

**TC74VHC9541P,TC74VHC9541FT,TC74VHC9541FK**

Octal Universal Schmitt Buffer with 3-State Outputs

The TC74VHC9541 is an ultra-high-speed octal Schmitt buffer fabricated using silicon-gate CMOS technology. The TC74VHC9541 combines low power consumption of CMOS with Schottky TTL speeds.

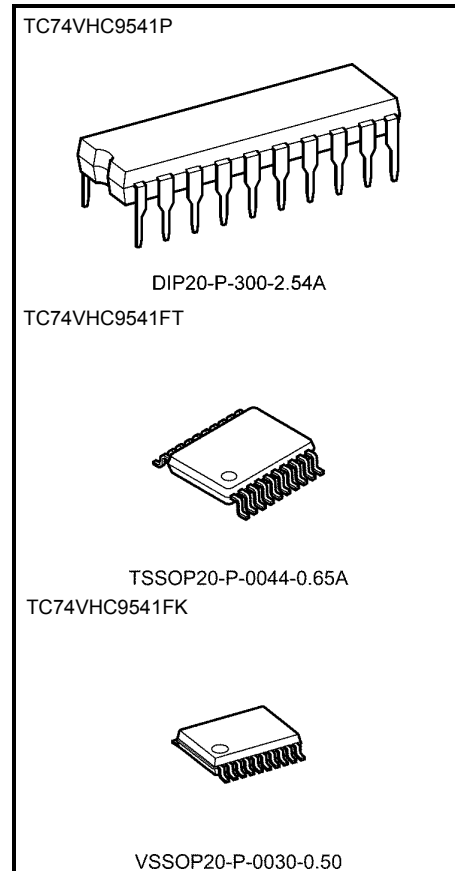
The outputs can be put in the high-impedance state by placing a logic HIGH on the Enable ( $\bar{G}$ ) input. The CONT input determines the logical inversion of data. A logic LOW on the CONT input configures the TC74VHC9541 as an inverter; a logic HIGH on the CONT input configures the TC74VHC9541 as a buffer.

All the inputs have hysteresis between the positive-going and negative-going thresholds. Thus the TC74VHC9541 is capable of squaring up transitions of slowly changing input signals and provides an improved noise immunity.

Additionally, all the inputs have a newly developed protection circuit without a diode returned to  $V_{CC}$ . This enables the inputs to be tolerant of up to 5 volts even when power supply is down. The input power-down protection capability makes the TC74VHC9541 ideal for a wide range of applications, such as interfacing between different voltages, voltage translation from 5 V to 3 V and battery back-up circuits.

**Features**

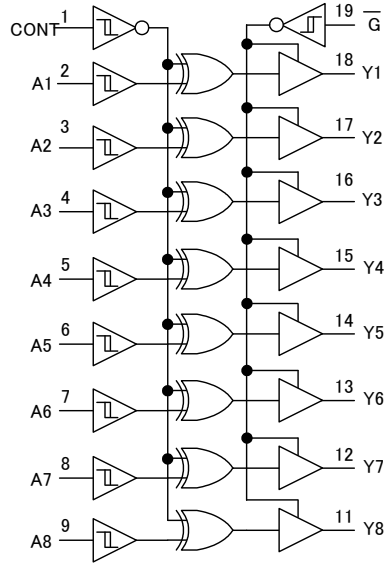
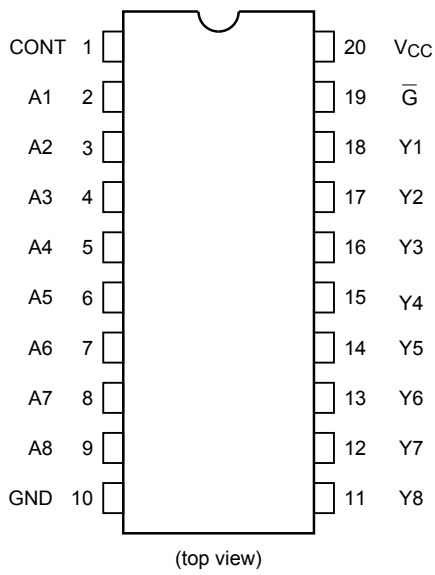
- High speed:  $t_{pd} = 5.0 \text{ ns (typ.) (} V_{CC} = 5 \text{ V)}$
- Low supply current:  $I_{CC} = 4 \mu\text{A (max) (} T_a = 25^\circ\text{C)}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- All inputs are provided with power-down protection.
- Symmetrical rise and fall delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 5.5 \text{ V}$
- Pin-compatible with TC74VHC540 and TC74VHC541



Weight

DIP20-P-300-2.54A:	1.30 g (typ.)
TSSOP20-P-0044-0.65A:	0.08 g (typ.)
VSSOP20-P-0030-0.50:	0.03 g (typ.)

## Pin Assignment



## Truth Table

Inputs			Outputs
$\bar{G}$	CONT	A <sub>n</sub>	Y <sub>n</sub>
H	X	X	Z
L	L	L	H
L	L	H	L
L	H	L	L
L	H	H	H

X: Don't care

Z: High impedance

## Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC 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
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180(TSSOP/VSSOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note 1: 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 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}C$ . From  $T_a = 65$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  shall be applied until 300 mW.

## Operating Ranges (Note)

Characteristics	Symbol	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	$^{\circ}C$

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.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40~85°C		Unit		
				V <sub>CC</sub> (V)	Min	Typ	Max	Min		Max	
Positive threshold voltage	V <sub>P</sub>	—		3.0	—	—	2.20	—	2.20	V	
				4.5	—	—	3.15	—	3.15		
				5.5	—	—	3.85	—	3.85		
Negative threshold voltage	V <sub>N</sub>	—		3.0	0.90	—	—	0.90	—	V	
				4.5	1.35	—	—	1.35	—		
				5.5	1.65	—	—	1.65	—		
Hysteresis voltage	V <sub>H</sub>	—		3.0	0.30	—	1.20	0.30	1.20	V	
				4.5	0.40	—	1.40	0.40	1.40		
				5.5	0.50	—	1.60	0.50	1.60		
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		I <sub>OH</sub> = -50 μA	2.0	1.9	2.0	—	1.9	—	V
					3.0	2.9	3.0	—	2.9	—	
				4.5	4.4	4.5	—	4.4	—		
				I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
4.5	3.94	—	—		3.80	—					
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		I <sub>OL</sub> = 50 μA	2.0	—	0.0	0.1	—	0.1	V
					3.0	—	0.0	0.1	—	0.1	
					4.5	—	0.0	0.1	—	0.1	
				I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—	0.44	
					4.5	—	—	0.36	—	0.44	
3-state output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND		5.5	—	—	±0.25	—	±2.50	μA	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	4.0	—	40.0	μA	

## AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (An-Yn)	t <sub>pLH</sub>	—	3.3 ± 0.3	15	—	6.0	8.0	1.0	10.0	ns
				50	—	9.0	12.5	1.0	15.0	
	5.0 ± 0.5		15	—	5.0	5.5	1.0	7.0		
			50	—	7.0	8.5	1.0	10.0		
Propagation delay time (CONT-Yn)	t <sub>pLH</sub>	—	3.3 ± 0.3	15	—	8.5	11.5	1.0	13.5	ns
				50	—	13.0	17.0	1.0	20.5	
	5.0 ± 0.5		15	—	6.5	8.0	1.0	9.5		
			50	—	10.5	12.5	1.0	15.0		
3-state output enable time	t <sub>pZL</sub>	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	15	—	6.0	8.0	1.0	9.5	ns
				50	—	10.5	13.5	1.0	16.5	
	5.0 ± 0.5		15	—	4.5	5.5	1.0	6.5		
			50	—	9.0	10.5	1.0	12.5		
3-state output disable time	t <sub>pLZ</sub>	R <sub>L</sub> = 1 kΩ	3.3 ± 0.3	50	—	12.5	13.5	1.0	16.0	ns
	t <sub>pHZ</sub>		5.0 ± 0.5	50	—	9.0	9.5	1.0	11.0	
Output to output skew	t <sub>osHL</sub>	(Note 1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
	t <sub>osLH</sub>		5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	C <sub>IN</sub>	—	—	—	4	10	—	10	pF	
Output capacitance	C <sub>OUT</sub>	—	—	—	6	—	—	—	pF	
Power dissipation capacitance (Note 2)	C <sub>PD</sub>	f <sub>IN</sub> = 1 MHz	—	—	11	—	—	—	pF	

Note 1: Parameter guaranteed by design.

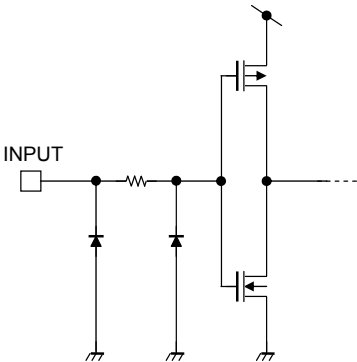
$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: C<sub>PD</sub> 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:

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

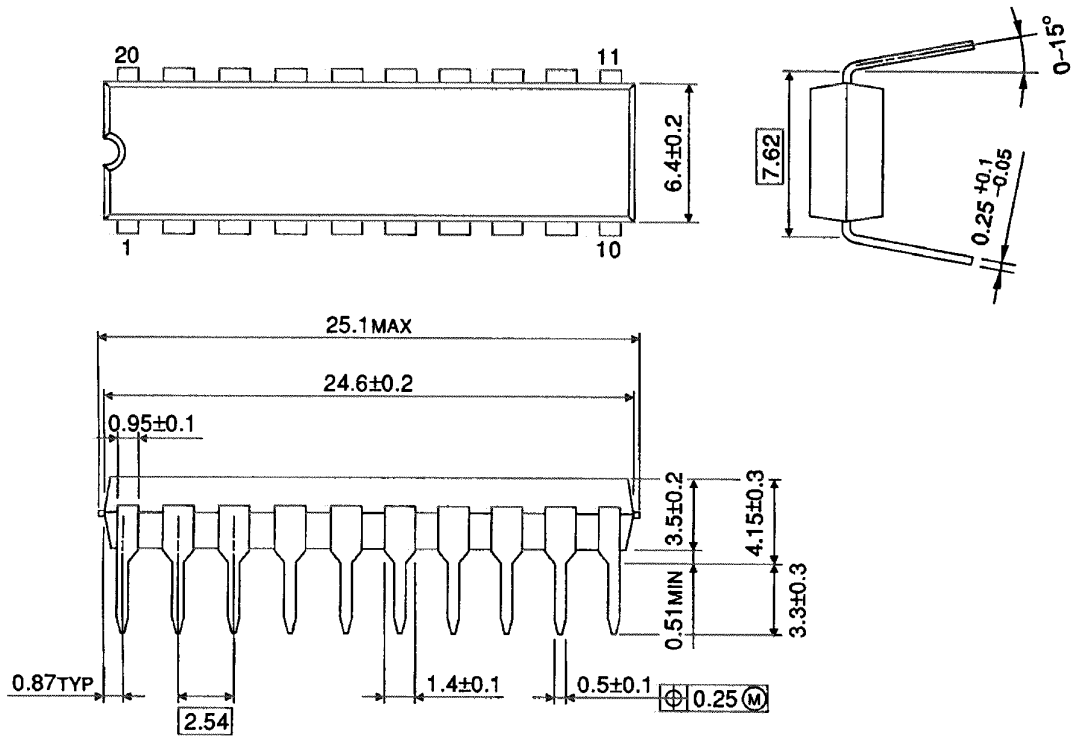
**Input Equivalent Circuit**



## Package Dimensions

DIP20-P-300-2.54A

Unit : mm

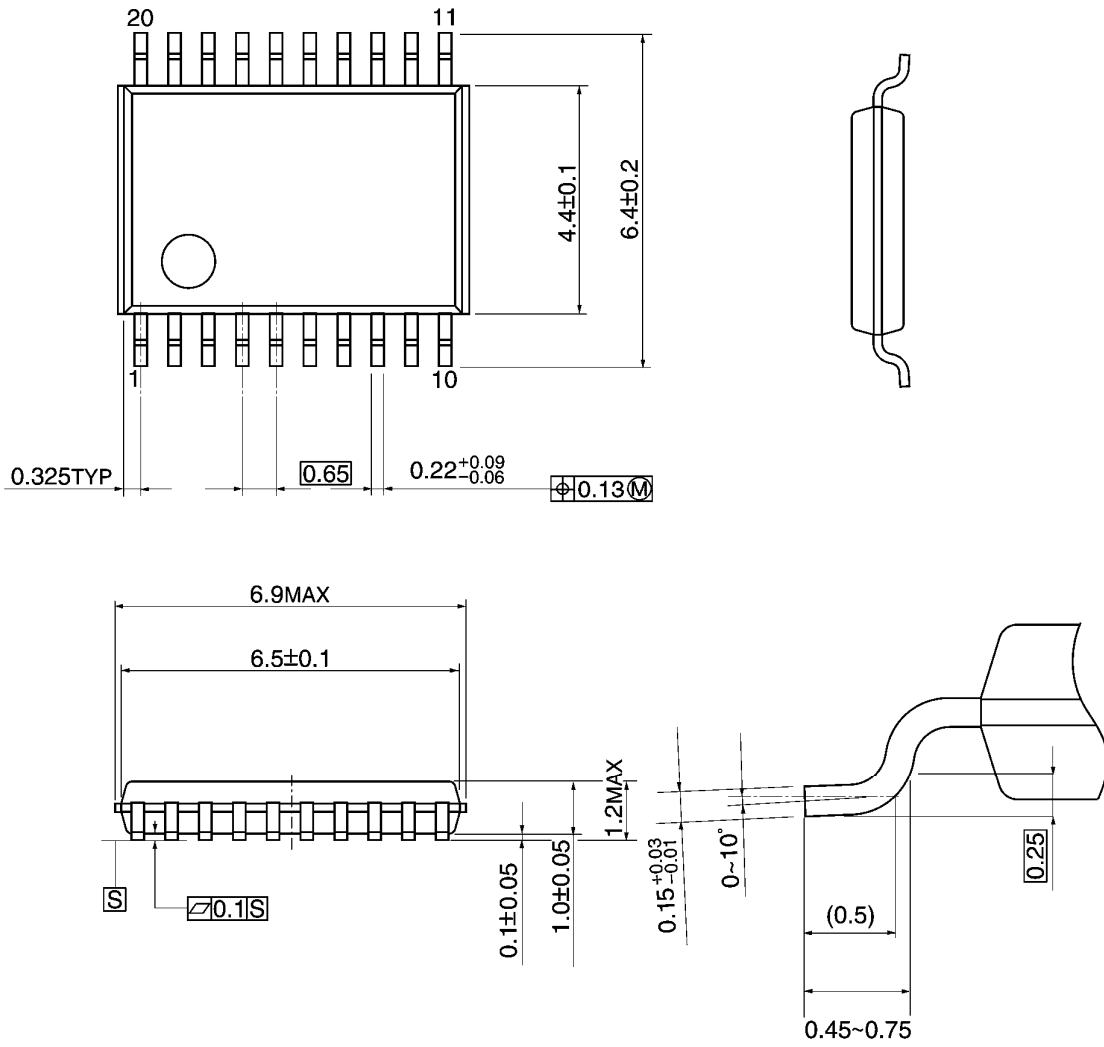


Weight: 1.30 g (typ.)

## Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm



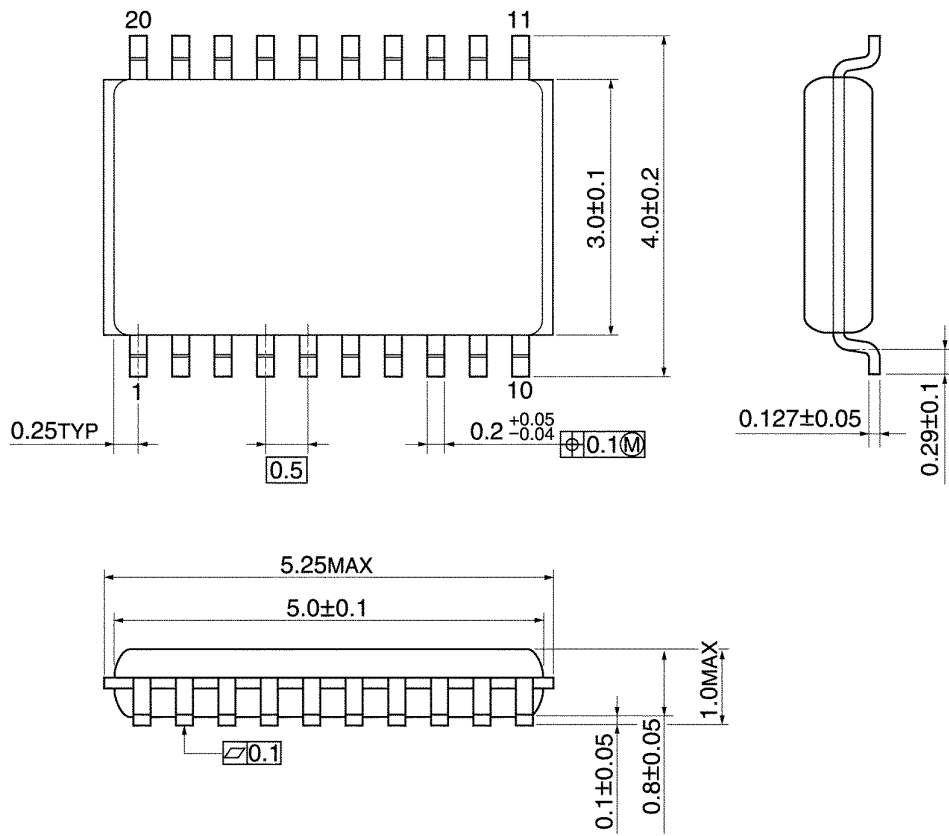
Weight: 0.08 g (typ.)



## Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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20070701-EN GENERAL

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