

# MC74VHCT14A

## Hex Schmitt Inverter

The MC74VHCT14A is an advanced high speed CMOS Schmitt inverter fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

Pin configuration and function are the same as the MC74VHCT04A, but the inputs have hysteresis and, with its Schmitt trigger function, the VHCT14A can be used as a line receiver which will receive slow input signals.

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 VHCT14A 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

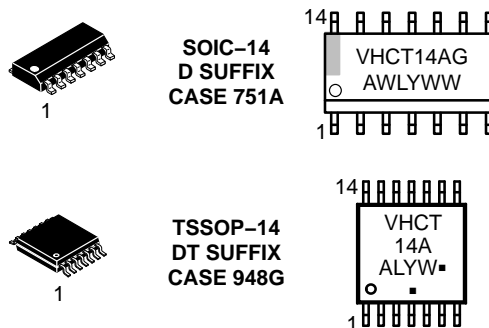
- High Speed:  $t_{PD} = 5.5$  ns (Typ) at  $V_{CC} = 5.0$  V
- Low Power Dissipation:  $I_{CC} = 2.0$   $\mu$ A (Max) at  $T_A = 25^\circ$ C
- TTL-Compatible Inputs:  $V_{IL} = 0.8$  V;  $V_{IH} = 2.0$  V
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise:  $V_{OLP} = 0.8$  V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: 60 FETs or 15 Equivalent Gates
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant



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### MARKING DIAGRAMS



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

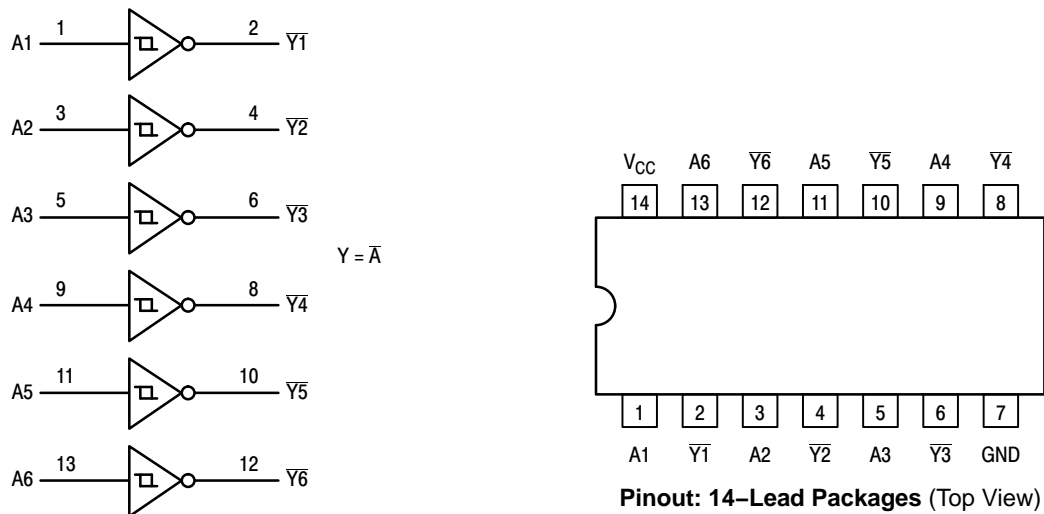
### FUNCTION TABLE

| Inputs | Outputs   |
|--------|-----------|
| A      | $\bar{Y}$ |
| L      | H         |
| H      | L         |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

# MC74VHCT14A



**Figure 1. Logic Diagram**

## MAXIMUM RATINGS

| Parameter                                       | 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 HIGH or LOW State (Note 1)   | $V_{OUT}$     | -0.5 to $V_{CC} + 0.5$ V |
| $V_{CC} = 0$ V                                  | $V_{OUT}$  | -0.5 to 7.0   | V                        |
| DC Input Diode Current                          | $I_{IK}$   | -20           | mA                       |
| DC Output Diode Current                         | $I_{OK}$   | $\pm 20$      | mA                       |
| DC Output Source/Sink Current                   | $I_O$  | $\pm 25$      | mA                       |
| DC Supply Current per Supply Pin                | $I_{CC}$   | $\pm 50$      | mA                       |
| DC Ground Current per Ground Pin                | $I_{GND}$  | $\pm 50$      | mA                       |
| Storage Temperature Range                       | $T_{STG}$  | -65 to +150   | $^{\circ}C$              |
| Lead Temperature, 1 mm from Case for 10 Seconds | $T_L$  | 260           | $^{\circ}C$              |
| Junction Temperature under Bias                 | $T_J$  | +150          | $^{\circ}C$              |
| Thermal Resistance                              | SOIC<br>TSSOP<br>$\theta_{JA}$   | 125<br>170    | $^{\circ}C/W$            |
| Power Dissipation in Still Air                  | SOIC<br>TSSOP<br>$P_D$   | 500<br>450    | mW                       |
| ESD Withstand Voltage                           | Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4) | $V_{ESD}$     | >2000<br>>200<br>2000    |
| Latchup Performance                             | Above $V_{CC}$ and Below GND at 85 $^{\circ}C$ (Note 5)                              | $I_{Latchup}$ | $\pm 300$<br>mA          |

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.  $I_O$  absolute maximum rating must be observed.
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.

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## RECOMMENDED OPERATING CONDITIONS

| Parameter                      | Symbol   | Min | Max      | Unit |
|--------------------------------|----------|-----|----------|------|
| Supply Voltage                 | $V_{CC}$ | 4.5 | 5.5      | V    |
| Input Voltage                  | $V_I$    | 0   | 5.5      | V    |
| Output Voltage (Note 6)        | $V_O$    | 0   | $V_{CC}$ | V    |
| $V_{CC} = 0$ V                 | $V_O$    | 0   | 5.5      | V    |
| Operating Free–Air Temperature | $T_A$    | –55 | +125     | °C   |

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.

6.  $I_O$  absolute maximum rating must be observed.

## DC ELECTRICAL CHARACTERISTICS

| Parameter   | Test Conditions   | Symbol    | $V_{CC}$<br>V | $T_A = 25^\circ\text{C}$ |     |              | $T_A \leq 85^\circ\text{C}$ |              | $T_A \leq 125^\circ\text{C}$ |              | Unit          |
|---|---|-----------|---------------|--------------------------|-----|--------------|-----------------------------|--------------|------------------------------|--------------|---------------|
|   |   |           |               | Min                      | Typ | Max          | Min                         | Max          | Min                          | Max          |               |
| Positive Threshold Voltage                                      |   | $V_{T+}$  | 4.5<br>5.5    |                          |     | 1.9<br>2.1   |                             | 1.9<br>2.1   |                              | 1.9<br>2.1   | V             |
| Negative Threshold Voltage                                      |   | $V_{T-}$  | 4.5<br>5.5    | 0.5<br>0.6               |     |              | 0.5<br>0.6                  |              | 0.5<br>0.6                   |              | V             |
| Hysteresis Voltage  |   | $V_H$     | 4.5<br>5.5    | 0.40<br>0.40             |     | 1.40<br>1.50 | 0.40<br>0.40                | 1.40<br>1.50 | 0.40<br>0.40                 | 1.40<br>1.50 | V             |
| Minimum High–Level Output Voltage<br>$I_{OH} = -50 \mu\text{A}$ | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$I_{OH} = -50 \mu\text{A}$ | $V_{OH}$  | 4.5           | 4.4                      | 4.5 |              | 4.4                         |              | 4.4                          |              | V             |
|   | $I_{OH} = -8.0 \text{ mA}$                                  |           | 5.5           | 3.94                     |     |              | 3.80                        |              | 3.66                         |              |               |
| Maximum Low–Level Output Voltage                                | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$I_{OL} = 50 \mu\text{A}$  | $V_{OL}$  | 4.5           |                          | 0.0 | 0.1          |                             | 0.1          |                              | 0.1          | V             |
|   | $I_{OL} = 8.0 \text{ mA}$                                   |           | 5.5           |                          |     | 0.36         |                             | 0.44         |                              | 0.52         |               |
| Maximum Input Leakage Current                                   | $V_{IN} = 5.5 \text{ V}$ or GND                             | $I_{IN}$  | 0 to 5.5      |                          |     | $\pm 0.1$    |                             | $\pm 1.0$    |                              | $\pm 1.0$    | $\mu\text{A}$ |
| Maximum Quiescent Supply Current                                | $V_{IN} = V_{CC}$ or GND                                    | $I_{CC}$  | 5.5           |                          |     | 2.0          |                             | 20           |                              | 40           | $\mu\text{A}$ |
| Quiescent Supply Current  | Input: $V_{IN} = 3.4 \text{ V}$                             | $I_{CCT}$ | 5.5           |                          |     | 1.35         |                             | 1.50         |                              | 1.65         | mA            |
| Output Leakage Current  | $V_{OUT} = 5.5 \text{ V}$                                   | $I_{OFF}$ | 0.0           |                          |     | 0.5          |                             | 5.0          |                              | 10           | $\mu\text{A}$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0 \text{ ns}$ )

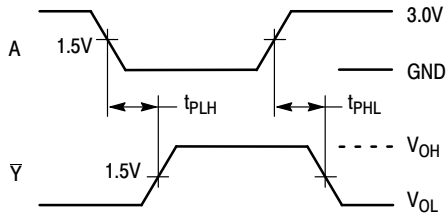
| Parameter                                 | Test Conditions  | Symbol                   | $T_A = 25^\circ\text{C}$                                |            |            | $T_A \leq 85^\circ\text{C}$ |             | $T_A \leq 125^\circ\text{C}$ |              | Unit |
|---|--|--------------------------|---|------------|------------|-----------------------------|-------------|------------------------------|--------------|------|
|   |  |                          | Min   | Typ        | Max        | Min                         | Max         | Min                          | Max          |      |
| Maximum Propagation Delay, A to $\bar{Y}$ | $V_{CC} = 5.0 \pm 0.5 \text{ V}$<br>$C_L = 15 \text{ pF}$<br>$C_L = 50 \text{ pF}$ | $t_{PLH}$ ,<br>$t_{PHL}$ |   | 5.5<br>7.0 | 7.6<br>9.6 | 1.0<br>1.0                  | 9.0<br>11.0 | 1.0<br>1.0                   | 11.5<br>13.5 | ns   |
| Maximum Input Capacitance                 |  | $C_{IN}$                 |   | 2.0        | 10         |                             | 10          |                              | 10           | pF   |
| Power Dissipation Capacitance<br>(Note 7) |  | $C_{PD}$                 | Typical @ $25^\circ\text{C}$ , $V_{CC} = 5.0 \text{ V}$ |            |            |                             |             |                              |              | pF   |
|   |  |                          | 11  |            |            |                             |             |                              |              |      |

7.  $C_{PD}$  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:  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/6$  (per buffer).  $C_{PD}$  is used to determine the no–load dynamic power consumption;  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

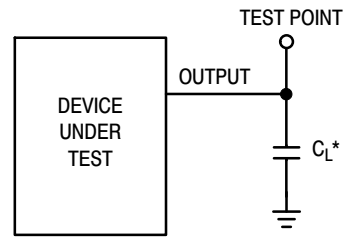
## NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0 \text{ ns}$ , $C_L = 50 \text{ pF}$ , $V_{CC} = 5.0 \text{ V}$ )

| Characteristic                           | Symbol    | $T_A = 25^\circ\text{C}$ |      | Unit |
|--|-----------|--------------------------|------|------|
|  |           | Typ                      | Max  |      |
| Quiet Output Maximum Dynamic $V_{OL}$    | $V_{OLP}$ | 0.8                      | 1.0  | V    |
| Quiet Output Minimum Dynamic $V_{OL}$    | $V_{OLV}$ | –0.8                     | –1.0 | V    |
| Minimum High Level Dynamic Input Voltage | $V_{IHD}$ |                          | 2.0  | V    |
| Maximum Low Level Dynamic Input Voltage  | $V_{ILD}$ |                          | 0.8  | V    |

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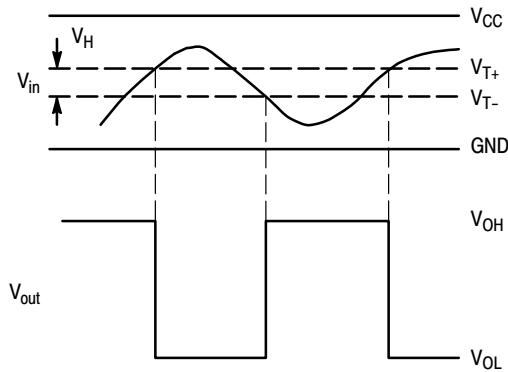
**Figure 2. Switching Waveforms**



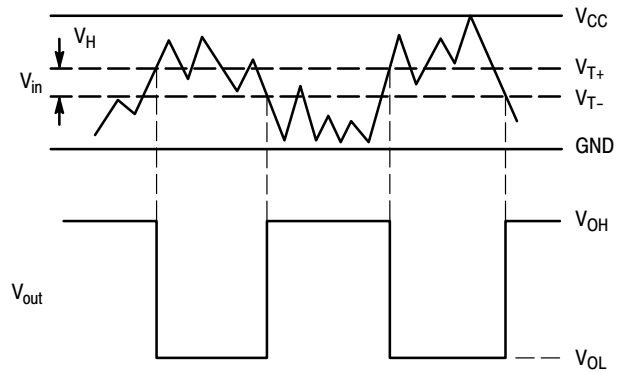
\*Includes all probe and jig capacitance

**Figure 3. Test Circuit**

(a) A Schmitt-Trigger Squares Up Inputs With Slow Rise and Fall Times



(b) A Schmitt-Trigger Offers Maximum Noise Immunity



**Figure 4. Typical Schmitt-Trigger Applications**

## ORDERING INFORMATION

| Device             | Package               | Shipping†          |
|--------------------|-----------------------|--------------------|
| MC74VHCT14ADR2G    | SOIC-14<br>(Pb-Free)  | 2500 / Tape & Reel |
| NLV74VHCT14ADR2G*  |                       |                    |
| MC74VHCT14ADTR2G   | TSSOP-14<br>(Pb-Free) |                    |
| NLV74VHCT14ADTR2G* |                       |                    |

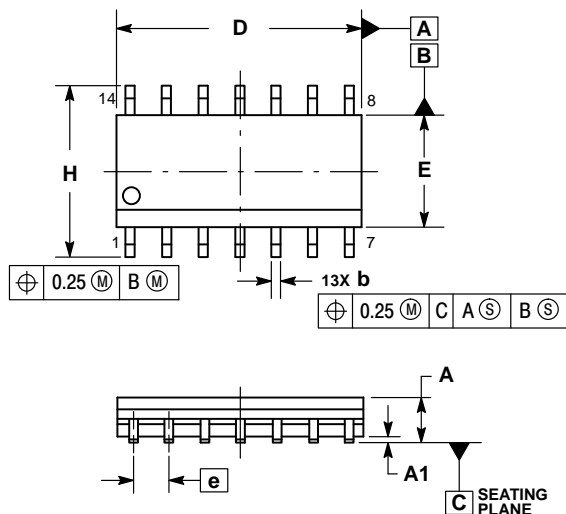
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

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## PACKAGE DIMENSIONS

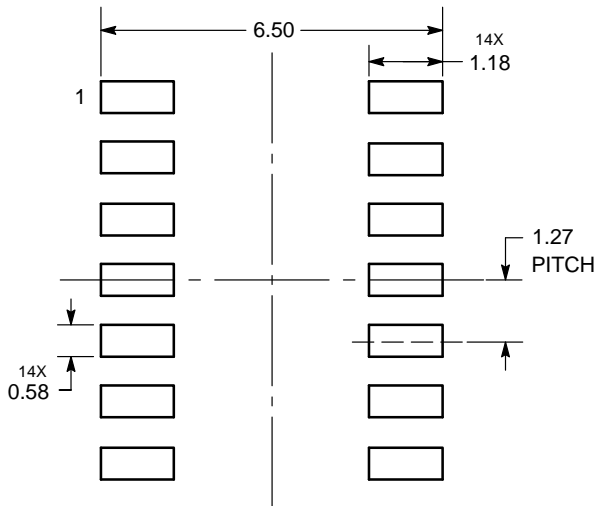
SOIC-14  
CASE 751A-03  
ISSUE K



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
  5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.35        | 1.75 | 0.054     | 0.068 |
| A1  | 0.10        | 0.25 | 0.004     | 0.010 |
| A3  | 0.19        | 0.25 | 0.008     | 0.010 |
| b   | 0.35        | 0.49 | 0.014     | 0.019 |
| D   | 8.55        | 8.75 | 0.337     | 0.344 |
| E   | 3.80        | 4.00 | 0.150     | 0.157 |
| e   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 5.80        | 6.20 | 0.228     | 0.244 |
| h   | 0.25        | 0.50 | 0.010     | 0.019 |
| L   | 0.40        | 1.25 | 0.016     | 0.049 |
| M   | 0°          | 7°   | 0°        | 7°    |

### SOLDERING FOOTPRINT\*



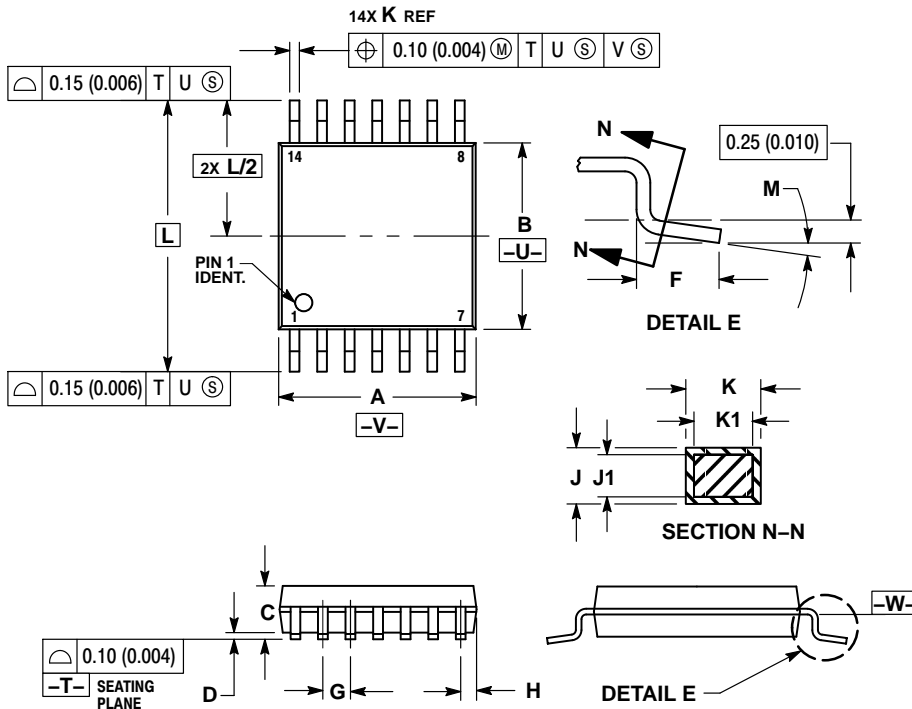
DIMENSIONS: MILLIMETERS

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

# MC74VHCT14A

## PACKAGE DIMENSIONS

TSSOP-14  
CASE 948G  
ISSUE B

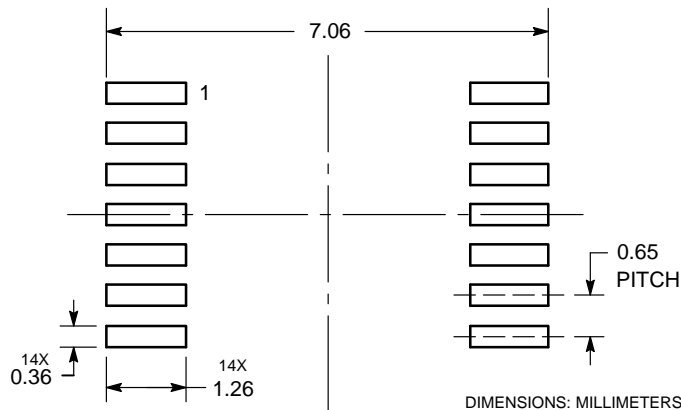


### NOTES:

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   | 0.50        | 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

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