

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 (OE) inputs. When (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

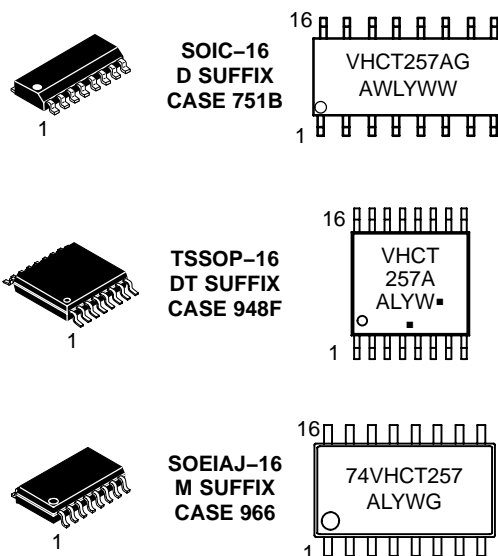
- High Speed: $t_{PD} = 4.1$ ns (Typ) at $V_{CC} = 5.0$ V
- Low Power Dissipation: $I_{CC} = 4.0$ μ A (Max) at $T_A = 25^\circ$ C
- TTL-Compatible Inputs: $V_{IL} = 0.8$ V; $V_{IH} = 2.0$ V
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 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
- Pb-Free Packages are Available*



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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 |
|--------|---|--------------------|
| 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.

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

MC74VHCT257A

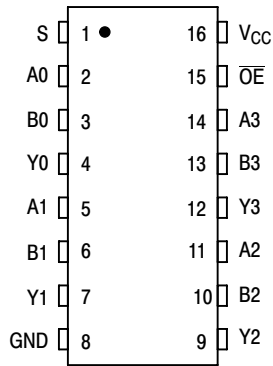


Figure 1. Pin Assignment

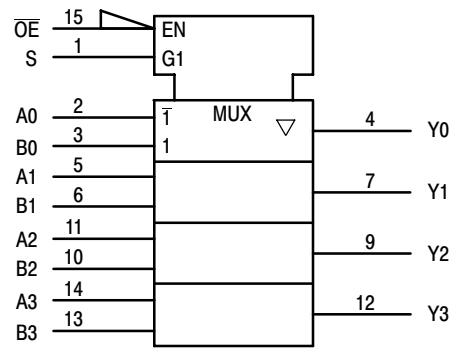


Figure 2. IEC Logic Symbol

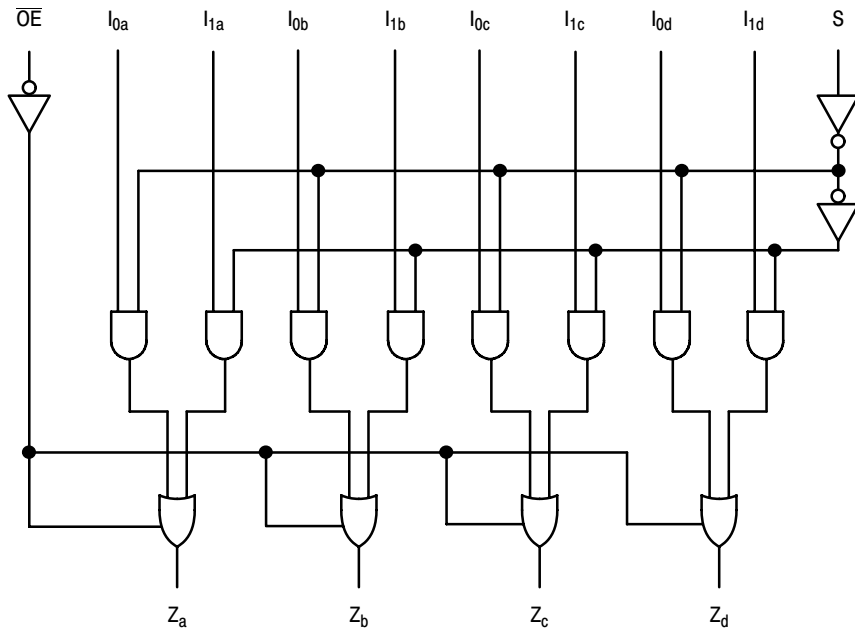


Figure 3. Expanded Logic Diagram

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 | ± 20 | mA |
| I_{OUT} | DC Output Current, per Pin | ± 25 | mA |
| I_{CC} | DC Supply Current, V_{CC} and GND Pins | ± 75 | mA |
| P_D | Power Dissipation in Still Air SOIC Package 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) | ± 300 | mA |
| θ_{JA} | Thermal Resistance, Junction-to-Ambient SOIC Package TSSOP | 143 164 | °C/W |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, 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 |

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 |

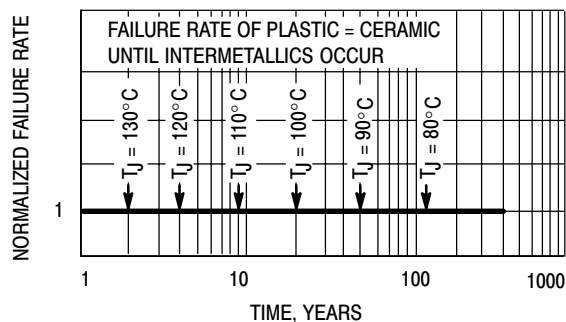


Figure 4. Failure Rate vs. Time Junction Temperature

MC74VHCT257A

DC CHARACTERISTICS (Voltages Referenced to GND)

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

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

| Symbol | Parameter | Test Conditions | T _A = 25°C | | | T _A ≤ 85°C | | -55°C ≤ T _A ≤ 125°C | | Unit |
|--|--|--|-----------------------|------------|--------------|-----------------------|--------------|--------------------------------|--------------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{PLH} , t _{PHL} | Maximum Propagation Delay, A or B to Y | V _{CC} = 3.3 ± 0.3 V C _L = 15 pF C _L = 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 _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 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 _{PLH} , t _{PHL} | Maximum Propagation Delay, S to Y | V _{CC} = 3.3 ± 0.3 V C _L = 15 pF C _L = 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 _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 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 _{PZL} , t _{PZH} | Maximum Output Enable, Time, OE to Y | V _{CC} = 3.3 ± 0.3 V C _L = 15 pF R _L = 1 kΩ C _L = 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 _{CC} = 5.0 ± 0.5 V C _L = 15 pF R _L = 1 kΩ C _L = 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 _{PLZ} , t _{PHZ} | Maximum Output Disable, Time, OE to Y | V _{CC} = 3.3 ± 0.3 V C _L = 50 pF R _L = 1 kΩ | | 10.5 | 14.0 | 1.0 | 15.0 | 1.0 | 15.0 | ns |
| | | V _{CC} = 5.0 ± 0.5 V C _L = 50 pF R _L = 1 kΩ | | 9.5 | 12.0 | 1.0 | 13.0 | 1.0 | 13.0 | |
| C _{IN} | Maximum Input Capacitance | | | 4 | 10 | | 10 | | 10 | pF |

| | | | | |
|-----------------|--|---|--|----|
| C _{PD} | Power Dissipation Capacitance (Note 5) | Typical @ 25°C, V _{CC} = 5.0 V | | pF |
| | | 20 | | |

5. 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}. 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)

| Symbol | Characteristic | T _A = 25°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 | | 2.0 | V |
| V _{ILD} | Maximum Low Level Dynamic Input Voltage | | 0.8 | V |

MC74VHCT257A

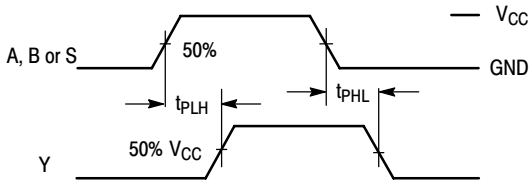


Figure 5. Switching Waveform

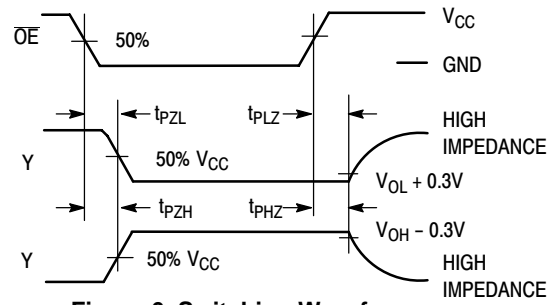
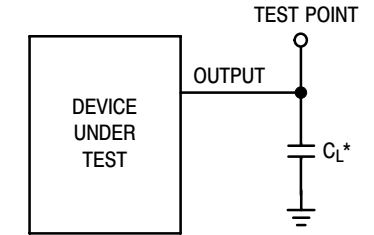
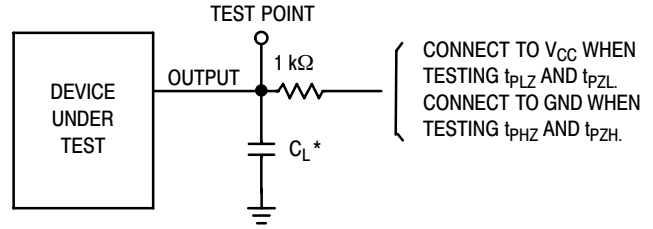


Figure 6. Switching Waveform



*Includes all probe and jig capacitance

Figure 7. Test Circuit



*Includes all probe and jig capacitance

Figure 8. Test Circuit

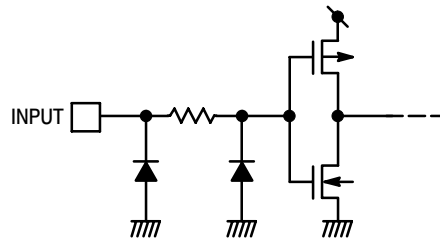


Figure 9. Input Equivalent Circuit

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|------------------|------------------------|-----------------------|
| MC74VHCT257AD | SOIC-16 | 48 Units / Rail |
| MC74VHCT257ADG | SOIC-16 (Pb-Free) | 48 Units / Rail |
| MC74VHCT257ADR2 | SOIC-16 | 2500 Tape & Reel |
| MC74VHCT257ADR2G | SOIC-16 (Pb-Free) | 2500 Tape & Reel |
| MC74VHCT257ADT | TSSOP-16* | 96 Units / Rail |
| MC74VHCT257ADTG | TSSOP-16* | 96 Units / Rail |
| MC74VHCT257ADTR2 | TSSOP-16* | 2500 Tape & Reel |
| MC74VHCT257ADTRG | TSSOP-16* | 2500 Tape & Reel |
| MC74VHCT257AM | SOEIAJ-16 | 50 Units / Rail |
| MC74VHCT257AMG | SOEIAJ-16 (Pb-Free) | 50 Units / Rail |
| MC74VHCT257AMEL | SOEIAJ-16 | 2000 Tape & Reel |
| MC74VHCT257AMELG | SOEIAJ-16 (Pb-Free) | 2000 Tape & Reel |

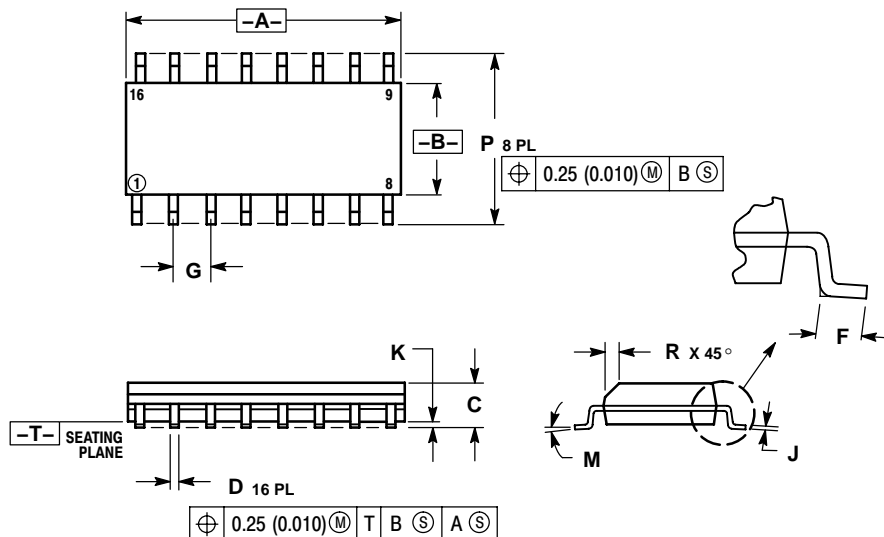
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*This package is inherently Pb-Free.

MC74VHCT257A

PACKAGE DIMENSIONS

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

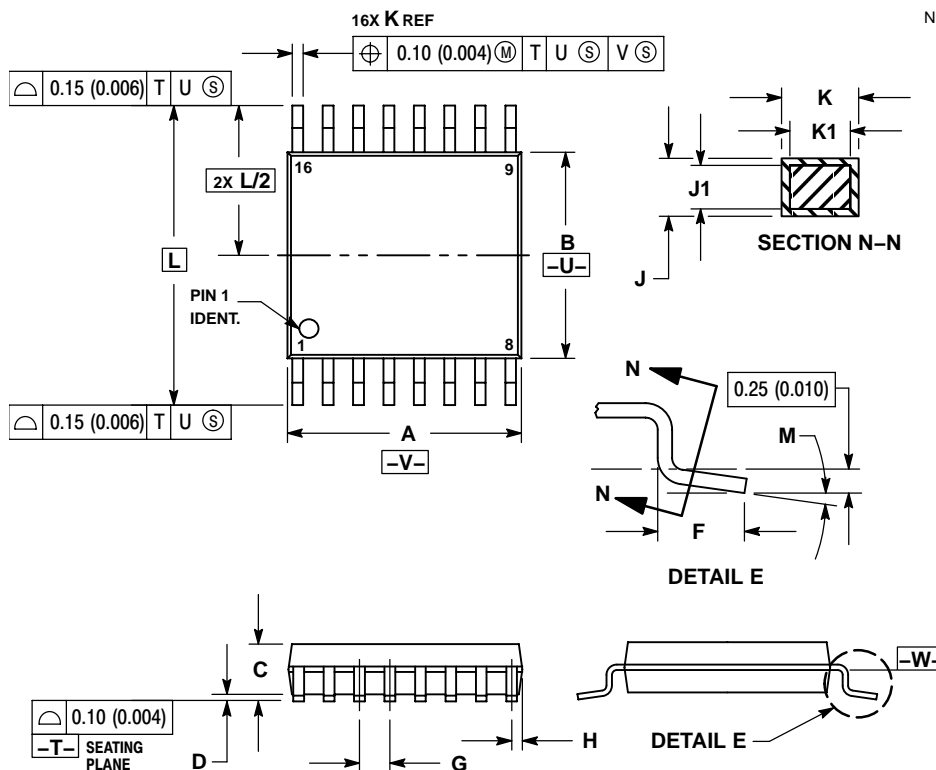


NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- 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 |

TSSOP-16
DT SUFFIX
CASE 948F-01
ISSUE A



NOTES:

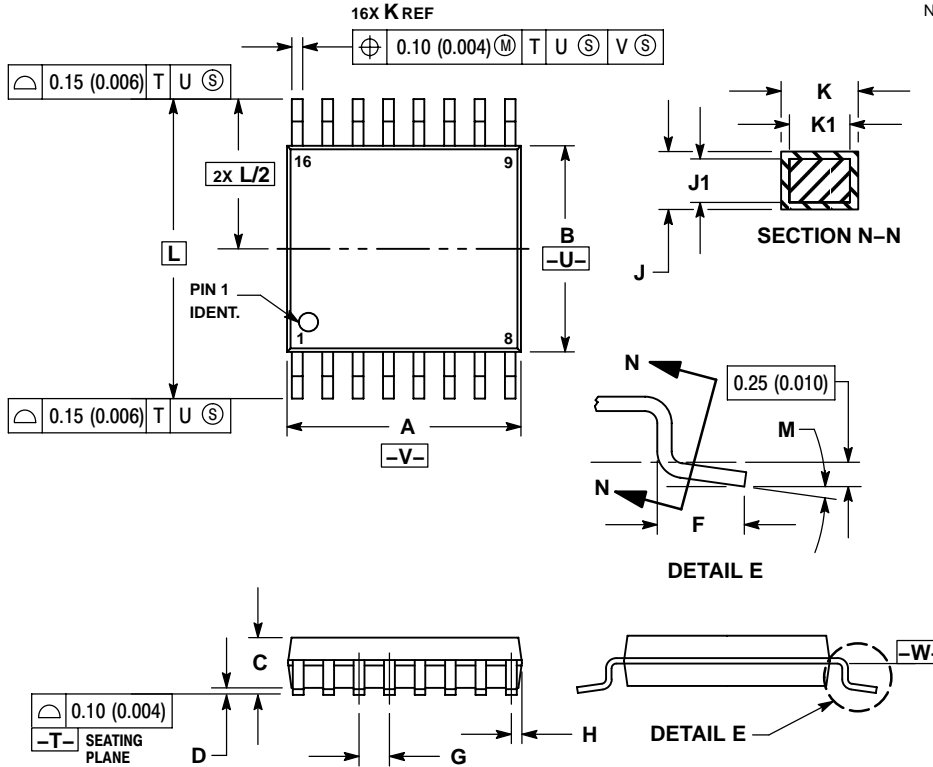
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- 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.
- TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- 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° |

MC74VHCT257A

PACKAGE DIMENSIONS

SOEIAJ-16
M SUFFIX
CASE 966-01
ISSUE A



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° |

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