

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHC9541P, 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.

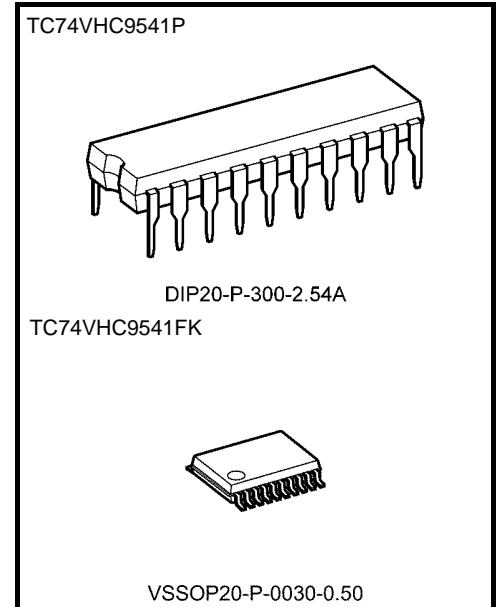
The outputs can be put in the high-impedance state by placing a logic HIGH on the Enable (\bar{G}) input. The CONT input determines the logical inversion of data. A logic LOW on the CONT input configures the TC74VHC9541 as an inverter; a logic HIGH on the CONT input configures the TC74VHC9541 as a buffer.

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

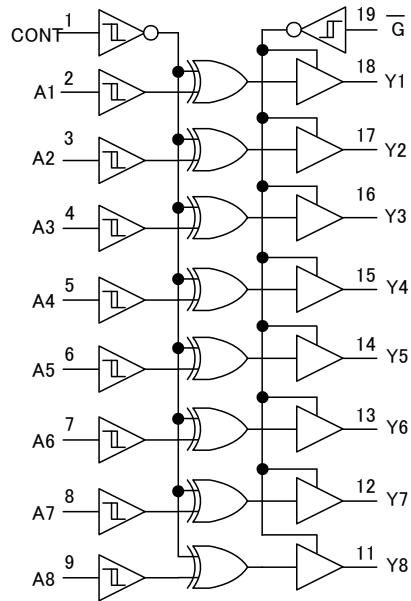
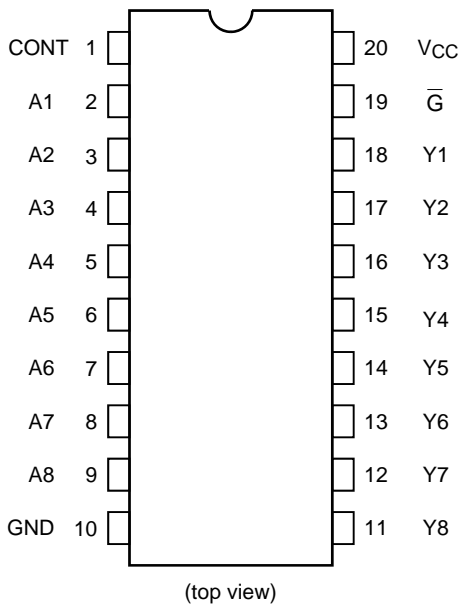
- High speed: $t_{pd} = 5.0 \text{ ns}$ (typ.) ($V_{CC} = 5 \text{ V}$)
- Low supply current: $I_{CC} = 4 \mu\text{A}$ (max) ($T_a = 25^\circ\text{C}$)
- All inputs are provided with power-down protection.
- Symmetrical rise and fall delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC}(\text{opr})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



Weight	
DIP20-P-300-2.54A:	1.30 g (typ.)
VSSOP20-P-0030-0.50:	0.03 g (typ.)

Start of commercial production
2008-02

Pin Assignment



Truth Table

Inputs			Outputs
\overline{G}	CONT	A_n	Y_n
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}	±20	mA
DC output current	I _{OUT}	±25	mA
DC V _{CC} /ground current	I _{CC}	±75	mA
Power dissipation	P _D	500 (DIP) (Note 2)/180(VSSOP)	mW
Storage temperature	T _{stg}	-65 to 150	°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°C. From T_a = 65 to 85°C a derating factor of -10 mW/°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	°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 to 85°C		Unit		
				V _{CC} (V)	Min	Typ.	Max	Min		Max	
Positive threshold voltage	V _P	—		3.0	—	—	2.20	—	2.20	V	
				4.5	—	—	3.15	—	3.15		
				5.5	—	—	3.85	—	3.85		
Negative threshold voltage	V _N	—		3.0	0.90	—	—	0.90	—	V	
				4.5	1.35	—	—	1.35	—		
				5.5	1.65	—	—	1.65	—		
Hysteresis voltage	V _H	—		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 _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -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 _{OH} = -4 mA		3.0	2.58	—	—	2.48		—
I _{OH} = -8 mA		4.5	3.94	—	—	3.80	—				
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 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 _{OL} = 4 mA		3.0	—	—	0.36	—		0.44
			I _{OL} = 8 mA		4.5	—	—	0.36	—		0.44
3-state output off-state current	I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = V _{CC} or GND		5.5	—	—	±0.25	—	±2.50	μA	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		5.5	—	—	4.0	—	40.0	μA	

AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
		VCC (V)	CL (pF)	Min	Typ.	Max	Min	Max		
Propagation delay time (An-Yn)	t_{pLH}	—	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_{pLH}	—	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_{pZL}	$R_L = 1$ k Ω	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_{pLZ}	$R_L = 1$ k Ω	3.3 ± 0.3	50	—	12.5	13.5	1.0	16.0	ns
			5.0 ± 0.5	50	—	9.0	9.5	1.0	11.0	
Output to output skew	t_{osHL}	(Note 1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
			5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	CIN	—		—	4	10	—	10	pF	
Output capacitance	COU	—		—	6	—	—	—	pF	
Power dissipation capacitance (Note 2)	CPD	$f_{IN} = 1$ MHz		—	11	—	—	—	pF	

Note 1: Parameter guaranteed by design.

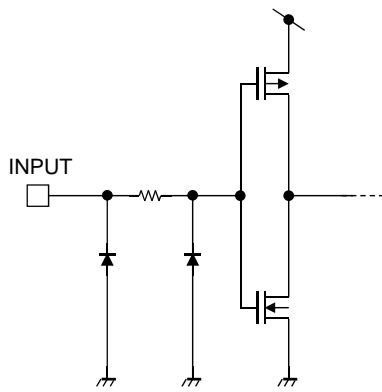
$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: CPD 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:

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

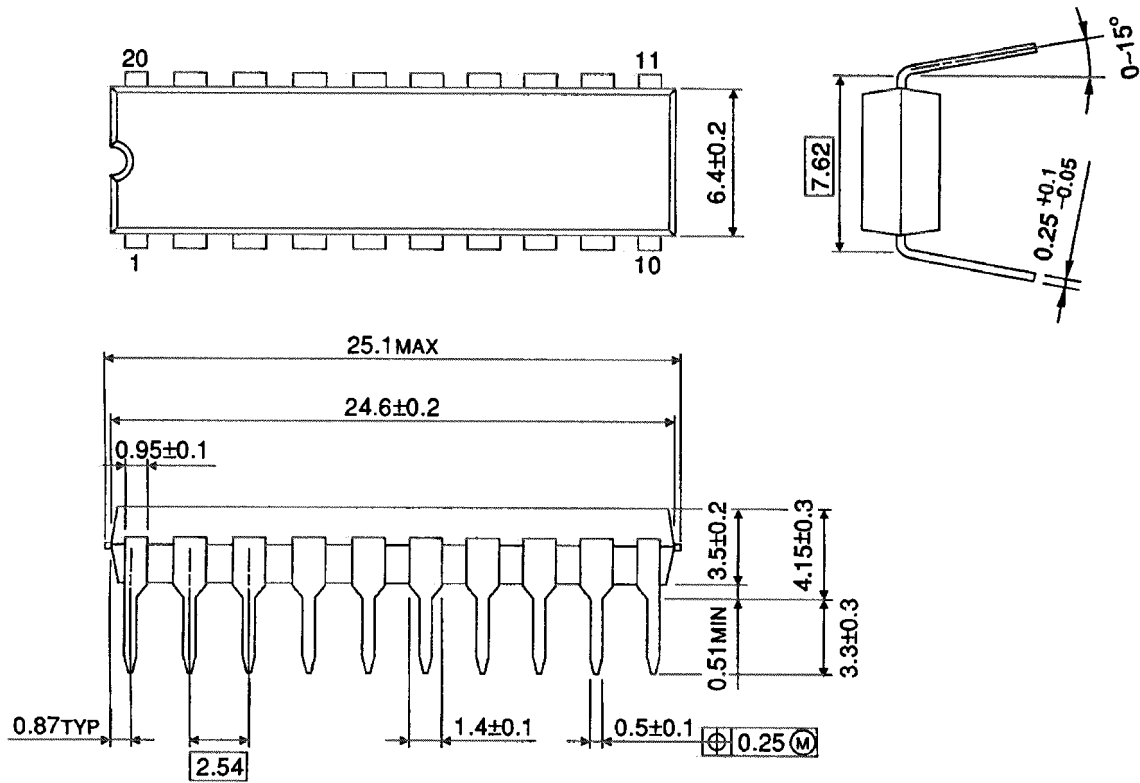
Input Equivalent Circuit



Package Dimensions

DIP20-P-300-2.54A

Unit : mm

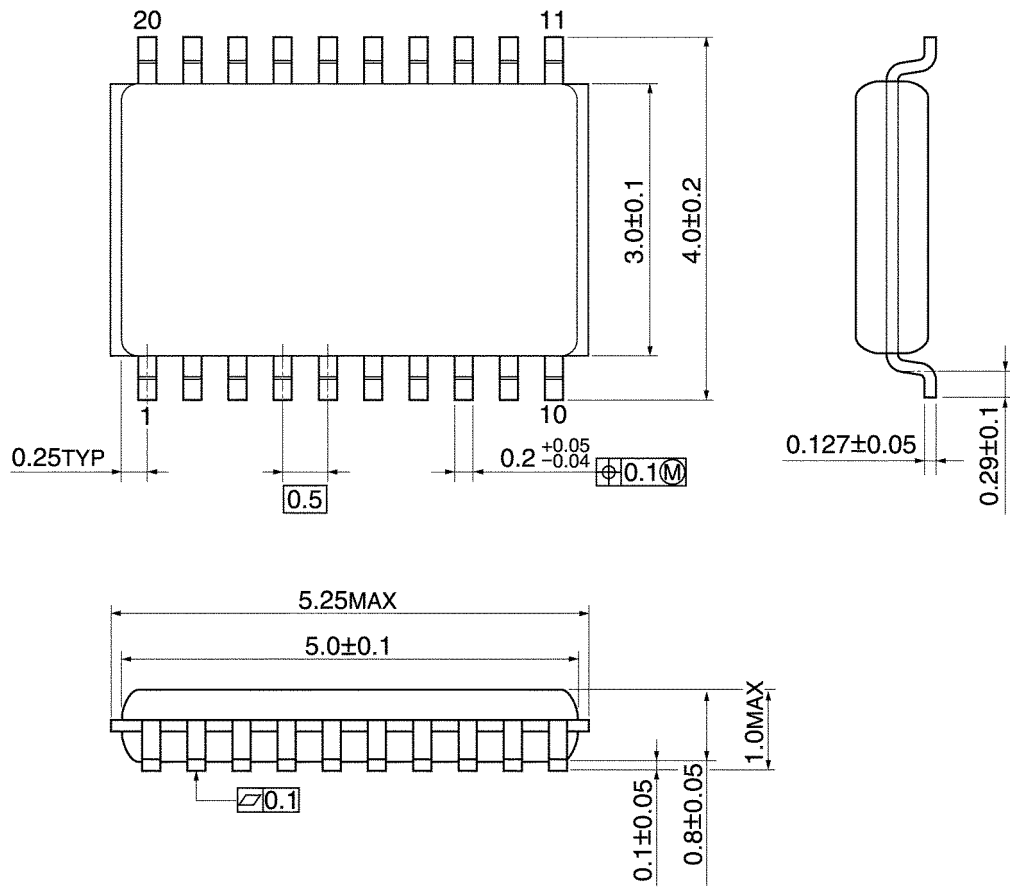


Weight: 1.30 g (typ.)

Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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