![National Semiconductor logo]

74VHC541
Octal Buffer/Line Driver with TRI-STATE® Outputs

General Description

The VHC541 is an advanced high-speed CMOS device fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The VHC541 is an octal buffer/line driver designed to be employed as memory and address drivers, clock drivers and bus oriented transmitter/receivers.

This device is similar in function to the VHC244 while providing flow-through architecture (inputs on opposite side from outputs). This pinout arrangement makes this device especially useful as an output port for microprocessors, allowing ease of layout and greater PC board density.

An input protection circuit insures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High speed
- Low power dissipation: $I_{CC} = 4\ \mu A$ (max) at $T_A = 25°C$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%\ V_{CC}$ (min)
- All inputs are equipped with a power down protection function
- Balanced propagation delays: $t_{PLH} \cong t_{PHL}$
- Wide operating voltage range: V_{CC} (opr) $= 2V \sim 5.5V$
- Low noise: $V_{OLP} = 0.8V$ (max)
- Pin and function compatible with 74HC541
- TRI-STATE outputs
- Inputs and outputs opposite side of package, allowing easier interface to microprocessors
- VHC541 provides noninverting outputs

Ordering Code: See Section 5

Logic Symbol

IEEE/IEC
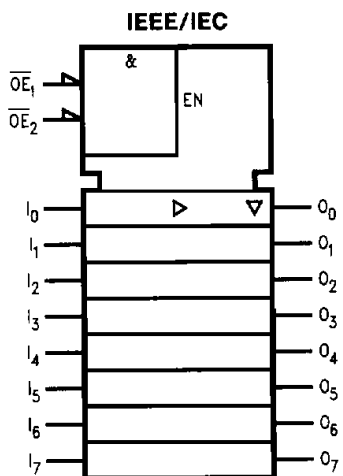
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Connection Diagram

Pin Assignment for SSOP and SOIC
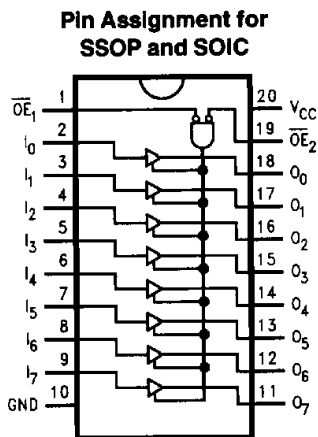
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Truth Table

Inputs			Outputs
$\overline{OE}_1$	$\overline{OE}_2$	I	
L	L	H	H
H	X	X	Z
X	H	X	Z
L	L	L	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	$-0.5V$ to $+7.0V$
DC Input Voltage (V_{IN})	$-0.5V$ to $+7.0V$
DC Output Voltage (V_{OUT})	$-0.5V$ to $V_{CC} + 0.5V$
Input Diode Current (I_{IK})	-20 mA
Output Diode Current (I_{OK})	±20 mA
DC Output Current (I_{OUT})	±25 mA
DC V_{CC}/GND Current (I_{CC})	±75 mA
Storage Temperature (T_{STG})	$-65°C$ to $+150°C$
Lead Temperature (T_L) (Soldering, 10 seconds)	$300°C$

Note 1: *Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation outside databook specifications.*

Recommended Operating Conditions

Supply Voltage (V_{CC})	2.0V to $+5.5V$
Input Voltage (V_{IN})	0V to $+5.5V$
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	$-40°C$ to $+85°C$
Input Rise and Fall Time (t_r, t_f)	
$V_{CC} = 3.3V \pm 0.3V$	$0 \sim 100$ ns/V
$V_{CC} = 5.0V \pm 0.5V$	$0 \sim 20$ ns/V

DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V_{CC} (V)	74VHC $T_A = 25°C$ Min	Typ	Max	74VHC $T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions	
V_{IH}	High Level Input Voltage	2.0	1.50			1.50		V		
		3.0–5.5	0.7 V_{CC}			0.7 V_{CC}				
V_{IL}	Low Level Input Voltage	2.0			0.50		0.50	V		
		3.0–5.5			0.3 V_{CC}		0.3 V_{CC}			
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50\ \mu A$
		3.0	2.9	3.0		2.9				
		4.5	4.4	4.5		4.4				
		3.0	2.58			2.48		V		$I_{OH} = -4$ mA
		4.5	3.94			3.80				$I_{OH} = -8$ mA
V_{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1	V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50\ \mu A$
		3.0		0.0	0.1		0.1			
		4.5		0.0	0.1		0.1			
		3.0			0.36		0.44	V		$I_{OL} = 4$ mA
		4.5			0.36		0.44			$I_{OL} = 8$ mA
I_{OZ}	TRI-STATE Output Off-State Current	5.5			±0.25		±2.5	μA	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND	
I_{IN}	Input Leakage Current	0–5.5			±0.1		±1.0	μA	$V_{IN} = 5.5V$ or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0		40.0	μA	$V_{IN} = V_{CC}$ or GND	

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DC Characteristics for 'VHC Family Devices: See Section 2 for Waveforms (Continued)

Symbol	Parameter	Vcc (V)	74VHC TA = 25°C		74VHC TA = −40°C to +85°C	Units	Conditions	Fig. No.
			Typ	Limits	Limits			
V_{OLP}**	Quiet Output Maximum Dynamic V_{OL}	5.0	0.5	0.8		V	C_L = 50 pF	2-11, 12
V_{OLV}**	Quiet Output Minimum Dynamic V_{OL}	5.0	−0.5	−0.8		V	C_L = 50 pF	2-11, 12
V_{IHD}**	Minimum High Level Dynamic Input Voltage	5.0		3.5		V	C_L = 50 pF	2-11, 12
V_{ILD}**	Maximum High Level Dynamic Input Voltage	5.0		1.5		V	C_L = 50 pF	2-11, 12

**Parameter guaranteed by design.

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AC Electrical Characteristics for 'VHC Family Devices: See Section 2 for Waveforms

Symbol	Parameter	V_{CC} (V)	74VHC $T_A = 25°C$ Min	Typ	Max	74VHC $T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions		Fig. No.
t_{PLH}, t_{PHL}	Propagation Delay Time	3.3 ± 0.3		5.0	7.0	1.0	8.5	ns		$C_L = 15\,pF$	2-5
				7.5	10.5	1.0	12.0			$C_L = 50\,pF$	
		5.0 ± 0.5		3.5	5.0	1.0	6.0	ns		$C_L = 15\,pF$	
				5.0	7.0	1.0	8.0			$C_L = 50\,pF$	
t_{PZL}, t_{PZH}	TRI-STATE Output Enable Time	3.3 ± 0.3		6.8	10.5	1.0	12.5	ns	$R_L = 1\,k\Omega$	$C_L = 15\,pF$	2-7, 8
				9.3	14.0	1.0	16.0			$C_L = 50\,pF$	
		5.0 ± 0.5		4.7	7.2	1.0	8.5	ns		$C_L = 15\,pF$	
				6.2	9.2	1.0	10.5			$C_L = 50\,pF$	
t_{PLZ}, t_{PHZ}	TRI-STATE Output Disable Time	3.3 ± 0.3		11.2	15.4	1.0	17.5	ns	$R_L = 1\,k\Omega$	$C_L = 50\,pF$	2-7, 8
		5.0 ± 0.5		6.0	8.8	1.0	10.0			$C_L = 50\,pF$	
t_{OSLH}, t_{OSHL}	Output to Output Skew	3.3 ± 0.3			1.5		1.5	ns	(Note 1)	$C_L = 50\,pF$	
		5.0 ± 0.5			1.0		1.0			$C_L = 50\,pF$	
C_{IN}	Input Capacitance			4	10		10	pF	$V_{CC} = $ Open		
C_{OUT}	Output Capacitance			6				pF	$V_{CC} = 5.0V$		
C_{PD}	Power Dissipation Capacitance			18				pF	(Note 2)		

Note 1: Parameter guaranteed by design. $t_{OSLH} = |t_{PLHmax} - t_{PLHmin}|$; $t_{OSHL} = |t_{PHLmax} - t_{PHLmin}|$.

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

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