MC74VHCT126A

Quad Bus Buffer

with 3−State Control Inputs

The MC74VHCT126A is a high speed CMOS quad bus buffer fabricated with silicon gate CMOS technology. It achieves noninverting high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The MC74VHCT126A requires the 3−state control input (OE) to be set Low to place the output into high impedance.

The VHCT inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3 V to 5.0 V, because it has full 5.0 V CMOS level output swings.

The VHCT126A input structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. The output structures also provide protection when V_{CC} = 0 V. These input and output structures help prevent device destruction caused by supply voltage − input/output voltage mismatch, battery backup, hot insertion, etc.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

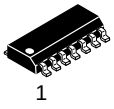
Features

- High Speed: t_{PD} = 3.8 ns (Typ) at V_{CC} = 5.0 V
- Low Power Dissipation: I_{CC} = 4.0 μA (Max) at T_A = 25°C
- TTL−Compatible Inputs: V_{IL} = 0.8 V; V_{IH} = 2.0 V
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise: V_{OLP} = 0.8 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: HBM > 2000 V; Machine Model > 200 V
- Chip Complexity: 72 FETs or 18 Equivalent Gates
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

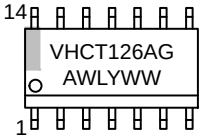
ON Semiconductor®

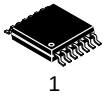
www.onsemi.com

MARKING DIAGRAMS

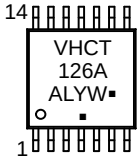


SOIC−14
D SUFFIX
CASE 751A





TSSOP−14
DT SUFFIX
CASE 948G



A = Assembly Location
WL, L = Wafer Lot
Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package

(Note: Microdot may be in either location)

See Applications Note #AND8004/D for date code and traceability information.

FUNCTION TABLE

VHCT126A		
Inputs		**Outputs**
A	OE	Y
H	H	H
L	H	L
X	L	Z

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

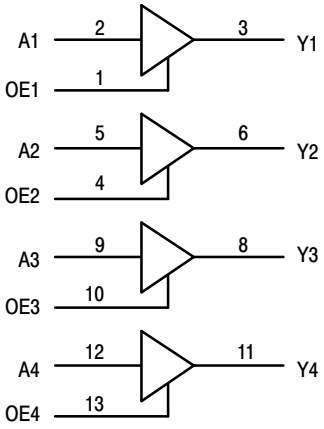


Figure 1. LOGIC DIAGRAM
Active−High Output Enables

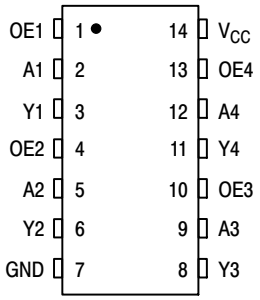


Figure 2. PIN ASSIGNMENT

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
DC Supply Voltage		V_{CC}	– 0.5 to + 7.0	V
DC Input Voltage		V_{in}	– 0.5 to + 7.0	V
DC Output Voltage	Output in 3−State High or Low State	V_{out}	– 0.5 to + 7.0 – 0.5 to V_{CC} + 0.5	V
Input Diode Current		I_{IK}	− 20	mA
Output Diode Current (V_{OUT} < GND; V_{OUT} > V_{CC})		I_{OK}	± 20	mA
DC Output Current, per Pin		I_{out}	± 25	mA
DC Supply Current, V_{CC} and GND Pins		I_{CC}	± 75	mA
Power Dissipation in Still Air,	SOIC Packages† TSSOP Package†	P_D	500 450	mW
Storage Temperature		T_{stg}	– 65 to + 150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
†Derating — SOIC Packages: – 7 mW/°C from 65° to 125°C
TSSOP Package: − 6.1 mW/°C from 65° to 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high−impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range GND ≤ (V_{in} or V_{out}) ≤ V_{CC}.
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

RECOMMENDED OPERATING CONDITIONS

Parameter		Symbol	Min	Max	Unit
DC Supply Voltage		V_{CC}	4.5	5.5	V
DC Input Voltage		V_{in}	0	5.5	V
DC Output Voltage	Output in 3−State High or Low State	V_{out}	0 0	5.5 V_{CC}	V
Operating Temperature		T_A	− 40	+ 85	°C
Input Rise and Fall Time	V_{CC} = 5.0 V ±0.5 V	t_r, t_f	0	20	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

Parameter	Test Conditions	Symbol	V_{CC} (V)	T_A = 25°C			$T_A \le 85°C$		$T_A \le 125°C$		Unit
				Min	Typ	Max	Min	Max	Min	Max	
Minimum High−Level Input Voltage		V_{IH}	3.0 4.5 5.5	1.2 2.0 2.0			1.2 2.0 2.0		1.2 2.0 2.0		V
Maximum Low−Level Input Voltage		V_{IL}	3.0 4.5 5.5			0.53 0.8 0.8		0.53 0.8 0.8		0.53 0.8 0.8	V
Minimum High−Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL}	$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -50$ μA	V_{OH}	3.0 4.5	2.9 4.4	3.0 4.5		2.9 4.4		2.9 4.4		V
	$V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -4.0$ mA $I_{OH} = -8.0$ mA		3.0 4.5	2.58 3.94			2.48 3.80		2.34 3.66		
Maximum Low−Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL}	$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 50$ μA	V_{OL}	3.0 4.5		0.0 0.0	0.1 0.1		0.1 0.1		0.1 0.1	V
	$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 4.0$ mA $I_{OL} = 8.0$ mA		3.0 4.5			0.36 0.36		0.44 0.44		0.52 0.52	
Maximum Input Leakage Current	$V_{IN} = 5.5$ V or GND	I_{IN}	0 to 5.5			± 0.1		± 1.0		± 1.0	μA
Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	I_{CC}	5.5			2.0		20		40	μA
Quiescent Supply Current	Input: $V_{IN} = 3.4$ V	I_{CCT}	5.5			1.35		1.50		1.65	mA
Maximum 3−State Leakage Current	$V_{IN} = V_{IH}$ or V_I $V_{OUT} = V_{CC}$ or GND	I_{OZ}	5.5			±0.25		±2.5		±2.5	μA
Output Leakage Current	$V_{OUT} = 5.5$ V	I_{OPD}	0.0			0.5		5.0		10	μA

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Parameter	Test Conditions	Symbol	T_A = 25°C			T_A = ≤ 85°C		$T_A \le 125°C$		Unit
			Min	Typ	Max	Min	Max	Min	Max	
Maximum Propagation Delay, A to Y	$V_{CC} = 3.3 \pm 0.3$ V $C_L = 15$ pF $C_L = 50$ pF	t_{PLH}, t_{PHL}		5.6 8.1	8.0 11.5	1.0 1.0	9.5 13.0		12.0 16.0	ns
	$V_{CC} = 5.0 \pm 0.5$ V $C_L = 15$ pF $C_L = 50$ pF			3.8 5.3	5.5 7.5	1.0 1.0	6.5 8.5		8.5 10.5	
Maximum Output Enable TIme, $\overline{OE}$ to Y	$V_{CC} = 3.3 \pm 0.3$ V $C_L = 15$ pF $R_L = 1.0$ kΩ $C_L = 50$ pF	t_{PZL}, t_{PZH}		5.4 7.9	8.0 11.5	1.0 1.0	9.5 13.0		11.5 15.0	ns
	$V_{CC} = 5.0 \pm 0.5$ V $C_L = 15$ pF $R_L = 1.0$ kΩ $C_L = 50$ pF			3.6 5.1	5.1 7.1	1.0 1.0	6.0 8.0		7.5 9.5	
Maximum Output Disable Time, $\overline{OE}$ to Y	$V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF $R_L = 1.0$ kΩ	t_{PLZ}, t_{PHZ}		9.5	13.2	1.0	15.0		18.0	ns
	$V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF $R_L = 1.0$ kΩ			6.1	8.8	1.0	10.0		12.0	
Output−to−Output Skew	$V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF (Note 1)	t_{OSLH}, t_{OSHL}			1.5		1.5		2.0	ns
	$V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF (Note 1)				1.0		1.0		1.5	
Maximum Input Capacitance		C_{in}		4	10		10		10	pF
Maximum Three−State Output Capacitance (Output in High Impedance State)		C_{out}		6						pF
			Typical @ 25°C, V_{CC} = 5.0V							
Power Dissipation Capacitance (Note 2)		C_{PD}	15							pF

1. Parameter guaranteed by design. $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$.
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: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/4$ (per buffer). C_{PD} is used to determine the no−load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ns, $C_L = 50$pF, $V_{CC} = 5.0$V)

Characteristic	Symbol	$T_A = 25°C$		Unit
		Typ	Max	
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	0.3	0.8	V
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	− 0.3	− 0.8	V
Minimum High Level Dynamic Input Voltage	V_{IHD}		3.5	V
Maximum Low Level Dynamic Input Voltage	V_{ILD}		1.5	V

SWITCHING WAVEFORMS

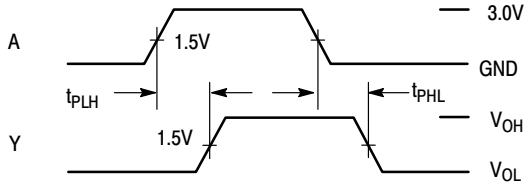


Figure 3.

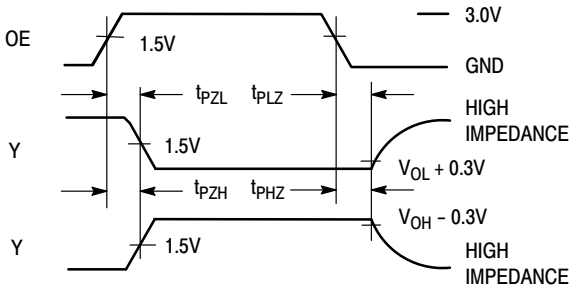
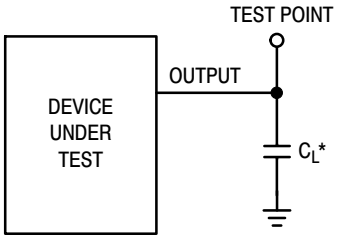
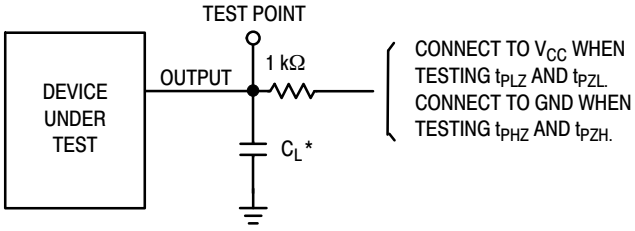


Figure 4.



*Includes all probe and jig capacitance

Figure 5. Test Circuit



*Includes all probe and jig capacitance

Figure 6. Test Circuit

ORDERING INFORMATION

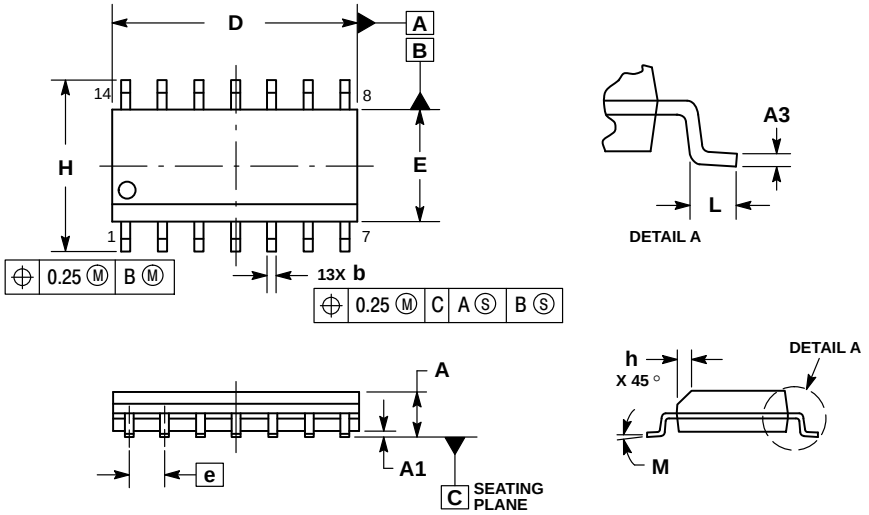
Device	Package	Shipping†
MC74VHCT126ADR2G	SOIC−14 (Pb−Free)	2500 / Tape & Reel
M74VHCT126ADTR2G	TSSOP−14 (Pb−Free)	2500 / Tape & Reel
NLVVHCT126ADTR2G*	TSSOP−14 (Pb−Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.

PACKAGE DIMENSIONS

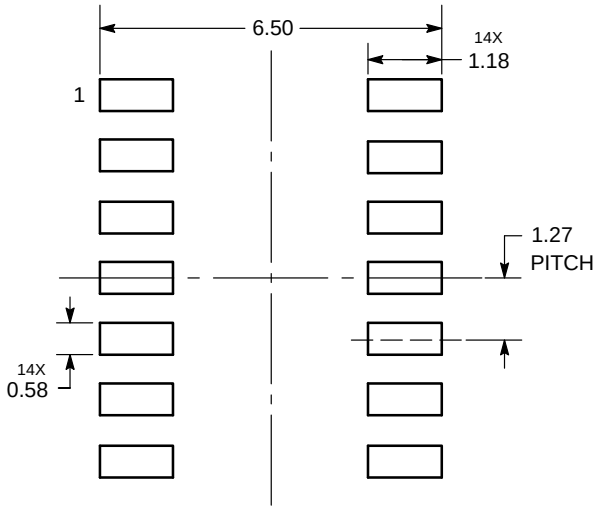
SOIC−14
CASE 751A−03
ISSUE K



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0 °	7 °	0 °	7 °

SOLDERING FOOTPRINT*

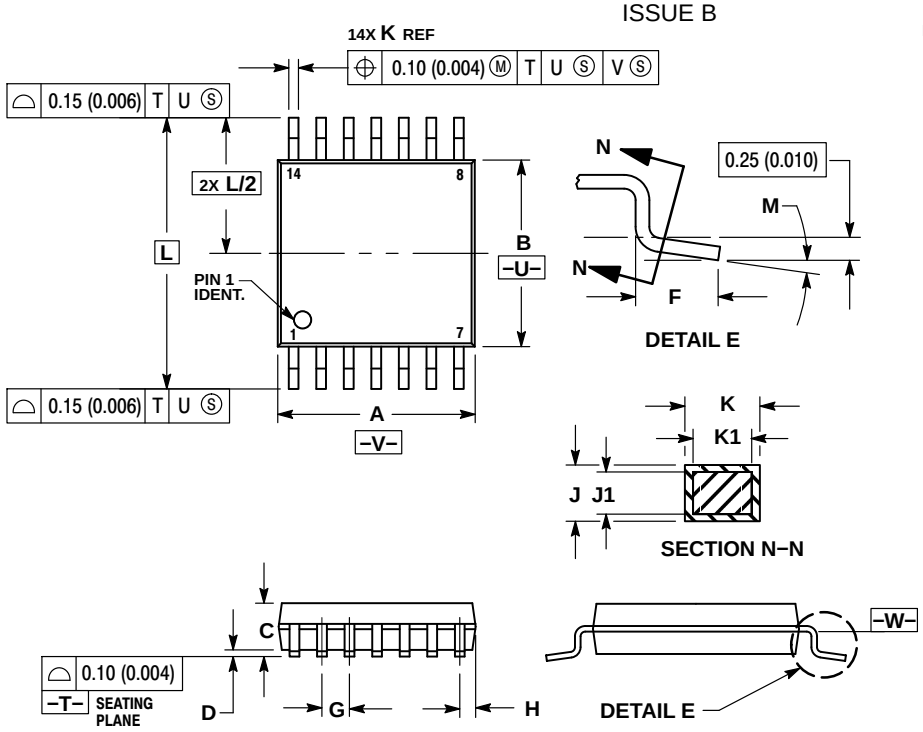


DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

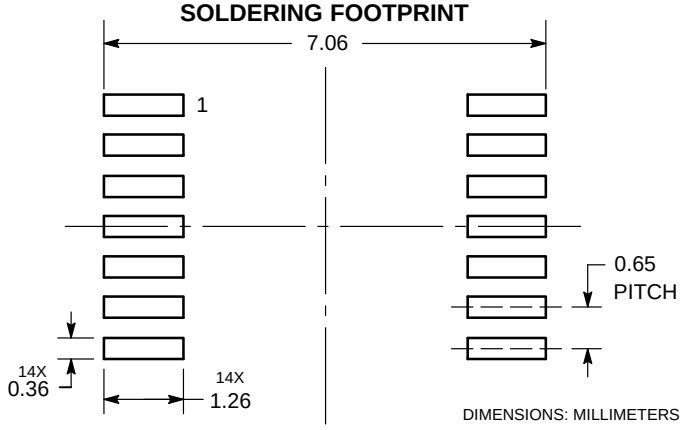
TSSOP−14
DT SUFFIX
CASE 948G
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative