.2	6.5	ns
		3.3 ± 0.3	5.0	
		5.0 ± 0.5	5.0	
Minimum setup time	t_S	2.5 ± 0.2	5.0	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	

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

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

11.7. 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	Typ.	Max	Unit
Propagation delay time (LE-Q)	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	—	8.9	16.2	ns
					50	—	11.8	19.1	
				3.3 ± 0.3	15	—	6.6	11.9	
					50	—	8.8	15.4	
				5.0 ± 0.5	15	—	5.0	7.7	
					50	—	6.6	9.7	
Propagation delay time (D-Q)	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	—	10.4	15.8	ns
					50	—	13.2	20.7	
				3.3 ± 0.3	15	—	7.5	11.0	
					50	—	9.5	14.5	
				5.0 ± 0.5	15	—	5.4	6.8	
					50	—	7.0	8.8	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	2.5 ± 0.2	15	—	7.6	16.2	ns
					50	—	10.7	19.0	
				3.3 ± 0.3	15	—	5.7	11.5	
					50	—	8.1	15.0	
				5.0 ± 0.5	15	—	4.2	7.7	
					50	—	6.1	9.7	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	2.5 ± 0.2	50	—	13.6	17.3	ns
				3.3 ± 0.3	50	—	10.5	14.5	
				5.0 ± 0.5	50	—	8.2	9.7	
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	
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} = $|t_{PLH}m - t_{PLH}n|$, 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) = 13 + 12 × 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 ± 0.2	15	1.0	19.0	ns
					50	1.0	23.0	
				3.3 ± 0.3	15	1.0	14.0	
					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}		—	2.5 ± 0.2	15	1.0	18.0	ns
					50	1.0	23.5	
				3.3 ± 0.3	15	1.0	13.0	
					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 kΩ	2.5 ± 0.2	15	1.0	19.0	ns
					50	1.0	22.0	
				3.3 ± 0.3	15	1.0	13.5	
					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 kΩ	2.5 ± 0.2	50	1.0	19.0	ns
				3.3 ± 0.3	50	1.0	16.5	
				5.0 ± 0.5	50	1.0	11.0	
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	
Input capacitance	C_{IN}		—			—	10	pF

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

11.9. 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 (LE-Q)	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	1.0	21.0	ns
					50	1.0	26.0	
				3.3 ± 0.3	15	1.0	16.0	
					50	1.0	19.5	
				5.0 ± 0.5	15	1.0	10.5	
					50	1.0	12.5	
Propagation delay time (D-Q)	t_{PLH},t_{PHL}		—	2.5 ± 0.2	15	1.0	19.5	ns
					50	1.0	25.5	
				3.3 ± 0.3	15	1.0	15.0	
					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 kΩ	2.5 ± 0.2	15	1.0	21.0	ns
					50	1.0	24.0	
				3.3 ± 0.3	15	1.0	15.5	
					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 kΩ	2.5 ± 0.2	50	1.0	20.5	ns
				3.3 ± 0.3	50	1.0	18.5	
				5.0 ± 0.5	50	1.0	12.5	
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	
Input capacitance	C_{IN}		—			—	10	pF

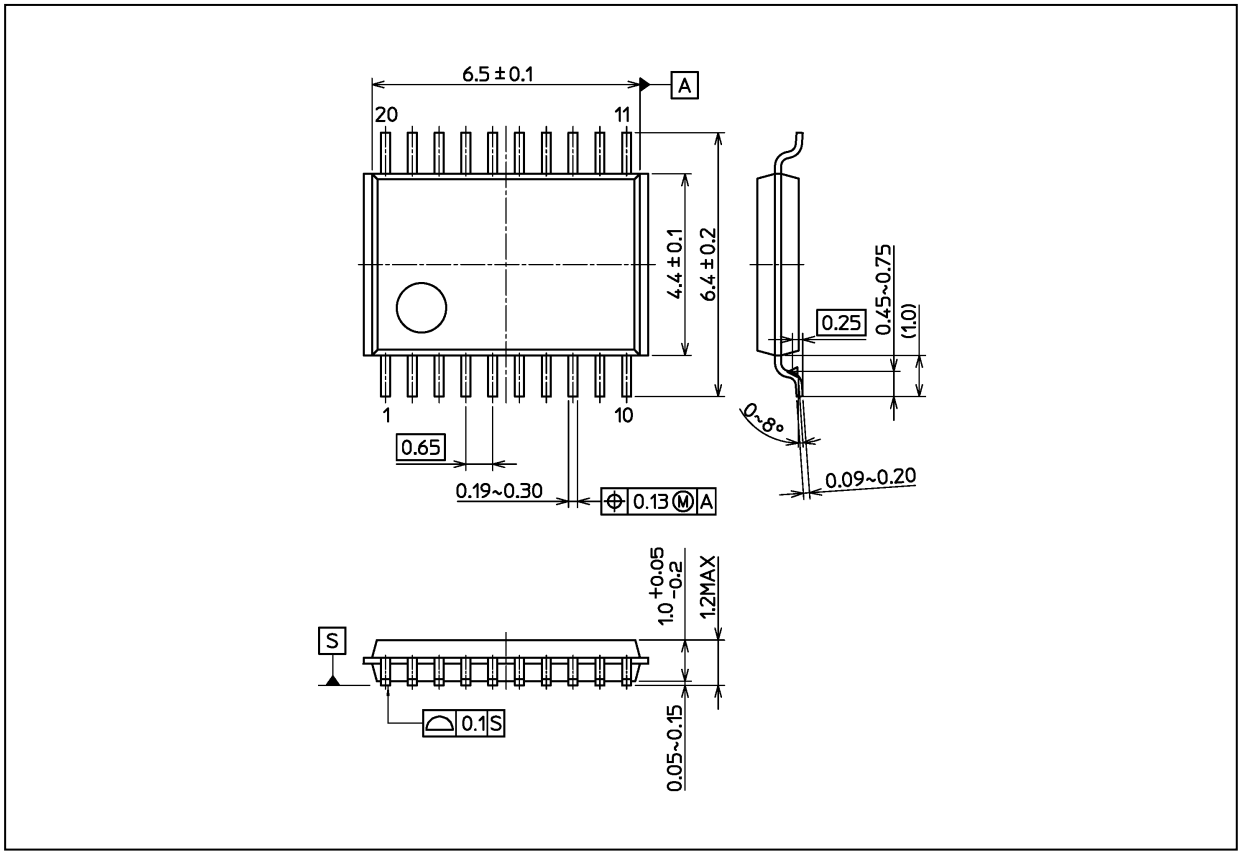
Note 1: Parameter guaranteed by design. ($t_{osLH} = |t_{PLH}m - t_{PLH}n|$, $t_{osHL} = |t_{PHL}m - t_{PHL}n|$)

11.10. 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

Package Dimensions

Unit: mm



Weight: 0.071 g (typ.)

Package Name(s)
Nickname: TSSOP20B

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