

# MC74VHC257

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

The MC74VHC257 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 inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

- 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  $T_A = 25^\circ$ C
- High Noise Immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$
- 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: FETs = 100; Equivalent Gates = 25
- These Devices are Pb-Free and are RoHS Compliant

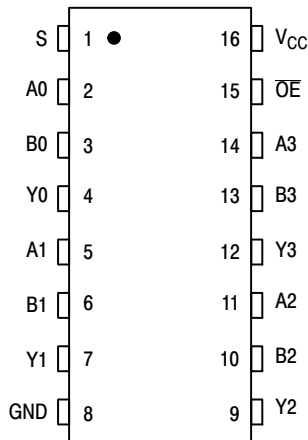


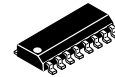
Figure 1. Pin Assignment



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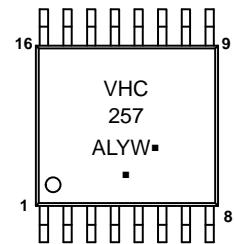
### MARKING DIAGRAMS



SO-16  
D SUFFIX  
CASE 751B



TSSOP-16  
DT SUFFIX  
CASE 948F



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

### ORDERING INFORMATION

Device	Package	Shipping
MC74VHC257DG	SO-16	48 Units/Rail
MC74VHC257DR2G	SO-16	2500 Units/Reel
MC74VHC257DTG	TSSOP-16	96 Units/Rail
MC74VHC257DTR2G	TSSOP-16	2500 Units/Reel

# MC74VHC257

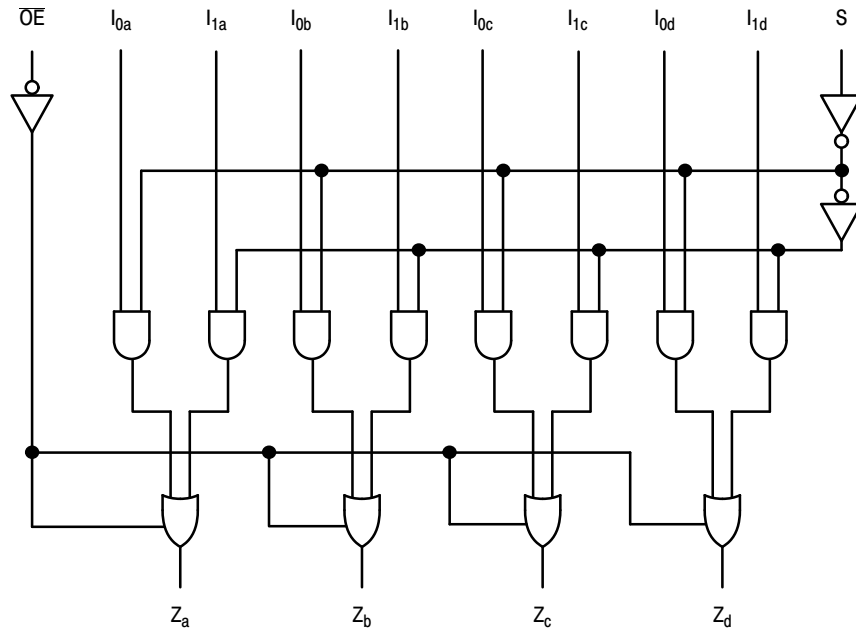


Figure 2. Expanded Logic Diagram

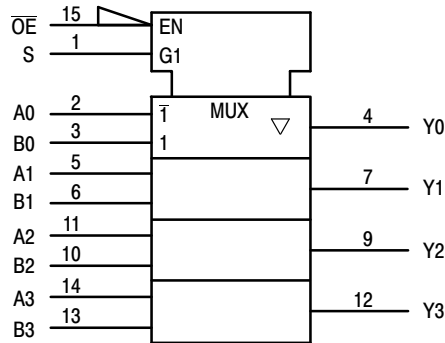


Figure 3. IEC Logic Symbol

## 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.

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.

# MC74VHC257

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit	
V <sub>CC</sub>	Positive DC Supply Voltage	-0.5 to +7.0	V	
V <sub>IN</sub>	Digital Input Voltage	-0.5 to +7.0	V	
V <sub>OUT</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> +0.5	V	
I <sub>IK</sub>	Input Diode Current	-20	mA	
I <sub>OK</sub>	Output Diode Current	± 20	mA	
I <sub>OUT</sub>	DC Output Current, per Pin	± 25	mA	
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins	± 75	mA	
P <sub>D</sub>	Power Dissipation in Still Air	SOIC Package TSSOP	200 180	mW
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C	
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 1) Machine Model (Note 2) Charged Device Model (Note 3)	>2000 >200 >2000	V
I <sub>LATCHUP</sub>	Latchup Performance	Above V <sub>CC</sub> and Below GND at 125°C (Note 4)	± 300	mA
θ <sub>JA</sub>	Thermal Resistance, Junction-to-Ambient	SOIC Package 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 <sub>CC</sub>	DC Supply Voltage	2.0	5.5	V
V <sub>IN</sub>	DC Input Voltage	0	5.5	V
V <sub>OUT</sub>	DC Output Voltage	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range, all Package Types	-55	125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Time			ns/V
			V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 0.5 V	0 100 20

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

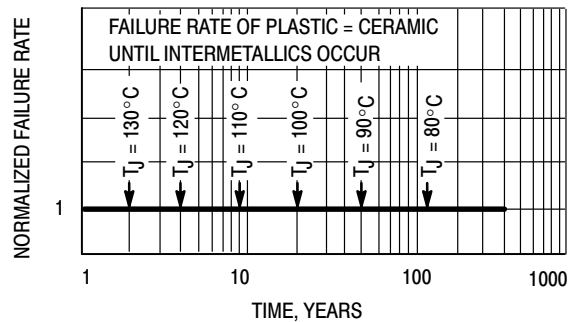


Figure 4. Failure Rate vs. Time Junction Temperature

# MC74VHC257

## 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		2.0 3.0 to 5.5	1.5 V <sub>CC</sub> 0.7			1.5 V <sub>CC</sub> 0.7	1.5 V <sub>CC</sub> 0.7	1.5 V <sub>CC</sub> 0.7		V
V <sub>IL</sub>	Maximum Low-Level Input Voltage		2.0 3.0 to 5.5			0.5 V <sub>CC</sub> 0.3		0.5 V <sub>CC</sub> 0.3		0.5 V <sub>CC</sub> 0.3	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	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		1.9 2.9 4.4		V
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = -4 mA I <sub>OH</sub> = -8 mA	3.0 4.5	2.58 3.94			2.48 3.8		2.34 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	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = 4 mA I <sub>OH</sub> = 8 mA	3.0 4.5			0.36 0.36		0.44 0.44		0.52 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			±0.25		±2.5		±2.5	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per package)	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5			4.0		40.0		40.0	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		5.8	9.3	1.0	11.0	1.0	11.0	ns
		C <sub>L</sub> = 50 pF		8.3	12.8	1.0	14.5	1.0	14.5	
		V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF		3.6	5.9	1.0	7.0	1.0	7.0	
		C <sub>L</sub> = 50 pF		5.1	7.9	1.0	9.0	1.0	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		7.0	11.0	1.0	13.0	1.0	13.0	ns
		C <sub>L</sub> = 50 pF		9.5	14.5	1.0	16.5	1.0	16.5	
		V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF		4.0	6.8	1.0	8.0	1.0	8.0	
		C <sub>L</sub> = 50 pF		5.5	8.8	1.0	10.0	1.0	10.0	
t <sub>PZL</sub> , t <sub>PZH</sub>	Maximum Output Enable Time OE to Y	V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 15 pF		6.7	10.5	1.0	12.5	1.0	12.5	ns
		R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 50 pF		9.2	14.0	1.0	16.0	1.0	16.0	
		V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF		3.6	6.8	1.0	8.0	1.0	8.0	
		R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 50 pF		5.1	8.8	1.0	10.0	1.0	10.0	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Maximum Output Disable Time OE to Y	V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 50 pF		12.0	15.0	1.0	16.0	1.0	17.5	ns
		R <sub>L</sub> = 1 kΩ								
		V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 50 pF		5.7	13.0	1.0	14.0	1.0	15.0	
		R <sub>L</sub> = 1 kΩ								
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> = 5.0V	
		20	
			pF

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>.

# MC74VHC257

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

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

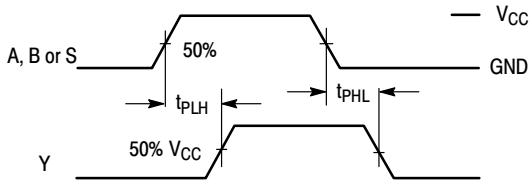


Figure 5. Switching Waveform

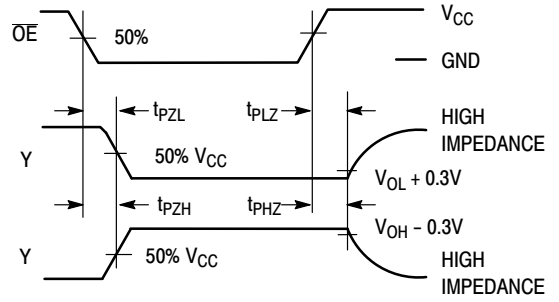
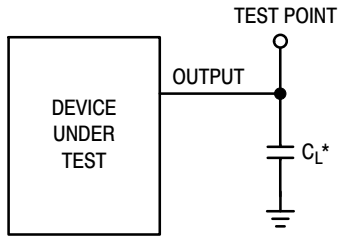
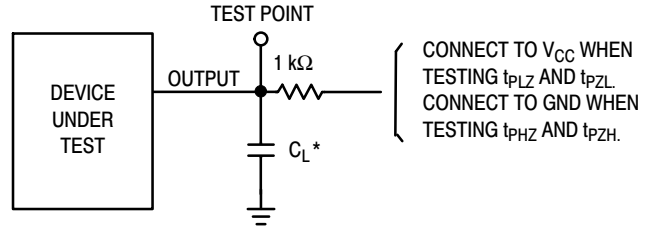


Figure 6. Switching Waveform



\*Includes all probe and jig capacitance

Figure 7. Test Circuit



\*Includes all probe and jig capacitance

Figure 8. Test Circuit

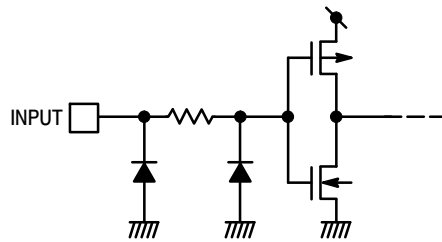


Figure 9. Input Equivalent Circuit

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

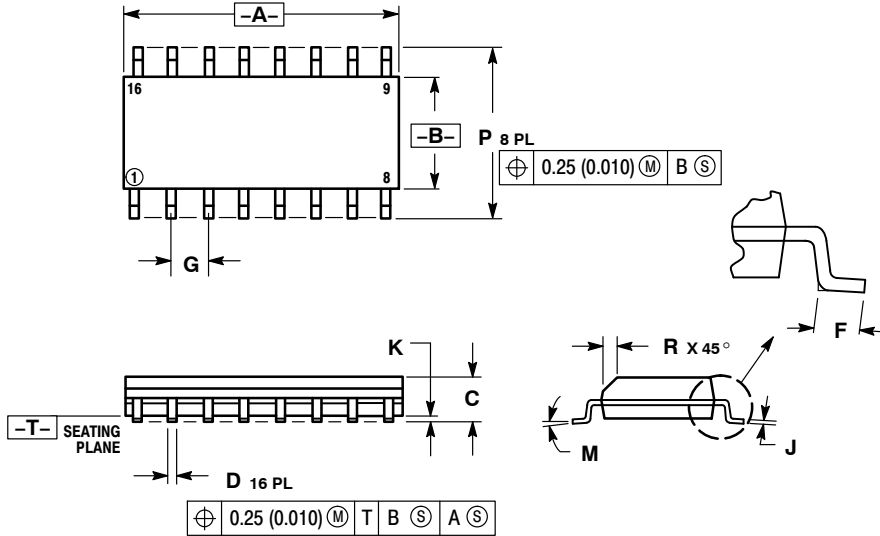
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SCALE 1:1

## SOIC-16 CASE 751B-05 ISSUE K

DATE 29 DEC 2006



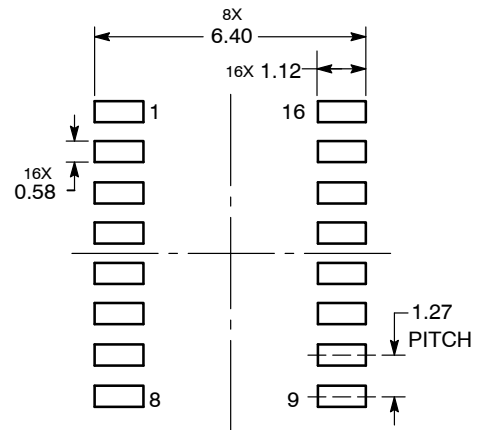
NOTES:

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

- |  |  |  |  |
|--|--|--|--|
| <p>STYLE 1:</p> <p>PIN 1. COLLECTOR</p> <p>2. BASE</p> <p>3. EMITTER</p> <p>4. NO CONNECTION</p> <p>5. EMITTER</p> <p>6. BASE</p> <p>7. COLLECTOR</p> <p>8. COLLECTOR</p> <p>9. BASE</p> <p>10. EMITTER</p> <p>11. NO CONNECTION</p> <p>12. EMITTER</p> <p>13. BASE</p> <p>14. COLLECTOR</p> <p>15. EMITTER</p> <p>16. COLLECTOR</p>                           | <p>STYLE 2:</p> <p>PIN 1. CATHODE</p> <p>2. ANODE</p> <p>3. NO CONNECTION</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. NO CONNECTION</p> <p>7. ANODE</p> <p>8. CATHODE</p> <p>9. CATHODE</p> <p>10. ANODE</p> <p>11. NO CONNECTION</p> <p>12. CATHODE</p> <p>13. CATHODE</p> <p>14. NO CONNECTION</p> <p>15. ANODE</p> <p>16. CATHODE</p> | <p>STYLE 3:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. BASE, #1</p> <p>3. EMITTER, #1</p> <p>4. COLLECTOR, #1</p> <p>5. COLLECTOR, #2</p> <p>6. BASE, #2</p> <p>7. EMITTER, #2</p> <p>8. COLLECTOR, #2</p> <p>9. COLLECTOR, #3</p> <p>10. BASE, #3</p> <p>11. EMITTER, #3</p> <p>12. COLLECTOR, #3</p> <p>13. COLLECTOR, #4</p> <p>14. BASE, #4</p> <p>15. EMITTER, #4</p> <p>16. COLLECTOR, #4</p>   | <p>STYLE 4:</p> <p>PIN 1. COLLECTOR, DYE #1</p> <p>2. COLLECTOR, #1</p> <p>3. COLLECTOR, #2</p> <p>4. COLLECTOR, #2</p> <p>5. COLLECTOR, #3</p> <p>6. COLLECTOR, #3</p> <p>7. COLLECTOR, #4</p> <p>8. COLLECTOR, #4</p> <p>9. BASE, #4</p> <p>10. EMITTER, #4</p> <p>11. BASE, #3</p> <p>12. EMITTER, #3</p> <p>13. BASE, #2</p> <p>14. EMITTER, #2</p> <p>15. BASE, #1</p> <p>16. EMITTER, #1</p> |
| <p>STYLE 5:</p> <p>PIN 1. DRAIN, DYE #1</p> <p>2. DRAIN, #1</p> <p>3. DRAIN, #2</p> <p>4. DRAIN, #2</p> <p>5. DRAIN, #3</p> <p>6. DRAIN, #3</p> <p>7. DRAIN, #4</p> <p>8. DRAIN, #4</p> <p>9. GATE, #4</p> <p>10. SOURCE, #4</p> <p>11. GATE, #3</p> <p>12. SOURCE, #3</p> <p>13. GATE, #2</p> <p>14. SOURCE, #2</p> <p>15. GATE, #1</p> <p>16. SOURCE, #1</p> | <p>STYLE 6:</p> <p>PIN 1. CATHODE</p> <p>2. CATHODE</p> <p>3. CATHODE</p> <p>4. CATHODE</p> <p>5. CATHODE</p> <p>6. CATHODE</p> <p>7. CATHODE</p> <p>8. CATHODE</p> <p>9. ANODE</p> <p>10. ANODE</p> <p>11. ANODE</p> <p>12. ANODE</p> <p>13. ANODE</p> <p>14. ANODE</p> <p>15. ANODE</p> <p>16. ANODE</p>                                 | <p>STYLE 7:</p> <p>PIN 1. SOURCE N-CH</p> <p>2. COMMON DRAIN (OUTPUT)</p> <p>3. COMMON DRAIN (OUTPUT)</p> <p>4. GATE P-CH</p> <p>5. COMMON DRAIN (OUTPUT)</p> <p>6. COMMON DRAIN (OUTPUT)</p> <p>7. COMMON DRAIN (OUTPUT)</p> <p>8. SOURCE P-CH</p> <p>9. SOURCE P-CH</p> <p>10. COMMON DRAIN (OUTPUT)</p> <p>11. COMMON DRAIN (OUTPUT)</p> <p>12. COMMON DRAIN (OUTPUT)</p> <p>13. GATE N-CH</p> <p>14. COMMON DRAIN (OUTPUT)</p> <p>15. COMMON DRAIN (OUTPUT)</p> <p>16. SOURCE N-CH</p> |  |

### SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

DOCUMENT NUMBER:	98ASB42566B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-16	PAGE 1 OF 1

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



TSSOP-16  
CASE 948F-01  
ISSUE B

DATE 19 OCT 2006



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



GENERIC MARKING DIAGRAM\*



- XXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- G or ■ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present.

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