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
- These Devices are Pb−Free and are RoHS Compliant

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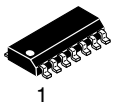
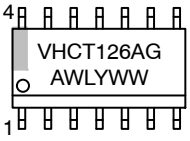
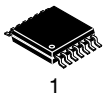
MARKING DIAGRAMS

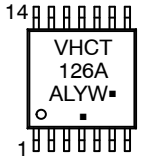


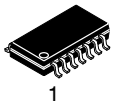
SOIC−14
D SUFFIX
CASE 751A



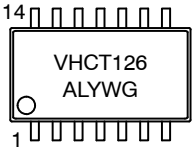


TSSOP−14
DT SUFFIX
CASE 948G





SOEIAJ−14
M SUFFIX
CASE 965



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

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.

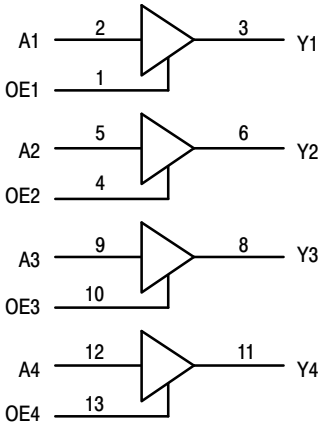


Figure 1. LOGIC DIAGRAM
Active–High Output Enables

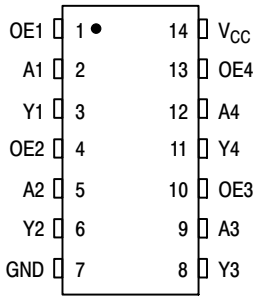


Figure 2. PIN ASSIGNMENT

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 Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†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

DC ELECTRICAL CHARACTERISTICS

Parameter	Test Conditions	Symbol	V_{CC} (V)	T_A = 25°C Min	T_A = 25°C Typ	T_A = 25°C Max	$T_A \le 85°C$ Min	$T_A \le 85°C$ Max	$T_A \le 125°C$ Min	$T_A \le 125°C$ Max	Unit
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			±0.2 5		±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 Min	T_A = 25°C Typ	T_A = 25°C Max	T_A = ≤ 85°C Min	T_A = ≤ 85°C Max	$T_A \le 125°C$ Min	$T_A \le 125°C$ Max	Unit
Maximum Propagation Delay, A to Y	V_{CC} = 3.3 ± 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 ± 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 ± 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 ± 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 ± 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 ± 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 ± 0.3 V C_L = 50 pF (Note 1)	t_{OSLH}, t_{OSHL}			1.5		1.5		2.0	ns
	V_{CC} = 5.0 ± 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} • V_{CC} • f_{in} + I_{CC}/4 (per buffer). C_{PD} is used to determine the no−load dynamic power consumption; P_D = C_{PD} • V_{CC}^2 • f_{in} + I_{CC} • 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

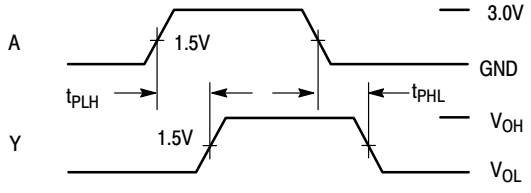


Figure 3.

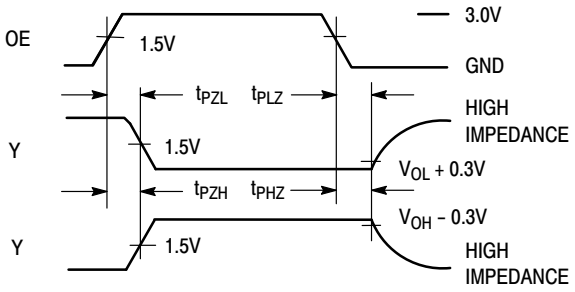
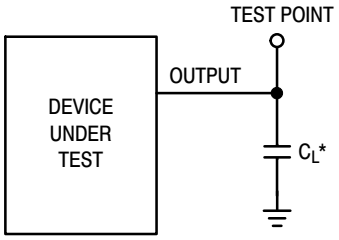
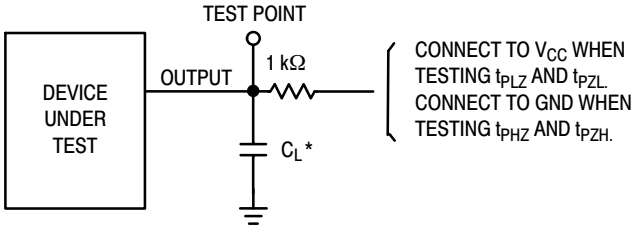


Figure 4.



*Includes all probe and jig capacitance

Figure 5. Test Circuit



*Includes all probe and jig capacitance

Figure 6. Test Circuit

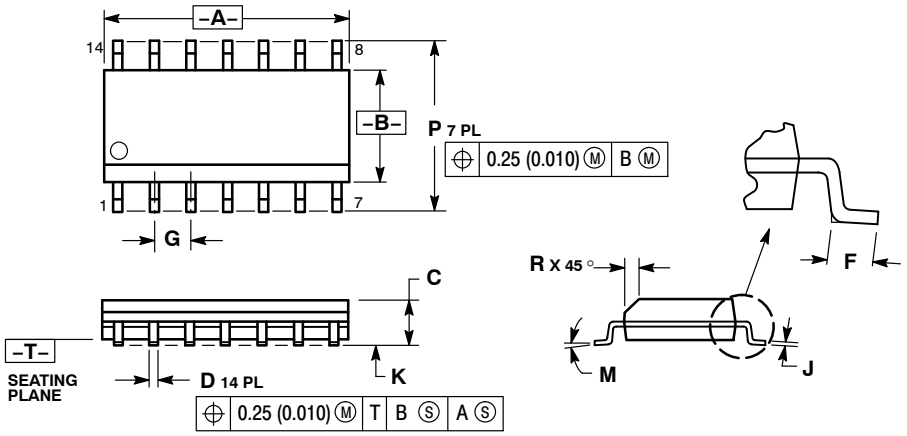
ORDERING INFORMATION

Device	Package	Shipping†
M74VHCT126ADTR2G	SOIC–14 (Pb–Free)	2500 / Tape & Reel
MC74VHCT126AMG	SOEIAJ–14 (Pb–Free)	50 Units / Rail
MC74VHCT126AMELG	SOEIAJ–14 (Pb–Free)	2000 / Tape & Reel
MC74VHCT126ADTRG	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.
*This package is inherently Pb–Free.

PACKAGE DIMENSIONS

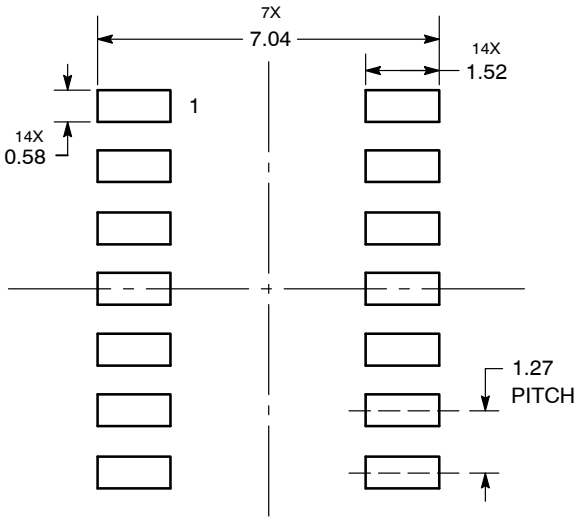
SOIC−14
D SUFFIX
CASE 751A−03
ISSUE J



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

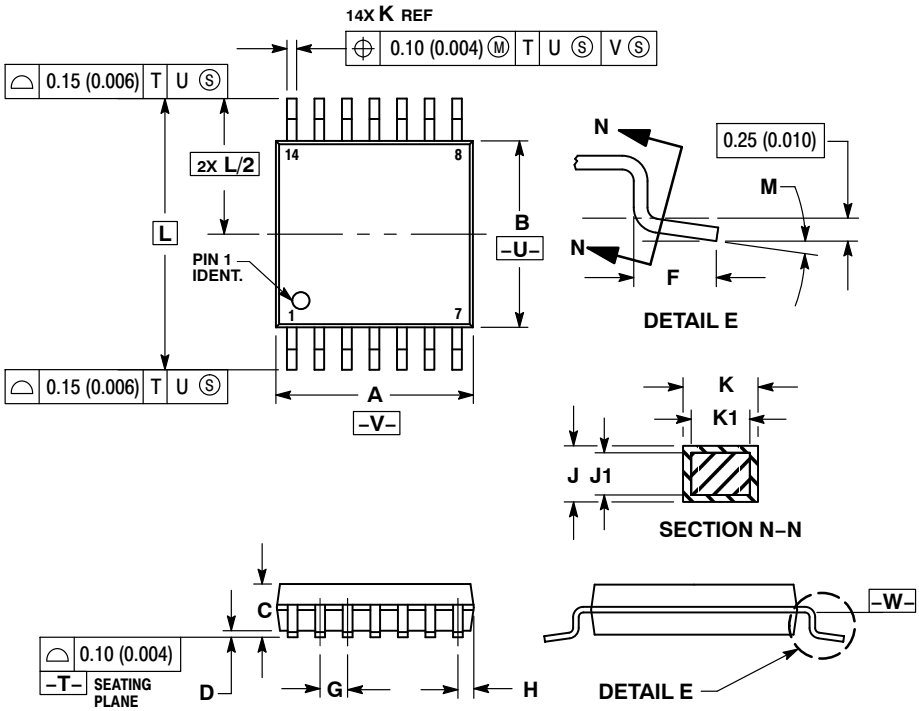
SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

PACKAGE DIMENSIONS

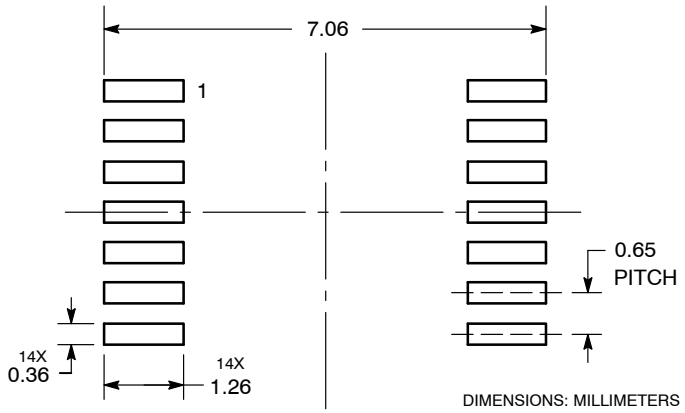
TSSOP−14
DT SUFFIX
CASE 948G−01
ISSUE B



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 °

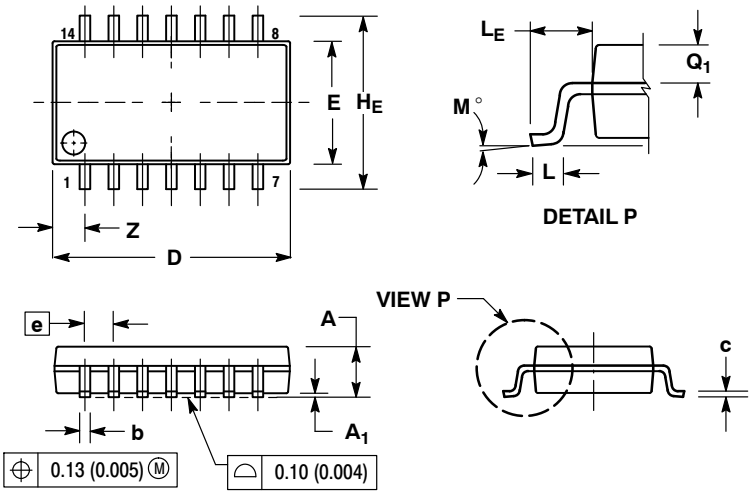
SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

PACKAGE DIMENSIONS

SOEIAJ−14
M SUFFIX
CASE 965−01
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.10	0.20	0.004	0.008
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 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
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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

MC74VHCT126A/D