

# MC74VHCT157A

## Quad 2-Channel Multiplexer

The MC74VHCT157A 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 ( $\bar{E}$ ) inputs. When  $\bar{E}$  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 V CMOS level output swings.

The VHCT157A 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 inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

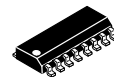
- High Speed:  $t_{PD} = 4.1$  ns (Typ) at  $V_{CC} = 5$  V
- Low Power Dissipation:  $I_{CC} = 4\mu$ A (Max) at  $T_A = 25^\circ$ C
- TTL-Compatible Inputs:  $V_{IL} = 0.8$  V;  $V_{IH} = 2.0$  V
- Power Down Protection Provided on Inputs and Outputs
- Balanced Propagation Delays
- Designed for 2 V 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 300mA
- ESD Performance: HBM > 2000 V; Machine Model > 200 V
- Chip Complexity: 82 FETs or 20 Equivalent Gates



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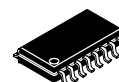
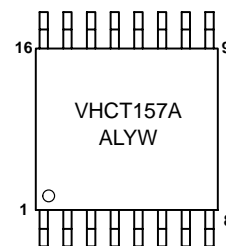
### MARKING DIAGRAMS



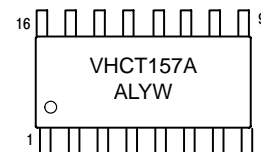
**SO-16**  
**D SUFFIX**  
**CASE 751B**



**TSSOP-16**  
**DT SUFFIX**  
**CASE 948F**



**EIAJ SO-16**  
**M SUFFIX**  
**CASE 966**



A = Assembly Location  
L, WL = Wafer Lot  
Y = Year  
W, WW = Work Week

### ORDERING INFORMATION

| Device           | Package    | Shipping         |
|------------------|------------|------------------|
| MC74VHCT157AD    | SO-16      | 48 Units/Rail    |
| MC74VHCT157ADR2  | SO-16      | 2500 Tape & Reel |
| MC74VHCT157ADT   | TSSOP-16   | 96 Units/Rail    |
| MC74VHCT157ADTR2 | TSSOP-16   | 2500 Tape & Reel |
| MC74VHCT157AM    | EIAJ-SO-16 | 50 Units/Rail    |
| MC74VHCT157AMEL  | EIAJ-SO-16 | 2000 Tape & Reel |

# MC74VHCT157A

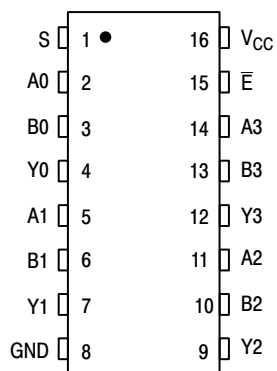


Figure 1. Pin Assignment

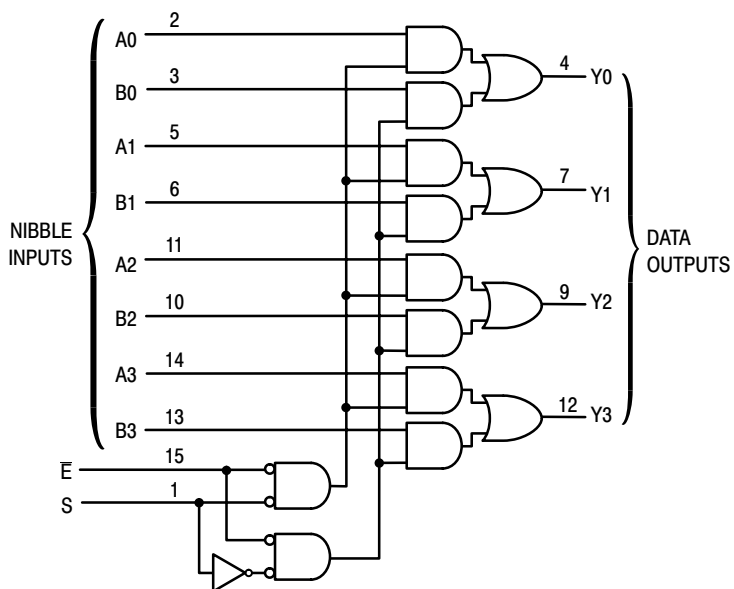


Figure 2. Expanded Logic Diagram

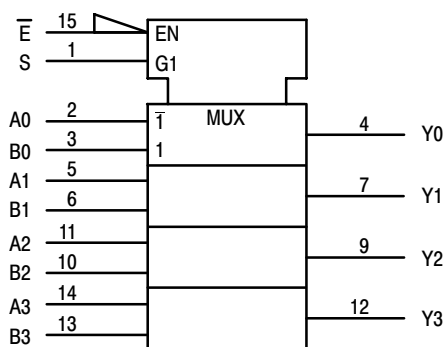


Figure 3. IEC Logic Symbol

FUNCTION TABLE

| Inputs |   | Outputs<br>Y0 – Y3 |
|--------|---|--------------------|
| E-bar  | S |                    |
| H      | X | L                  |
| 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.

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## MAXIMUM RATINGS (Note 1.)

| 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                               | Output in 3-State<br>High or Low State<br>-0.5 to +7.0<br>-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<br>TSSOP<br>200<br>180   | mW          |
| T <sub>STG</sub>      | Storage Temperature Range                       | -65 to +150   | °C          |
| V <sub>ESD</sub>      | ESD Withstand Voltage                           | Human Body Model (Note 2.)<br>Machine Model (Note 3.)<br>Charged Device Model (Note 4.)<br>>2000<br>>200<br>>2000 | V           |
| I <sub>LATCH-UP</sub> | Latch-Up Performance                            | Above V <sub>CC</sub> and Below GND at 125°C (Note 5.)  | ± 300<br>mA |
| θ <sub>JA</sub>       | Thermal Resistance, Junction to Ambient         | SOIC Package<br>TSSOP<br>143<br>164   | °C/W        |

1. Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.
2. Tested to EIA/JESD22-A114-A
3. Tested to EIA/JESD22-A115-A
4. Tested to JESD22-C101-A
5. Tested to EIA/JESD78

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Characteristics                                | Min                             | Max             | Unit       |
|---------------------------------|--|---------------------------------|-----------------|------------|
| V <sub>CC</sub>                 | DC Supply Voltage                              | 4.5                             | 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                        | V <sub>CC</sub> = 5.0 V ± 0.5 V | 0               | 20<br>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         |

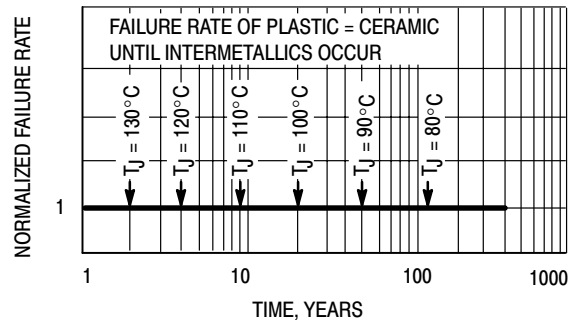


Figure 4. Failure Rate vs. Time Junction Temperature

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## DC CHARACTERISTICS (Voltages Referenced to GND)

| Symbol           | Parameter                                     | Condition  | V <sub>CC</sub><br>(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                     | 0.8  | 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><br>I <sub>OH</sub> = -50 μA                           | 4.5                    | 4.4                   | 4.5 |      | 4.4                   |      | 4.4                            |      | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -8 mA                            | 4.5                    | 3.94                  |     |      | 3.8                   |      | 3.66                           |      | V    |
| V <sub>OL</sub>  | Maximum Low-Level Output Voltage              | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 50 μA                            | 4.5                    |                       | 0.0 | 0.1  |                       | 0.1  |                                | 0.1  | V    |
|                  |   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = 8 mA                             | 4.5                    |                       |     | 0.36 |                       | 0.44 |                                | 0.52 | V    |
| 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>CC</sub>  | Maximum Quiescent Supply Current              | V <sub>IN</sub> = V <sub>CC</sub> or GND   | 5.5                    |                       |     | 4.0  |                       | 40.0 |                                | 40.0 | μA   |
| I <sub>CCT</sub> | Additional Quiescent Supply Current (per Pin) | Any one input:<br>V <sub>IN</sub> = 3.4 V<br>All other inputs:<br>V <sub>IN</sub> = V <sub>CC</sub> or GND | 5.5                    |                       |     | 1.35 |                       | 1.5  |                                | 1.5  | 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> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay<br>A to B to Y | V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 5.6<br>8.0 | 7.0<br>10.0 | 1.0<br>1.0            | 7.7<br>11.0  | 1.0<br>1.0                     | 7.7<br>11.0  | ns   |
|  |  | V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 4.1<br>5.6 | 6.4<br>8.4  | 1.0<br>1.0            | 7.5<br>9.5   | 1.0<br>1.0                     | 7.5<br>9.5   |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay<br>S to Y      | V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 6.1<br>8.5 | 7.5<br>10.5 | 1.0<br>1.0            | 8.2<br>11.5  | 1.0<br>1.0                     | 8.2<br>11.5  | ns   |
|  |  | V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 5.3<br>6.8 | 8.1<br>10.1 | 1.0<br>1.0            | 9.5<br>11.5  | 1.0<br>1.0                     | 9.5<br>11.5  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay<br>E to Y      | V <sub>CC</sub> = 3.3 ± 0.3 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 6.1<br>8.5 | 7.5<br>10.5 | 1.0<br>1.0            | 8.2<br>11.5  | 1.0<br>1.0                     | 8.2<br>11.5  | ns   |
|  |  | V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 5.6<br>7.1 | 8.6<br>10.6 | 1.0<br>1.0            | 10.0<br>12.0 | 1.0<br>1.0                     | 10.0<br>12.0 |      |
| C <sub>IN</sub>                        | Maximum Input Capacitance                |   |                       | 4          | 10          |                       | 10           |                                | 10           | pF   |

| C <sub>PD</sub> | Power Dissipation Capacitance (Note 6.) | Typical @ 25°C, V <sub>CC</sub> = 5.0 V |  | pF |
|-----------------|---|---|--|----|
|                 |   | 20                                      |  |    |
|                 |   |   |  |    |

6. 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>.

# MC74VHCT157A

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

| 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 |                          | 2.0  | V    |
| $V_{ILD}$ | Maximum Low Level Dynamic Input Voltage  |                          | 0.8  | V    |

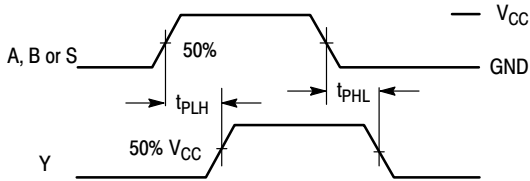


Figure 5. Switching Waveform

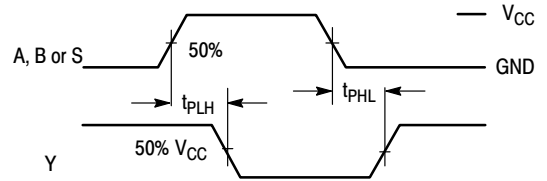
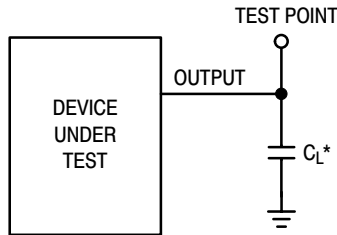


Figure 6. Inverting Switching



\*Includes all probe and jig capacitance

Figure 7. Test Circuit

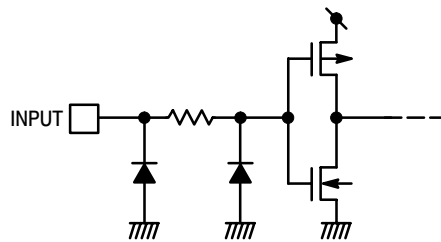
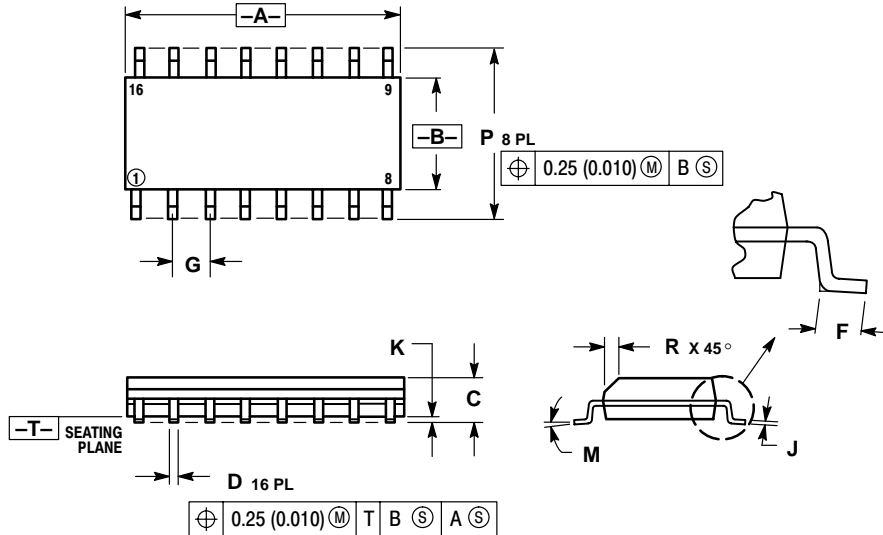


Figure 8. Input Equivalent Circuit

# MC74VHCT157A

## PACKAGE DIMENSIONS

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

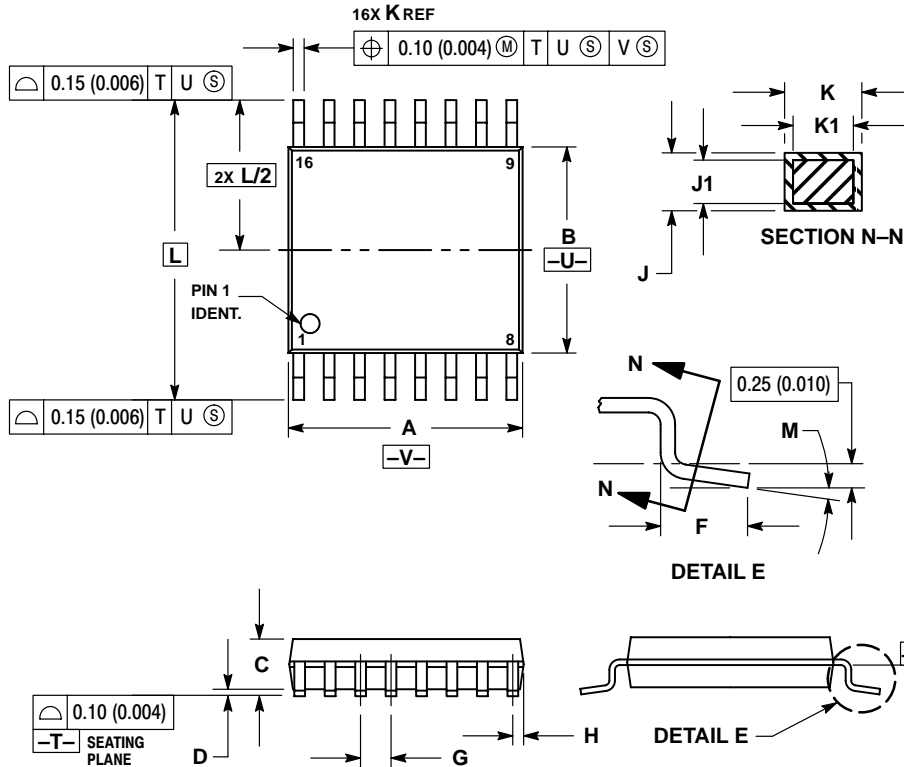


**NOTES:**

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.

| 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 O



**NOTES:**

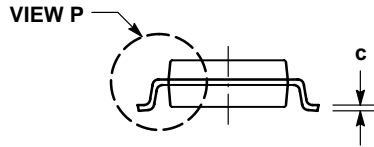
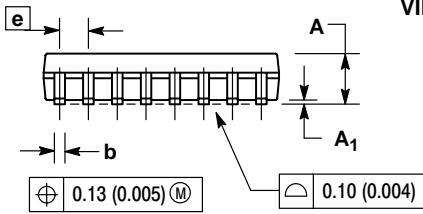
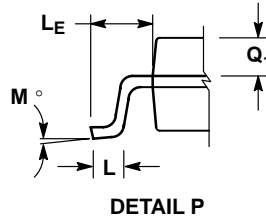
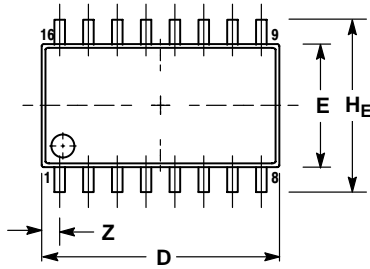
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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°    |

# MC74VHCT157A

## PACKAGE DIMENSIONS

SOIC EIAJ-16  
M SUFFIX  
CASE 966-01  
ISSUE O



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).

| DIM            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.18        | 0.27  | 0.007     | 0.011 |
| 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 |       |
| HE             | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| LE             | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0°          | 10°   | 0°        | 10°   |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 0.78  | ---       | 0.031 |

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