National Semiconductor

54VHC/74VHC240 • 54VHCT/74VHCT240
Octal Buffer/Line Driver with TRI-STATE® Outputs

General Description

The 'VHC/'VHCT240 is an advanced high speed CMOS octal bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The 'VHC/'VHCT240 is an inverting TRI-STATE buffer having two active-low output enables. These devices are designed to drive buslines or buffer memory address registers.

An input protection circuit ensures 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

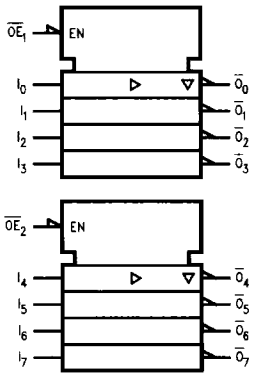
- High speed: t_{PD} = 3.9 ns (typ.) at V_{CC} = 5V
- Low power dissipation: I_{CC} = 4 μA (max) at T_A = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)
- All inputs are equipped with a power down protection function
- Balanced propagation delays: $t_{PLH} \cong t_{PHL}$
- Wide operating voltage range: V_{CC} (opr) = 2V ~ 5.5V
- Low noise: V_{OLP} = 0.8V (max)
- Pin and function compatible with 74HC/HCT240

NOTE: 'VHCT SPECIFICATIONS ARE PRELIMINARY
MILITARY SPECIFICATIONS ARE PRELIMINARY

Ordering Code: See Section 5

Logic Symbol

IEEE/IEC



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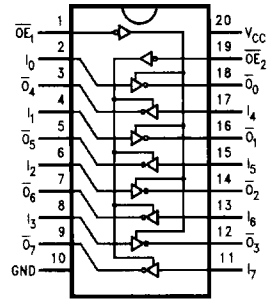
Connection Diagrams

Pin Assignment for DIP, Flatpack, SSOP and SOIC



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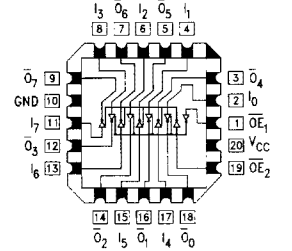
Pin Assignment for LCC



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Pin Names	Description
$\overline{OE}_1$, $\overline{OE}_2$	TRI-STATE Output Enable Inputs
I_0–I_7	Inputs
$\overline{O}_0$–$\overline{O}_7$	Outputs TRI-STATE Outputs

Truth Tables

Inputs		Outputs (Pins 12, 14, 16, 18)
$\overline{OE}_1$	I_n	
L	L	H
L	H	L
H	X	Z

Inputs		Outputs (Pins 3, 5, 7, 9)
$\overline{OE}_1$	I_n	
L	L	H
L	H	L
H	X	Z

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

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})	
VHC	−0.5V to V_{CC} + 0.5V
VHCT*	−0.5V to +7.0V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	
VHC	±20 mA
VHCT	−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

*V_{OUT} > V_{CC} only if output is in H or Z state.

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})	
VHC	2.0V to 5.5V
VHCT	4.5V to 5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	
54VHC/VHCT	−55°C to +125°C
74VHC/VHCT	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} = 3.3V ±0.3V (VHC only)	0 ns/V ~ 100 ns/V
V_{CC} = 5.0V ±0.5V	0 ns/V ~ 20 ns/V

DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V_{CC} (V)	74VHC T_A = 25°C Min	74VHC T_A = 25°C Typ	74VHC T_A = 25°C Max	54VHC T_A = −55°C to +125°C Min	54VHC T_A = −55°C to +125°C Max	74VHC T_A = −40°C to +85°C Min	74VHC T_A = −40°C to +85°C Max	Units	Conditions	
V_{IH}	High Level Input Voltage	2.0	1.50			1.50		1.50		V		
		3.0–5.5	0.7 V_{CC}			0.7 V_{CC}		0.7 V_{CC}				
V_{IL}	Low Level Input Voltage	2.0			0.50		0.50		0.50	V		
		3.0–5.5			0.3 V_{CC}		0.3 V_{CC}		0.3 V_{CC}			
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		1.9		V	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50 μA
		3.0	2.9	3.0		2.9		2.9				
		4.5	4.4	4.5		4.4		4.4				
		3.0	2.58			2.40		2.48		V		I_{OH} = −4 mA
		4.5	3.94			3.70		3.80				I_{OH} = −8 mA
V_{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1		0.1	V	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA
		3.0		0.0	0.1		0.1		0.1			
		4.5		0.0	0.1		0.1		0.1			
		3.0			0.36		0.50		0.44	V		I_{OL} = 4 mA
		4.5			0.36		0.50		0.44			I_{OL} = 8 mA
I_{OZ}	TRI-STATE Output Off-State Current	5.5			±0.25		±10.0		±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		±1.0	μA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0		160.0		40.0	μA	V_{IN} = V_{CC} or GND	

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

Symbol	Parameter	V_{CC} (V)	74VHC $T_A = 25°C$ Typ	74VHC $T_A = 25°C$ Limits	54VHC $T_A = -55°C$ to $+125°C$ Limits	74VHC $T_A = -40°C$ to $+85°C$ Limits	Units	Conditions	Fig. No.
**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 Low Level Dynamic Input Voltage	5.0		1.5			V	$C_L = 50$ pF	2-11, 12

**Parameter guaranteed by design.

DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V_{CC} (V)	74VHCT $T_A = 25°C$ Min	Typ	Max	54VHCT $T_A = -55°C$ to $+125°C$ Min	Max	74VHCT $T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions	
V_{IH}	High Level Input Voltage	4.5 5.5	2.0 2.0					2.0 2.0		V		
V_{IL}	Low Level Input Voltage	4.5 5.5			0.8 0.8				0.8 0.8	V		
V_{OH}	High Level Output Voltage	4.5	3.15	3.65				3.15		V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50\ \mu A$
		4.5	2.5					2.4		V		$I_{OH} = -8$ mA
V_{OL}	Low Level Output Voltage	4.5		0.0	0.1				0.1	V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = 50\ \mu A$
		4.5			0.36				0.44	V		$I_{OH} = 8$ 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	$V_{IN} = 5.5$V or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0				40.0	μA	$V_{IN} = V_{CC}$ or GND	
I_{CCT}	Maximum I_{CC}/Input	5.5			1.35				1.50	mA	$V_{IN} = 3.4$V, Other Inputs = V_{CC} or GND	
I_{OPD}	Output Leakage Current (Power Down State)	0.0			+0.5				+5.0	μA	$V_{OUT} = 5.5$V	

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

Symbol	Parameter	V_{CC} (V)	74VHCT $T_A = 25°C$ Typ	74VHCT $T_A = 25°C$ Limits	54VHCT $T_A = -55°C$ to $+125°C$ Limits	74VHCT $T_A = -40°C$ to $+85°C$ Limits	Units	Conditions	Fig. No.
**V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	5.0					V	C_L = 50 pF	2-11, 12
**V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	5.0					V	C_L = 50 pF	2-11, 12
**V_{IHD}	Minimum High Level Dynamic Input Voltage	5.0					V	C_L = 50 pF	2-11, 12
**V_{ILD}	Maximum Low Level Dynamic Input Voltage	5.0					V	C_L = 50 pF	2-11, 12

**Parameter guaranteed by design.

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	54VHC $T_A = -55°C$ to $+125°C$ Min	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		5.3	7.5			1.0	9.0	ns		C_L = 15 pF	2-5
				7.8	11.0			1.0	12.5			C_L = 50 pF	
		5.0 ±0.5		3.6	5.5			1.0	6.5	ns		C_L = 15 pF	2-5
				5.1	7.5			1.0	8.5			C_L = 50 pF	
t_{PZL} t_{PZH}	TRI-STATE Output Enable Time	3.3 ±0.3		6.6	10.6			1.0	12.5	ns	R_L = 1 kΩ	C_L = 15 pF	2-7, 8
				9.1	14.1			1.0	16.0			C_L = 50 pF	
		5.0 ±0.5		4.7	7.3			1.0	8.5	ns		C_L = 15 pF	2-7, 8
				6.2	9.3			1.0	10.5			C_L = 50 pF	
t_{PLZ} t_{PHZ}	TRI-STATE Output Disable Time	3.3 ±0.3		10.3	14.0			1.0	16.0	ns	R_L = 1 kΩ	C_L = 50 pF	2-7, 8
		5.0 ±0.5		6.7	9.2			1.0	10.5			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			17						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} * V_{CC} * f_{IN} + $I_{CC}/8$ (per bit).

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

Symbol	Parameter	V_{CC} (V)	74VHCT $T_A = 25°C$ Min	Typ	Max	54VHCT $T_A = -55°C$ to $+125°C$ Min	Max	74VHCT $T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions		Fig. No.
t_{PLH} t_{PHL}	Propagation Delay Time	5.0 ±0.5								ns		$C_L = 15$ pF	2-5
												$C_L = 50$ pF	
t_{PZL} t_{PZH}	TRI-STATE Output Enable Time	5.0 ±0.5								ns	$R_L = 1$ kΩ	$C_L = 15$ pF	2-7, 8
												$C_L = 50$ pF	
t_{PLZ} t_{PHZ}	TRI-STATE Output Disable Time	5.0 ±0.5								ns	$R_L = 1$ kΩ	$C_L = 50$ pF	2-7, 8
t_{OSLH} t_{OSHL}	Output to Output Skew	5.0 ±0.5								ns	(Note 1)	$C_L = 50$ pF	
C_{IN}	Input Capacitance									pF	V_{CC} = Open		
C_{OUT}	Output Capacitance									pF	$V_{CC} = 5.0$V		
C_{PD}	Power Dissipation Capacitance									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.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$ (per bit).