

# MC74VHCT257A

## Quad 2-Channel Multiplexer with 3-State Outputs

The MC74VHCT257A is an advanced high speed CMOS quad 2-channel multiplexer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

It consists of four 2-input digital multiplexers with common select (S) and enable ( $\overline{OE}$ ) inputs. When ( $\overline{OE}$ ) is held High, selection of data is inhibited and all the outputs go Low.

The select decoding determines whether the A or B inputs get routed to the corresponding Y outputs.

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 VHCT257A 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 buffered 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

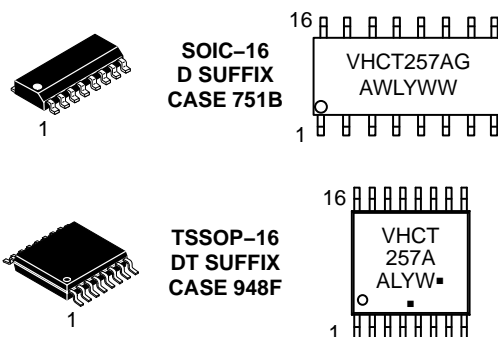
- High Speed:  $t_{PD} = 4.1$  ns (Typ) at  $V_{CC} = 5.0$  V
- Low Power Dissipation:  $I_{CC} = 4.0$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- TTL-Compatible Inputs:  $V_{IL} = 0.8$  V;  $V_{IH} = 2.0$  V
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Designed 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:
  - Human Body Model > 2000 V;
  - Machine Model > 200 V
- These Devices are Pb-Free and are RoHS Compliant



ON Semiconductor®

<http://onsemi.com>

### MARKING DIAGRAMS



A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW, W = Work Week  
G or  $\blacksquare$  = Pb-Free Package  
(Note: Microdot may be in either location)

### FUNCTION TABLE

Inputs		Outputs Y0 – Y3
$\overline{OE}$	S	
H	X	Z
L	L	A0–A3
L	H	B0–B3

A0 – A3, B0 – B3 = the levels of the respective Data–Word Inputs.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# MC74VHCT257A

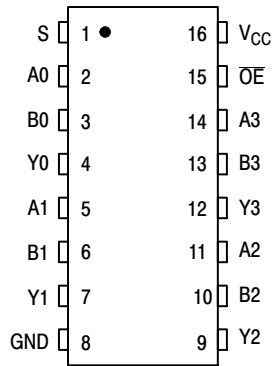


Figure 1. Pin Assignment

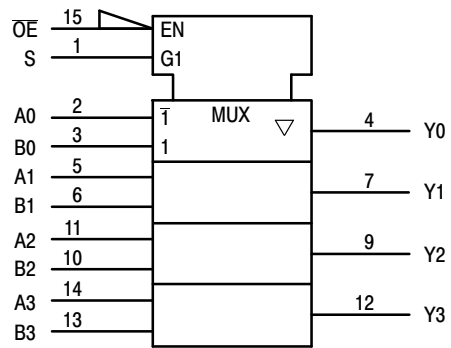


Figure 2. IEC Logic Symbol

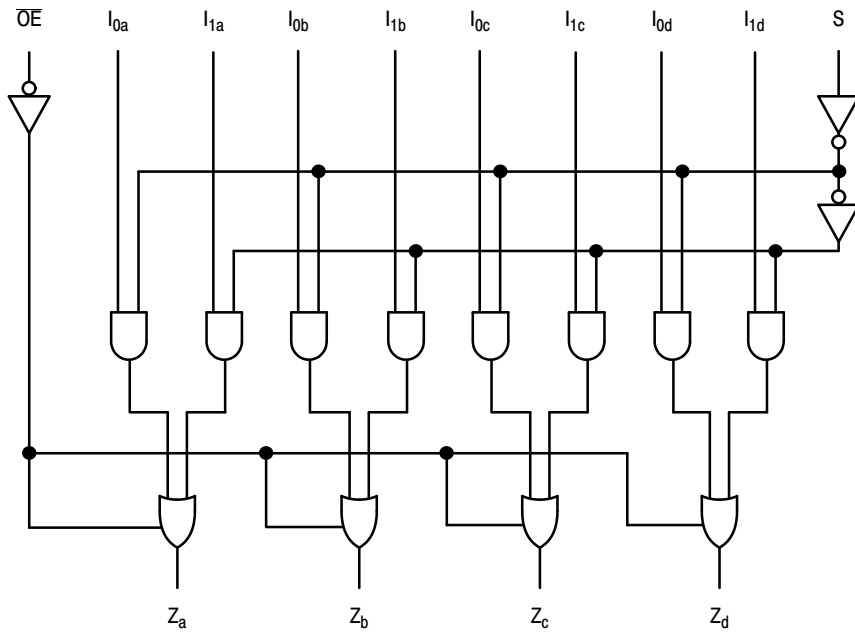


Figure 3. Expanded Logic Diagram

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  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . 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.

# MC74VHCT257A

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	Positive DC Supply Voltage	-0.5 to +7.0	V
$V_{IN}$	Digital Input Voltage	-0.5 to +7.0	V
$V_{OUT}$	DC Output Voltage Output in 3-State High or Low State	-0.5 to +7.0 -0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	Input Diode Current	-20	mA
$I_{OK}$	Output Diode Current	$\pm 20$	mA
$I_{OUT}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 75$	mA
$P_D$	Power Dissipation in Still Air SOIC TSSOP	200 180	mW
$T_{STG}$	Storage Temperature Range	-65 to +150	°C
$V_{ESD}$	ESD Withstand Voltage Human Body Model (Note 1) Machine Model (Note 2) Charged Device Model (Note 3)	>2000 >200 >2000	V
$I_{LATCHUP}$	Latchup Performance Above $V_{CC}$ and Below GND at 125°C (Note 4)	$\pm 300$	mA
$\theta_{JA}$	Thermal Resistance, Junction-to-Ambient SOIC TSSOP	143 164	°C/W

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.

1. Tested to EIA/JESD22-A114-A
2. Tested to EIA/JESD22-A115-A
3. Tested to JESD22-C101-A
4. Tested to EIA/JESD78

## RECOMMENDED OPERATING CONDITIONS

Symbol	Characteristics	Min	Max	Unit
$V_{CC}$	DC Supply Voltage	4.5	5.5	V
$V_{IN}$	DC Input Voltage	0	5.5	V
$V_{OUT}$	DC Output Voltage	0	5.5	V
$T_A$	Operating Temperature Range, all Package Types	-55	125	°C
$t_r, t_f$	Input Rise or Fall Time $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	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.

## DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

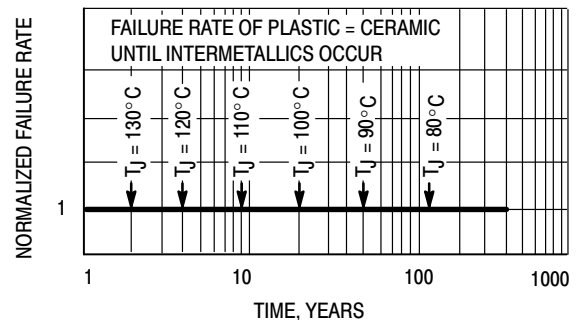


Figure 4. Failure Rate vs. Time Junction Temperature

# MC74VHCT257A

## DC CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> ≤ 85°C		-55°C ≤ T <sub>A</sub> ≤ 125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V <sub>IH</sub>	Minimum High-Level Input Voltage		4.5 to 5.5	2			2		2		V
V <sub>IL</sub>	Maximum Low-Level Input Voltage		4.5 to 5.5			0.8		0.8		0.8	V
V <sub>OH</sub>	Maximum High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -50 μA	4.5	3.94			3.8		3.66		V
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -8 mA	4.5	3.94			3.8		3.66		
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 50 μA	4.5		0	0.1		0.1		0.1	V
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = 8 mA	4.5			0.36		0.44		0.52	
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I <sub>OZ</sub>	Maximum 3-State Leakage Current	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND	5.5			±0.2 5		±2.5		±2.5	μA
I <sub>CCT</sub>	Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5			1.35		1.5		1.65	mA
I <sub>CC</sub>	Additional Quiescent Supply Current (per pin)	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5			4.0		40		40	μA
I <sub>OPD</sub>	Output Leakage Current	V <sub>OUT</sub> = 5.5 V	0			0.5		5		5	μA

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

Symbol	Parameter	Test Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> = ≤ 85°C		-55°C ≤ T <sub>A</sub> ≤ 125°C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, A or B to Y	V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		5.8 8.3	9.3 12.8	1.0 1.0	11.0 14.5	1.0 1.0	11.0 14.5	ns
		V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		3.6 5.1	5.9 7.9	1.0 1.0	7.0 9.0	1.0 1.0	7.0 9.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, S to Y	V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		7.0 9.5	11.0 14.5	1.0 1.0	13.0 16.5	1.0 1.0	13.0 16.5	ns
		V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15 pF C <sub>L</sub> = 50 pF		4.0 5.5	6.8 8.8	1.0 1.0	8.0 10.0	1.0 1.0	8.0 10.0	
t <sub>PZL</sub> , t <sub>PZH</sub>	Maximum Output Enable, Time, $\overline{\text{OE}}$ to Y	V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15 pF R <sub>L</sub> = 1 k $\Omega$ C <sub>L</sub> = 50 pF		6.7 9.2	10.5 14.0	1.0 1.0	12.5 16.0	1.0 1.0	12.5 16.0	ns
		V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15 pF R <sub>L</sub> = 1 k $\Omega$ C <sub>L</sub> = 50 pF		3.6 5.1	6.8 11.0	1.0 12.0	8.0 10.0	1.0 1.0	8.0 12.0	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Maximum Output Disable, Time, $\overline{\text{OE}}$ to Y	V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 50 pF R <sub>L</sub> = 1 k $\Omega$		10.5	14.0	1.0	15.0	1.0	15.0	ns
		V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 50 pF R <sub>L</sub> = 1 k $\Omega$		9.5	12.0	1.0	13.0	1.0	13.0	
C <sub>IN</sub>	Maximum Input Capacitance			4	10		10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	Typical @ 25°C, V <sub>CC</sub> = 5.0 V								pF
		20								

5. C<sub>PD</sub> 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<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no-load dynamic power consumption; P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

## NOISE CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns, C<sub>L</sub> = 50 pF, V<sub>CC</sub> = 5.0 V)

Symbol	Characteristic	T <sub>A</sub> = 25°C		Unit
		Typ	Max	
V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>	0.3	0.8	V
V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	- 0.3	- 0.8	V
V <sub>IHD</sub>	Minimum High Level Dynamic Input Voltage		2.0	V
V <sub>ILD</sub>	Maximum Low Level Dynamic Input Voltage		0.8	V

# MC74VHCT257A

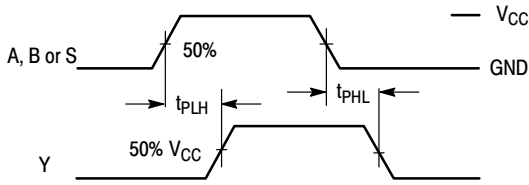


Figure 5. Switching Waveform

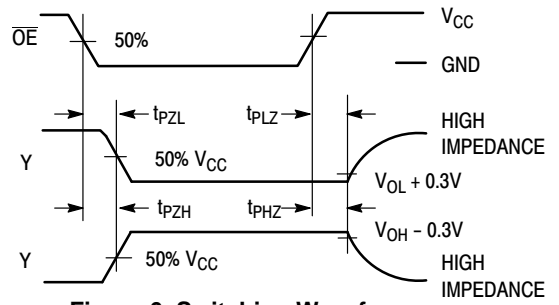
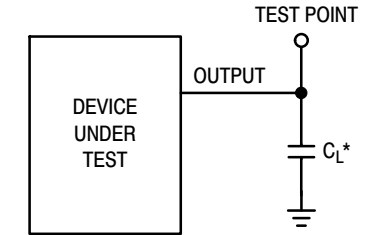
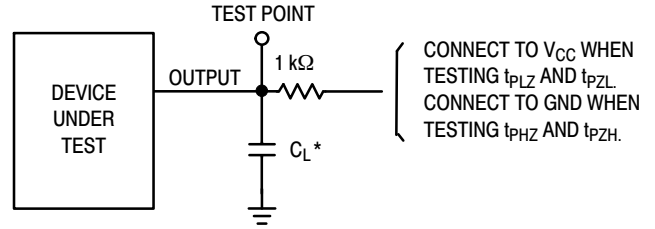


Figure 6. Switching Waveform



\*Includes all probe and jig capacitance

Figure 7. Test Circuit



\*Includes all probe and jig capacitance

Figure 8. Test Circuit

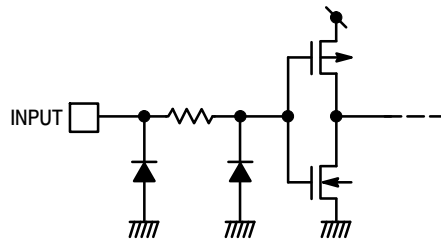


Figure 9. Input Equivalent Circuit

## ORDERING INFORMATION

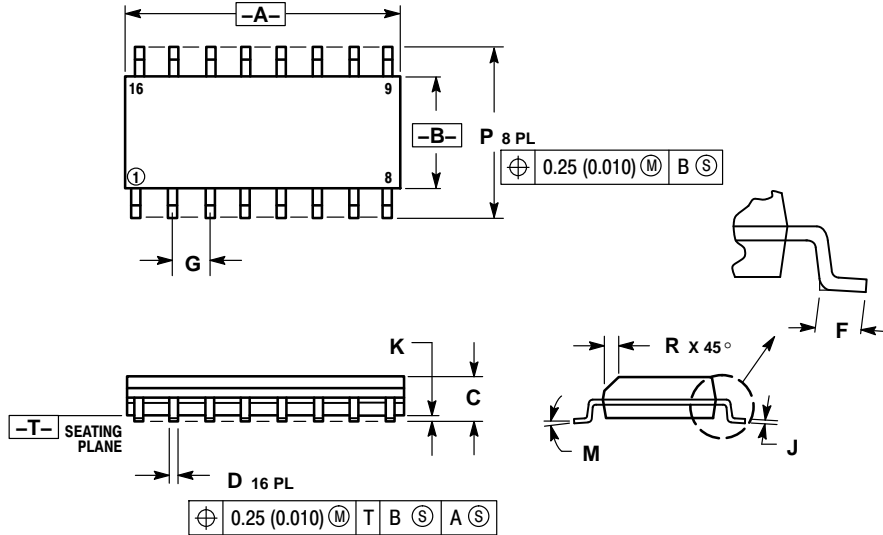
Device	Package	Shipping†
MC74VHCT257ADG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74VHCT257ADR2G	SOIC-16 (Pb-Free)	2500 Tape & Reel
MC74VHCT257ADTG	TSSOP-16 (Pb-Free)	96 Units / Rail
M74VHCT257ADR2G	TSSOP-16 (Pb-Free)	2500 Tape & Reel

†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.

# MC74VHCT257A

## PACKAGE DIMENSIONS

SOIC-16  
D SUFFIX  
CASE 751B-05  
ISSUE K

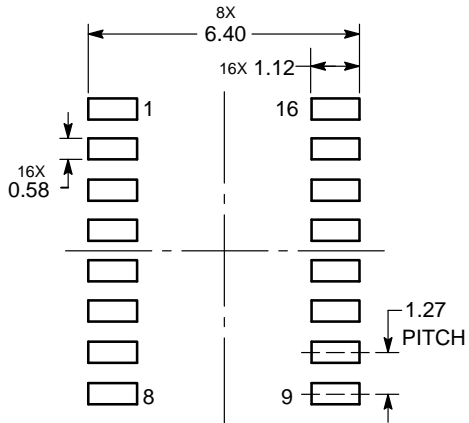


### NOTES:

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.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
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	0.229	0.244
R	0.25	0.50	0.010	0.019

## SOLDERING FOOTPRINT

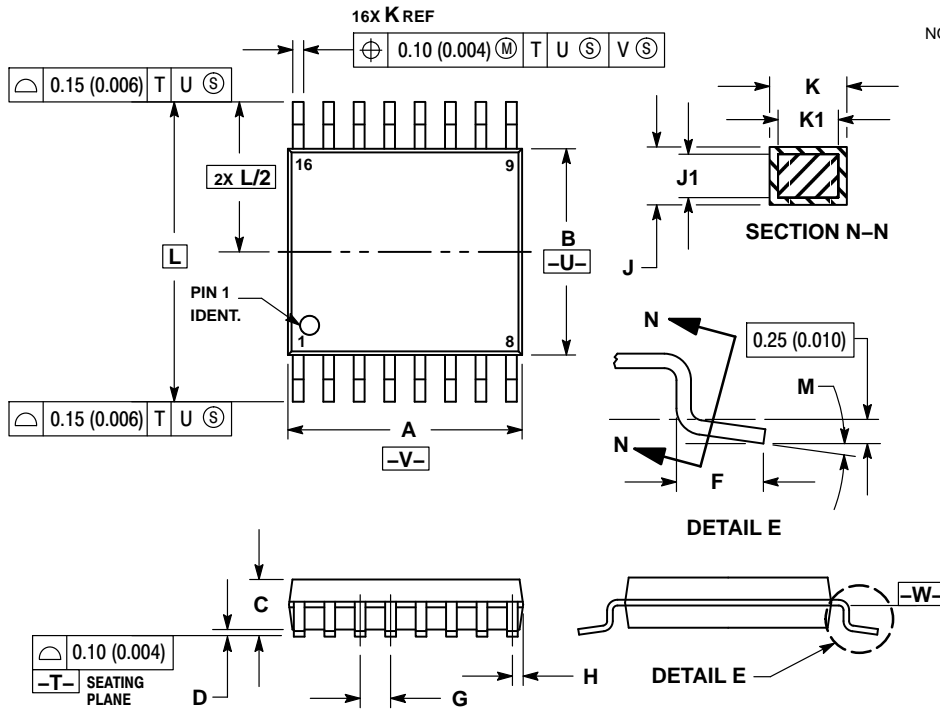


DIMENSIONS: MILLIMETERS

# MC74VHCT257A

## PACKAGE DIMENSIONS

TSSOP-16  
CASE 948F  
ISSUE B

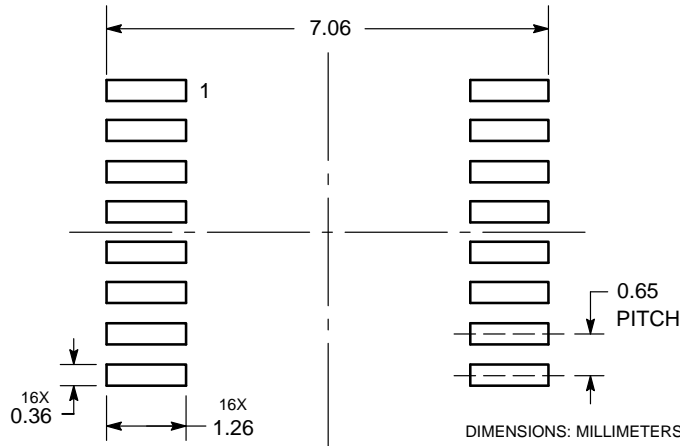


### NOTES:

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-.

DIM	MILLIMETERS		INCHES	
	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	0.18	0.28	0.007	0.011
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



ON Semiconductor and the are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marketing.pdf](http://www.onsemi.com/site/pdf/Patent-Marketing.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### 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](mailto: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](http://www.onsemi.com)

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

For additional information, please contact your local Sales Representative

MC74VHCT257A/D