

MC74VHCT00A

Quad 2-Input NAND Gate

The MC74VHCT00A is an advanced high speed CMOS 2-input NAND gate fabricated with silicon gate CMOS technology. It achieves high speed operation while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output.

The device input is compatible with TTL-type input thresholds and the output has a full 5 V CMOS level output swing. The input protection circuitry on this device allows overvoltage tolerance on the input, allowing the device to be used as a logic-level translator from 3.0 V CMOS logic to 5.0 V CMOS Logic or from 1.8 V CMOS logic to 3.0 V CMOS Logic while operating at the high-voltage power supply.

The MC74VHCT00A input structure provides protection when voltages up to 7 V are applied, regardless of the supply voltage. This allows the MC74VHCT00A to be used to interface 5 V circuits to 3 V circuits. 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.

- High Speed: $t_{PD} = 5.0$ ns (Typ) at $V_{CC} = 5$ V
- Low Power Dissipation: $I_{CC} = 2$ 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 3.0 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: 48 FETs or 12 Equivalent Gates
- These Devices are Pb-Free and are RoHS Compliant



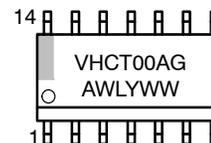
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<http://onsemi.com>

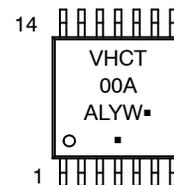
MARKING DIAGRAMS



SOIC-14
D SUFFIX
CASE 751A



TSSOP-14
DT SUFFIX
CASE 948G



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

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the dimensions section on page 6 of this data sheet.

MC74VHCT00A

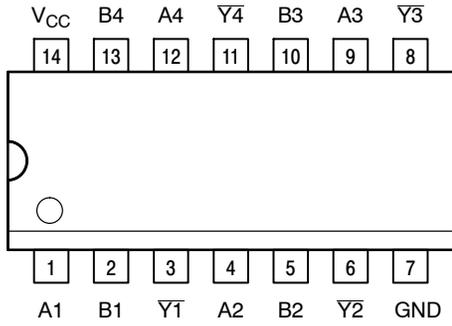


Figure 1. Pin Assignment
(Top View)

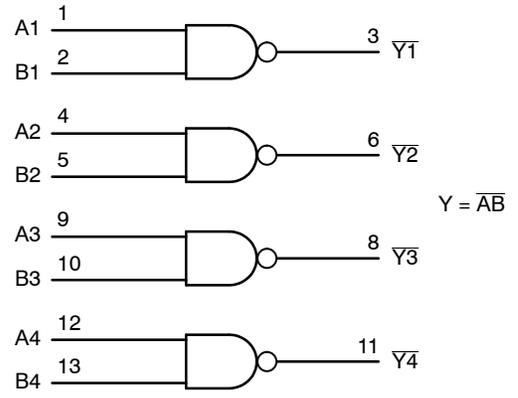


Figure 2. Logic Diagram

| PIN ASSIGNMENT | |
|----------------|---------------------|
| 1 | IN A1 |
| 2 | IN B1 |
| 3 | OUT $\overline{Y1}$ |
| 4 | IN A2 |
| 5 | IN B2 |
| 6 | OUT $\overline{Y2}$ |
| 7 | GND |
| 8 | OUT $\overline{Y3}$ |
| 9 | IN A3 |
| 10 | IN B3 |
| 11 | OUT $\overline{Y4}$ |
| 12 | IN A4 |
| 13 | IN B4 |
| 14 | V_{CC} |

FUNCTION TABLE

| Inputs | | Output |
|--------|---|----------------|
| A | B | \overline{Y} |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

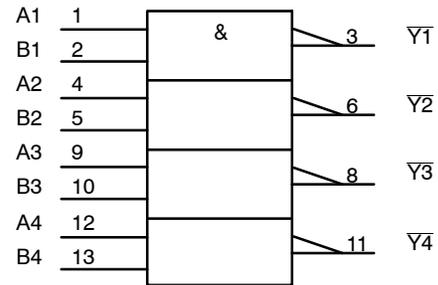


Figure 3. IEC LOGIC DIAGRAM

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MAXIMUM RATINGS (Note 1)

| Symbol | Characteristics | Value | Unit |
|-----------------------|---|--|------|
| V _{CC} | DC Supply Voltage | -0.5 to +7.0 | V |
| V _{IN} | DC Input Voltage | -0.5 to +7.0 | V |
| V _{OUT} | DC Output Voltage V _{CC} = 0 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 V _{OUT} < GND; V _{OUT} > V _{CC} | +20 | mA |
| I _{OUT} | DC Output Current, per Pin | +25 | mA |
| I _{CC} | DC Supply Current, V _{CC} and GND | +50 | mA |
| P _D | Power Dissipation in Still Air, SOIC Package (Note 2) TSSOP Package (Note 2) | 500 450 | mW |
| T _L | Lead temperature, 1 mm from case for 10 s | 260 | °C |
| T _{stg} | Storage temperature | -65 to +150 | °C |
| V _{ESD} | ESD Withstand Voltage Human Body Model (Note 3) Machine Model (Note 4) Charged Device Model (Note 5) | > 2000 > 200 > 3000 | V |
| I _{Latch-Up} | Latch-Up Performance (Note 6) Above V _{CC} and Below GND at 125°C | ±300 | mA |

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 ≤ (V_{in} or V_{out}) ≤ 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.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

- Maximum Ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.
- Derating – SOIC Package: -7 mW/°C from 65° to 125°C
– TSSOP Package: -6.1 mW/°C from 65° to 125°C
- Tested to EIA/JESD22-A114-A
- Tested to EIA/JESD22-A115-A
- Tested to JESD22-C101-A
- Tested to EIA/JESD78

RECOMMENDED OPERATING CONDITIONS

| Symbol | Characteristics | Min | Max | Unit |
|---------------------------------|--|------------|------------------------|------|
| V _{CC} | DC Supply Voltage | 3.0 | 5.5 | V |
| V _{IN} | DC Input Voltage | 0.0 | 5.5 | V |
| V _{OUT} | DC Output Voltage V _{CC} = 0 High or Low State | 0.0 0.0 | 5.5 V _{CC} | V |
| T _A | Operating Temperature Range | -55 | +125 | °C |
| t _r , t _f | Input Rise and Fall Time V _{CC} = 3.3 V ± 0.3 V V _{CC} = 5.0 V ± 0.5 V | 0 0 | 100 20 | ns/V |

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The θ_{JA} of the package is equal to 1/Derating. Higher junction temperatures may affect the expected lifetime of the device per the table and figure below.

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 |

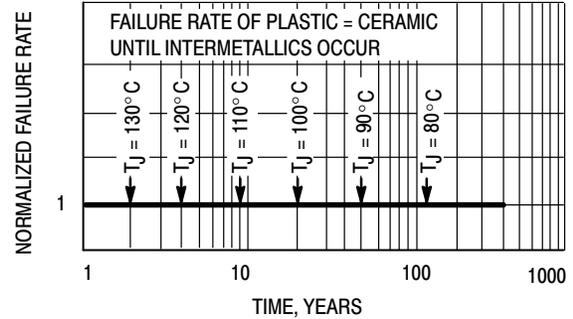


Figure 4. Failure Rate vs. Time Junction Temperature

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = 25°C | | | T _A ≤ 85°C | | T _A ≤ 125°C | | Unit |
|------------------|---|--|------------------------|-----------------------|------------|--------------------|-----------------------|--------------------|------------------------|--------------------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{IH} | Minimum High-Level Input Voltage | | 3.0 4.5 5.5 | 1.4 2.0 2.0 | | | 1.4 2.0 2.0 | | 1.4 2.0 2.0 | V | |
| V _{IL} | Maximum Low-Level Input Voltage | | 3.0 4.5 5.5 | | | 0.53 0.8 0.8 | | 0.53 0.8 0.8 | | 0.53 0.8 0.8 | V |
| V _{OH} | Minimum High-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | V _{IN} = V _{IH} or V _{IL} I _{OH} = -50 μA | 3.0 4.5 | 2.9 4.4 | 3.0 4.5 | | 2.9 4.4 | | 2.9 4.4 | V | |
| | | V _{IN} = V _{IH} or V _{IL} I _{OH} = -4 mA I _{OH} = -8 mA | 3.0 4.5 | 2.58 3.94 | | | 2.48 3.80 | | 2.34 3.66 | V | |
| V _{OL} | Maximum Low-Level Output Voltage V _{IN} = V _{IH} or V _{IL} | V _{IN} = V _{IH} or V _{IL} I _{OL} = 50 μA | 3.0 4.5 | | 0.0 0.0 | 0.1 0.1 | | 0.1 0.1 | | 0.1 0.1 | V |
| | | V _{IN} = V _{IH} or V _{IL} I _{OL} = 4 mA I _{OL} = 8 mA | 3.0 4.5 | | | 0.36 0.36 | | 0.44 0.44 | | 0.52 0.52 | V |
| I _{IN} | Maximum Input Leakage Current | V _{IN} = 5.5 V or GND | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | μA |
| I _{CC} | Maximum Quiescent Supply Current | V _{IN} = V _{CC} or GND | 5.5 | | | 2.0 | | 20 | | 40 | μA |
| I _{CCT} | Quiescent Supply Current | Input: V _{IN} = 3.4 V | 5.5 | | | 1.35 | | 1.50 | | 1.65 | mA |
| I _{OPD} | Output Leakage Current | V _{OUT} = 5.5 V | 0.0 | | | 0.5 | | 5.0 | | 10 | μA |

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AC ELECTRICAL CHARACTERISTICS $C_{load} = 50 \text{ pF}$, Input $t_r = t_f = 3.0 \text{ ns}$

| Symbol | Parameter | Test Conditions | $T_A = 25^\circ\text{C}$ | | | $T_A \leq 85^\circ\text{C}$ | | $T_A \leq 125^\circ\text{C}$ | | Unit |
|--------------------------|--|----------------------------------|--------------------------|-----|------|-----------------------------|------|------------------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t_{PLH} , t_{PHL} | Maximum Propagation Delay, Input A or B to Y | $V_{CC} = 3.3 \pm 0.3 \text{ V}$ | | 4.1 | 10.0 | | 11.0 | | 13.0 | ns |
| | | $C_L = 15 \text{ pF}$ | | 5.5 | 13.5 | | 15.0 | | 17.5 | |
| | | $V_{CC} = 5.0 \pm 0.5 \text{ V}$ | | 3.1 | 6.9 | | 8.0 | | 9.5 | |
| | | $C_L = 50 \text{ pF}$ | | 3.6 | 7.9 | | 9.0 | | 10.5 | |
| C_{IN} | Maximum Input Capacitance | | | 5.5 | 10 | | 10 | | 10 | pF |

| Symbol | Parameter | Typical @ 25°C , $V_{CC} = 5.0 \text{ V}$ | | Unit |
|----------|--|---|-----|------|
| | | Min | Max | |
| C_{PD} | Power Dissipation Capacitance (Note 7) | | 17 | pF |

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: $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}$. 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 $t_r = t_f = 3.0 \text{ ns}$, $C_L = 50 \text{ pF}$, $V_{CC} = 5.0 \text{ V}$, Measured in SO Package)

| Symbol | Characteristic | $T_A = 25^\circ\text{C}$ | | Unit |
|-----------|--|--------------------------|------|------|
| | | Typ | Max | |
| V_{OLP} | Quiet Output Maximum Dynamic V_{OL} | 0.4 | 0.8 | V |
| V_{OLV} | Quiet Output Minimum Dynamic V_{OL} | -0.4 | -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 |

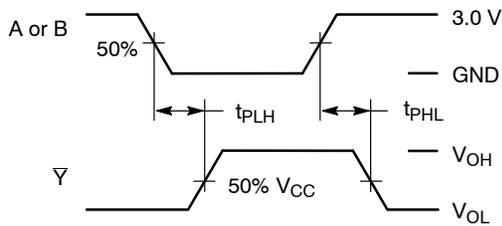
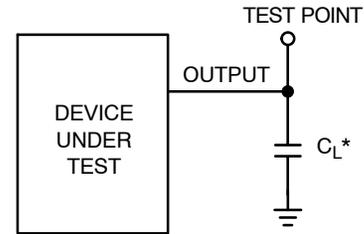


Figure 5. Switching Waveforms



*Includes all probe and jig capacitance

Figure 6. Test Circuit

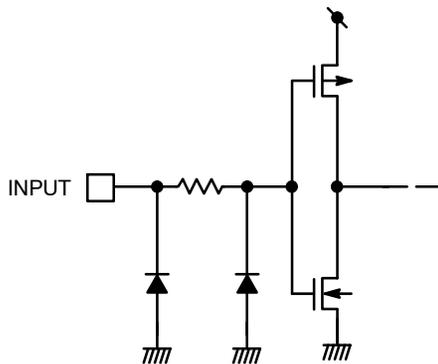
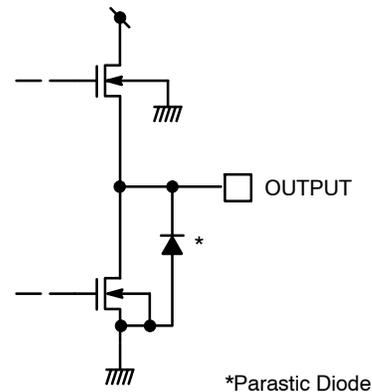


Figure 7. Input Equivalent Circuit



*Parasitic Diode

Figure 8. Output Equivalent Circuit

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ORDERING INFORMATION

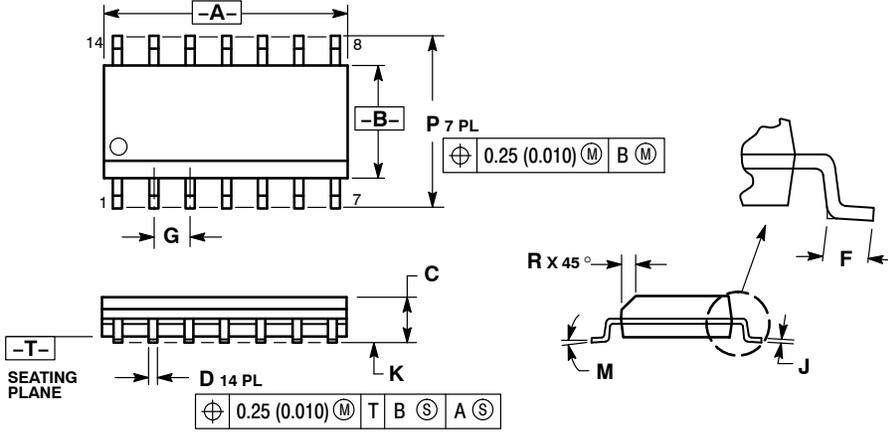
| Device | Package | Shipping† |
|------------------|-----------------------|--------------------|
| MC74VHCT00ADR2G | SOIC-14 (Pb-Free) | 2500 / Tape & Reel |
| MC74VHCT00ADTR2G | TSSOP-14 (Pb-Free) | 2000 / Tape & Reel |

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

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PACKAGE DIMENSIONS

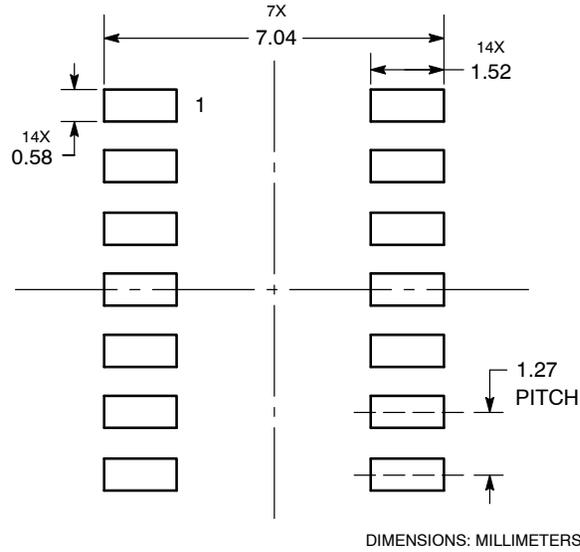
SOIC-14
D SUFFIX
CASE 751A-03
ISSUE J



- 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 | 8.55 | 8.75 | 0.337 | 0.344 |
| 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 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

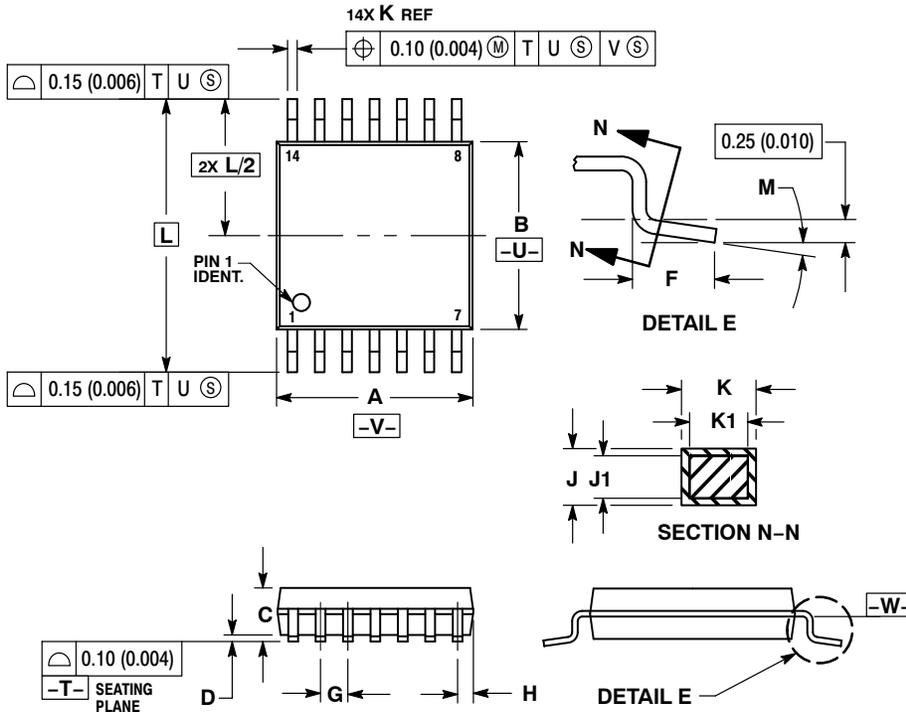
SOLDERING FOOTPRINT



MC74VHCT00A

PACKAGE DIMENSIONS

TSSOP-14
DT SUFFIX
CASE 948G-01
ISSUE B

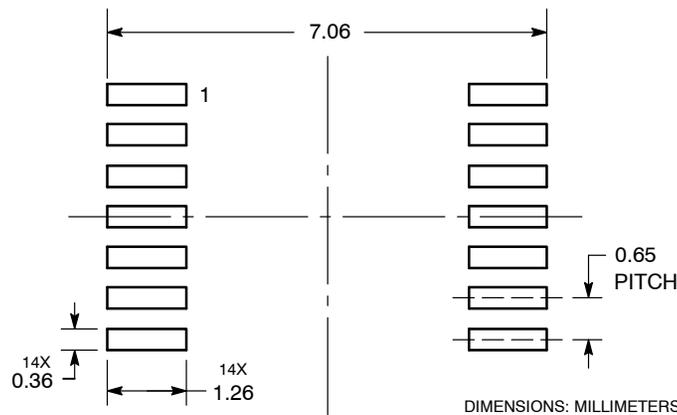


NOTES:

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° |

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